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PELVIC FLOOR DYSFUNCTION AND SOCIAL AND MENTAL HEALTH SEQUELAE FOLLOWING CHILDBIRTH INJURIES IN WOMEN IN EASTERN AND CENTRAL AFRICA

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ABSTRACT

Female pelvic organ dysfunction occurring in eastern and central Africa results in significant morbidity and adverse social and mental health sequelae. Lack of adequate resources available for health care compounds the suffering faced by these women. Obstetric fistula (OF), chronic 4th degree obstetric tears and severe pelvic organ prolapse (POP) are all common gynaecological morbidities seen in Uganda, D.R. Congo and Ethiopia. Despite successful closure of OF, bladder dysfunction and incontinece may persist due to detrusor overactivity, stress urinary incontinence and voiding dysfunction. Chronic 4th degree obstetric tears require effective surgical repair. Women suffering with severe POP need to be given surgical and non-surgical options of treatment. Non-surgical options include the availability and use of support pessaries. This research has focused on evaluation of post-OF bladder dysfunction assessment and treatment options. In particular, urodynamic bladder function studies were utilized and a bulking agent used as an option for post-OF repair continence surgery. A surgical repair technique for chronic 4th degree obstetric tears has been described with post-operative follow-up of women giving encouraging results. Support pessaries have been introduced and evaluated for women experiencing severe POP.

In order to be able to improve treatment and management options available for women affected with such pelvic floor dysfunction, additional information and understanding regarding risk factors and anatomical defects are needed.

The relevance of height and age as risk factors for OF have been evaluated here. Pelvic floor anatomy as measured with 4D pelvic floor ultrasound includes levator hiatal dimensions and identification of levator muscle trauma. Assessment of nulliparous Ugandan women has documented differences in levator hiatal dimensions compared to non-Ugandan women, and Ugandan women with OF, chronic 4th degree obstetric tears and severe POP have also been scanned and levator hiatal areas and incidence of levator muscle trauma compared. Significantly, the levator hiatal area in women with OF is smaller than in women with chronic 4th degree obstetric tears and severe POP. Possible reasons for these findings are discussed. The incidence of levator muscle

defects in women with pelvic floor dysfunction is compared with all 3 groups experiencing a similar high rate of complete levator muscle trauma.

The social and mental health of women with pelvic floor dysfunction including risk of domestic violence has been assessed. High levels of loss of social cohesion and mental health dysfunction have been identified in women with OF, chronic 4^{th} degree obstetric tears and severe POP.

Through identifying and highlighting the health sequelae faced by women with pelvic floor dysfunction including OF, chronic 4^{th} degree obstetric tears and severe POP, effective treatment and management options can be evaluated and promoted. Further research is required to consolidate the peri-operative outcomes of the surgical techniques described here with functional long-term outcomes necessary to guide future recommendations. Understanding risk factors associated with the development of pelvic floor dysfunction may guide strategies for prevention. Social and mental health dysfunction needs to be identified and addressed within this group of women with the availability of adequate support networks and treatment. In addition, there must be community-wide awareness of the prevalence of domestic violence with effective solutions promoted.

STATEMENT OF ORIGINALITY

The work presented in this thesis is, to the best of my knowledge and belief, original and my own work, except as acknowledged in the text. This work has not been submitted, either in whole or in part, for a degree or diploma in any university.

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AAFH	Addis Ababa Fistula hospital
AAS Abuse	Assessment Screen
ACTH	Adrenocorticotrophic hormone
ADH	Anti-diuretic hormone
CTS	Conflict Tactics Scale
3D	3 dimensional
4D	4 dimensional
FSH	Follicle stimulating hormone
GH	Growth hormone
HITS	Hurt, Insult, Threaten, Scream
ICS	International Continence Society
IPV	Intimate partner violence
IUGA	International Urogynecology Association
LH	Luteinizing hormone
MSH	Melanocyte-stimulating hormone
MUCP	Maximum urethral closure pressure
OAB	Overactive bladder
OASIS	Obstetric anal sphincter injury
OF	Obstetric fistula
PFBD	Post-fistula bladder dysfunction
PFMC	Pelvic floor muscle contraction
PID	Pelvic inflammatory disease
POP	Pelvic organ prolapse
PRL	Prolactin
PVS	Partner violence Screen
TSH	Thyroid-stimulating hormone
UNFPA	United Nations Population Fund
WAST	Women Abuse Screening Tool
WAST-SF	Women Abuse Screening Tool – short form

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INTRODUCTION

Childbirth can result in many significant and debilitating injuries worldwide, with treatment often unavailable due to the seriousness of the injury or lack of resources or inability to access resources. Obstetric fistula has long been identified as resulting from complications of childbirth, as have obstetric anal sphincter injuries (Zacharin, 1988). Obstetric fistula is caused by birth trauma. It is an abnormal communication between the genital tract and urinary tract or rectum. The prolonged obstructed labour leads to pressure necrosis of the anterior vaginal wall and the underlying urethra and bladder or posterior vaginal wall and rectum (Chapple et al., 2006). The incidence and outcomes of obstetric fistula secondary to prolonged obstructed labour have become more exposed in recent years due to international funding which has allowed increased surgeries, training and research to take place.

Obstetric fistula results in urinary and/or faecal incontinence depending on the site of injury (Zacharin, 1988). In addition, there are numerous other medical, psychological, sexual and social sequelae of obstetric fistulae that impact women suffering with obstetric fistulae. Other medical sequelae include vulval dermatitis, menstrual dysfunction, secondary infertility, nerve damage which often results in foot-drop, urinary tract infections, and renal tract calculi (Goh & Krause, 2004). Psychological sequelae includes mental health dysfunction especially depression (Goh et al., 2005). Sexual sequelae results from significant vaginal scarring with restriction in size of the vagina, as well as the discomfort and distress of constant urine and/or faecal leakage through the vagina. The social implications of obstetric fistulae commonly includes social isolation due to abandonment by their partners and being ostrasized by society (Alio et al., 2011, Krause et al., 2014).

There are however many aspects of childbirth injuries that remain poorly identified with inadequate treatment options available. The sequelae of obstetric fistula even following successful closure, remains an area where women experiencing those complications have few effective management options available (Goh et al., 2008). Currently the majority of obstetric fistula and hence sequelae of obstetric fistula occur in countries with inadequate access to obstetric care. Nations well-resourced in health

care now rarely see obstetric fistula and its sequelae as obstetric fistula secondary to prolonged obstructed labour is avoided with accessible obstetric care (Tuncalp et al., 2015).

Obstetric anal sphincter injuries are a common complication of childbirth worldwide (Power et al., 2006, Marsh et al., 2011). However current strategies and protocols for effective treatment and repair of obstetric anal sphincter injuries means that where comprehensive obstetric care is available, obstetric anal sphincter injuries are rapidly repaired and managed (Greentop Guideline no. 29). There are usually few women in well-resourced countries who remain with an unrepaired obstetric anal sphincter injury. Only case reports are published on such intermittent cases due to their rarity (Altomare et al., 2007). Thus the medical, psychological, sexual and social sequelae of chronic obstetric anal sphincter injuries, in particular 4th degree obstetric tears, remain unreported with minimal world literature addressing these issues.

The lack of access to treatment for obstetric fistula, its sequelae and chronic 4th degree obstetric tears are likely to result in social and mental health dysfunction for those women affected and unable to access any effective treatment. Women may live for many years suffering the consequences of their childbirth injuries as no treatment options are available in their communities (Bashah et al., 2018).

The countries with the highest incidence of maternal mortality and also obstetric fistula and other maternal morbidities are those in sub-Saharan Africa (Tuncalp et al., 2015). Many of these countries have health care provision which is inadequate for their population (Sud, 2018). This may be due to political instability, financial limitations of the government, poverty and poor infrastructure. The United Nations Population Fund (UNFPA, 2016) estimates that there are more than 2 million women worldwide living with an obstetric fistula, with between 50,000 and 100,000 women developing a new fistula each year (UNFPA, 2016). UNFPA also advocates for women suffering with pelvic organ prolapse who have no access to any effective management options. They describe their collaboration with organisations providing surgical intervention for pelvic organ prolapse especially in Nepal and Ethiopia (UNFPA, 2018).

UNFPA is the United Nations sexual and reproductive health agency. Their published Strategic Plan 2018-2021 incorporates goals to improve maternal health and achieve gender equality and empowerment of women and girls. Identifying these goals and planning for improvements will help worldwide to reduce childbirth injuries and to ease the suffering of women who have had no access to any medical intervention or treatment of their childbirth injuries and sequelae.

The following sequelae of pelvic floor injuries and dysfunction following childbirth in eastern and central Africa will be discussed:

Obstetric fistula

Post-fistula closure bladder dysfunction

Unrepaired (chronic) 4th degree obstetric tears

Severe pelvic organ prolapse

Social aspects and mental health dysfunction

Risk of domestic violence

Hypothesis

Childbirth in African women results in significant pelvic floor injury and dysfunction.

Aims

The aims of this study are to:

- Document in detail the extent of the types of injuries caused by childbirth. This will include the causes and treatment options available.

- Assess and describe the anatomical injuries of childbirth using 4 dimensional (4D) pelvic floor ultrasound scan imaging. This will include assessment of the nulliparous pelvic floor of Ugandan women which will be compared to already documented 4D pelvic floor ultrasound scan descriptions of Caucasian and Asian women. Women with obstetric fistula, unrepaired 4th degree obstetric tears and severe pelvic organ prolapse will also be analysed with 4D pelvic floor ultrasound scanning in order to identify pelvic floor injuries which have occurred.

- Identify risk factors which may predispose to the development of obstetric fistula. In particular, identifying any relationship between heights and ages of women and the development of obstetric fistula in areas with similar health care availability will be pursued.

- Identify the extent of chronic unrepaired 4th degree obstetric tears and reasons for unavailability of treatment. Surgical repair options will be described and a new surgical repair technique with subsequent outcome measures will be described.

- Evaluate post-fistula closure bladder dysfunction to determine causes and treatment options. Post-fistula closure bladder dysfunction is a newly acknowledged but longstanding problem facing a significant number of women following successful fistula closure. Further assessment is required:

    - identify and clarify post-fistula repair bladder dysfunction as an entity
    - diagnose the pathophysiology of post-fistula repair bladder dysfunction
    - identify and prospectively evaluate treatment options
    - prospectively assess new targeted surgical techniques for post-fistula closure bladder dysfunction stress urinary incontinence.

- Introduce and assess the potential use of vaginal support pessaries for management of severe pelvic organ prolapse.

- Assess the social and psychological impacts including risk of domestic violence, in women suffering with obstetric fistula, unrepaired 4th degree obstetric tear, and severe pelvic organ prolapse. Questionnaires will be used to identify the occurrence of social disruption and mental health dysfunction and risk of domestic violence.

Overall, pelvic floor dysfunction in women and the associated sequelae of social disruption and mental health dysfunction creates a large burden of suffering which women face worldwide. However, in countries and regions of limited resources where effective health care is unavailable, the distress and hardship that results from ill health may be heightened even further. Establishing a baseline of current pelvic floor dysfunction and its sequelae in resource poor regions of eastern and central Africa is important in order to be able to highlight these issues and promote effective treatment and management options and future equality of health care.

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CHAPTER 1

LITERATURE REVIEW OF PELVIC FLOOR DYSFUNCTION

1.1 OVERVIEW OF TYPES OF INJURIES AND DYSFUNCTION RESULTING FROM CHILDBIRTH

While childbirth has always been an essential part of the existence of humans, a history of injuries resulting from childbirth can be identified back thousands of years.
The problems and complications of pregnancy itself and the delivery and immediate postpartum period will not be discussed here. Those issues include genetic and developmental abnormalities, medical diseases of pregnancy, antepartum and postpartum haemorrhage, uterine rupture, infection, etc. Maternal morbidity and mortality, and foetal and perinatal morbidity and mortality, have been well documented with significant variations of incidence usually depending on access to effective medical care.

The issues discussed here include those childbirth injuries that may result in subsequent lifelong suffering.

1. Obstetric fistula
2. Post-fistula closure bladder dysfunction
3. Menstrual dysfunction, secondary infertility
4. Nerve injuries – foot drop, neuropathic bladder dysfunction
5. Psychosocial and mental dysfunction
6. Sexual dysfunction
7. Pelvic organ prolapse
8. Unrepaired (chronic) 4th degree obstetric tear

1.1.1. Obstetric Fistula

The term genital tract fistula refers to any fistula involving any part of the female genital tract. It includes urogenital fistulas of the bladder or ureters and also fistulas involving the bowel. These fistulas can develop secondary to pressure necrosis,

traumatic lacerations or surgical injury, or inflammatory or malignant processes (Walters & Karram, 2015).

When childbirth is the precedent to fistula formation, the cause is either pressure necrosis from prolonged obstructed labour or injury from lacerations relating to the delivery or surgical complications. Pressure necrosis occurs when the circulation to an area of tissue is compromised due to the application of pressure over that area, causing that tissue to die (Gebhardt, 2002). During labour, if the presenting foetal part in the pelvis becomes impacted, pressure necrosis may result. It is the length of time the presenting part is impacted rather than the amount of pressure itself that determines the degree of tissue necrosis. The tissue at risk of necrosis when the presenting part is impacted depends on the amount of cervical dilatation that has occurred and the level and descent of the presenting part (Goh&Krause, 2004). Therefore, the tissues at risk of necrosis include the uterus, vagina, bladder, ureters, and rectum. When the necrotic tissue sloughs away, a communication between the 2 structures results, causing a fistula.

Worldwide the most common cause for genital tract fistulas is prolonged obstructed labour (Zacharin, 1988). Where fistulas are secondary to obstetric factors such as prolonged obstructed labour, these are called obstetric fistulas (OF) and include fistulas affecting the urinary tract and bowel.

There are a number of possible reasons for an obstructed labour including:

- dysfunction of the labour itself
- malposition of the presenting part of the foetus
- disproportion of size in relation to the anatomy of the woman and foetus

The term dysfunctional labour is derived from labour dystocia. This has Greek origins: dys = difficult, painful, disordered, abnormal; and tokos = birth. Dysfunctional labour indicates a slowed or stopped labour with the most common cause being inefficient uterine contractions. International labour management protocols aim to optimise labour outcomes (Cunningham et al., 2005).

The most common foetal presentation is the cephalic presentation with the vertex presentation being the most common cephalic presentation. This is where the occiput of the head is the leading part. The vertex is the part of the foetal skull bounded anteriorly by the anterior fontanelle and coronal sutures, posteriorly by the posterior fontanelle and lambdoid suture, and laterally by 2 lines passing through the parietal eminences. All other presentations are malpresentations (Cunningham et al., 2005). In the vertex presentation the head is flexed and the occiput is presenting. When the head is extended, the face becomes the leading part. The chin presentation is a variant of face presentation with maximal extension of the head. In sincipital presentation the large anterior fontanelle is the presenting part. In brow presentation, the head is slightly extended. Non-cephalic presentations are breech, footling, transverse and shoulder presentations.

Cephalo-pelvic disproportion is when the capacity of the pelvis is inadequate to allow the foetal head to be delivered. Causes of cephalo-pelvic disproportion include 1. Large baby; 2. Abnormal foetal position; 3. Small pelvis; 4. Abnormally shaped pelvis (Cunningham et al., 2005).

When obstruction occurs the soft tissues of the genital tract are compressed between the bones of the presenting part of the foetus (usually the foetal head) and the bony pelvis. Over time this results in pressure necrosis of the genital tract tissues. The usual outcome of the pregnancy when the labour is prolonged and obstructed where there is no access to intervention to deliver the foetus is intrauterine foetal death (Goh et al., 2008). Once the foetus has died the foetal size is relatively reduced and finally delivery of the foetus will usually occur. When the genital tract tissue which has become necrotic sloughs away, the fistula is evident. The woman then becomes incontinent of urine and/or faeces depending on where the fistula has formed. Unless the women is able to access medical assessment and intervention then the condition becomes lifelong. There are then numerous medical, psychological and social sequelae that follow.

1.1.2. Post-fistula closure bladder dysfunction

Despite a successful closure of a urogenital fistula, ongoing urinary incontinence is common. This may be due to stress urinary incontinence, overactive bladder, voiding difficulty with overflow incontinence or urinary tract infection or bladder stones. Stress urinary incontinence is the complaint of involuntary loss of urine on effort or physical exertion, or on sneezing or coughing (Haylen et al., 2010). This is essentially activity-related incontinence.

Overactive bladder syndrome is a symptom complex of urinary urgency, usually accompanied by frequency and nocturia, with or without urinary incontinence, in the absence of urinary tract infection or other obvious pathology (Haylen et al., 2010).

Voiding difficulty may include numerous voiding symptoms such as hesitancy, slow stream, intermittency, straining to void and feeling of incomplete voiding. In the most severe cases urinary retention may be the complaint which is the complete inability to pass urine despite persistent effort (Haylen et al., 2010). Urinary retention may be acute – defined as a generally painful, palpable, or percussable bladder, when the patient is unable to pass any urine when the bladder is full; or chronic – defined as a non-painful bladder, where there is a chronic high post-void residual volume (Haylen et al., 2010). Overflow incontinence then occurs as involuntary incontinence with no associated urge to urinate.

Initially assessment for failed fistula repair or previously undiagnosed ureteric fistula should be undertaken as these diagnoses can be easily missed. Urinary tract infection and bladder calculi if present need to be diagnosed and managed accordingly.

Ideally urodynamics assessment should be performed to give an accurate diagnosis of urodynamic stress incontinence, detrusor overactivity and voiding dysfunction. Urodynamics testing is the functional study of the lower urinary tract (Walters & Karram, 2015). It generally involves assessing a person with free uroflowmetry and post-void residual volume, followed by filling and voiding cystometry. Free uroflowmetry includes the voluntary passing of urine over a uroflowmeter. This allows for measurement of flow rate, voided volume, maximum urine flow rate, flow time,

average flow rate, voiding time, time to maximum flow and interpretation of the normality of free uroflowmetry. Post-void residual urine volume, which is the volume of urine left in the bladder at completion of micturition, can then be assessed using an ultrasound or catheter. Cystometry is the measurement of the pressure/volume relationship of the bladder during filling and/or pressure flow study during voiding. The aims of filling cystometry are to assess bladder sensation, bladder capacity, detrusor activity, and bladder compliance. Normal detrusor function is evident when there is little or no change in detrusor pressure with filling. Detrusor overactivity is diagnosed with the occurrence of involuntary detrusor contractions, which may be spontaneous or provoked, during filling cystometry (Haylen et al., 2010). Urethral function is also assessed with a number of different techniques available. Most commonly the maximum urethral closure pressure (MUCP), which is the maximum difference between the urethral pressure and intravesical pressure, is used. Also the indirect techniques of leak point pressures can be used. Voiding cystometry is the pressure volume relationship of the bladder during micturition. The measurements recorded include the intravesical, intra-abdominal, and detrusor pressures and urine flow rate.

In resource poor settings, standardised equipment for formal urodynamics testing is often not available. An initial dye test should be performed to exclude any undiagnosed residual fistula. A simplified clinical urodynamics test (Krause et al., 2014) can be performed where formal urodynamics testing is unavailable. The bladder is first catheterised to measure post-void residual urine volume after voiding. Normal post-void residual volume is less than 100ml. A Foley catheter is placed in the bladder and the bladder filled with saline to at least 300ml. The catheter is then held vertically approximately 15 cm above the pubic symphysis and the level of fluid in the catheter identified. If there is no elevation of the fluid and no urge symptoms then the detrusor is considered to be stable. If the fluid level rises above 15 cm in height above the symphysis pubis (vesical pressure) with associated urge, then detrusor overactivity may be diagnosed. In the absence of detrusor overactivity, if leakage occurs with coughing, then stress incontinence is diagnosed.

While there has been significant research aimed at documenting the successful surgical closure of fistulas, little attention has been given as to whether these women

with successful fistula closure have ongoing troublesome urinary symptoms and urinary incontinence. There is also very little understanding of the causes of ongoing urinary symptoms and incontinence, and of effective treatment options.

1.1.3. Menstrual dysfunction, secondary infertility

Amenorrhoea may be a problem following the development of an OF. At the time of caesarean section for obstructed labour, occasionally a hysterectomy will be performed to control bleeding from a hypotonic uterus or ruptured uterus. There are many cases where the woman has not been informed of this surgery and remains unaware of the reason for her secondary amenorrhoea and subsequent secondary infertility. Full disclosure to the woman of all elective or emergency surgery performed on her is essential and should be a normal standard of care. It is distressing that women may not be advised of such significant information relating to their surgical care.

Intrauterine adhesions including Ashermann's syndrome may be secondary to the prolonged obstructed labour (Cunningham et al., 2005, Goh & Krause, 2004, Hancock, 2009). This is often secondary to pelvic infection. The symptoms of Ashermann's syndrome include infertility, recurrent pregnancy loss, and menstrual dysfunction including hypomenorrhoea or amenorrhoea. Essentially it is scar tissue that either replaces the endometrium or blocks the outflow of menstrual blood. Cyclical pain can occur if the scar tissue blocks the menstrual blood causing uterine cramping and pelvic pain. This condition is diagnosed either radiologically or hysteroscopically. Treatment involves hysteroscopic resection of the adhesions with subsequent management often with oral oestrogen, to avoid the reformation of adhesions. There is varying success following treatment.

Sheehan's syndrome caused by post-partum pituitary necrosis is also a reason for amenorrhoea (Cunningham et al., 2005, Hancock, 2009). It is a condition that affects women who lose a life-threatening amount of blood or who have severely low blood pressure during or after childbirth. The resultant damage to the pituitary gland causes the permanent underproduction of pituitary hormones. The anterior pituitary gland secretes adrenocorticotrophic hormone (ACTH), thyroid-stimulating hormone (TSH),

luteinising hormone (LH), follicle-stimulating hormone (FSH), prolactin (PRL), growth hormone (GH), and melanocyte-stimulating hormone (MSH). The posterior pituitary gland secretes anti-diuretic hormone (ADH) and oxytocin. Common symptoms of Sheehan's syndrome include the lack of breast milk following delivery, fatigue, loss of pubic and axillary hair, low blood pressure and amenorrhoea.

Hypothalamic amenorrhoea is possible due to malnutrition or psychological stress (Cunningham et al., 2005). The hypothalamus synthesizes and secretes neurohormones (also called releasing hormones or hypothalamic hormones) that then stimulate or inhibit the secretion of the pituitary hormones.

Secondary infertility following OF formation may be due to her amenorrhoea, either due to the intrauterine adhesions or anovulation (Goh & Krause, 2004). Pelvic inflammatory disease (PID) causing tubal dysfunction is also a common reason for infertility (Cunningham et al., 2005). Following obstructed labour, untreated PID can cause tubal blockage. Sexual dysfunction and male factors are also a cause of infertility for women.

1.1.4. Nerve injuries – foot drop, neuropathic bladder dysfunction

Pelvic and lower limb neurological damage is possible following an obstructed labour resulting in OF (Hancock, 2009). In severe cases, ischemia to the lumbosacral nerve plexus may result in the inability to walk following delivery. Saddle anaesthesia may also be present and the combination of immobility and saddle anaesthesia can lead to pressure sores.

Footdrop of varying degrees can occur following prolonged obstructed labour (Hancock, 2009, Goh & Krause, 2004). This is where the woman is unable to dorsiflex her foot and thus walks with a high stepping gait and limp. If the injury is bilateral, it can result in significant mobility difficulties. A number of mechanisms may be responsible for causing footdrop, however as yet there is no complete understanding. The lumbosacral nerve plexus in the pelvis that may be injured by direct pressure may be the cause of foot drop as the L5 nerve root is responsible for the innervation of those lower limb muscles. In addition, the common peroneal nerve that innervates

muscles in the lower limb can be readily damaged by pressure on the nerve with prolonged squatting or straining in childbirth.

Good nursing care and physiotherapy are required to allow recovery of this form of nerve and lower limb injury. Without such assistance, contractures can form and permanent disability ensues. Approximately 2% of women with OF presenting to the Addis Ababa Fistula hospital in Ethiopia have contractures (Hancock, 2009). Many months are usually required for recovery. Complete recovery is not always possible in the most severe cases of nerve damage.

Neuropathic bladder dysfunction can be the result of an over-distension injury to the bladder during a prolonged labour, especially where the foetal head is low in the pelvis and obstructs voiding (Lim, 2010). Such over-distension injuries can result in atony of the detrusor muscle that can be permanent. Subsequent voiding difficulties may result in urinary incontinence, overactive bladder symptoms and recurrent urinary tract infections.

1.1.5. Psychosocial and mental dysfunction

The social isolation and suffering faced by women with OF has been well described in the literature (Goh& Krause, 2004). Following occurrence of the OF, the woman faces the prospect of ongoing urinary and/or faecal loss through her vagina. The offensive odours and constant contamination of her surroundings with urine and/or faeces makes family and community living difficult. Often the woman's husband will leave her as their baby was stillborn and she is no longer able to be sexually active. She may then be forced to live in relative isolation with work in the fields her only option for survival. If she is able to reunite with her family, the family itself may be ostracized also because of her condition, resulting in further suffering.

There is minimal documented information regarding the social integration of women suffering with severe pelvic organ prolapse and unrepaired 4th degree perineal tear in this same setting. Pelvic organ prolapse which is the protrusion of the pelvic organs into the vagina, can be of varying severity and have varying symptoms. In the most severe cases, a large lump which can be bigger than a tennis ball, is constantly

positioned outside of the vaginal introitus. The main symptom of unrepaired 4th degree perineal tear (where the perineum is completely disrupted with the anal sphincter and anorectal mucosa not intact) is faecal incontinence. It may be expected that these women would also face social stigma and isolation due to these other pelvic floor injuries. Research is needed to identify any social sequelae that may be prevalent in women with severe pelvic organ prolapse and unrepaired 4th degree perineal tears.

Goh et al (2005) highlighted the mental health dysfunction occurring in women suffering OF. Women with OF have most commonly delivered a stillborn child and thus are exposed to significant distress associated with that traumatic event. In addition, they then develop urinary and/or faecal incontinence that results in ongoing psychological, mental and social distress and dysfunction. In 1597, Luiz Mercado (Falk & Tancer, 1954) stated that the lives of women suffering from genital tract fistula were "empty and tragic … and how great are their embarrassments; for the bladder and the intestines move at the same time, and the uncontrolled urine and faeces run from the fistulae with ease … to render life very grim".

A mental health questionnaire has been used in a number of different cultural and language settings to screen for significant mental health concerns that would then need to be addressed. The General Health Questionnaire (GHQ-28) is a validated screening instrument to help with the detection of psychological distress and current psychiatric conditions (Goldberg & Hillier, 1979). The GHQ-28 consists of 4 groups of questions regarding somatic symptoms, anxiety and insomnia, social dysfunction, and severe depression. When combined these answers give a composite measure of psychological symptoms. Goh et al (2005) identified that 97% of women with genital tract fistula in both Bangladesh and Ethiopia screened positive for potential mental health dysfunction. It was therefore estimated from this study that between 23.3% and 38.8% of fistula women would have major depression. These remarkably high rates of mental health dysfunction in women with OF deserves more attention.

There is little data available on mental health dysfunction in women with other pelvic floor pathologies such as pelvic organ prolapse or unrepaired 4th degree perineal tears. These women also face significant psychological and social distress and are therefore

likely to be exposed to the risk of mental health dysfunction. The mental health of women facing these conditions deserves more attention.

In resource poor settings the availability of mental health services is often inadequate and thus access to treatment options are limited.

1.1.6. Sexual dysfunction

In cultures and societies where women's sexual health and function is not commonly discussed, the availability of information regarding women's sexual dysfunction is often limited. Women who have suffered with obstetric fistula are expected to have a high risk of subsequent sexual dysfunction due to their physical and psychological injuries (Barageine et al., 2015). The prolonged obstructed labour with resultant pressure necrosis is often the cause of extensive vaginal and pelvic scarring. When assessing women with fistula prior to surgical repair, in severe cases it can be difficult to even pass a speculum into the vagina because of the scarring which results in stenosis or significant narrowing of the vagina. At time of surgical repair, it is often necessary to perform releasing incisions within the vagina or occasionally an episiotomy, to be able gain access to the fistula and proceed with the surgery (Goh & Krause, 2004). Hence once the fistula has been closed, the total loss of vaginal tissue may result in ongoing narrowing or obliteration of the vagina.

If vaginal stenosis and scarring is present following successful fistula closure, there are a number of surgical and non-surgical options for treatment. Releasing incisions or skin or pedicle grafts may be utilised to increase the vaginal capacity (Goh& Krause, 2004). The use of vaginal dilators is essential following such surgery to prevent reformation of the vaginal stenosis. Graduated vaginal dilators may be used in the absence of surgery, however where the scarring is extensive, this option is less successful.

Even in cases where the capacity of the vagina is adequate for sexual intercourse including penetration, there may be significant vaginal pain secondary to the scarring or levator muscle hypertonicity. Ongoing anxiety and other psychological factors relating to her traumatic birth and subsequent surgery may significantly affect her sexual function (Barageine et al., 2015).

Sexual health and function in relation to women suffering from pelvic organ prolapse and unrepaired 4th degree perineal tears, has also not been well assessed or documented in low-resource areas. While sexual issues in women with pelvic organ prolapse have been well documented in high-resource settings (Tok et al., 2010), there is very little in the literature regarding women with poor access to effective gynaecological services. In addition, unrepaired 4th degree perineal tears are rarely seen in high-resource settings, and thus there is minimal information at all on this childbirth injury in relation to sexual dysfunction. Pelvic organ prolapse may result in obstruction to sexual intercourse, in particular in cases of procidentia where the vagina is everted. The term procidentia is derived from the Latin word procidere – to fall forward. Hence procidentia refers to the falling down of an organ from its normal anatomical position, which in the case of uterine prolapse means that the uterus has fallen to its maximal extent outside of the vagina. Urinary and bowel dysfunction including coital incontinence often co-exist with pelvic organ prolapse adding to sexual dysfunction (Jha & Gopinath, 2016). In addition, anxiety and psychological factors are likely to reduce sexual wellbeing. Unrepaired 4th degree perineal tears are often associated with faecal incontinence and women may wish to avoid sexual activity due to this problem and their associated embarrassment. Women with this condition often keep themselves constipated to try to avoid faecal incontinence and therefore do go ahead with sexual intercourse however have ongoing anxieties. The resultant cloacal opening in women with unrepaired 4th degree perineal tears would also add to their sexual dysfunction.

Certainly there is the need to further assess and evaluate the degree of sexual dysfunction that women suffering with genital tract fistula, pelvic organ prolapse and chronic 4th degree perineal tears face in low-resource settings.

1.1.7. Pelvic organ prolapse

Pelvic organ prolapse (POP) is the protrusion of pelvic organs into the vaginal canal. Prolapse of pelvic organs occurs when their attachments, neural connections and supports fail. In the world literature POP occurs commonly in women, affecting approximately one third of all women who have vaginally delivered one or more

children (Barber & Maher, 2013). Symptoms of POP include a lump in or outside of the vagina, the sensation of heaviness or dragging, voiding difficulty, incomplete bowel emptying, and sexual dysfunction (Goh & Flynn, 2017). Severe cases of total uterine prolapse are called procidentia, and severe cases in women with prior hysterectomy are called vault eversion.

The current standardized classification system to describe the degree of prolapse on examination is the Pelvic Organ Prolapse Quantification (POP-Q) classification (Bump et al., 1996). Essentially the vagina is divided into 3 compartments that are separately assessed and described. These compartments include the anterior, posterior and apical compartments. There are no specific investigations necessary in the assessment of POP however if urinary or bowel dysfunction are co-existing, then further assessment of those issues may be advisable. Management options for POP depend upon the woman's symptoms. If her symptoms are bothersome then the management options include the use of a pessary or surgical repair of the prolapse (Chapple et al., 2006).

There are numerous different types of pessaries available. These are inserted into the vagina and provide a mechanical support for the prolapse (Goh & Flynn, 2017). There are also numerous surgical options available depending on which compartment or compartments of the vagina require repairing. Surgery can be approached via the abdomen or via the vagina. The abdominal approach usually refers to the sacral colpopexy or sacral hysteropexy which uses a biomaterial (usually synthetic mesh) to support the vagina vault or cervix and upper vagina to the ligament over the sacral promontory. The vaginal approach allows for repair of the anterior compartment and posterior compartment, and repair of the apical compartment via the sacrospinous or uterosacral ligaments (Chapple et al., 2006).

While POP assessment, management and outcomes are under constant development and are documented extensively in the world literature, minimal attention has been paid to women suffering with POP in low-resource countries. Women in these settings face the unavailability of medical care and therefore suffer the symptoms of POP with

no relief. The likely development of medical, psychological and social sequelae are unreported.

1.1.8. Unrepaired (chronic) 4th degree obstetric tear

Traumatic injury of the vagina and perineum due to vaginal childbirth is common. These injuries are classified as first, second, third or fourth-degree tears (Sultan, 1999). First-degree tears involve the vaginal epithelium and perineal skin but not the underlying fascia and muscle. Second-degree tears involve the fascia and muscles of the perineal body but not the anal sphincter, in addition to the vaginal epithelium and perineal skin. Third-degree tears also involve the anal sphincter and fourth-degree tears extend to the anorectal mucosa. Episiotomies are intentional incisions of the perineal body. There are a number of episiotomy techniques, however the incision thought to result in least spontaneous extension of the incision into the anal sphincter and rectum is the mediolateral episiotomy at 60 degrees away from the midline when the perineum is distended (RCOG Green Top Guidelines, 2015).

Obstetric anal sphincter injuries (OASIS) refer to third- and fourth-degree perineal injuries (Sultan, 1999). Third-degree injuries are classifies as 3a, 3b, and 3c.

3a – no more than half the external anal sphincter (EAS) is disrupted

3b – more than half the EAS is disrupted

3c – both the EAS and internal anal sphincter (IAS) are completely disrupted

Fourth-degree injuries describe disruption of the anal sphincter and anorectal mucosa.

OASIS occurs in 2.5-11 % of women who deliver vaginally depending on episiotomy practices (Sultan, 1997). In Australia, the Australian Council on Healthcare Standards (ACHS) reports a 4.3% incidence of 3rd degree tears in primiparous women and a less than 0.5% incidence of 4th degree tears in primiparous women (ACHS, 2014). The risk of OASIS in multiparous women is lower. Current best practice advises repair of the injury in the acute setting. Guidelines (RCOG Green Top Guidelines, 2015) detail the necessary components of effective surgical repair of OASIS.

These recommendations (RCOG Green Top Guidelines, 2015) include an experienced surgeon repairing or supervising the repair, the repair being performed in an operating

theatre, good lighting, adequate analgesia and antibiotic cover. The method of repair advises the anal mucosa is repaired with a 3-0 absorbable suture using interrupted or continuous sutures, the internal anal sphincter is identified and repaired separately with delayed absorbable sutures, the external anal sphincter is repaired by overlap or end-to-end method using a 2-0 or 3-0 delayed absorbable sutures. The perineal body should then be repaired in 2 layers with absorbable sutures. A rectal examination is the necessary to ensure an adequate repair. Broad spectrum antibiotics should be given to reduce the risk of infection and wound complications.

In areas where information and education regarding the repair of OASIS is lacking, or where women do not have access to effective health care, repair of OASIS does not occur. Women may be unable to access health care due to either a geographical lack of services, or the woman's inability to access the services for social or financial reasons. Women living in poverty lack the necessary resources (transportation, medical fees) to cover their health care needs.

In such areas, many women who have developed OASIS have been unable to have their condition repaired, and live indefinitely with an unrepaired OASIS (Krause et al., 2014). While there are different grades of OASIS, the most severe, 4th degree tear, results in more symptoms and distress.

The women with unrepaired 4th degree perineal tears will usually present with faecal and flatal incontinence as their anal sphincter is completely disrupted. These women usually try to constipate their bowel motions to minimise their symptoms. In addition, with the absence of a perineal body separating the vagina from the anal canal, sexual intercourse can be problematic.

There is no documentation of the psychosocial or mental health issues in women suffering with unrepaired 4th degree perineal tears in low-resource settings. This is an area needing further evaluation in order to highlight the difficulties faced by this group of women who are unable to access the appropriate medical care.

1.2 OBSTETRIC FISTULA

Prolonged obstructed labour is the most common cause for genital tract fistula worldwide. In order to understand how abnormal labour causes obstetric fistula, it is also important to understand the characteristics of normal labour.

1.2.1 Characteristics of normal labour

Labour can be divided into 3 stages – first stage of labour, second stage of labour and third stage of labour (Cunningham et al., 2005). The first stage of labour begins when uterine contractions which bring about demonstrable effacement and dilatation of the cervix commence. When the diagnosis of the commencement of labour is confirmed, 2 phases of cervical dilatation begin - the latent phase and then the active phase. Usually with the onset of the latent phase of the first stage of labour the woman perceives regular contractions. This phase typically ends between 3-5 cm of dilation. The active phase of the first stage of labour can then be considered to commence with cervical dilatation of 3-5 cm in the presence of uterine contractions, and concludes at full dilatation of the cervix. Friedman (1954) developed a graph for normal progress of labour, and while this has subsequently been subject to modifications and challenges, it remains the basis for our understanding of normal labour. Friedman (1954) described a characteristic sigmoid pattern for labour by graphing cervical dilatation against time. Typically the active phase of labour results in more rapid dilatation of the cervix than the latent phase of labour.

The second stage of labour begins when the cervix is fully dilated and concludes with delivery of the foetus. The median duration of the second stage of labour is 50 minutes for nulliparas and 20 minutes for multiparas (Kilpatrick & Laros, 1989). These authors also reported that the mean length of first and second stage of labour (without regional analgesia) was 9 hours for nulliparas and 6 hours for multiparas (Kilpatrick & Laros, 1989).

The third stage of labour includes placental separation and delivery of the placenta.

In summary, normal labour is characterised by efficient dilatation of the cervix followed by delivery of the foetus with no undue delays. When abnormalities occur in

the progress of labour, numerous potential complications can occur due to the prolongation of the labour. In the case of an obstructed labour, the stages of labour can be prolonged for many days, thus causing significant obstetric injuries.

1.2.2 Obstetric Fistula

Definition

The definition of a fistula is an abnormal communication between 2 organs. A genital tract fistula is thus a communication between the genital tract and the urinary tract or the genital tract and the bowel. Obstetric injury is the most common cause for genito-urinary fistula with an estimated 2% of Ugandan women in reproductive age complaining of symptoms of fistulae (Uganda Bureau of Statistics, 2011).

History

There is evidence of the occurrence of urogenital fistula dating back as far as ancient Egypt. An Egyptian mummy (circa 2050BC) when examined, demonstrated a large urogenital fistula. This mummy is presumed to be Henhenit, a Lady in the court of Mentuhotep (Mahfouz, 1929, Williams, 1929). Possibly the first documentation of urogenital fistula is in the Ebers papyrus dated at 1550BC. One fragment appears to relate to urogenital fistula translating as: “Prescription for a woman whose urine is in an irksome place: if the urine keeps coming and she distinguishes it, she will be like this forever” (Zacharin, 1988). There is also documentation of urogenital fistula is in ancient Hindu medical writings (Vedas 800-600BC) where when discussing the management of bladder stones in women it is written “care must be taken not to thrust the knife too far forward, as it will wound the uterus and the urine will pass through the vagina, forming a fistula”(Falk & Tancer, 1954). Avicenna (980-1037), an Arabo-Persian physician, was the first to describe and document urogenital fistula and its association with childbirth.

It is not until the 1500’s that there is any further significant documentation regarding fistula. In 1597 Felix Plater described cases of vesico-vaginal fistula following difficult labour and Mercato, a Spanish physician, was the first to coin the word “fistula” rather than “rupture”. Mercato’s words have been used by many to describe the effect of a urogenital fistula on a woman’s life: “What an empty and tragic life is led by the

affected victims and how great are their embarrassments; for the bladder and the intestines move at the same time, and the uncontrolled urine and faeces run from the fistulae with ease; and even those who because of their natural resistance tend to improve somewhat, may in future deliveries have a recrudescence or even a total breakdown, for the only alleviation results when a fistula tends to become adherent to surrounding tissues, but even here the drawn-out period of recovery is so fraught with thousands of bodily miseries and weaknesses, as to render life very grim." (Falk & Tancer, 1954).

Hendrick von Roohuysen (of Amsterdam) published a book on operative gynaecology in 1663. He gave a description of vesico-vaginal fistula and proposed a surgical technique for treatment. His technique included using the lithotomy position, use of a speculum to expose the fistula, denudation of the fistulous opening and the use of sharpened swan quill pins to approximate the edges (Falk & Tancer, 1954). In 1675 Johann Fatio claimed to have cured 2 cases using von Rooohuysen's techniques (this work was published posthumously in 1752) (Falk & Tancer, 1954). In 1679 Christoph Volter described injecting barley water into the urethra and then identifying the fluid in the vagina to assist with diagnosos of a fistula and advised to use a bladder catheter after the repair (Zacharin, 1988).

Very little was written regarding fistulas in the 18th century and then publications recommenced in the 19th century. In 1834 Jobert De Lamballe first reported the importance of a tension-free closure of the fistula. He was also the first to note that recently acquired fistulas may heal spontaneously with bladder drainage (Falk & Tancer, 1954). Also in 1834 Gosset reported the use of silver sutures and advised the knee-elbow position to allow access for repair (Falk & Tancer, 1954). Von Metzler in 1846 described a speculum which was similar to the one subsequently described and credited to Marion Sims, however he did not provide a drawing (Falk & Tancer, 1954).

Marion Sims, often referred to as the "father of modern gynaecology" published his is findings in 1852 (Falk & Tancer, 1954). He documented his consistent success in closure of fistulas and founded the first fistula hospital in New York. Thomas Emmett was recruited by Sims to continue his work. Collis (1857) described the flap-splitting

technique for the repair of fistula. Between 1881-1890, Trendelenburg described and promoted the suprapubic approach to fistula repair followed by Forgue in 1906 who described an intraperitoneal technique (Farsht, 1940). Throughout the 1900's, John Lawson, Chassar Moir, Naguib Mahfouz, Heinrich Martius, John Garlock, and others added significantly to the understanding of urogenital fistula repair around the world (Falk & Tancer, 1954, Zacharin, 1988). Elkins (1997) documents other more recent fistula surgeons who have published series of their fistula repairs.

The second fistula hospital in the world was opened in Addis Ababa Ethiopia in May 1975 by Reginald and Catherine Hamlin. Reginald and Catherine Hamlin dedicated their lives to help these women suffering with fistula by studying and improving surgical techniques and caring for the women who could not be cured. Their vision of founding a midwifery college to train and place midwives all over Ethiopia in an attempt to reduce the incidence of fistula is now a reality.

Causes

Obstetric fistulae (OF) are caused by either pressure necrosis from obstructed labour or trauma from operative deliveries.

Pressure necrosis usually results in the most extensive injuries with often large amounts of tissue sloughing away due to the necrotic injury. When a labour is obstructed, the bony parts of the foetus are compacted into the bony maternal pelvis, with the tissues between being compressed for a prolonged period of time. The necrotic tissues including genital tract tissue and urinary tract and bowel tissue, subsequently slough away leaving a hole between those organs. Urine and/or faecal material can then pass directly into the genital tract and this marks the beginning of a continuous and uncontrollable leakage of urine/faeces from the vagina.

Trauma from operative deliveries including caesarean section or instrumental deliveries can also result in genital tract fistulae. While there is a risk of these injuries with all operative deliveries, in situations where the operating conditions are suboptimal and the operator is inexperienced, injuries are more common (Barageine et al., 2014). In addition, when either the presentation of the patient with obstructed

labour to a health care facility is delayed, or where the decision to intervene with an operative delivery is delayed, the technical aspects of an operative delivery are more difficult and inherently the risk of complications increase.

Risk factors

The risk factors leading to the development of OF are poorly understood. However, the main risk factor for the development of OF is lack of access to effective obstetric care. While obstructed labour is the cause of most OF, in the presence of effective obstetric care the sequelae of OF development can be minimized. Effective obstetric care during labour includes the monitoring of foetal wellbeing and the maternal vital signs. The urinary function of the woman should be followed and bladder over-distension avoided. Labour management protocols utilise amniotomy and oxytocics to assist with progress of labour if required. In cases where a vaginal delivery is not appropriate then timely caesarean section can be employed. After full dilatation of the cervix and when clinically appropriate and indicated, assisted vaginal delivery with vacuum extraction or forceps can be utilised.

Friedman (1954) was the first obstetrician to graph the progress of labour. Philpott (1972) subsequently developed a partogram which he introduced in Rhodesia in 1972. The partogram includes an alert and action line to help with labour management when the progress of labour falls below average. Most obstetric units today do use some form of adapted partogram to assist with the management of labour. The World Health Organisation recommends the use of partograms (Souberbielle & O'Brien, 1994) and designed its own partogram for use in developing countries (Dujardin et al., 1992).

Thus effective obstetric care is necessary to minimise complications of labour and delivery. The lack of access to obstetric care is often due to a lack of infrastructure in the woman's location with a lack of available health services and a lack of appropriately trained staff at health care facilities. In addition, where services are provided by inexperienced staff, injuries secondary to instrumental deliveries and caesarean sections may be more frequent and result in OF. A lack of education and poverty are also significant factors.

The risk factors commonly quoted to be significant for OF development include primiparity, short stature, and reduced pelvic dimensions (caused by early age of childbearing, chronic disease, malnutrition and rickets) (Norman et al., 2007). While short stature may well be significant as a risk factor for OF, this has not been accurately demonstrated in the literature. Often studies do indicate that the women presenting for treatment of OF are shorter compared to the national average, however these women have not been compared to other women in their region who have delivered without developing an OF. It is possible that national average data regarding height may have been obtained in cities or regions far from the OF population where differences in resources and genetics would make the comparison unsustainable. Further comparison of women suffering with OF should be made with women from the same region and catchment area to either confirm or refute this claim.

Browning et al (2014) analysed a combined cohort of women with OF from 2 African countries and identified a shortened height and smaller intertuberous space (as measured by the number of examiners knuckles admitted) as risk factors for OF. The intertuberous space as measured by knuckles was proposed as an easy way to identify women who may be at risk of obstructed labour and hence OF if no effective obstetric care is available. However, the controls who delivered normally were delivered at the hospital where the OF surgery was taking place, and therefore that cohort does not necessarily reflects the heights and intertuberous spaces of women in the same regions as where the OF women delivered. The study was limited in numbers however these possible identifying risk factors deserve further research. It is possible that the suprapubic angle of a woman's pelvis may be predictive of risk for obstructed labour and therefore result in an increased risk of development of OF. Further assessment of this measurement with ultrasound may be helpful.

Known risk factors for obstructed labour itself, which is the precursor for OF, includes cephalopelvic disproportion and fetal malposition and fetal malpresentaion (Dolea & AbouZahr, 2003). Thus when these factors for obstructed labour are identified in the setting of antenatal care or intra-partum care, appropriate management will include ensuring that these women will have adequate access to effective intra-partum care so

that timely and safe delivery can occur and obstructed labour and its inherent sequelae can be avoided.

Prevention

Prevention or minimization of OF is possible through prevention of prolonged obstructed labour, and through training of health professionals to reduce risks during operative deliveries.

Strategies to prevent OF include (Goh & Krause, 2004):

- Promotion of fistula awareness
- Promotion of participation in general health and reproductive health education in the general population
- Support from community leaders
- Implementation of infrastructure
- Training of health care professionals

The promotion of fistula awareness needs to be aimed at government and non-government organisations as these groups have the visibility and capacity to reach out into the community. Policies promoting women's health may also help to prevent OF. There is a great need for increased community access to general health care and health education including family planning, both for men and women. Education needs to take place in schools, colleges and religious forums. Without the help and support of community leaders, it is often not possible to implement any programs. Therefore, community leaders need to be approached and the importance of prevention of OF needs to be embraced by them and their teams. Community leaders can then encourage their community's participation in reproductive health care education and family planning.

Infrastructure is essential when planning for ways to reduce OF. Effective transport services are required if women are to be able to access obstetric facilities. This includes good roads/ railways and affordability and reliability of public transportation. Antenatal care needs to be available and accessible to all pregnant women. This is important with regard to screening for potential problems during pregnancy, and

provides education for women so they can plan for the onset of their labour and delivery. Care in labour should follow appropriate guidelines such as a partogram with alert and action lines for early identification of women with potential obstructed labour. If women are not in a facility able to manage obstetric emergencies, then they need prompt transfer to centres with emergency obstetric services. 24-hour emergency obstetric services need to be available within communities to allow women early access to interventions such as caesarean section or instrumental deliveries if obstructed labour is identified. If women live remote from such facilities, then appropriate "waiting" accommodation should be available so they have access to effective obstetric care when their labour commences.

Training of health care professionals is extremely important. The health care professionals must be educated in the causes of OF, availability of treatment options, and strategies for prevention of OF. They must also be educated in family planning in order for them to provide advice and effective options on family planning within their communities. Continuing medical education for health care professionals needs to be ongoing and include updates on antenatal care, intrapartum and postpartum care, and family planning. Policies and guidelines for referral to centres where emergency obstetric care is available must be developed and distributed to all health care professionals. Training of generalists and specialists in surgical technique is necessary in order to minimise the risk to pelvic organs during surgical procedures. Finally specialist teams must be trained in the management of women with genital tract fistula.

There are many factors that contribute to obstetric fistula and these factors need to be addressed in order to reduce its occurrence. Some cultural/traditional customs and practices, poor resources with the accompanying lack of infrastructure, poverty and lack of education all contribute to high rates of obstetric fistula (Bangser et al., 2011, Tahzib, 1993, Norman et al., 2007).

With respect to cultural/traditional practices, in many parts of rural Africa, a woman is expected to deliver at her home or at the home of her mother, and not at a health care facility (Kiguli et al., 2015). In addition, if there is a poor outcome from the delivery

including a stillbirth or development of an obstetric fistula, often the belief is that it was due to fate or that the woman was cursed. These attitudes do not allow for prevention strategies.

Lack of infrastructure includes roads and transportation options, health centres, trained health workers, equipment and medical supplies. Poverty also delays or prevents access to medical care. In areas where a family earns US$1-2 per day, costs involving transport to the health care facility and then the costs of treatment can be prohibitive. The cost for fistula surgery can be over US$300.

Achieving education is an important factor in reducing maternal mortality and morbidity. In a study to describe and determine different factors associated with the maternal mortality rates in sub-Saharan countries (Alvarez et al., 2009), a number of variables correlated significantly with maternal mortality rates. These included prenatal care coverage, births assisted by skilled health personnel, access to an improved water source, the gross national income per capita, the per-capita government expenditure on health, and with regards to education, adult literacy rate, primary female enrolment, and education index were important variables. Norman et al (2007) compares the adult literacy rates and maternal mortality in Sri Lanka and Nigeria. Sri Lanka and Nigeria are equally poor, however the literacy rate in Sri Lanka is 83% compared to 31% in Nigeria. The maternal mortality rate in Sri Lanka is 50 per 100,000 which is in contrast to Nigeria's maternal mortality rate of over 800 per 100,000. When comparing literacy and maternal mortality rates within Nigeria, the maternal mortality is higher in illiterate women. In a study reviewing health outcomes in 29 countries (Tuncalp et al., 2014), women with lower levels of education were found to be at a greater risk for severe maternal outcomes. This finding was most marked in countries with poorer markers of social and economic development.

Education is even an important factor in reducing the risk of child mortality, with the mothers reading skills highly associated with childhood mortality. The mothers' formal schooling even to a primary level is associated with a lower risk of child mortality (Smith-Greenway, 2013).

While education of girls and women is clearly an important goal that has been demonstrated to reduce poor health outcomes including obstetric fistula, the community leaders and decision-makers also need education regarding obstetric fistula. These people who influence their communities have the ability to promote ideology, recommendations and practical assistance that will improve health outcomes.

Immediate urinary and faecal incontinence

Urinary incontinence and/or faecal incontinence due to the fistula is the immediate sequelae of development of an OF. With a fistula, the resultant communication between the urinary tract or bowel and genital tract bypasses the sphincters and cause a constant leakage of urine and/or faeces through the vagina. With urogenital fistulae in particular, this results in unrelenting urinary leakage. In cases of rectovaginal fistulae, women often try to keep themselves constipated to reduce the constant loss of faeces. This may be difficult as dietary manipulation for control of faecal consistency is often determined by cost and availability of seasonal crops.

In resource poor settings, women are faced with the constant vaginal leakage of urine without access to continence pads or good perineal hygiene. This results in a strong odour of urine and leakage of urine down their legs and onto the floor, thus making personal hygiene and care of their home very difficult. Dermatological conditions including urine dermatitis can exacerbate their discomfort. Women therefore, very early after the development of their fistula, are faced with major social and personal disruption, often including family fragmentation, social isolation and loss of employment options (Barageine et al., 2015).

Treatment

When an OF is identified very early after the injury or if a women with a prolonged obstructed labour is identified prior to the development of a fistula, conservative management with prolonged and continuous bladder drainage may result in spontaneous closure and prevention of the fistula, or reduction in size of the fistula (Goh & Krause, 2004). Continuous bladder drainage for up to 6 weeks is required. Immediate postpartum repair of an OF secondary to obstructed labour is not possible

as the tissue surrounding the fistula is necrotic and often infected. This necrotic tissue will subsequently slough away.

If the above management is unsuccessful or if a women presents at a later date then surgical management is the next option. Firstly a thorough history and examination is required. The fistula should then be classified according to an effective classification system.

There is currently no universally accepted system of classification for genital tract fistulae. Several systems have been used which are often classified according to type, size and site. McConnachie (1958) proposed one of the first classification systems using grade (including scarring) and type (including size). Lawson (1968), Hamlin and Nicholson (1969), Bird (1967), Waaldjik (1995), Goh (2004), Arrowsmith (2007), Tafesse (2008) and others have all developed systems for classification of genital tract fistulas.

The Goh classification system (Goh, 2004) is one such system that is currently fairly widely used. It has attempted to reduce intra- and inter-observer bias by using fixed reference points.

<u>Genitourinary Fistula</u>

Type 1: Distal edge of fistula >3.5cm from external urinary meatus

Type 2: Distal edge of fistula 2.5-3.5cm from external urinary meatus

Type 3: Distal edge of fistula 1.5- <2.5cm from external urinary meatus

Type 4: Distal edge of fistula <1.5cm from external urinary meatus

a. Size <1.5cm
b. Size 1.5-3cm
c. Size >3cm

i. No or mild fibrosis around fistula/vagina AND/OR vaginal length 6cm, normal capacity
ii. Moderate or severe fibrosis around fistula/vagina AND/OR reduced vaginal length/capacity
iii. Special consideration eg post-radiation, circumferential, ureteric involvement, previous repair

Genito-anorectal fistula

Type 1: Distal edge of fistula >3.5cm from hymen

Type 2: Distal edge of fistula 2.5-3.5cm from hymen

Type 3: Distal edge of fistula 1.5-<2.5cm from hymen

Type 4: Distal edge of fistula <1.5cm from hymen

a. Size <1.5cm
b. Size 1.5-3cm
c. Size >3cm
   i. No or mild fibrosis around fistula/vagina
   ii. Moderate or severe fibrosis
   iii. Special consideration eg post-radiation, inflammatory disease, malignancy, previous repair

Inter- and intra-observer accuracy has been assessed with high concordance in inter- and intra-observer reproducibility (Goh et al, 2009). Such a scoring system allows for precise communication of findings between clinicians.

Circumferential genitourinary fistulas result where the whole circumference of the urethra/bladder has been destroyed and the urethra is consequently completely detached from the remaining bladder (Goh & Krause, 2004). Obtaining an anatomical and functional closure is challenging and requires experience and attention to surgical technique. A series of 77 surgical repairs of circumferential fistulas by an experienced surgeon achieved an anatomical success rate of 91% (including 5 patients who were inoperable) (Browning, 2007). The continence rate was 50%. Less experienced surgeons would be likely to achieve significantly lower success rates.

A number of investigations pre-operatively may be required depending on the clinical findings e.g. intravenous urogram if a ureteric fistula is suspected. Appropriate pre-operative preparation is required.

Pre-operative management of concomitant conditions is necessary depending on the history, clinical findings and results of relevant investigations (Goh & Krause, 2004). Issues with malnutrition, anaemia, renal function, and infection may require attention and management prior to proceeding with surgery. Bladder calculi need removal prior

to attempting surgical closure of the fistula. Nerve injuries including foot drop need extensive and ongoing rehabilitation. Psychological and mental health issues may also need immediate attention.

Bowel preparation is recommended prior to repair of rectovaginal fistulae (Goh & Krause, 2004, Hancock, 2009). The clinical assessment of the fistula should identify the condition of the tissues, and if sloughing, inflammation or infection is present, then the surgical repair should be delayed until the tissues heal and surgical conditions are more optimal.

The principles of surgical repair includes (Goh & Krause, 2004):

1. Anaesthetic considerations
2. Good lighting
3. Identification of ureteric orifices and cannulation if close to fistula edge
4. Wide mobilization of the bladder/bowel from surrounding epithelial tissue
5. Tension-free repair of the bladder/bowel
6. Dye test to ensure a water-tight closure and to identify any additional fistulae
7. Closure of epithelium (occasionally not possible if excessive tissue loss with vaginal stenosis is present)
8. If urogenital fistula, continuous bladder drainage for 1.5 – 3 weeks depending on site of fistula
9. Graft or flap where indicated

Surgical techniques

Surgical techniques for closure of genital tract fistulas include vaginal repair, transanal repair, transperineal repair and the abdominal route, depending on whether the fistula is genitourinary or rectovaginal and experience/preference of the surgeon.

<u>Vaginal techniques</u>

The vaginal approach for closure of fistulas is the most common route worldwide for a few reasons. Firstly this approach avoids a potentially more morbid abdominal incision and easily suits a spinal anaesthetic (Goh & Krause, 2004).

a) Flap-splitting technique – the fistula is widely mobilised off the vagina then the defect is closed tension-free. This is currently the most popular technique as it

maximises vaginal function post-operatively and much of the published literature have described this technique in their case series.

b) Latzko procedure – a circular incision is made through the vaginal epithelium approximately 1 cm away from the edge of the fistula. The vaginal epithelium within the circle is excised, then the bladder is closed followed by the vaginal epithelium. This essentially is a partial colpocleisis and is more likely to be used in vault fistula repairs, however with resultant shortening of the vagina.
c) Futh-mayo technique – the fistula is circumcised with a small rim of vaginal epithelium left around the fistula. The vaginal epithelium is then mobilised. The fistula with the small rim of vaginal epithelium is invaginated into the bladder during closure of the fistula.
d) Sims saucerisation technique – a small circle of vaginal epithelium surrounding the fistula is excised creating a shallow saucer. There is no further dissection and the defect is closed in 1 layer.
e) Modified Sims-Emmet technique – the fistulous tract is excised and the vagina mobilised off the fistula prior to closure.
f) Moir technique – the fistulous tract is excised with minimal mobilisation of the fistula. The fistula is closed in 1 layer and then the vaginal epithelium is closed with vertical mattress sutures.
g) Sliding layers technique – the bladder mucosa is closed and then the muscularis of the bladder is closed with its suture line approximately 1 cm from the mucosal suture line. The vaginal epithelium is then closed with its suture line also away from the muscularis suture line.
h) Colpocleisis – the vagina is obliterated after denuding the vaginal epithelium and suturing it together. The vagina then acts as a container for urine and hence results in a high risk of urinary tract infections.

Transanal repair

Transanal repair of an anorectal fistula requires the woman to be in prone position. The fistula is mobilised off the vagina and the anorectum closed. The vaginal epithelium is left unrepaired. Technically this is only possible with lower anorectal fistulas (Goh & Krause, 2004).

Transperineal repair

A transverse incision is made over the perineum and then the anorectum dissected and exposed. The mobilised rectal fistula is repaired followed by the vaginal epithelium (Goh & Krause, 2004).

Abdominal route

(Goh & Krause, 2004)

a) O'Connor technique – the bladder is opened in the sagittal plain, with the incision extending posteriorly until the fistula is reached. This essentially bivalves the bladder. The bladder and vagina are closed separately.
b) Transvesical approach – the bladder dome is opened vertically. The fistula is approached transvesically with the bladder wall around the fistula incised and mobilised. The bladder and vagina are closed separately.
c) Extravesical approach – the vesicouterine peritoneal fold is entered and the bladder mobilised off the uterus until the fistula is reached. The bladder and vagina are closed separately. A peritoneal or omental flap can be interposed to augment the repair.
d) Ureteric reimplatation
e) Colorectal anastomosis

The post-operative surgical phase is vital as any blockage of the catheter with distension of the bladder will result in breakdown of the surgical repair (Goh & Krause, 2004). When the catheter is due for removal at the planned time, ideally a dye test can be done prior to removal of the catheter to ensure closure, and then a trial of void with checking of post-void residual urine volumes should be undertaken to avoid bladder overdistension in cases of voiding dysfunction.

Once the surgical repair has been confirmed and the woman is discharged, the woman requires education regarding her post-operative recovery of 3 months and possible future sequelae and pregnancies (Goh & Krause, 2004, Hancock, 2005, Hancock, 2009). This information and education is best provided over the course of the woman's admission to allow for complete understanding and for any questions to be answered. Full tissue strength following surgery occurs after 3 months. It is therefore advisable for the woman to avoid sexual intercourse during that recovery period. The possibility of future post OF sequelae such as urinary incontinence or infertility should be

discussed and future access to services addressing these issues determined. Where a future pregnancy occurs, the woman needs to be advised to seek early antenatal care and to be in a position to access an elective caesarean section.

Failure of surgical repair

Despite good expertise in surgical repair of OF, there is a risk of wound breakdown and hence failure of the repair with recurrent fistula. Breakdown of the wound may be attributed to infection, overdistension of the bladder due to a blocked catheter, or poor tissue perfusion and scarring. Success rates for successful closure will vary depending on type of fistula and special considerations including scarring, circumferential fistulas and whether it is a primary repair. Overall success rates for fistula closure are quoted at over 80% (Wall, 2006). Goh et al (2008) prospectively followed 987 women undergoing OF repair with a 97% rate of successful closure. The type or size of fistula (Goh classification) did not affect the success of closure however special considerations including scarring, circumferential fistulae and previous repairs were significant factors for failure of closure.

Hancock (2009) presents his personal series of 790 consecutive previously untreated cases. The fistulas were considered too extensive to attempt a repair in 2.4% and were irreparable at time of operation in 1%. The fistula was closed in the first attempt in 90% of cases operated upon. In Andrew Browning's series of 400 new cases (Hancock, 2009), his closure rate was 97.5% with 2% of cases too extreme to attempt surgery.

In a large retrospective analysis of OF cases undergoing surgical repair in Ethiopia (Nardos et al., 2009), the following risk factors for failure were identified – small bladder, urethral destruction, circumferential injury and severe vaginal scarring. Goh et al (2008) identified significant vaginal scarring and circumferential fistulae as having a higher risk of closure failure. Therefore, when using the Goh classification system (Goh, 2004), a score including severe scar (ii) or circumferential (iii) will be predictive of a higher risk of closure failure.

Where the first attempt at fistula closure fails, the success rate of subsequent attempts at closure is likely to be reduced due to extra scarring and possibly persistence of the initial reasons that the closure was unsuccessful.

Sequelae

The impact of OF on a women is marked. There are numerous possible medical, psychological, sexual and social sequelae, even following successful closure of a fistula (Goh & Krause, 2004).

Medical

The medical problems that women may face following the development of OF includes urinary incontinence and dysfunction, faecal incontinence, vulval dermatitis, menstrual dysfunction, secondary infertility, nerve damage including foot drop, urinary tract infections, and bladder calculi.

Urinary incontinence as the result of a urogenital fistula results in constant urinary leakage via the vagina. In cases of anorectal genital fistulas there can be a constant uncontrolled loss of faeces via the vagina. Both urinary and faecal incontinence can then cause dermatitis affecting the vulva due to the constant contact of urine or faeces onto the skin. The vulva can become very excoriated. Post-fistula repair urinary dysfunction will be discussed in detail in chapter 2.

Menstrual dysfunction and secondary infertility are common sequelae due to the development of intrauterine adhesions (Ashermann's syndrome) or pelvic inflammatory disease secondary to the trauma of the prolonged obstructed labour. Infection following the labour and delivery is common, as often several days elapse from onset of labour and rupture of membranes to delivery, with intrauterine foetal demise and associated degradation of foetal tissues compounding the risk of infection.

Nerve damage may occur due to compression of the lumbo-sacral plexus during prolonged obstructed labour. Foot drop is the most common result due to involvement of the L5 nerve root. These injuries may recover slowly over time and with adequate

physiotherapy rehabilitation, however in severe cases there may be residual functional defects.

Urinary tract infections occur when the bladder is no longer intact and in direct communication with the vagina via the fistula. Ascending infections involving the kidneys are also common and can result in renal function compromise or failure over time. Bladder calculi are frequently seen in women with urogenital fistulas. These may occur where a foreign material has migrated or been pushed into the bladder. Also where women with fistula fluid restrict themselves in order to reduce the amount of urine leakage, the urine becomes very concentrated which then predisposes them to the formation of renal tract calculi. Bladder calculi must be removed prior to the repair of the fistula.

Psychological

The onset of mental health problems following the development of OF is not surprising. These women have usually suffered a prolonged obstructed labour with a resultant stillborn infant. They then are impacted with the onset of constant and uncontrollable urine/faeces loss through their vagina.

Studies on the mental health of women with obstetric fistula in low-resource countries are few. Goh et al (2005) surveyed women in Ethiopia and Bangladesh suffering with genital tract fistula using the General Health Questionnaire-28 that is a screening tool for mental heath dysfunction. In their study 32% of controls screened positive giving an estimated prevalence of major depression between 8-13% which is consistent with an up to 10% estimated prevalence of clinically diagnosed major depression in western adults. However, 97% of the women with genital tract fistula screened positive for potential mental health dysfunction giving a likely incidence for major depression of 23-38% in women suffering with fistula.

Sexual

Sexual dysfunction following development of an OF is likely for a number of reasons. The woman has constant vaginal leakage of urine and/or faeces into the vagina that creates reluctance to pursue sexual activities. Frequently scarring and restriction of the

vaginal capacity secondary to the obstructed labour results in dyspareunia or apareunia. There is minimal information in the published literature regarding these concerns and the extent of this problem.

Social

OF results in major disruptions to women's social situations and expectations. Firstly the stillbirth of a woman's child is unexpected and traumatic and often associated with social stigma. The subsequent continuous and uncontrollable loss of urine /faeces causes problems with an offensive smell and not only personal hygiene, but also the hygiene of everyone in the family unit within which she lives. This can result in abandonment by her partner and family. The woman's usual occupation which provides her financial security may also be unavailable to her due to these issues.

Commonly in the literature, authors state that these women are often abandoned by their partners and ostracized from society (Alio et al., 2011). A patient who was treated by Dr Catherine Hamlin at the Addis Ababa Fistula Hospital for Poor Women with Childbirth Injuries declared to Catherine as she left the hospital fully cured of her fistula: "I love you next to God. To think I have been sitting alone, begging, for 40 years when I could have been cured long ago. I could have had babies, but instead my life has been wasted." (Hamlin & Little, 2001).

In the words of Dr Catherine Hamlin, Addis Ababa Fistula Hospital for Poor Women with Childbirth Injuries: "What we always think of in our mind is what we can give to these women who have lost their husband, homes, babies, self respect and hope, and who have come all the way from their villages out in the countryside on foot, by camel, donkey, horse and mule, looking for help. We give them love, welcome and the necessary medical care, and our reward is seeing them cured, their lives, bodies, minds and hope revived. We love the work, and it is our joy to do it" (p118 Zacharin, 1988).

1.3 UNREPAIRED (CHRONIC) 4TH DEGREE OBSTETRIC TEARS

1.3.1 Anatomy of the anorectum

The perineum is the diamond shaped area of the pelvic outlet, caudal to the pelvic diaphragm. Anteriorly the perineum is bordered by the inferior pubic rami and posteriorly by the sacrotuberous ligaments. The pelvic outlet can be divided by a transverse line joining the anterior parts of the ischial tuberosities. This creates the anterior urogenital triangle and the posterior anal triangle. Within the anterior urogenital triangle is a superficial and deep group of muscles separated by a fibrous connective tissue layer called the perineal membrane. This superficial group of muscles includes the bulbospongiosis, superficial transverse perineal and ischiocavernosus muscles. The deep perineal compartment consists of the deep transverse perineal muscles, portions of the external urethral sphincter muscles, portions of the anal sphincter and vaginal musculofascial attachments (Chapple et al., 2006, Walters & Karram, 2015).

The perineal body itself is the fibromuscular area between the vagina and anal canal and is the central fixation point of the perineum. It contains interlacing muscle fibres from the bulbospongiosus, superficial and deep transverse perineal and external anal sphincter muscles. Above this level are contributions from the longitudinal rectal muscle and medial fibres of the puborectalis muscle. The perineum has its motor and sensory innervation via the pudendal nerve which originates in sacral nerve roots S2-S4. The pudendal nerve exits the pelvis through the greater sciatic foramen, hooks around the ischial spine, travels along the obturator internus, traverses through the ischiorectal fossa via Alcock's canal and then divides into 3 branches – the clitoral, perineal, and inferior rectal nerves (Chapple et al., 2006, Walters & Karram, 2015).

The posterior anal triangle includes the anal sphincters and the ischiorectal fossa. The rectum, anal canal and anal sphincters comprise the anorectum.

The rectum extends from the junction with the sigmoid colon to the anus. It is approximately 15cm in length and acts as a reservoir with a low intrarectal pressure. It

is composed of an outer longitudinal layer of muscle and inner circular layer of muscle (Chapple et al., 2006, Walters & Karram, 2015).

The anal canal is 3-5cm in length and lies below the anorectal junction. The puborectalis muscle forms the anorectal junction. Within the anal canal is the dentate line which is the transition zone from colonic mucosa to squamous epithelium. This area is richly innervated and allows for the area to distinguish between gas, liquid and solid content in the upper anal canal. Anal cushions are present at 3, 7, and 11 o'clock in the anal canal, and these anal cushions contribute to the resting anal pressure and provides a mucosal seal in the anal canal. The anal sphincters consist of the external anal sphincter and the internal anal sphincter. The external anal sphincter is a striated muscle with superficial and deep portions. Posteriorly it is inseparable from the puborectalis muscle. It is tonically contracted most of the time, however is also voluntarily contracted. The internal anal sphincter is a continuation of the inner circular smooth muscle of the rectum. It is under autonomic control and responsible for 75-85% of the resting anal pressure. It is separated from the external anal sphincter by the conjoint longitudinal smooth muscle of the rectum (Chapple et al., 2006, Walters & Karram, 2015).

The anorectal angle is produced by the anterior pull of the puborectalis muscle. At rest the puborectalis muscle is tonically contracted and creates a 90 degree anorectal angle. This helps with maintenance of anal continence. Anorectal continence is achieved through a complex of factors including normal colonic motility, consistency of stool, and rectal storage, normal innervation of the anorectum, maintenance of the anorectal angle at rest, and an intact anal sphincter (Chapple et al., 2006, Walters & Karram, 2015).

1.3.2 Definition of perineal tears

Perineal tears are classified as follows (Sultan, 1999) (NICE, 2013):

1. First degree – injury to perineal skin
2. Second degree – injury to perineum involving the perineal muscles but not involving the anal sphincters
3. Third degree – injury to perineum involving the anal sphincter complex:

a. 3a: less than 50% of external anal sphincter (EAS) thickness
b. 3b: more than 50% EAS thickness
c. 3c: both EAS and internal anal sphincter (IAS) involved

4. Fourth degree – involves anal sphincter complex (EAS and IAS) and anorectal mucosa

The most common cause of perineal tears is from obstetric trauma during vaginal delivery. The term used for this type of injury when the anal sphincter is involved is obstetric anal sphincter injury (OASIS) and includes all 3rd and 4th degree tears.

Clinically symptoms of anal incontinence occur when the anal sphincter is disrupted. Anal incontinence is defined as the complaint of involuntary loss or flatus and/or faeces affecting quality of life (Haylen et al, 2010).

1.3.3 Incidence of OASIS

The documented clinical incidence of OASIS varies in the literature with reports of less than 1% and up to 9% (Power et al, 2006, Marsh et al, 2011). The rates of 3rd- and 4th-degree tears are often included together when cited. The rates of 4th-degree tears (where the tear extends into the anal mucosa) are quoted at between 0.03% - 0.2% of all vaginal deliveries and these 4th-degree tears comprise 4.4% - 12.9% of all OASI (Groutz et al, 2011, Kumar, 2012, Lindqvist & Jernetz 2010, Ramalingam & Monga 2013).

Established risk factors for OASIS include primiparity, assisted forceps delivery, persistent occipito posterior position, and birth weight greater than 4000g. There are a number of less established risk factors which include maternal age, postdates pregnancy, induction of labour, prolonged 2nd stage of labour, precipitate labour, epidural anaesthetic, and various birth positions (Byrd et al., 2005). In an obstetric unit (Groutz et al., 2011) where avoidance of forceps delivery, avoidance of midline episiotomy, and selective use of mediolateral episiotomy is practiced, the significant risk factors for severe perineal tears were primiparity, vacuum extraction, and heavier birth weight.

The RCOG Green-top guidelines (2015) on “The management of third- and fourth-degree perineal tears” cite Asian ethnicity, nulliparity, birth weight greater than 4kg,

shoulder dystocia, persistent occipito-posterior position, prolonged second stage of labour and instrumental delivery, as risk factors for OASIS. There is limited evidence regarding risk of sustaining recurrent OASIS. Risk factors identified for recurrent OASIS are Asian ethnicity, forceps delivery, and a birth weight of greater than 4kg (Edozien et al., 2014).

1.3.4 Prevention of OASIS

There are a few techniques with varying levels of evidence associated with their use, which may reduce the risk of OASIS (RCOG Green-top guidelines, 2015). With regard to episiotomy, clinicians should explain to women that the evidence for the protective effect of episiotomy is conflicting. Mediolateral episiotomy should be considered in instrumental deliveries. Where episiotomy is indicated, the mediolateral technique is recommended, with careful attention to ensure that the angle is 60 degrees away from the midline when the perineum is distended. Perineal protection at crowning can be protective and warm compression during the second stage of labour reduces the risk of OASIS.

1.3.5 Technique to repair acute OASIS

The techniques for repair of OASIS will vary depending on whether the injury is acute or chronic.

Acute repair (RCOG Green-top guidelines, 2015): Ideally OASIS should be repaired as soon as possible after the diagnosis. With the acute injury, delay will result in increasing oedema, haemorrhage and need for further analgesia. For optimal outcomes of OASIS repair, the following issues should be accessed – adequate access, adequate anaesthesia or analgesia, good lighting, aseptic conditions and appropriate surgical instruments. Initial careful assessment of the perineum it is necessary to document the degree of injury. Adequate anaesthesia/analgesia allows for accurate assessment, adequate muscle relaxation to retrieve retracted sphincter ends, and repair without tension. The anal/rectal mucosa can be repaired using interrupted or continuous absorbable sutures eg 3/0 vicryl or 3/0 PDS. The internal anal sphincter should be identified if involved, and repaired separately with interrupted delayed absorbable sutures eg 3/0 PDS or 2/0 PDS.

The external anal sphincter can be repaired by one of two methods – end-to-end or overlap techniques. Traditionally the most common type of repair performed for primary sphincter repair is the end-to-end technique. The end-to-end technique is where the torn ends of the sphincter are approximated and repaired with interrupted mattress or figure-of-8 sutures. A delayed absorbable monofilamentous suture such as 2/0 PDS can be used. The overlap repair of the EAS requires the torn sphincter ends to be identified and mobilised. The ends are mobilised to allow a couple of cm of overlap of the sphincter ends. Two rows of absorbable sutures such as 2/0 PDS are used to secure the repair. The perineal repair is then completed as per a second degree tear with repair of the perineal body muscles, vaginal epithelium and skin closure. Potential advantages of the overlap technique include that the full length and width of the torn sphincter ends are easily identified, there is a greater surface area of contact between the sphincter ends, and the overlap allows for some retraction of the sphincter ends while still maintaining apposition.

Monofilamentous sutures are less likely to precipitate infection compared to multifilamentous sutures. Prophylactic antibiotics are recommended to help reduce the risk of wound breakdown. Good post-operative bowel management is important as straining and passage of hard stools may disrupt the repair.

1.3.6 Techniques to repair chronic OASIS

When a perineal tear is unrepaired, it will heal by secondary intention. Thus in the case of 4th-degree tear, the torn edges of the vagina and anorectum will fuse and the divided anal sphincter complex will remain separated. The end result is the appearance of a cloacal deformity.

There are a number of described techniques to reconstruct such cloacal-type deformities, which are usually secondary to obstetric injuries. The publications to date are small case series or case-studies. Many describe the repair technique following breakdown of a primary repair rather than following cases of chronic OASIS or more specifically, unrepaired 4thdegree perineal tears.

Altomare et al (2007) presents a single case of chronic 4th-degree tear where they use a modified lotus petal flap following overlapping sphincteroplasty. A loop ileostomy was also utilised. The right gluteal cutaneous flap does result in significant scarring which is evident in the figures in the case report. Abcarian et al (1989) and Vankatesh et al (1989) did not recommend faecal diversion in the management of obstetric injuries to the anorectum. Abcarian et al (1989) described a technique consisting of reconstruction of the perineal body with puborectalis interposition and overlapping external sphincteroplasty. They did advocate a partial closure of the perineal incision to facilitate drainage. Kaiser (2008) also did not use any faecal diversion for any of their series of 12 women with post-obstetric injury associated cloacal-like deformity. Kaiser (2008) did utilise X-flaps for reconstruction of the perineum. These flaps do result in quite extensive incisions over the buttocks. The follow-up at 38 months demonstrated good continence.

Hollingshead et al (2009) presented a series of 29 women who underwent surgical repair of their chronic 4th-degree obstetric tear. There were no flaps used for reconstruction, and the perineal wound was either left with a defect centrally of a drain was inserted. Faecal diversion was used with a colostomy formed in over half of the women. A series of 4 cases of chronic 4th-degree obstetric tear is presented by Valente and Khanduja (2012). These cases were repaired in layers without the use of flaps or faecal diversion. The perineal skin was not completely closed to allow for any drainage. There were no wound breakdowns and 4.5 year follow-up demonstrated perfect anal continence for all 4 women.

1.3.7 Sequelae of unrepaired/ chronic OASIS

After the occurrence of a 4th degree perineal tear, if it remains unrepaired, significant faecal and flatal incontinence will result as the sphincter is completely disrupted. Intuitively women usually try to ensure that their stools are firm or hard to try to reduce these incontinence symptoms. Sexual function is also altered as the genital hiatus is now pathologically enlarged, and sexual intercourse may inadvertently result in rectal penetration via the resultant cloaca.

A case report from Cameroon (Weledji et al., 2014) illustrates the symptoms suffered by a woman with an unrepaired 4th degree tear secondary to a vaginal delivery 2 years earlier. A technique for sphincter repair is described with an overlapping repair of the EAS utilised. Her initial recovery was excellent however no long-term follow-up outcomes were available. Overall however, there are very few case reports of the unrepaired 4th degree tear with little acknowledgement in the published literature of this common problem affecting large numbers of women in areas of limited access to inadequate medical resources.

1.3.8 Documentation of chronic 4th degree perineal tears in the low-income setting

Until very recently, the worldwide literature has not acknowledged or documented any significant numbers of women suffering with unrepaired 4th degree perineal tears. Certainly in low-income countries and regions where women commonly deliver vaginally in their home without any trained health care professional available, it would be expected that many women would develop a 4th degree perineal tears without any treatment available. Interestingly in a study published in 2015 (Browning & Whiteside, 2015) where 1100 cases of genital tract fistula presenting to a fistula unit in Ethiopia were assessed, 124 women (11.7%) had a rectovaginal fistula with or without a co-existing vesicovaginal fistula. Of these 124 cases, only 15 were attributed to an unrepaired 4th degree perineal tear. All defects were successfully closed.

1.4 PELVIC ORGAN PROLAPSE

1.4.1 Normal anatomy

The term pelvic floor incorporates the pelvic organs, the peritoneum overlying it, endopelvic fascia, levator ani muscles, coccygeus, obturator internus, piriformis, and perineal membrane (Wei & DeLancey, 2004). These muscles, fascia, ligaments, and fascial attachments of the viscera all combine to support the load and contents of the abdominopelvic cavity. The ligaments and fascia are mainly composed of extracellular matrix, which is made of a ground substance of proteoglycans and glycoproteins with collagen type I and III, and also elastin. There have been 28 types of collagen described in the body, with type I and III the most common types in the pelvic floor.

The pelvic bones are comprised of the ilium, ischium, pubic rami, sacrum and coccyx. The sacrum is the fusion of the 5 sacral vertebrae. The coccyx is inferior and is the posterior border of the pelvic outlet. The bony landmarks of the bony pelvis include the pubic symphysis, pubic rami, ischial spines, ischial tuberosity and coccyx. The sacrospinous ligaments attach to the ischial spines and extend to the sacrum. The arcus tendineus extends laterally from the ischial spines to attach anteriorly to the lower pubic bone. Prior to its attachment to the pubic bone, the arcus tendineus splits to form the tendinous arch of the pelvic fascia and the tendinous arch of the levator ani. The pubocervical fascia arises from the tendinous arch of the pelvic fascia, and the levator ani muscles arise from the tendinous arch of the levator ani (Chapple et al., 2006, Walters & Karram, 2015).

The pelvic floor muscles comprise the levator ani muscles and the coccygeus muscles. The levator ani muscle group consists of the puborectalis, pubococcygeus, and iliococcygeus muscles. This was originally described in 1976 by Woodburne (Woodburne,1976). More recently the terminology has changed to reflect the origins and insertions of various components (Kearney et al., 2004). The pubovisceral muscle now refers to all levator muscles medial to the iliococcygeus. The levator ani muscle group extends from the inner surface of the pubic bone, attaches laterally to the arcus tendineus, and extends posteriorly and attaches medially to the midline raphe between the rectum and coccyx. The pubovisceral component essentially forms a thick

U-shaped muscle and inserts into or forms a sling around the urethra, vagina and rectum. This pubovisceral component can then be divided into the puboperinealis, pubovaginalis, and puboanalis, reflecting their specific insertion points.
The coccygeus muscles originate on the ischial spines and sacrospinous ligaments and inserts on the lateral lower sacrum and coccyx and overlies the sacrospinous ligament. The coccygeus is posterior to the levator ani muscles.

The pelvic sidewalls are formed by the obturator internus and piriformis muscles. The obturator internus muscles originate on the internal surface of the obturator membrane, posterior bony margin of the obturator foramen, the pubic rami, and rami of the ischium, and insert into the medial surface of the greater trochanter of the femur. The arcus tendineus fascia pelvis (also called the arcus tendineus levator ani) is a linear thickening of the fascia covering the obturator internus muscle and is commonly known as the “white line”. The piriformis muscles arises from the anterolateral sacrum, passes through the greater sciatic foramen and inserts onto the greater trochanter. The lumbosacral plexus lies above the piriformis muscles (Chapple et al., 2006, Walters & Karram, 2015).

The perineum lies superficially to the pelvic floor. It can be divided into an upper urogenital triangle and a lower anal triangle. The perineal body is located between the vagina and anus and is the central fixation point of the perineum. The muscles of the urogenital triangle include the bulbospongiosus, ischiocavernosus and superficial transverse perineus muscles. In addition the perineum is divided into a superficial and deep compartment, with the deep transverse perineal muscle lying deep to a fibrous connective tissue layer called the perineal membrane (previously called the urogenital diaphragm). The lower anal triangle comprises the ischiorectal fossa, external anal sphincter muscle and anal canal (Chapple et al., 2006, Walters & Karram, 2015).

1.4.2 Anatomy and symptoms of prolapse

With injury or disruption to any of the components of the pelvic floor anatomy, comes the likelihood of pathologies including pelvic organ prolapse (POP). POP is essentially a hernia of components of the pelvic floor. It refers to descent of the anterior vaginal

wall, posterior vaginal wall, and/or uterus or apex of the vagina. POP becomes a clinical issue when it becomes symptomatic.

POP symptoms include the sensation of a lump in or outside of the vagina, a dragging sensation or discomfort, voiding difficulty, bowel evacuation dysfunction, and sexual dysfunction (Goh & Flynn, 2017). In the most severe cases of procidentia, a woman can have difficulty walking due to the large prolapse between her legs, and she may need to manually reduce the prolapse in order to void or move her bowels. The constant rubbing of the vaginal surfaces which are everted causes bleeding and ulceration.

1.4.3 Assessment and classification

In order to be able to be accurate in communicating the type and severity of prolapse, a classification system is necessary. This allows both inter- and intra-observer consistency with documentation. Prior to 1996, numerous classification systems were in use. Criteria described by Baden et al (1968) and Beecham (1980) with subsequent modifications were utilised. However following the description of the International Continence Society (ICS) standardization of terminology of female pelvic organ prolapse by Bump et al (1996), the Pelvic Organ Prolapse Quantification (POPQ) system has become widely used. The ICS/IUGA did publish a revision in 2010 (Haylen et al., 2010) and 2016 (Haylen et al., 2016).

The ICS POPQ system documents 9 measurements in total, including 6 defined point measurements and 3 other measured lengths. These are all site-specific measurements indicating the degree of pelvic organ support. The 6 defined point measurements are measured relative to the hymen which is a fixed anatomic landmark. Anteriorly are points Aa and Ba, posteriorly are points Ap and Bp, and apically point C and D refer to descent of the apex. All measurements are in centimetres and will be either a positive number or negative number depending on the position of that point in relation to the hymen. The remaining 3 measurements, total vaginal length (TVL), genital hiatus (GH) and perineal body (PB), are measured in centimetres and will always be a positive number.

Point Aa – midline in the anterior vaginal wall 3cm proximal to the external urethral meatus. The measurements will be from -3 (normal position) to +3cm.

Point Ba – the most distal position of the anterior upper vaginal wall in the midline from point Aa to the anterior vaginal fornix or vaginal cuff. The measurements will be from -3 (normal position) to a positive number depending on the degree of prolapse.

Point Ap – midline in the posterior vaginal wall 3cm proximal to the hymen. The measurements will be from -3 (normal position) to +3cm.

Point Bp – the most distal position of the posterior upper vaginal wall in the midline from point Ap to the posterior vaginal fornix or cuff. The measurements will be from -3 (normal position) to a positive number depending on the degree of prolapse.

Point C – represents the most distal descent of the cervix or vaginal cuff if previous total hysterectomy.

Point D – represents the most distal descent of the posterior fornix if the uterus remains present. This point is excluded in the absence of a cervix.

TVL – the total length of the vagina from hymen to apex once the apex is reduced to its normal position.

GH – measurement from the middle of the external urethral meatus to the posterior midline hymen.

PB – measurement from the posterior margin of the genital hiatus to the mid-anal opening.

The measurements of descent should be obtained during straining/ Valsalva or with traction.

All 9 measurements are easily documented in a 3x3 grid. These measurements are then converted into an ordinal staging system.

The stages of POP range from stage 0 to stage IV according to the most severe portion of the prolapse:

Stage 0 – No prolapse.

Stage I – the most distal portion of the prolapse is >1cm above the hymen (ie quantification < -1cm).

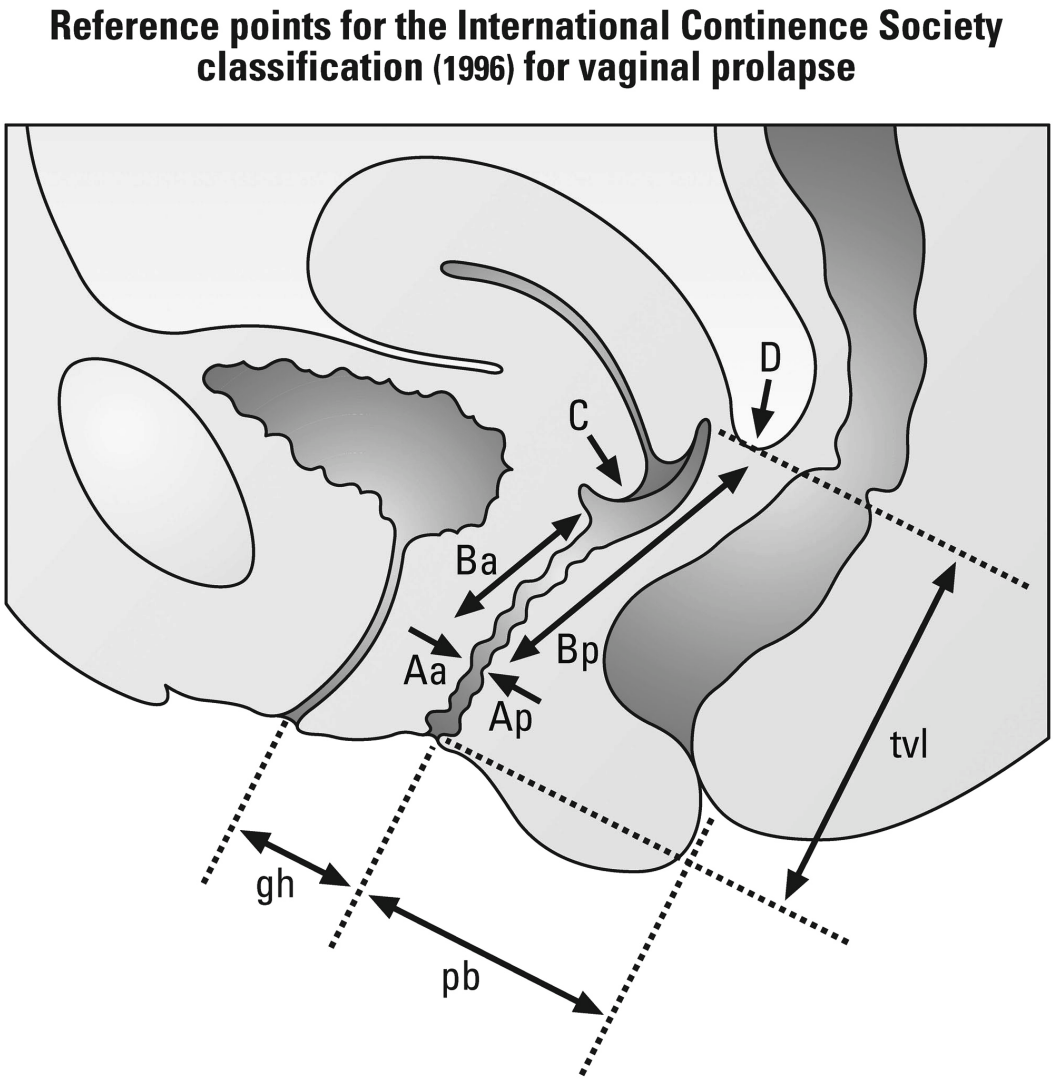
Stage II – the most distal portion of the prolapse is < or = 1cm proximal to or distal to the hymen (ie quantification > or = -1cm but < or = +1cm).

Stage III – the most distal portion of the prolapse is > 1cm below the hymen but does not protrude further than 2cm less than the TVL (ie quantification > +1cm but < (TVL-2)cm).

Stage IV – complete eversion of the TVL or at least (TVL – 2)cm.

See Figure 1.4.1

Figure 1.4.1. Reference points for the International Continence Society classification (1996) for pelvic organ prolapse (Bump et al., 1996)



In 2016, in the International Urogynecological Association/ International Continence Society joint report on the terminology for female pelvic organ prolapse (Haylen et al., 2016), a simplified POP-Q was presented. This included using only 4 points of

measurement instead of 9: Ba, Bp, C, D. In addition stage 0 is combined with stage I, therefore the staging is stage I, II, III, and IV.

Using the POPQ and ordinal staging system has allowed for a more universal approach to assessing and documenting and comparing POP. In particular, the incorporation of these definitions into research has allowed for accurate comparisons of POP assessments and outcome measures following treatments for POP.

1.4.4 Prevalence of POP

The prevalence of POP in a population will vary depending on the definition of prolapse and its symptoms, and whether it is assessed according to symptoms or assessment or both. When examination (POP-Q) alone was assessed in a North American population of postmenopausal women, the prevalence of prolapse at or beyond the hymen was 25.6 – 49.4% (Nygaard et al., 2004, Bradley et al., 2007). In Nygaard's study (Nygaard et al., 2004) on women with an intact uterus enrolled in the WHI Hormone Replacement Therapy clinical trial where the average age was 68.3 years, 97.7% of the women on assessment had prolapse to some degree. As most of those women did not have symptoms of prolapse they concluded that this finding was not necessarily clinically relevant. Other studies in the USA based on symptoms of prolapse alone document a prevalence of prolapse symptoms of 2.9-5.7% (Nygaard et al., 2008, Bradley et al., 2005, Rortveit et al., 2007). Also in the USA, 6% of over 4000 community dwelling women reported having symptoms attributable to POP (Lawrence et al., 2008).

In Sweden, the overall prevalence of POP is 31% (Samuelsson et al., 1999), whereas the prevalence of symptomatic prolapse is 8-15% (Tegerstedt et al., 2005, Uustal Rornell et al., 2003).

The lifetime risk of surgical intervention for POP has been quoted at 10-20% (Olsen et al., 1997, Smith et al., 2010). Recently in western Australia, Smith et al (2010) calculated the lifetime risk for surgery for pelvic organ prolapse in the general female population by age 85 to be 19% based on the most recent cross-sectional rates.

1.4.5 Risk factors for POP

Age, parity, childbirth, chronic straining (eg chronic cough, constipation), connective tissue disorders, genetic/ familial factors, congenital factors, and obesity, are all thought to increase the risk of development of pelvic organ prolapse.

In a landmark study published in 1997 (Mant et al., 1997), 17032 women who attended family planning clinics between 1968 and 1974 were followed up to identify the incidence of hospital admission for prolapse and associated risk factors. Age, parity, calendar period and weight were significantly associated with the risk of an inpatient admission with prolapse. There were also significant trends observed in relation to smoking and obesity. The most marked risk factor detected was parity, with an 11-fold increase in risk of prolapse in women with 4 or more children compared with nulliparous women. Most of that increase in risk occurred after a woman had 2 children.

In 2005 the Pelvic Organ Support Study (POSST) confirmed increasing parity was associated with prolapse (Swift et al., 2005), with the risk of prolapse increasing by 1.2 times with each vaginal delivery. Age was also a risk factor for development of prolapse with a 100% increased risk of prolapse for each decade of life. There are numerous factors that may be implicated with aging including physiological aging, hypoestrogenism, and age-related degenerative and organic diseases.

A chronic increase in intra-abdominal pressure is certainly likely to be a risk factor for the development of prolapse, however studies have found this difficult to document. Chronic constipation, chronic coughing and repetitive heavy lifting most likely predispose women to prolapse. A study in Denmark (Jorgensen et al., 1994) did identify that women performing duties which included repetitive straining had an increased risk of developing prolapse compared to the general population.

A recent review of the literature related to the epidemiology of pelvic floor disorders and childbirth (Hallock & Handa, 2016) highlighted a lifespan model for pelvic floor disorders published by DeLancy et al (2008). Three phases are identified across a

woman's life in the lifespan model of development of pelvic floor disorders (Hallock & Handa, 2016).

Phase 1: predisposing factors for pelvic floor disorders. To date no specific genetic cause for pelvic floor disorders have been identified, however there is significant epidemiological evidence for a genetic predisposition. Lince et al (2012) performed a meta-analysis of clinical studies on family history of pelvic organ prolapse and calculated that the relative odds for pelvic organ prolapse among women with a genetic predisposition was 2.58. Ward et al (2014) presented a systematic review of genetic studies which identified that collagen type 3 alpha 1 was associated with pelvic organ prolapse. Campeau et al (2011) also reviewed our understanding of familial tendencies, extracellular matrix including collagen architecture and content, collagen synthesis, collagen breakdown, and elastin, hormonal contributions and genetic contributions, in relation to pelvic floor disorders. Studies of pelvic tissues showed differences between control subjects and women with pelvic organ prolapse and stress urinary incontinence in elastin and collagen structure at a molecular and fibrillar level.

Overall the various studies analysed showed a trend towards decreased collagen and elastin content in women with pelvic floor dysfunction. Genetic mutations (polymorphisms) may be related to familial predisposition. There have been polymorphisms identified in genes of extracellular matrix component proteins, proteolytic enzymes, regulatory proteins and receptors. Therefore these mutations may be responsible for down-regulating the synthesis of collagen and elastin or up-regulating their breakdown (Campeau et al., 2011). More recently Cartwright et al (2015) published a systematic review and metaanalysis of genetic association studies of urinary symptoms and prolapse in women. This analysis provided moderate epidemiological evidence for associations of variation of COL1A1 (collagen, type 1, alpha 1) with prolapse. Type 1 collagen is a major structural component of the vaginal epithelium and of the endopelvic fascia. Numerous other studies on have focused on variation in genes which are involved in extracellular matrix organisation and breakdown, in particular with focuses on collagen and metalloendopeptidase genes.

Phase 2: inciting factors for pelvic floor disorders. In the lifespan model, the second phase assesses the impact of acquired risk factors including obstetric events. It is well documented that pelvic organ prolapse is more common in vaginally parous women compared to nulliparous women (Quiroz et al., 2011, Handa et al., 2011, Gyhagen et al., 2012). This increase in risk is most marked with the first birth (Quiroz et al., 2011, Handa et al., 2011). Quiroz et al (2012) found that vaginal delivery increased the odds of prolapse to or beyond the hymen (OR 9.73), however an additional vaginal delivery did not increase the odds further. They did not find that caesarean section was associated with prolapse. Labour in the absence of vaginal delivery, has not been found to modify the later development of pelvic floor disorders. Handa et al (2011) did not find any increase in risk for pelvic floor disorders in women delivered only by caesarean section, even when active labour or complete cervical dilatation had occurred. In the same study, operative vaginal delivery with either forceps or vacuum extraction do appear to be significant risk factors for development of pelvic floor disorders. When compared with normal vaginal delivery, there was a significant increase in the odds ratio for all pelvic floor disorders with operative deliveries, with the highest increase for pelvic organ prolapse (OR 7.5) (Handa et al., 2011).

Understanding the pathophysiological basis for this strong association between vaginal delivery and pelvic floor disorders is necessary. Damage to the levator ani muscles is likely to be an important factor. Much work has been published trying to identify the role of levator injury with pelvic floor disorders (Strohbehn et al., 1996, DeLancey et al., 2003, Ashton-Miller & DeLancey, 2009, Dietz & Wilson, 2005, Dietz & Lanzarone, 2005, Dietz & Simpson, 2008). The mechanism for injury of the levator muscle is thought to be stretch (overdistension or microtrauma) or avulsion (disruption of muscle or macrotrauma) (Guzman Rojas et al., 2013). Overall there is thought to be a high rate of levator ani injuries occurring, with a review by Schwertner -Tiepelmann et al (2012) finding the prevalence of levator ani muscle injuries in vaginally parous women to be 13-36%. Following levator ani muscle injury, the prognosis is not clear and further studies are required to determine impact on future development of pelvic floor disorders.

3D computer models have been developed to try to determine the likelihood neuromuscular injuries during vaginal delivery (Lien et al., 2005), however the subsequent occurrence of pelvic floor disorders is unknown. There may be some maternal adaptations in preparation for parturition which occur which may help to reduce the risks of intrapartum injuries. For example, greater activity of elastase in the first-trimester has been associated with uncomplicated normal vaginal deliveries (Oliphant et al., 2014). Fetal birth weight has been shown to be a risk factor for symptomatic pelvic organ prolapse (Gyhagen et al., 2012). In this study, short mothers (160cm or less) who delivered a child weighing 4000g or more, had twice the prevalence of pelvic organ prolapse compared to short mothers with smaller babies.

Phase 3: intervening factors for pelvic floor disorders. Age is a known risk factor associated with the prevalence and severity of all pelvic floor disorders. Miedel et al (2009) surveyed 5489 women from age 30 to 79 and identified age as an independent risk factor for symptomatic pelvic organ prolapse. Obesity and its association with pelvic organ prolapse has not been clear to date, however some studies have provided subjective associations of obesity with prolapse (Gyhagen et al., 2012).

This lifespan model tries to identify causal factors for pelvic floor disorders over time. It includes understanding the effects of pregnancy physiology, childbirth mechanics, obstetric interventions, and predisposing factors such as genetics, on the development of pelvic floor disorders over a lifetime.

1.4.6 POP in low-resource settings

There is a paucity of studies based in Africa that have assessed the prevalence of POP or symptoms of POP of women living in Africa. Walker and Gunaseka (2011) reviewed 30 studies based in locations defined as low-income economies (8 of these studies were in Africa), and calculated a mean prevalence of POP of 19.7% (range 3.4% – 56.4%). Risk factors for POP were similar as for higher-income economies with increased age and parity being associated, however other factors including poor nutrition and heavy work are also risk factors in these countries.

A retrospective Nigerian study (Eleje et al., 2014) identified an incidence of 6.5% of the diagnosis of POP in women attending a gynaecology outpatient clinic. The identifiable risk factors were multiparity, menopause, chronic increase in intra-abdominal pressure (from constipation, chronic cough, strenuous activity including farming), and aging. In this study most patients were lost to follow-up and conservative managements were not utilised. Clearly this type of hospital attendance based incidence estimate does not account for women who are unaware of a service treating POP at a hospital or are unable to afford the service or unable to access the service for other reasons. Typically women suffering with non-acute medical conditions (such as POP, OF and unrepaired 4^{th} degree perineal tears) are less likely to be able to seek medical assistance compared to those suffering with acute conditions.

In Ethiopia, Gjerde et al (2016) interviewed women of low-income symptomatic with prolapse to try to identify how this pathology affected their lives. The woman attributed the cause of their prolapse to physical strain on their body including childbirth, food scarcity, and hard physical work, especially during pregnancy and shortly after delivery. These women tried to avoid disclosing their condition to their families due to embarrassment and fear of being social consequences such as being expelled from the household. These authors highlighted how symptomatic pelvic organ prolapse may significantly affect the lives of women living in a low-income setting.

1.4.7 Ethnicity and prolapse

It could be expected that there may be different rates of pelvic organ prolapse between different ethnic groups in different geographical locations due to potential variation in anatomy, physiology and external factors.

Some prevalence studies have compared rates of POP between black and white women (living in USA) (Bump, 1993). Bump's series described a similar prevalence of severe prolapse between the 2 groups. Another study (Graham et al., 2010) also found no racial differences with respect to prevalence or severity of POP between the referral populations of black and white American women. Sewell et al (2007) compared the prevalence of prolapse in an asymptomatic group of Asian American, and black and white ethnic groups presenting to a hospital in USA for routine

gynaecological examinations. The study found higher levels of prolapse in the Asian American women compared to the black or white American women.

There is limited data assessing prevalence and management of POP in African women of differing ethnic groups. While there are genetic similarities between black American and African women, numerous external factors such as fertility rates, life expectancy, and rates of obstetric, gynaecological and medical diseases vary significantly.

In resource poor countries and regions in Africa, fertility rates are high, life expectancy is short, access is effective obstetric and medical care is limited and there are lower rates of obesity. Scherf et al (2002) investigated the prevalence of POP in rural Gambia in a community- based reproductive survey. 46% of the women were examined as having some degree of prolapse with 14% identified as having prolapse severe enough to warrant surgical intervention. However only 13% of the women with moderate/ severe prolapse reported symptoms on direct questioning. This study was performed prior to the widespread use of the POP-Q classification. In the Gambian population surveyed, there was a high incidence of anaemia and low body mass index. Such issues of health and nutrition may play a role in initial body growth and development in girls and subsequent maintenance of tissue strength in adulthood.

A recent study in northwest Ethiopia (Megabiaw et al., 2013) sought to assess the prevalence and risk factors for pelvic floor disorders and also assessed the validity of a prolapse questionnaire. 395 women were recruited with a median age of 35 years. Symptomatic pelvic organ prolapse (POP) was volunteered in 6.3% of the women, however anatomical POP stage 2-4 (stages of POP based on POPQ) was identified in 55.1% of the women examined. The prolapse questionnaire had poor validity. Carrying heavy loads for 5 or more hours per day and a history of prolonged labour were associated with anatomical POP. This study does highlight possible issues of non-disclosure in this population as while the prevalence of symptomatic prolapse was low, the prevalence of anatomical prolapse was high. Numerous social and cultural variations are also likely to have been a factor in the results obtained.

1.4.8 Management of symptomatic prolapse

The management of POP will be determined by symptoms and degree of bothersomeness. Initial conservative management with pelvic floor rehabilitation and modification of bowel dysfunction and recommendation of "pelvic floor safe" exercises should be advised.

Where women are finding their POP symptoms troublesome, then further management with either the use of a pessary or POP surgery should be offered.

Management of Pelvic Oragn Prolapse with Pessary

Pessaries are a widely used conservative option for the management of symptomatic pelvic organ prolapse in women (Chapple et al., 2006, Walters & Karram., 2015). The degree of prolapse present should be described and quantified, and abdominal and pelvic pathology should be excluded prior to proceeding with pessary management.

Women most likely to choose and benefit from this treatment option include women who are wishing to avoid surgery, medically unfit for surgery or elderly with co-morbidities, awaiting surgery, pregnant, in the postpartum period or have not completed their family (Chapple et al., 2006, Walters & Karram., 2015). While there are no absolute predictors of whether or not a pessary will be successful for an individual, there are a number of patient factors which may indicate either success or failure in fitting a pessary. Factors often contributing to an unsuccessful pessary fitting includes: short total vaginal length, wide genital hiatus, past history of hysterectomy, previous prolapse surgery, and significant posterior vaginal prolapse (Komesu et al., 2007, Clemons et al., 2004, Maito et al., 2006, Fernando et al., 2007, Wu et al., 1997, Mutone et al., 2005).

There are numerous different types of pessaries including ring with or without support, oval with or without support, shelf, donut, Gellhorn, and cube. Each type has numerous sizes, and material composition and mechanical characteristics vary. Most of the pessaries are made of PVC or medical-grade silicone, however the shelf pessary is made of acetal copolymer. Medical-grade silicone is the most recent material used for pessaries. Silicone is non-allergenic, does not readily absorb odours or secretions, is

resistant to repeat cleaning and autoclaving, and is soft and pliable. Pessaries are usually either support pessaries or space-filling pessaries. Support pessaries use a spring mechanism that rests in the posterior fornix and against the posterior aspect of symphysis pubis (eg ring pessary). The space-filling pessaries create suction between the pessary and vaginal walls, provide a diameter larger than the genital hiatus, or utilize both mechanisms (eg cube, donut, shelf, Gellhorn).

The ring pessary is often tried initially as it is usually the easiest to insert and remove, however clinical assessment and experience will guide the practitioner (Atnip & O'Dell, 2012).

Common complications from the use of pessaries includes vaginal discharge, vaginal wall ulceration and bleeding (Hanson et al., 2006, Bai et al., 2005). Occult urinary stress incontinence may become symptomatic which is often a reason for discontinuation of pessary use. Fistula formation is a serious but less common complication of pessary use (Robert et al., 2013, Torbey, 2014). The use of topical vaginal oestrogen (in the absence of any contraindications) in postmenopausal women and women with vaginal atrophy may be helpful in reducing pessary complications and is commonly prescribed however high level evidence for its use is lacking.

Pessary care following insertion involves regular monitoring of the pessary (continence.org.au). The woman may be suitable for "self-care" or may be "not for self-care". When self-care is chosen, the woman is taught to insert and remove her pessary, and continues to remove her pessary and leave it out overnight approximately once per week. Annual speculum assessment by her health care provider is then recommended. If the woman is not for self-care, then she is advised to see her health care provider every 3-6 months for removal of the pessary and speculum examination. Timing of pessary checks will vary according to health care providers' preferences and patient factors, in the absence of high level evidence.

While pessaries are used extensively, there are few randomised-controlled trials reported to date on which to base the management of pessaries (Bugge et al., 2013).

Pessaries are available as an option for management of pelvic organ prolapse with high satisfaction rates and low serious complication rates.

However, in low resource countries and regions (in particular in Africa), there is very little data or evidence that pessaries are an available treatment option.

Surgical Management of Pelvic Organ Prolapse

Most POP surgeries aim to re-support the prolapse and retain sexual function. Alternatively, the vagina can be obliterated to prevent the prolapse descending through the genital hiatus by performing a colpocleiesis (Chapple et al., 2006, Walters & Karram, 2015). A colpocleisis is only an option where the woman is no longer sexually active and has no desire to retain the possibility of future sexual activity. The colpocleisis is essentially a superficial surgery which excises the vaginal epithelium anteriorly and posteriorly to allow suturing of the anterior vaginal epithelium to the posterior vaginal epithelium. This then closes the vagina preventing the prolapse from falling into the vagina or out of the genital hiatus. There are a few modifications for this procedure and the uterus can be conserved in the absence of uterine pathology.

Reconstructive POP surgery can be performed via the abdominal or vaginal routes (Chapple et al., 2006, Walters & Karram, 2015). Abdominally the most common POP surgery is a sacral colpopexy which usually requires a synthetic mesh to attach the upper vagina and vault to the ligament over the sacral promontory. Various modifications exist including the use of a biological graft instead of a synthetic graft, and sacral hysteropexy where the uterus is conserved. Abdominally the surgery can be performed via laparotomy, laparoscopy or robotic techniques.

Vaginally the repair options include: anterior vaginal repair, posterior vaginal repair, sacrospinous ligament fixation, uterosacral ligament fixation, Manchester repair procedure, and the option of concurrent vaginal hysterectomy or uterine conservation (Chapple et al., 2006, Walters & Karram, 2015). Biological and synthetic grafts have been used in an attempt to reinforce the repair and improve longevity of the repair. Perineorraphy to normalise the genital hiatus is also performed when the genital

hiatus is enlarged. Numerous variations and modifications of techniques for all of these surgeries exist.

A standard anterior native tissue vaginal repair involves a midline epithelial incision followed by dissection of the vaginal epithelium laterally off the pubocerical fascial tissue. The pubocervical fascia can then be plicated using delayed absorbable sutures. Any excess vaginal epithelium is excised and then the vaginal epithelium is repaired using an absorbable suture. A native tissue posterior vaginal repair also involves a midline incision over the posterior vaginal epithelium. The vaginal epithelium is dissected off the underlying tissues. The rectovaginal fascial tissue is then plicated with delayed absorbable sutures. Excess vaginal epithelium is excised followed by repair of the posterior vaginal epithelium with absorbable sutures (Chapple et al., 2006, Walters & Karram, 2015).

The sacrospinous ligament fixation sutures may be performed in combination with anterior and/or posterior vaginal repairs (Chapple et al., 2006, Walters & Karram, 2015). The sacrospinous ligament may be accessed either via the anterior vagina, posterior vagina or vault. Most commonly the sacrospinous ligament is accessed via the posterior vagina leaving a vaginal bridge for approximately 2-3cm to the vault. Therefore, following incision and dissection of the posterior vaginal epithelium, blunt dissection laterally to the ischial spine is undertaken. Once the ischial spine is identified, the sacrospinous ligament is cleared of tissue by sweeping from lateral to medial with the fingers. This is necessary to retract the rectum medially and protect the rectum from the subsequent sutures.

A number of devices can be used to then place the delayed absorbable sutures into the sacrospinous ligament including the reusable Miya hook or aneurysm needle, and the disposable Capio ligature carrier (Manning & Arnold, 2014). Usually 2 sutures can be placed unilaterally on the right or left sacrospinous ligament. The sutures are placed 1.5-2.5cm medial to the ischial spine. With the Miya hook and aneurysm needle the suture must then be retrieved with the help of a long retractor such as the Briesky-Navratil retractor and a suture-capturing hook. The Capio device is a self-suture capturing device and therefore does not require any attempts at suture retrieval. The

sutures are then passed full thickness through the upper posterior vaginal epithelium. After closure of the vaginal epithelium, the sacrospinous ligament fixation sutures are tied. Some surgeons may use a permanent suture, and in these cases the suture must be buried and tied before complete closure of the vaginal epithelium. A rectal examination is performed following placement of these sutures to ensure no rectal penetration of the sutures. Postoperative buttock pain with reported incidences of 3-13.7% due to possible injury of the pudendal or levator ani nerves may occur, however this pain usually resolves spontaneously within 6 weeks (Paz-Levy et al., 2017). Bleeding due to vascular injury is possible with rates of 0.5 – 2.5% reported and rectal injury rates are uncommon with reported rates of 0.6-0.8% (Paz-Levy et al., 2017).

High uterosacral ligament vaginal vault suspension can also be performed in combination with anterior and/or posterior vaginal repairs (Chapple et al., 2006, Walters & Karram, 2015). The vaginal vault is opened and the enterocoele sac entered. With downward traction of the vault the uterosacral ligaments are palpated and identified. Delayed absorbable sutures are placed bilaterally on each uterosacral ligament, with the highest of these sutures as near as possible to the ischial spines. These sutures are then passed full thickness through the vaginal walls. The vaginal epithelium is closed with absorbable sutures. The uterosacral ligament vault suspension sutures are then tied in order to elevate the vault. Cystoscopy with assessment of ureteric function is then required in order to document bilateral ureteral patency. Uterosacral ligament suspension has relatively high success rates. However there are significant rates of ureteric obstruction of up to 9%, however immediate identification of this complication and release of the sutures reverse the problem in two thirds of cases (Paz-Levy et al., 2017). Another common complication is nerve entrapment pain in the S1-S4 distribution. Postoperative removal of the ipsilateral sutures usually results in complete resolution of the pain.

The Manchester repair procedure is a uterine-conserving procedure in particular used for women with cervical elongation (Walters & Karram, 2015). The original description of the technique was for amputation of the cervix plus anterior and posterior vaginal repair. Subsequently Fothergill modified the procedure by attaching the cardinal ligaments to the cervical stump. Recent studies assessing outcomes of this procedure

have quoted rates of recurrent surgical intervention between 0-4% at follow-up of 2-6 years (Ayhan et al., 2006, deBoer et al., 2009, Alkis et al., 2014, Thys et al., 2011). A complication of the Manchester repair is cervical stenosis which has been reported as high as 11.3% (Ayhan et al., 2006). Other complications include postoperative urinary retention, and bladder and rectal injuries. While the uterus is preserved using this technique, there is a potential decrease in fertility rates and increased risk of miscarriage and preterm delivery (Skiadas et al., 2006).

1.4.9 How is POP related to childbirth?

The occurrence of POP has always been assumed to be related to childbirth in some way. However it is more recent times, with the development of detailed imaging techniques, that the underlying pathophysiology of childbirth related injuries has become evident. In fact the pregnancy itself appears to result in an increase in POP. In 2002 O'Boyle et at (O'Boyle et al., 2002) identified that on POP-Q examination, pregnant nulliparous women in a case-control study had more POP than other nulligravid women. This is most likely related to the hormonal changes occurring in pregnancy. Molecular and histological assessment of rat vaginal tissues have identified higher levels of extracellular matrix in the fibromuscular layers, less densely packed collagen, and alterations in smooth muscle cells from a contractile to a synthetic phenotype (Daucher et al., 2007). Studies continue to search for the mechanisms causing the significant physiological changes in humans that occur during the course of a routine pregnancy.

The delivery of the presenting part of the foetus itself results in significant changes of the levator ani muscles including stretching and elongation of these muscles. Lien et al (2004) developed a biomechanical model to simulate the effect of a foetal head descending on the levator ani muscles during the second stage of labour. The model assessed the stretch ratios of the muscles and the authors determined that the medial levator ani complex muscles have the greatest risk of injury during delivery. The findings of this biomechanical model is in agreement with MRI and 3D/4D ultrasound studies which have identified abnormalities/injuries in this area in 20-30% of primiparous women who delivered vaginally (DeLancey et al., 2003, Dietz & Lanzarone, 2005).

This information has not translated into a finding of all women with POP having identified levator muscle injuries, and in fact not all women with POP have had any pregnancy at all. Other factors are clearly in play in relation to the development of pelvic organ prolapse in women.

However evidence does exist that demonstrates a higher likelihood of women with POP having evidence of levator muscle defects (DeLancey et al., 2007, Dietz, 2007). Parity does increase the risk for POP and surgery for POP (Mant et al., 1997, Carley et al., 1999). Evidence has also been mounting that there is a higher risk of recurrence of prolapse following surgical repair, in particular the anterior compartment, in women with a diagnosis of levator muscle trauma (Weemhoff et al., 2012, Rodrigo et al., 2014).

Recommendation

While there are clearly enormous challenges related to reducing the suffering of women acquiring and living with POP, the steps to achieve improvements include:

1. identification of the prevalence of POP
2. education to eliminate social stigma related to POP
3. delay marriage and childbearing until adulthood, and provide good access to family planning
4. universal access to safe and effective obstetric care
5. widespread education of women in pelvic floor rehabilitation following childbirth
6. widespread access to conservative options for treatment of POP including the use of vaginal pessaries
7. availability of surgeons trained in POP surgery

These goals require education within communities so that women can identify these issues and seek the appropriate management options. In addition, healthcare workers require education in pelvic floor muscle rehabilitation training programs and identification and management of POP including the use and care of pessaries. Finally surgical options for treatment of POP must be available to women, and the surgeons must be well trained and effective in the surgical options available.

1.5 PELVIC FLOOR IMAGING

There have been significant advances in pelvic floor imaging technology in recent years. This vision into the pelvic floor has increased our understanding of the pathophysiology and anatomy of pelvic floor disorders. Magnetic resonance imaging (MRI) and ultrasound scanning are at the forefront of this advancing technology.

MRI creates high-resolution images of soft tissues, and has multi-planar imaging capability including axial, sagittal and coronal planes (Walters & Karram, 2015). 3-D MRI technology including dynamic imaging, allows for visualisation of the entire vagina and pelvic floor and can assess pelvic floor injury and dysfunction. MRI does allow for accurate identification of the different muscle groups within the levator ani muscle complex. The reference points used in MRI are the bony landmarks. The line between the inferior border of the symphysis pubis and the last coccygeal joint is the pubococcygeal line and the line extending along the longitudinal axis of the symphysis pubis in the sagittal plane is the midpubic line. The midpubic line has some correlation to the level of the hymen in cadaveric studies (Walters & Karram, 2015).

The levator ani muscle complex of the pelvic floor consists of the ileococcygeus, pubococcygeus and puborectalis muscle groups. The ileococcygeus and puborectalis are horizontal sheet-like muscles that originate from the pubic bone and junction of the arcus tendineus fascia pelvis and fascia of the internal obturator muscle. They then fan out to insert at the pelvic sidewall. The coronal plane of the MRI captures this configuration well and is able to demonstrate normal thickness and symmetry of the muscle fibres. The puborectalis arising from the pubic bone and forming a sling around the rectum is easily imaged in the axial plane with MRI.

Within the levator ani muscle complex, the puborectalis muscle can therefore be identified separately with MRI. Puborectalis muscle disruptions can be located and can be unilateral or bilateral. Hoyte and Damaser (2007) present images of nulliparous women with intact puborectalis muscles and parous women where there is disruption of the puborectalis muscles. DeLancey et al (2003) imaged both nulliparous and

primiparous women and observed disruption in the puborectalis muscle in 20% of primiparous women however none in nulliparous women.

While MRI does provide us with superb images, as yet there are no studies using 2D or 3D MRI which have been fully validated clinically or surgically. Other limitations of MRI include the expense and availability of MRI. However a clear advantage of dynamic MRI over ultrasound scanning is the better view of pelvic organ prolapse obtained with dynamic MRI, as when ultrasound scanning is used the perineal probe partly inhibits decent of the pelvic organ prolapse that is assessing.

As these modalities for assessing pelvic floor anatomy (MRI and ultrasound scanning) are more widely used, it is important to have reliable assessment techniques for each instrument which avoids intra- and inter-assessor variability. In addition, it is important to correlate measurements between the 2 modalities so that meaningful comparisons can be made, with both modalities measuring the same thing. Gregory et al (2011) identified differences in measurements of the area of the levator hiatus with axial MRI imaging with rotation of the acquisition plane from slices in the traditional axial to body plane versus the axial plane parallel to the direction of the puborectalis muscle. Certainly the acquisition planes which vary between ultrasound and MRI currently make comparisons between the 2 modalities difficult.

Ultrasound scanning has some practical advantages over MRI scanning. In particular, ultrasound scans are more portable, less costly, avoids ionizing radiation, and can be readily used in the office setting. Three-dimensional (3D) ultrasonography images the axial, transverse and coronal views to construct the 3D image. Four-dimensional (4D) ultrasound involves real-time acquisition of images. This then allows for the assessment of functional anatomy including analysis of the change in anatomy and position with straining and Valsalva manoeuvre. The pelvis and pelvic floor can be imaged via the transabdominal, transvaginal, transperineal (translabial) or transrectal (endoanal) approach.

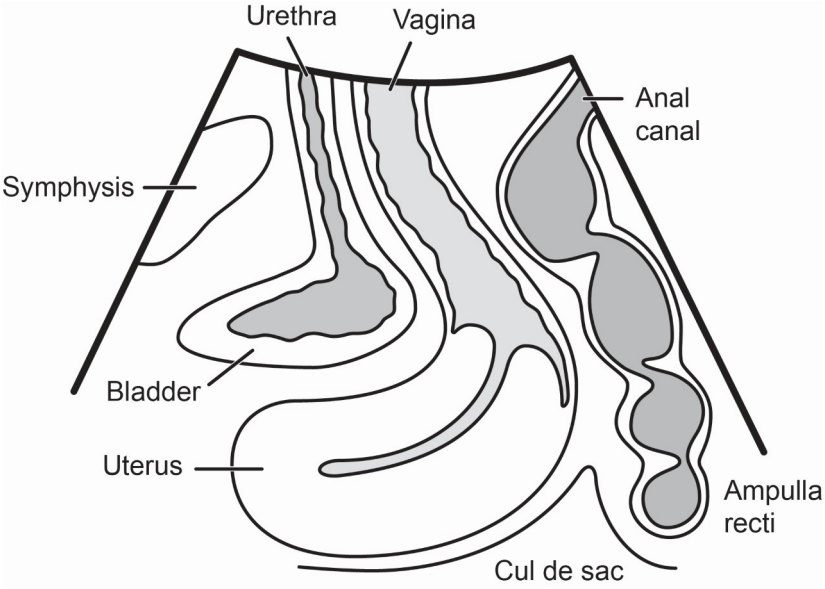
The transperineal (translabial) approach has been widely used in the assessment of pelvic floor anatomy (Walters & Karram, 2015). This approach is less invasive than the

transvaginal probe and is less likely to compress and distort the anatomy to be assessed. The transperineal probe can be used with the woman supine, semi-reclined, or standing. The transperineal probe was used in the following studies included in this research and therefore will be further discussed.

The transperineal probe is a curved array probe with frequency between 3.5-6 MHz (Walters & Karram, 2015). The initial image obtained is in the mid-sagittal plane with visualisation of the anatomy between the pubic symphysis and posterior levator ani muscles. Therefore the urethra, bladder, vagina, cervix, rectum and anal canal are identified.

See Figure 1.5.1

Figure 1.5.1 Mid-sagittal view seen on transperineal ultrasound



There are 4 display modes with the 3D ultrasound (Walters & Karram, 2015):

1. Midsagittal
2. Coronal
3. Axial
4. Rendered

With 3D and 4D ultrasound technology a multiplanar display mode allows visualisation of cross-sectional planes. Dynamic changes to the pelvic floor such as with Valsalva

manoeuvre, can be assessed with the 4D ultrasound in real-time. Cine-loops can then store this information. Advanced post-processing software is designed to provide post-clinical manipulation and assessment of the images.

With the advent of new techniques to evaluate anatomical and functional characteristics of the pelvic floor, determination of normal values for different cultural groups is necessary to then identify abnormal findings. Brazilian nulliparous asymptomatic young women were submitted to anatomical and functional measurements with 3D endovaginal ultrasound (Murad-Regadas et al., 2013). Normal values for this cultural group was thus defined. When comparing measurements at rest to those during Valsalva manoeuver, the hiatal area was significantly larger during Valsalva. The urethra was significantly shorter and the anorectal angle was significantly greater during Valsalva. Mean values for normal perineal descent was 0.6cm and bladder neck descent was 0.5cm above the symphysis pubis. That study confirmed the results of Santoro et al (2009) and were similar to Shobeiri et al (2013) findings.
Current routine uses for ultrasound in the evaluation of the lower urinary tract and pelvic floor includes assessing for bladder neck mobility, post-void residual volume, pelvic floor descent, pelvic floor muscle defects, anal sphincter defects, and any related abnormalities or pathology.

In relation to pelvic organ prolapse, the most relevant pelvic floor ultrasound finding to date appears to be the identification of levator muscle integrity. While pelvic organ descent can be observed with perineal ultrasound scanning, the degree of pelvic organ prolapse is best documented with standardized classification and staging systems which requires a vaginal assessment of prolapse. As this method of ultrasound scanning for patient evaluation increases in popularity and frequency, it is likely that appropriate definitions and staging of prolapse through this mode of assessment will become standardized.

Delivery-related levator muscle trauma was first reported in 1907 by Halban and Tandler (Halban & Tandler, 1907). They describe an almost complete loss of the anteromedial aspects of the levator ani muscles in women with prolapse and speculate the cause to be childbirth. In 1943, Howard Gainey published data on a series of 1000

primiparous women with levator muscle trauma which was identified by digital vaginal examination (Gainey, 1943). In 1955, Gainey again published his findings of levator mscle trauma, and described an incidence of trauma in primiparous women of 20-30% (Gainey, 1955).

With the development and accessibility of MRI, more recent studies imaging the female pelvic floor were able to identify the levator muscle trauma first described early in the 20th century (Walters & Karram, 2015). For over a decade now, 3D/4D pelvic floor ultrasound scanning has further significantly added to our knowledge and understanding of the normal pelvic floor and pelvic floor injury. These levator ani muscle defects can be referred to as microtrauma (thinning or partial defects) and macrotrauma (avulsion or complete defects). These defects are thought to occur during vaginal childbirth.

Currently there is much research and publications in the literature assessing women for levator ani muscle defects in relation to childbirth options, urinary and prolapse symptoms, clinical findings of pelvic floor dysfunction, and pre- and post-operatively in cases of surgical repair of prolapse.

When assessing Ugandan women with pelvic floor dysfunction, detailed anatomical analysis via 3D/4D pelvic floor ultrasound may be valuable. However to obtain meaningful data, a comparison would be required with women of the same ethnicity who have no pelvic floor concerns. The following study (chapter 5.1) therefore focused on identifying pelvic floor ultrasound characteristics of nulliparous Ugandan women from the same region as those with pelvic floor dysfunction (including obstetric fistula, pelvic organ prolapse, and unrepaired 4th degree perineal tear). A subsequent study (chapter 5.2) assesses the 3D/4D pelvic floor characteristics of multiparous women suffering with pelvic floor dysfunction. In addition to documenting the pelvic floor characteristics of nulliparous Ugandan women, this data will be compared to previously collected data of nulliparous women of Caucasian and Asian origin to search for differences which may be relevant to their future pelvic floor health.

1.6 SOCIAL SEQUELAE INCLUDING DOMESTIC VIOLENCE AND MENTAL HEALTH OUTCOMES OF PELVIC FLOOR INJURY AND DYSFUNCTION

1.6.1 Social Sequelae

In general, all health concerns will alter some aspects of the individual's life and lifestyle including their social interactions. In the case of pelvic floor injury and dysfunction in women, it would be expected that these issues may significantly impact on the woman's lifestyle and social situation.

Obstetric fistula remains a major health issue for women, with obstructed labour the most common cause worldwide. In 2007 in Uganda, it was estimated that 2.6% of reproductive age women (Uganda demographic and health survey, 2007) had a fistula which equated to 142 000 women (Population and housing census, 2002). The more recent census in 2011 identified 2% of women aged 15-49 years having symptoms of genital tract fistula (UBOS, 2011). The overall management of obstetric fistula remains fragmented, with accessibility to treatment variable.

It is now well documented that women with untreated obstetric fistula suffer significantly with debilitating health issues and social isolation (Melah et al., 2007, Bangser et al., 2011). Specifically, divorce from their husbands is a common consequence following development of an obstetric fistula. In Uganda over 52% of women with obstetric fistula were found to be divorced from their husbands (Bangser et al., 2011) and in Nigeria, over 73% of women were divorced after acquiring an obstetric fistula (Melah et al., 2007). An Ethiopian study however, documented a much lower divorce rate after fistula of 5% (Nielsen et al., 2009). In a long-term follow up of women in rural Ethiopia following obstetric fistula repair, quality of life scores were significantly lower when women were living with fistula compared to after surgical closure of the fistula (Nielsen et al., 2009). Within the quality of life questionnaire, the lowest scores were on the indicators that assessed social interactions including visiting friends, travelling by bus, and going to the market. In that study 3 women were identified with a persistent fistula. In these cases of persistent fistula, there was no improvement in their quality of life compared to prior to their surgery.

There has been however a paucity of information on the perceptions of women suffering severe pelvic organ prolapse in developing countries or its effect on their social situation. In addition, there is little information on the lives of women with unrepaired (chronic) 4th degree perineal tears.

The prevalence of pelvic organ prolapse in worldwide literature is around 32% (Handa et al., 2004) with 19% of women (Smith et al., 2010) requiring surgery for prolapse in their lifetime. In Nepal the prevalence of pelvic organ prolapse is high, with a prevalence of over 10 % estimated in the reproductive age group, and 24% in women between 45-49 years of age (Gurung et al., 2007). Also in Nepal, a more recent study obtained quality of life data both before and after surgical repair of prolapse (Dhital et al., 2013). The initially low social relationships domain score increased significantly by the 3-month post surgical follow up. In a rural community in Ghana, a study identified a prevalence of pelvic organ prolapse of 12.07% (Wusu-Ansah & Opare-Addo, 2008). In another Ghanaian study (Gumanga et al., 2014), which was hospital based, the prevalence of pelvic organ prolapse seen in the outpatients population was documented at only 2.68%. The mean age of the women presenting was 45.9 years, with the most common age group of women between 30 -39 years of age. These figures are unlikely to be a true reflection of actual prevalence of pelvic organ prolapse in these communities as there are numerous barriers (including social restrictions and financial limitations) that may prevent women presenting with or disclosing this condition and older women are not well represented in these studies. In addition, definitions of prolapse have varied in different studies. While there is only limited and sporadic data available on prevalence or incidence of prolapse and the likely social impact of this condition in countries where health systems are unable to meet its reproductive and women's health needs, it would be expected to be at least of a similar level as identified in more affluent countries.

1.6.2 Mental Health

Mental health disorders are common worldwide. It is estimated that mental and behavioural disorders account for 7.4% of the burden of disease globally (Murray et al., 2012). Chronic physical illness and injury increase the likelihood of mental health disorders (Mitchell et al., 2011, Wilhelm et al., 2003). Case identification of mental

health dysfunction in people with chronic disease has been promoted (Department of Health, 2004, NICE, 2008), as effective treatment of depression may reduce their overall disease burden.

In low income settings where inadequate access to effective health care is common, women suffering with serious gynaecological issues including severe pelvic organ prolapse, unrepaired 4th degree obstetric tear, and obstetric fistula may be at risk of a higher than average rate of mental health dysfunction.

Several studies have been published which have investigated the risk of mental health dysfunction and depression among women with obstetric fistula. Goh et al (2005) assessed women with obstetric fistula in Bangladesh and Ethiopia identified this group as having a significantly higher risk of mental health dysfunction compared to controls. The General Health Questionnaire-28 (GHQ-28) was utilised with women screened prior to OF surgery. 68 women with OF and 28 controls completed the GHQ-28. 66 of the 68 women (97%) screened positive for probable mental health dysfunction compared to 9 out of the 28 controls (32%).

In a Kenyan study (Weston et al., 2011), women attending a surgical fistula camp were subject to a questionnaire which included a depression score. The Patient Health Questionnaire-9 (PHQ-9) was utilised to obtain levels of depression experienced by women with obstetric fistula. This questionnaire is a brief 9-item scale that has previously been validated in Kenya with a population of cancer patients (Omoro et al., 2006). Of the 70 women interviewed by Weston et al (2011), depression was identified in 51 (72.9%) of the patients, with 18 (25.7%) meeting the criteria for severe depression.

In Tanzania, Wilson et al (2015) compared OF patients with general gynaecology outpatients with respect to symptoms of depression. A questionnaire, the Centre for Epidemiologic Studies Depression Scale (CES-D) was used. It is a 20-item scale used to assess depression and has previously been validated in South Africa (Radloff, 1977). This study concluded that OF patients suffered with more severe psychological distress than gynaecology outpatients.

Therefore while women with obstetric fistula have already been identified as a high risk group for mental health dysfunction, other women suffering with serious gynaecological issues including severe pelvic organ prolapse and unrepaired 4th degree perineal tears in a similar low income and resource poor setting may also be at a higher risk of mental health dysfunction.

Ghetti et al (2015) in a United States based study aimed to qualitatively describe the emotional burden experienced by women seeking treatment for pelvic organ prolapse. Information was obtained via phone interviews and focus groups. Three main themes were identified: (1) emotions associated with the condition of prolapse; (2) communicating emotions related to prolapse; (3) emotions relating to treatment. The conclusions were that prolapse significantly impacted upon women's emotional health and subjective well-being, and women's emotions strongly impacted their willingness to discuss and seek care for prolapse, and their treatment choices and recovery.

Prior to this study, Ghetti et al (2010) studied the effects of prolapse on body image. The Patient Health Questionnaire-9 was used to identify rates of depression. Prior to surgery, 22% of women with prolapse screened positive for depression, compared to 6% of their control group. Depressive symptoms were common in this group of women with prolapse and reduced following surgical treatment. At 6 months post-operatively, only 9% of women screened positive for depression with the Patient Health Questionnaire-9 compared to the 22% preoperatively.

In another United States based study, Jelovsek and Barber (2006) addressed the issue of body image in women with POP seeking treatment. They concluded that POP had a negative impact on body image with overall associated reduction in quality of life. Zeleke et al (2013) in Ethiopia assessed 269 women with stage 3 or 4 POP and 37 women with OF for prevalence of depression. Depression measures were obtained using the Beck's Depression Inventory (BDI) tool. The DPI includes 21 questions, with a cut-off score indicating 'symptomatic for depression'. The prevalence of depression in in women with POP was 67.7%, and the prevalence of depression in women with OF was 97.3%.

A number of screening questionnaires exist which aim to identify risk of mental health dysfunction and depression. Several of these have been utilised in the studies discussed above including the PHQ-9, CES-D, BDI, and GHQ-28.

The General Health Questionnaire-28 (GHQ-28) is a validated screening tool used to diagnose psychological distress and psychiatric dysfunction (Goldberg & Hillier, 1979). It has been identified as an effective instrument for case identification of mental health dysfunction (Meader et al., 2011). The GHQ-28 was modified from the original full length General Health Questionnaire (GHQ) which used a 60-item questionnaire. The GHQ-28 consists of 4 groups of questions regarding somatic symptoms, anxiety and insomnia, social dysfunction, and severe depression, which combined gives a composite measure of psychological symptoms.

The questions are as follows:

1. Have you recently – been feeling perfectly well and in good health? –been feeling in need of some medicine to make you feel better? –been feeling run down and tired? – been getting a feeling of tightness or pressure in your head? – been having hot or cold spells? –felt that you are ill? – been getting pains in your head?
2. Have you recently – lost much sleep over worry? – had difficulty staying asleep? – felt under constant strain? – been getting moody and bad-tempered? – been getting scared or panicky for no good reason? – found everything getting on top of you? – been feeling nervous and uptight all the time?
3. Have you recently – been managing to keep yourself busy and occupied? – been taking longer over the things you do? – felt on the whole you were doing things well?- been satisfied with the way you have carried out your tasks? – felt capable of making decisions about things? – felt that you are playing a useful part in things? – been able to enjoy your normal day-to-day activities?
4. Have you recently – been thinking of yourself as a worthless person? – felt that life is entirely hopeless? – felt that life isn't worth living? – thought of the possibility of killing yourself? – found at times you could not do anything because your nerves were too bad? –found yourself wishing you were dead and away from it all? – found the idea of taking your own life kept coming into your mind?

This short form of the General Health Questionnaire (GHQ-28) (Lobo et al., 1986, Goldberg et al., 1997) has been validated and shows good discriminative power, and is shorter and easier to fill in, compared to the lengthy original version of the GHQ.

In Namibia (Haidula et al., 2003), a version of the GHQ-28 was developed using Oshiwambo speaking patients. The GHQ-28 was translated into Oshiwambo and subjects were also interviewed with Clinical Interview Schedule (CIS). Using the CIS data as a marker for psychiatric caseness, the sensitivity and specificity of the Oshiwambo GHQ-28 were assessed and validity established. In Nigeria (Aderibigbe & Gureje, 1992), the GHQ-28 was also validated by comparison with the Psychiatric Assessment Schedule (PAS).

Utilising some form of screening tool to assess for risk of mental health dysfunction in women suffering with severe pelvic organ prolapse, chronic 4th-degree obstetric tear and genital tract fistula in low income countries, would identify the degree of risk faced by these women, and would encourage appropriate support programs to be developed to render assistance.

Importantly, following treatment of the medical condition or injury which has triggered significant social disruption and mental health dysfunction, there may be significant improvements in the women's social standing and mental health. Browning et al (2007) used the GHQ-28 prior to obstetric fistula surgery and again 2 weeks following the surgery. On the initial GHQ-28 all women (100%) screened positive for risk of mental health dysfunction. At the second GHQ-28 questionnaire 2 weeks following surgery, 36% continued to screen positive for risk of mental health dysfunction. The women who had persisting urinary incontinence despite successful fistula closure continued to scree positive for risk of mental health dysfunction. Therefore there were significant improvements mental health demonstrated with successful surgical repair of obstetric fistula, especially if the woman's urinary incontinence was resolved.

1.6.3 Domestic Violence

Domestic violence is prevalent and of significant concern worldwide. In Australia the presence of domestic violence within the community has only more recently been highlighted with active government and community interventions implemented.

Domestic violence can be defined as all acts of physical, sexual, psychological or economic violence that are committed by family members or intimate partners. In Australia the Family Law Act 1975 (Family Law Act, 1975) defines domestic violence as "violent, threatening or other behaviour by a person that coerces or controls a member of the person's family, or causes the family member to be fearful". Statistically domestic violence is most commonly perpetrated by males against their female partners, but it also includes violence against men by their female partners and violence within same-sex relationships. Within Australia, the terminology itself varies between the states with the terms “family violence”, “domestic and family violence”, “domestic abuse” used in addition to “domestic violence”.

Intimate partner violence (IPV) is domestic violence by an intimate partner (including a spouse or a partner in an intimate relationship) against their intimate partner. The partner can be a current or former intimate partner with the violence including physical, sexual, psychological (verbal, emotional) and economic abuse (Centers for Disease Control, 2012).

Apart from the risk of acute injuries and consequences, IPV can result in mental health issues including depression, anxiety, and post-traumatic stress disorder (Bauer et al., 2013, Ellsberg et al., 2008). Also physical health problems including cardiovascular, respiratory, chronic pain, and gynaecological disorders can be exacerbated by or a consequence of IPV (Dichter et al., 2011, Campbell, 2002, Humphreys et al., 2011).

The benefit of IPV screening is controversial with many major medical organisations performing and recommending routine screening, while the US Preventative Services Task Force advises that there is insufficient evidence to determine whether its usefulness outweighs any potential harm (Rabin et al., 2009). The concerns previously raised in relation to IPV screening includes reprisal violence, psychological distress,

family disruption, and risk of child protective services removing a child from the family environment (MacMillan et al., 2009). A study screening 3271 women attending medical services was unable to conclude whether IPV screening in health care settings was effective (MacMillan et al., 2009). Recently a Cochrane review (O'Doherty et al., 2015) reviewed 10 studies which included 10074 women. They identified that screening increased the clinical identification of women experiencing IPV in healthcare settings (OR 2.95, 95% CI 1.79-4.87). There was no evidence of an effect for other outcomes including harm arising from screening. There remained insufficient evidence to justify screening in healthcare settings. Implementation challenges are often a significant barrier to building effective screening programs. Current recommendations for screening emphasize confidential, in-person assessment with a normalising framing statement, and a clear protocol for referral (Ramachandran et al., 2013).

Various screening tools are available. These have been developed by comparing them to more lengthy and detailed assessments including the Revised Conflict Tactics Scale (CTS-2). The CTS-2 is often referred to as the "gold standard" as it is a very widely adopted scale measuring prevalence, chronicity, and severity of intimate partner conflicts.

The IPV screening tools which have been most studied and assessed in the literature include the:

1. Hurt/Insult/Threaten/Scream (HITS) tool - four items. Developed for outpatient settings.
2. Women Abuse screening Tool (WAST) and WAST-Short-Form (WAST-SF) – 8 items/ 2 items. Used for both outpatient and emergency department settings.
3. Partner Violence Screen (PVS) – three items. Developed for use in the emergency department.
4. Abuse Assessment Screen (AAS) – five items. Developed to detect abuse perpetrated against pregnant women.

1. HITS:

Questions – How often does your partner –

1) physically hurt you?

2) insult you or talk down to you?

3) threaten you with harm?

4) scream or curse at you? Answer: never (1), rarely (2), sometimes (3), fairly often (4), frequently (5).

Scoring is from 4-20 points. A score of 11 or more indicates a positive screen for IPV.

The HITS scale was developed as a short domestic violence screening tool for outpatient clinical settings (Sherin et al., 1998). HITS has only 4 items, 2 each that address verbal and physical aggression. The authors advocate the brevity of the tool and also it is an easily remembered acronym. Their study to assess this tool showed that the HITS scale showed good internal consistency and concurrent validity with the CTS verbal and physical aggression items. Responses are scored from 1-5 with the total minimum score of 4 and a maximum score of 20. A score of 10.5 or more indicates that the individual is suffering from IPV. Sherin et al (1998) identified a sensitivity of 96% and a specificity of 91% when using the cut-off score of 10.5 to identify women suffering IPV.

In a recent study (Iverson et al., 2013) which surveyed female veterans with both the four-item HITS and 39-item Revised Conflict Tactics Scales (CTS-2), the HITS score demonstrated good clinical utility. The cut-off score of 6 on the four-item HITS tool accurately detected 78% of women who had been identified as abused within the past year by the more comprehensive Revised Conflict Tactics Scales (CTS-2).

2. WAST/ WAST-SF:

Questions –

1) In general, how would you describe your relationship – a lot of tension, some tension, no tension?

2) Do you and your partner work out arguments with great difficulty, some difficulty or no difficulty?

Questions 3-7 response options: often, sometimes, never

3) Do arguments ever result in you feeling down or bad about yourself?

4) Do arguments ever result in hitting, kicking or pushing?

5) Do you ever feel frightened by what your partner says or does?

6) Has your partner ever abused you physically?

7) Has your partner ever abused you emotionally?

8) Has your partner ever abused you sexually?

The current WAST is an 8-item instrument measuring physical, sexual and emotional abuse in the last 12 months. The scoring is between 8-24.The standard cut-off score for positive screening is 13.

The WAST was originally designed as a 7-item instrument by Brown et al (1996) for use by family physicians to assess female patients who were experiencing emotional and/or physical abuse by their partner. They initially proposed 8 questions however excluded 1 item relating to whether the respondent had witnessed her mother being abused by her father as a child as it did not alter the internal consistency of the measure of the WAST. This study (Brown et al., 1996) also identified that the initial 2 questions from the WAST were effective in detecting women who may be experiencing abuse and would therefore benefit from the full WAST. These 2 questions were then called the WAST-Short and can be used for initial screening purposes. The WAST-Short correctly classified 100% of non-abused women and 92% of abused women within a known-group analysis. Respondents were asked to indicate their comfort level in answering the questions, and the 2 WAST-Short questions were the questions they felt most comfortable answering.

Brown et al (2000) then modified their WAST to include the question “has your partner ever abused you sexually?” The WAST-Short alone was scored 1 for the most extreme positive response, and 0 for the other 2 responses. Thus a score of 1 or 2 was considered a positive screen for IPV and then the full WAST was recommended. When the WAST is used in its entirety, the 3 options for each question are given scores of 1,2,3 and therefore the total score ranges from a minimum of 8 to a maximum of 24. In this study the comfort levels of family physicians administering the WAST was also assessed. With the WAST-Short alone, 8.5% of the women screened were identified as experiencing abuse. The physicians reported feeling comfortable using the WAST, and

91% of the women self-reported feeling comfortable when asked the WAST questions by their family physician.

The WAST 8-item instrument has subsequently been used by other authors (MacMillan et al., 2009) who have further modified the scoring to score as 0,1,2, and therefore a cut-off score of 4 or more indicated a positive exposure to IPV. MacMillan et al (2009) did not find adequate evidence to support IPV screening in health care settings.

Another proposed cut-off score for a positive screen is 10, with some authors suggesting a cut-off of 10 would result in improved sensitivity but less specificity (Iskander et al., 2015). When Rabin et al (2009) performed a systematic review to summarize IPV screening tools tested in healthcare settings, they were unable to determine what cut-off scores were used with the WAST to constitute a positive score.

3. PVS:

Questions –

1) Have you been hit, kicked, punched, or otherwise hurt by someone in the past year?

2) Do you feel safe in your current relationship?

3) Is there a partner from a previous relationship who is making you feel unsafe now?

An adverse answer to any of these questions is equal to a positive screen for domestic violence.

While the 3-item PVS is the shortest of these tools, the sensitivities reported vary from as low as 35% to 71%. Maximum sensitivity is the goal with IPV screening (Rabin et al 2009). Rabin et al (2009) could not identify any studies reporting on the internal reliability of the PVS. Compared to the other tools available, the PVS used a narrower definition of IPV including only questions about physical violence and safety.

4. AAS:

Questions –

1) Have you ever been emotionally or physically abused by your partner or someone important to you?

2) Within the last year, have you been hit, slapped, kicked, or otherwise physically hurt by someone? If yes, by whom? How many times?

3) Since you have been pregnant, have you been hit, slapped, kicked, or otherwise physically hurt by someone? If yes, by whom? How many times and where? A body map is used to document areas of injury.
4) In the last year, has anyone forced you to have activities? If so, whom? How many times? 5) Are you afraid of your partner or anyone listed above?
If any questions on the screen are answered affirmatively, the AAS is considered positive for abuse.
The AAS has been used widely in many healthcare settings internationally. It has been interpreted into a number of languages other than English. The Chinese AAS demonstrated satisfactory measurement accuracy and utility for identifying IPV when compared to the Chinese CTS2 (Tiwari et al., 2007).

A systematic review of IPV screening tools (Rabin et al 2009) concluded that no single IPV screening tool had well-established psychometric properties. Even the most frequently evaluated tools had few studies assessing their use. Sensitivities and specificities did vary widely within and between the screening tools. They reported the sensitivities and specificities as follows: HITS – sensitivity 30-100%, specificity 86-99%; WAST – sensitivity 47%, specificity 96%; PVS – sensitivity 35-71%, specificity 80-94%; AAS – sensitivity 93-94%, specificity 55-99%.

In Canada the WAST was found to be a reliable and valid measure of abuse in the family practice setting. Both the patients and the physicians reported comfort with including the WAST as a part of the consultation (Brown et al., 2000).

The prevalence of IPV varies between regions and countries. A multi-country study by WHO on women's health and domestic violence against women over 15 sites estimated a lifetime prevalence of physical or sexual violence between 15% and 71% (Garcia-Moreno et al., 2006). In a hospital outpatient department in Tanzania, IPV screening using a modified Abuse Assessment Screening tool identified 78% of women having experienced emotional, physical or sexual violence (Laisser et al., 2011). The 2011 Uganda Demographics and Health Survey (UBOS and ICF International: Uganda Demographic and Health Survey, 2011) reported an overall prevalence of intimate

partner physical violence (IPPV) as 41%. This included 25% experiencing physical violence and 21% experiencing sexual violence within 12 months prior to the survey.

Interpersonal violence is another broader term which refers to violence between family members and intimate partners as well as violence between acquaintances and strangers. In the Caribbean, 70.9% of respondents in a population-based study reported having been victims of interpersonal violence that was most commonly caused by a relationship partner (62.8%) (Le Franc et al., 2008). Recently a study from Brazil identified that physical intimate partner violence was associated with food insecurity of households (Ribeiro-Silva et al., 2015). The paper identified a very high prevalence of food insecurity of 62.5%. The authors suggest that the intimate partner violence that occurs may affect the couples' capacity to organise their domestic environment and manage their financial resources in order to guarantee the food security of their family. However many other factors are likely to be relevant which need further evaluation.

Kwagala et al (2013) analysed the 2011 Uganda Demographic and Health Survey data for empowerment, partner's behaviours and intimate partner physical violence (IPPV) among married women in Uganda. They concluded that women's empowerment had limited mitigating effect on IPPV due to partners' negative behaviours and with a history of witnessing parental violence. Empowerment is a personal phenomenon and multidimensional process that requires autonomy, power, and status (Kasturirangan, 2008). It is the ability of an individual to make and put into effect choices (Kabeer, 2005). Kwagala et al (2013) advises that to reduce IPPV in Uganda men should be targeted to address excessive alcohol intake and raise awareness and instil security in relationships. These 2 features (excess intake of alcohol and insecurities in a relationship) are indications of disempowerment. Empowerment programs need to address both men and women.

In the context of women suffering with pelvic floor dysfunction in rural African communities, whether or not these women are subject to the national average for IPV or are at a higher risk of IPV is unknown.

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CHAPTER 2

POST-FISTULA CLOSURE BLADDER DYSFUNCTION

- METHODS, RESULTS, DISCUSSION

Published papers:

1. Goh JTW, Krause H, Tessema AB, Abraha G. Urinary symptoms and urodynamics following obstetric genitourinary fistula repair. Int Urogynecol J 2013; 24: 947-951
2. Krause HG, Lussy JP, Goh JTW. The use of periurethral injections of polyacrylamide hydrogel for treating post-vesicovaginal fistula closure urinary stress incontinence. J Obstet Gynaecol Res 2013; 40: 521-525

Urinary incontinence amongst women is a very common pathology, with a number of different causes. The Continence Foundation of Australia defines urinary incontinence as follows: "Incontinence is a term that describes any accidental or involuntary loss of urine from the bladder. Incontinence is a widespread condition that ranges in severity from 'just a small leak' to complete loss of bladder control" (Continence Foundation of Australia, 2018).

The causes of urinary incontinence include stress urinary incontinence, urgency urinary incontinence, overflow incontinence and genito-urinary fistula. Stress urinary incontinence is a symptom which refers to the complaint of involuntary loss of urine on effort or physical exertion, or on sneezing or coughing (Haylen et al., 2010). Urgency urinary incontinence is also a symptom and is the complaint of involuntary loss of urine associated with urgency (Haylen et al., 2010). Overflow incontinence of urine relates to urinary incontinence occurring in association with voiding dysfunction and poor bladder emptying.

The prevalence rates of urinary incontinence which identify the total number of cases of the condition in the population at a specific time, vary between 15.7% (Nygaard, 2008) and 49.6% in the USA (Dooley, 2008), however the definition of urinary incontinence used in each study varies. Other studies subdividing prevalence into different types of urinary incontinence document the prevalence of urinary stress incontinence at 12 – 25% (Dooley, 2008, Peyrat, 2002), urge incontinence 1.6-9.9% (Peyrat, 2002, Minassian, 2008), and mixed urinary incontinence between 9 and 17% (Dooley, 2008, Hannestad, 2000).

When assessing urinary dysfunction, symptoms other than incontinence also need to be identified including urinary frequency, nocturia, and urgency without urge leakage. In addition, the severity and bothersomeness of the lower urinary tract symptoms will vary. Coyne (2009), Irwin (2006) and Milsom (2001) conducted large population-based studies of prevalence of lower urinary tract symptoms. Overall the prevalence of lower urinary tract symptoms was 59.2 – 76.3%, however the prevalence of urinary incontinence was 9.3 – 14.8%. The prevalence of urinary incontinence does increase with age.

This component of the research is specifically targeting causes and management of urinary dysfunction in women following successful closure of genito-urinary fistula.

Post-fistula closure bladder dysfunction (PFBD) is a newly acknowledged but longstanding problem facing a significant number of women following successful fistula closure.

In many cases, despite successful closure of the fistula, women still remain incontinent or have other troublesome urinary symptoms. Stress urinary incontinence, overactive bladder symptoms and incomplete bladder emptying occur commonly following successful obstetric urogenital OF repair. Persisting urinary incontinence has been reported in between 16% and 24% of women despite successful fistula closure (Wall et al., 2004, Goh et al., 2008, Roenneburg et al., 2008).

In a 6-month follow-up of women following obstetric fistula repair in Ethiopia, 61.5% returned for review. Of the original 390 cases, 24.3% of the total cohort at review complained of ongoing urethral urinary incontinence. Overall, continence status at discharge was largely maintained (Browning & Menber, 2008).

Two main areas have been studied here –

1. The type of bladder dysfunction is assessed with urodynamics studies of women with persisting bladder dysfunction despite successful closure of their fistula
2. Treatment options for bladder dysfunction are discussed. In particular, surgical options for USI are reviewed and a surgical option not previously used in this group of women is trialled.

Post-operative follow-up of women following successful fistula closure in areas where OF is common can be difficult. Issues preventing women returning for follow-up assessment include poverty /low income hence resulting in a lack of funds for transportation to the hospital, political instability with resultant dangers including personal safety, and limited or no access to a phone or postal service. Once women have had their fistula surgery and the closure of the fistula is documented (usually after 2-3 weeks), they are then sent home to continue with their post-surgical recovery. If the woman then has ongoing urinary leakage or bladder dysfunction, she may not have the resources to return to the hospital. In addition, many hospitals providing fistula surgery at no cost do not have the funds nor expertise to manage post-fistula closure bladder dysfunction.

There is a paucity of literature regarding post-fistula closure bladder dysfunction and previously clinicians have resorted to surgical options to treat women with urinary incontinence with no prior investigations. Both standard stress incontinence surgeries and unproven novel surgical approaches have been used with minimal data on outcomes reported.

2.1 ASSESSMENT OF BLADDER DYSFUNCTION FOLLOWING CLOSURE OF OBSTETRIC FISTULA

Urodynamics refers to a number of interactive diagnostic tests used to obtain functional information regarding bladder filling, storage of urine, and voiding. An initial uroflowmetry is usually performed to assess flow rate (volume of urine expelled via the urethra per unit time). Urine flow may be defined as continuous or intermittent. The total voided volume is measured along with maximum flow rate, flow time, average flow rate, voiding time, and time to maximum flow. Nomograms have been developed in order to assist with the interpretation of the normality of free uroflowmetry. Post-void residual volume (volume of urine left in the bladder at the completion of micturition) is also measured. Post- void residual urine volume may be measured either with catheter drainage or ultrasound scanning.

Catheter tubing is then placed into the bladder (to obtain intravesical pressure = p ves) and either into the vagina or rectum (to obtain abdominal pressure = p abd). The measurements of the pressures in the bladder and vagina/rectum are subtracted to identify the detrusor pressure (p det). Filling cystometry describes the pressure/ volume relationship of the bladder during filling. The aims of filling cystometry are to assess the bladder sensation, bladder capacity, detrusor activity, and bladder compliance. Cystometrogram (CMG) is the graphical recording of the bladder pressures and volumes over time.

Urethral pressure profilometry measures the pressure within the length of the urethra with the bladder at rest. Urethral pressure and urethral closure pressure are concepts which represent the ability of the urethra to prevent leakage. The maximum urethral closure pressure (MUCP) measures the difference between the maximum urethral pressure and the intravesical pressure. The urethral pressure profile (UPP) is a graph indicating the intraluminal pressure along the length of the urethra.

The woman is asked to cough during the test to assess for urodynamic stress incontinence which is the involuntary leakage of urine in the absence of a detrusor rise. Voiding cystometry at conclusion of the test measures the pressure volume

relationship of the bladder during micturition. The measurements recorded include intravesical, intra-abdominal, and detrusor pressures and the urine flow rate. Normal detrusor function during voiding is achieved by urethral relaxation followed by a continuous detrusor contraction which leads to complete bladder emptying within a normal time span.

The following terminologies for pelvic floor dysfunction are documented in a joint report by the International Urogynecological Association (IUGA) and International Continence Society (ICS) (Haylen et al., 2010). The diagnosis of urodynamic stress incontinence is by symptom, sign and urodynamic investigations and involves the finding of involuntary urinary leakage during filling cystometry, associated with increased intra-abdominal pressure, in the absence of detrusor contractions. Detrusor overactivity is a diagnosis by symptoms and urodynamic investigations made in women with lower urinary tract symptoms, when involuntary detrusor muscle contractions occur during filling cystometry. Voiding dysfunction is a diagnosis by symptoms and urodynamics investigations, and is defined as abnormally slow urine flow rates and abnormally high post-void residuals.

The following assessment of women following successful obstetric fistula closure with ongoing bladder dysfunction was undertaken to try to determine the causes of their urinary symptoms.

METHODS

Women with successful fistula closures at the Addis Ababa Fistula hospital (AAFH), Addis Ababa, Ethiopia, who had persisting bladder dysfunction, were offered urodynamic studies at that facility. This facility is one of the few dedicated fistula units in the world with access to urodynamic assessment. Urodynamics allow identification of voiding dysfunction, detrusor overactivity, and urodynamic stress incontinence. Established targeted treatment options were then offered, with follow up of outcomes.

All post-fistula repair women at AAFH are currently questioned to establish whether any PFBD is present, therefore the target group of women is already identified.

Currently there is an ad hoc approach to the management of these women, with established treatment options for conditions such as detrusor overactivity and urodynamic stress incontinence not followed, due to an assumption that recognized treatment options would not be effective in this group of women.

This study was a prospective study of women at the Addis Ababa Fistula hospital following fistula closure, with ongoing urinary bladder dysfunction. Formal questionnaires and bladder diary information allows accurate identification of this group of women. Investigations to diagnose PFBD was undertaken including urodynamics studies, and then appropriate targeted management commenced. Both medical and surgical treatment options were recommended according to findings. The techniques of standard urodynamics studies do need to be modified in some cases due to specific post-fistula issues. Urethral plugs were also able to be employed to assist with diagnosis and as a predictor for outcome. Available medications for detrusor overactivity were employed as indicated. Surgery was offered if the urodynamics outcomes indicated surgical treatment may offer a successful outcome.

Between December 2008 and September 2009, data was collected on consecutive women referred to the Urodynamic Unit at the AAFH for further assessment of their urinary symptoms. These women had previous OF with documented successful fistula closure. All the urodynamics assessments were performed or supervised by Dr Hannah Krause and Prof Judith Goh. Ethics approval was obtained for this study. These women were interviewed regarding their current presentation and past history. Medical records were reviewed if available.

Urodynamics was performed using dual-channel subtracted filling cystometry, placing a catheter in the bladder and in the rectum. The bladder was filled with normal saline at room temperature in the supine position. All procedures were performed as recommended by the International Continence Society except where stated and terminology used conforms to the IUGA/ICS standards for terminology. Information obtained included voided urinary volumes, residual volumes, detrusor pressure during filling, maximal urethral closure pressure, and demonstrable urinary incontinence with/without provocation. Voiding studies and monitoring detrusor pressure during

voiding was challenging and unobtainable as most of these women were not accustomed to voiding on a commode with catheters in-situ and could only void in a squatting position on the floor. In this position, the uroflowmetry equipment was not able to be used. Residual urinary volumes were performed using a catheter following voiding in the squatting position. Cystoscopic assessment of these women and ultrasound assessment was not available.

RESULTS

A total of 152 women with previous surgery for OF and with ongoing urinary symptoms were evaluated with urodynamic studies. The average age of this group of women was 22.6 years (range 12-68, median 20). 18 women did not know their age. In many rural Ethiopian communities, date of birth is often not recorded, but rather age is relative to various life or community events. The average parity was 1.7 (range 1-12). Only 3 women had a live birth for the delivery that caused the fistula, with all other women having a stillbirth. Of the 132 women who could recall the length of their labour, the average was 3.8 days (range 1-8). 89 women (67%) had a spontaneous vaginal delivery, 25 women (19%) had an instrumental delivery, and 18 women (14%) had a caesarean section. The time interval from fistula surgery to presentation at the AAFH Urodynamics Unit varied from 2 months to 31 years. 24 women had no available surgical records (either surgery done elsewhere or lost record) and could not remember the date of their surgery.

Previous operation records were obtained and reviewed where available. There was no standardized method of classifying or describing the fistulas in the operative notes and therefore an analysis of previous fistula type with urodynamic studies was not possible. This highlights the importance of standardization in classification of genital tract fistulas. 42 women had 52 previous procedures for urinary symptoms. This information was obtained from past procedure notes. Often these clinical notes were quite sparse with little documentation regarding the procedure or indication for the procedure apart from urinary incontinence or urinary symptoms. Previous surgeries included: paraurethral hitch (11), pubococcygeal sling (6), Kelly plication (8), pubovaginal sling (11), Raz (3), urethral lengthening (5), urethral tightening (4), urethral dilation (1), unknown procedure done elsewhere (3). Within this group of 42

women with previous continence surgery, 1 had recurrence of her fistula, 23 (56%) had urodynamic stress incontinence only, 3 (7%) had detrusor activity only, and 15 (37%) had both detrusor overactivity and urodynamic stress incontinence.

The majority of the women presenting with urinary symptoms complained of being "wet all the time" or having continuous incontinence. 3 of the 152 women were diagnosed as having a recurrent urogenital fistula, and therefore their urodynamics studies were not completed. Therefore 149 women underwent and completed urodynamic studies to assess their PFBD symptoms. 139 women (92%) had urodynamic stress incontinence. 73 women (49%) had urodynamic stress incontinence only. 69 women (46%) had detrusor overactivity. 64 women (43%) had both detrusor overactivity and urodynamic stress incontinence. 7 women had neither detrusor overactivity nor urodynamic stress incontinence. 2 of these 7 women had significant post-void residual volumes (>200ml), 1 had bladder hypersensitivity and 4 had no abnormalities detected. In total, 9 women had residual urine volumes of 150ml or greater (range 150-500ml).

During the filling phase of the urodynamics assessment, 1 in 3 women (50 women) leaked per urethra without a detrusor rise or provocation. Digital paraurethral compression (performed vaginally) was required to enable filling of the bladder, if the women had no sensation of bladder filling and no rise in detrusor pressure. This technique to enable urodynamics assessment may be necessary due to possible marked reduction in the function of these urethras. All of these women requiring digital paraurethral compression had urodynamic stress incontinence (45% of whom had mixed incontinence). While this technique is not a standardized for urodynamics, it is a practical method to perform bladder filling in some women.

In summary, over 90% of women had urodynamic stress incontinence and 46% had detrusor overactivity. The rate of mixed urinary incontinence was 42.7%.

DISCUSSION

There are only a few previous studies using urodynamics to assess PFBD to compare with the present study. Schleicher et al (1993) reviewed 18 women following fistula

repair. 2 had recurrent fistulas. Of the remaining 16 women, half had no urinary incontinence and the remaining 8 complained of urinary stress incontinence. Urodynamics was performed on the 8 women with no abnormalities noted in 2 women (25%) and urodynamic stress incontinence only diagnosed in 5 women (62.5%) and 1 women (12.5%) had mixed incontinence. Murray et al (2002) reviewed 55 women following fistula repair and identified 30 women with urinary incontinence. Urodynamics studies were performed on the 30 women, with 17 women (56.7%) having urodynamic stress incontinence only, 2 (6.7%) having detrusor overactivity only, and 11 (36.7%) having mixed incontinence. The current study has a much larger cohort and the results are similar to those of Murray et al (2002).

The main weakness with this study is the lack of availability of surgical records with no standardization of classification regarding the repaired fistula. It is not possible to comment on any association of previous fistula findings and subsequent cause for urinary incontinence. A prospective study of all women undergoing fistula repair with detailed and thorough assessment and documentation of findings and procedures would be required to try to identify any association between PFBD and fistula type. It would be expected that fistulas involving the urethra would be more likely to result in post-repair stress urinary incontinence than fistulas more proximal in the vagina and not involving the urethra. With regard to detrusor overactivity, it is unknown whether different fistula types and locations would affect incidence.

Following these assessments, women with a urodynamic diagnosis of detrusor overactivity were commenced on short or extended release oxybutynin medication (an established treatment for detrusor overactivity). This did result in an improvement of symptoms in many of the treated women, however there was no formal outcome follow-up performed. Women diagnosed with mixed urinary incontinence were first treated with the oxybutynin medication to try to stabilize the bladder before considering surgical options for their urodynamic stress incontinence.

Women with urodynamic stress incontinence were offered urethral plugs (intra-urethral devices) or considered for continence surgery if appropriate. The AAFH has been using urethral plugs to assist with the management of stress urinary incontinence

for many years. The women are taught to use and self-manage the plugs. There are possible complications relating to using plugs including urinary tract infection and losing the plug into the bladder. The size of the plug often needs to be increased over time due to apparent stretching of the urethra.

The above research into the diagnoses of PFBD has identified detrusor overactivity as being a significant problem occurring in 46% of women with post-fistula closure urinary incontinence. There is little documented in the literature regarding detrusor overactivity following fistula closure, however some individual fistula units have recently started identifying and treating these women. Conservative managements with bladder retraining and medications for detrusor overactivity including anticholinergic therapy and beta3-adrenoreceptor agonists, are likely to be beneficial for many of these women.

2.2 TREATMENT OPTIONS FOR WOMEN WITH USI FOLLOWING REPAIR OF OBSTETRIC FISTULA

The problem of stress urinary incontinence following successful closure of an OF remains a common and challenging problem. Despite many decades of various treatment options, the effective management of post-fistula stress urinary incontinence remains unresolved. The following component of research aimed to assess the feasibility of periurethral injections of polyacrylamide hydrogel commonly used for urinary stress incontinence in non-fistula women, in women with post-fistula closure stress urinary incontinence.

Following the development of OF, the genital tract and lower urinary tract have often suffered marked tissue loss and scarring. It is therefore not surprising that these women are at significant risk of post-fistula closure bladder dysfunction including stress urinary incontinence. The treatment of post-fistula stress urinary incontinence includes pelvic floor rehabilitation, urethral plugs and a number of continence surgery options.

Hilton et al (1998) was first to describe the use of periurethral injections of autologous fat for the treatment of "sphincter insufficiency" following successful closure of obstetric urogenital fistula. Their series comprised of six cases of women with urinary stress incontinence following closure of obstetric fistula, and did demonstrate a 66% cure/improvement rate with short-term follow-up. Subsequently a study of women with urinary stress incontinence with no history of fistula by Lee et al (2001) compared peri-urethral injection of fat with periurethral injection of saline (control) at a follow-up of 3 months. These results did not show any benefit of fat injection compared to saline injection, with both groups having a success rate of around 20-22%. In addition to this low rate of success, one death due to pulmonary fat embolism occurred out of a total of 189 procedures. To date, there have been no documented studies or cases of the use of synthetic bulking agents in women with post-obstetric fistula repair stress urinary incontinence.

METHODS

The following study used periurethral injections of polyacrylamide hydrogel (Bulkamid, Ethicon, Johnson & Johnson Medical Pty, Ltd, North Ryde, Australia) as a periurethral bulking agent in a series of 4 women with residual stress urinary incontinence following successful closure of obstetric genito-urinary fistula.

Ethics approval for this study was obtained. The study took place between 29/8/2011 and 9/9/2011 when 65 women presented to the fistula clinic at HEAL Africa Hospital, Goma, Democratic Republic of Congo, for assessment of presumed fistula. Of these women, 4 gave with a history of previous VVF repair and were assessed to have an intact bladder with a negative dye test, however stress urinary incontinence was identified. These women were assessed to be suitable for bulking agent continence surgery. Bulkamid hydrogel is a transparent polyacrylamide gel consisting of 97.5% non-pyrogenic water and 2.5% cross-linked polyacrylamide (Ethicon, Johnson & Johnson). In Goma at the HEAL Africa Hospital, urodynamics assessment and cystoscopy were not available. Therefore, continence surgery was only considered after a thorough clinical assessment of the bladder. A methylene blue dye test was performed in all cases to exclude any residual fistula. As urodynamics testing was not available at this hospital, a modified form of clinical urodynamics was performed to

assess bladder function. Immediately following voiding, the bladder was catheterised with a Foley catheter and the residual urine volume measured. The bladder was then filled with saline to ≥300ml. The catheter was held vertically approximately 15 cm above the pubic symphysis and the level of fluid in the catheter above the plane of the symphysis pubis identified. If there was no significant elevation of the fluid (ie less than 15cm) and no urge symptoms, then the detrusor was considered to be stable. If there was no clinical assessment of detrusor overactivity and the residual urine volume was < 100 mls, and a positive cough test demonstrated, then a bulking agent continence surgery was offered.

The surgery to inject the bulking agent was performed under general anaesthesia. As there was no cystoscopic equipment available, cystoscopy was not used. The urethral length and estimated location of the urethrovesical junction was measured and established using a Foley catheter. The direction of the urethra and path of the urethra was determined using a metal catheter. Bulkamid (1ml per patient) was then injected with a long 23G needle through the periurethral skin and vaginal epithelium, in three sites, at 3, 6 and 9 o'clock. The bladder was emptied at the conclusion of the procedure and the procedure was covered with prophylactic intravenous antibiotics. The external genital anatomy was abnormal in a number of women as they had a history of previous "urethral lengthening" to assist with urinary incontinence. This procedure involved using the skin of the labia minora to elongate the urethra and hence the new external urinary meatus following the procedure is near the clitoris.

RESULTS

There were four cases of periurethral bulking surgeries and these are presented below.

Case 1: A 33 year old women, para 2 (vaginal deliveries) with no live children, presented with urinary incontinence. She had a history of undergoing four VVF repairs over the previous nine years. She was initially booked for an examination in the operating theatre as the initial assessment in the clinic was inconclusive. Her dye test was negative and the bladder was filled to 300ml with no observed rise in detrusor pressure. Marked stress incontinence was demonstrated with this assessment. She was then was planned for continence surgery and proceded to periurethral injection of

1ml bulking agent (Bulkamid). At day 1 postoperatively she developed urinary retention which required drainage with an in/out catheter. She subsequently was able to void well without any further intervention. At 12 days postoperatively, she remained dry.

Case 2: A 48 year old woman, para 7 (vaginal deliveries) with one live child, presented with urinary incontinence. She had undergone 10 VVF repairs previously, with her last repair two years earlier. She also required an examination in the operating theatre for further assessment due to an inadequate assessment in the outpatients. She had a negative dye test, and marked urinary stress incontinence was demonstrated. The bladder was filled to 300ml with no rise in detrusor pressure observed. The woman had a 5cm elongated functionless urethra due to a previous urethral lengthening procedure. With this diagnosis of stress urinary incontinence and no residual VVF, 1ml of Bulkamid was injected at the bladder neck. On day 2 postoperatively she complained of symptoms of a urinary tract infection, which was treated with further antibiotics. The symptoms of infection resolved rapidly. At final assessment 11 days postoperatively she remained continent of urine.

Case 3: A 35 year old woman para 1 (stillbirth) presented with continuous urinary incontinence despite 11 previous attempts at VVF repair over the preceding 10 years. On examination, an elongated 5cm urethra (from previous urethral lengthening) was evident and was distorting the external genital anatomy, and the vagina was markedly stenosed. The dye test was negative for residual fistula. She underwent periurethral injection of 1ml Bulkamid at the bladder neck. She had no immediate postoperative concerns and at 10 days postoperatively, she had only mild urinary stress incontinence.

Case 4: A 23 year old woman, para 1 (caesarean section) stillbirth, presented with continuous urinary incontinence and a history of 3 previous VVF repairs, with her last repair one year earlier. She also had an elongated urethra from a history of urethral lengthening with marked leakage per urethra. A catheter was unable to be inserted in the outpatients department due to the unusual angulation of the urethra from the previous urethral lengthening surgery and therefore she required an examination under anaesthesia where a catheter was able to be inserted. The dye test was negative

excluding any residual fistula. The bladder was filled to 300ml with no detrusor overactivity observed using clinical urodynamics testing. Continence surgery was planned and pubococcygeal sling surgery was performed. Postoperatively she had some improvement in her incontinence with remaining dry in bed, however she had ongoing significant leakage while walking. She was then rescheduled for injection of Bulkamid, where 1ml Bulkamid was injected periurethrally. There were no postoperative complications. At her final assessment 5 days following the Bulkamid injection she did not complain of any leakage of urine even when walking.

DISCUSSION

Post-obstetric fistula closure stress urinary incontinence continues to be a challenging problem especially in areas where long-term follow-up assessments are difficult to achieve. While urethral plugs have been used widely in a few fistula centres with moderate success and complications (Goh & Browning, 2005), effective surgery for stress urinary incontinence would be a more definitive management option.

Many surgical procedures are documented in the literature and these include abdominal sling procedures using fascia lata, rectus fascia, or synthetics, and vaginal pubococcygeal or fibro-muscular slings. Ascher-Walsh et al (2010) reviewed 140 women who had undergone treatment with a sling procedure for stress urinary incontinence following successful fistula closure. The outcomes were assessed clinically with a median follow-up time of just over two months, with 24.4% being identified as dry. In the group of women treated with a polypropylene mesh sling, the mesh erosion rate was 20% (Ascher-Walsh et al., 2010). Carey et al (2002) using standardised urodynamic assessment, identified a group of nine women with urodynamic stress incontinence only following obstetric fistula closure. The following continence surgery was then performed: abdominal retropubic urethrolysis, and insertion of a rectus sheath fascial sling and retropubic omental graft. The success rate (subjective) at 4 weeks follow-up was 78% and the success rate (subjective and objective with repeat urodynamic studies) at 16 months follow-up was 67%. While abdominal urethrolysis with rectus sheath fascial sling results in a moderate success rates, it does require an abdominal approach which often includes complicated dissections as the space of Retzius is usually obliterated and therefore does increase

the risk of significant complications. In 1958 (McConnachie, 1958), local muscle sling procedures were first described for the treatment of post-fistula stress urinary incontinence. In 2004 a similar technique was re-introduced (Browning, 2004) which did result in a success rate of 67% immediately postoperatively (Browning, 2006). Limitations with this technique is that it is not possible in many women who have suffered serious injury with loss of tissue, resulting in insufficient pubococcygeal/fibro-muscular tissue to create an adequate sling. As yet long term follow-up of results of this technique is not yet available and the benefit of the local tissue sling would be expected to decline over time. Where continence surgery is not successful, urinary diversion may be used.

Periurethral injections of bulking agents have been used in the treatment of stress urinary incontinence for over a century (Meyer, 1904) with significant improvements in safety and success rates with the development of material technologies. Several bulking agents are currently in use including bovine collagen, porcine collagen, carbon coated zirconium beads, silicon particles, calcium hydroxylapatite, and polyacrylamide hydrogel. Kirchin et al (2012) reviewed 14 trials which included 2004 women. They concluded that the evidence available was insufficient to guide clinical practice. Recent studies assessing polyacrylamide hydrogel (Lose et al., 2006) have demonstrated a good safety profile and useful success rates in women with symptomatic stress urinary incontinence. A potential benefit of periurethral bulking agents is that it is minimally invasive surgery. Lose et al (2006) determined a 66% subjective response rate in 135 women with symptomatic stress or mixed urinary incontinence at 12 month follow-up, with no injection site or product-specific adverse events identified. Maggiore et al (2013) studied 82 women with a 12 month follow-up, quoting a subjective success rate of over 74%. These women were discharged on the same day and no intraoperative complications were noted. A 24 month follow-up of periurethral injection of polyacrylamide hydrogel for women with stress and stress predominant mixed urinary incontinence demonstrated a subjective responder rate of 64% (Toozs-Hobson et al., 2012). Mohr et al (2013) published a 12 month follow up of elderly women with stress urinary incontinence treated with one of four types of injection therapy, including 44 women receiving polyacrylamide hydrogel. Pad tests were negative in over 73% of women after bulking therapy. The overall complication rate was low for all agents,

with no complications at all documented for the group who received polyacrylamide hydrogel.

While the overall success of periurethral injection of polyacrylamide hydrogel ranges from 64-74% depending on outcome measures (Lose et al., 2006, Lose et al., 2010, Maggiore et al., 2013, Toozs-Hobson et al., 2012, Mohr et al., 2013), the success rates in women with serious anatomical dysfunction/ loss of tissue secondary to obstetric fistula trauma would be expected to be lower. The polyacrylamide hydrogel bulking agent is injected near the bladder neck which is reliably identified with a Foley catheter balloon in women with previous obstetric fistulae. The anatomy of the external genitalia can often be distorted from previous injuries or surgery, and thus the technique using a Foley catheter balloon is simple yet effective. In comparison, the placement of a sling in the midurethral position can be difficult again due to anatomical distortions of the urethra in this population with post-obstetric fistula repair urinary stress incontinence. Dissection to create a tunnel for the placement of a sling can be hazardous due to scarring and poor quality tissue, resulting in iatrogenic injuries which can then be difficult to repair.

This case series is limited with only four cases of periurethral injection of bulking agent performed and very short-term follow-up achieved, however it does demonstrate the use of a synthetic bulking agent without the availability of cystoscopy, and with initial satisfactory outcomes. Three out of four women were dry, and the remaining woman's symptoms were improved. While urodynamics equipment is still not available in most fistula centres, assessments of the bladder with Foley catheter/bladder filling to identify signs of detrusor overactivity and bladder capacity, cough test to demonstrate urinary stress incontinence, and residual urine volume to assess voiding function, does give a useful clinical overview of bladder function and dysfunction. Unfortunately, the high cost of the bulking agent may limit its use in developing countries where there is limited funds available for health care services.

Follow-up of treatment options is often difficult in such regions where fistula is prevalent due to the significant costs required for travel, and where there are concerns regarding personal safety especially when women travel alone, and where political

instability results in violence. In addition, these women often do not have access to a postal service or telephone services which would otherwise allow for further communication.

This series of 4 cases demonstrates that the use of periurethral injection of polyacrylamide hydrogel in women with post-fistula closure stress urinary incontinence may be a promising option. Larger studies are required, with preferably the availability of standardised urodynamics assessment, to determine outcomes and success rates for this form of treatment.

In summary, PFBD is a common problem following successful fistula closure. The causes of PFBD include USI, DO, and voiding dysfunction. Management options for women suffering from these problems includes conservative management with pelvic floor rehabilitation such as bladder retraining, pelvic floor exercises and voiding techniques, the use of clean intermittent self catheterisation for severe voiding difficulty, medication for detrusor overactivity, and surgical options for urinary stress incontinence.

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CHAPTER 3

SURGICAL AND NON-SURGICAL MANAGEMENT OF OBSTETRIC TEARS AND PELVIC ORGAN PROLAPSE – METHODS, RESULTS, DISCUSSION

3.1 REPAIR OF CHRONIC 4th DEGREE OBSTETRIC TEARS

Published paper:

Goh JTW, Tan SBM, Natukunda H, Singasi I, Krause HG. Outcomes following surgical repair using layered closure of unrepaired 4th degree perineal tear in rural western Uganda. Int Urogynecol J 2016; 27: 1661-1666.

There are guidelines readily available for the management of acute perineal tears occurring at time of vaginal delivery. Perineal tears are classified as follows by Sultan (1999) and adopted by the National Institute of Clinical Excellence (NICE, 2013) and the International Consultation on Incontinence and the Royal College of Obstetricians and Gynaecologists (RCOG) as incorporated in the Green-top Guideline No.29 (2015):

1. First degree – injury to perineal skin
2. Second degree – injury to perineum involving the perineal muscles but not involving the anal sphincters
3. Third degree – injury to perineum involving the anal sphincter complex:
    a. 3a: less than 50% of external anal sphincter (EAS) thickness
    b. 3b: more than 50% EAS thickness
    c. 3c: both EAS and internal anal sphincter (IAS) involved
4. Fourth degree – involves anal sphincter complex (EAS and IAS) and anorectal mucosa

There is however a paucity of data on the delayed management of 4th degree perineal tears and subsequent functional outcomes following surgical repair. The unrepaired 4th degree tear is uncommon in high-income countries as the injury is diagnosed immediately in the birthing suite and repaired as soon as possible after. In many parts of low-income countries, women do not deliver in health care centres but in their local

villages. In the villages, there is usually no infrastructure available to assist the women with the repair of any perineal tears. These tears are left to heal spontaneously by secondary intention.

Unrepaired 4th degree obstetric perineal tears have not been widely studied in women living in resource-poor settings where the immediate repair of such tears has not been achieved. This study aimed to describe the surgical technique for management of the unrepaired 4th degree perineal tear performed without flaps, and to perform a short-term follow up on anal incontinence symptoms. A validated questionnaire is utilised to assess anal incontinence symptoms. This technique where surgical repair is performed without large tissue flaps or faecal diversion, appears to be well suited to resource poor settings.

METHODS

The research into the follow-up of women undergoing surgical repair of unrepaired 4thdegree perineal tears was undertaken during 2 separate fistula camps (18-29 December 2013 and 3-14 October 2015) at the Kagando Hospital, western Uganda. This study has Ethics committee approval.

All women who presented with an unrepaired 4th degree perineal tear requesting treatment were invited to participate in the study. Prior to the commencement of the surgical camps, radio announcements were made in the local languages to notify the women with these health concerns of the services available and the dates of the surgical camps. These surgeries were all performed without any cost to the patient, irrespective of whether or not they elected to enrol in the study. The service provided for the women included their surgery, hospital care, food and transportation to and from the hospital. Prior to surgery, the surgical procedure, risks and complications of surgery, and post-operative recovery and care, were explained to the patient in their local language. A consent form was signed, or as many women in this rural community are illiterate, a thumbprint was used as their identifying mark.

Pre-operatively, interviews to obtain history, and the Cleveland Clinic Continence Score (CCCS) were undertaken. The women were contacted 4-6 weeks post-operatively, and

again 12 months post-operatively, to reassess their Cleveland Clinic Continence Score. The Cleveland Clinic Continence Score consists of 5 questions.

The questions ask how often the patient experiences the following:

1. solid stool leakage
2. liquid stool leakage
3. gas/flatus leakage
4. pad use for stool leakage
5. lifestyle restriction

The score for each question ranges from 0-4. When the answer to the question is 'never' the score is 0, 'rarely less than once a month' the score is 1, 'sometimes less than a week' the score is 2, 'usually less than once a day' the score is 3 and 'always everyday' the score is 4. A total score of 0 indicates perfect anal continence, and the worst possible score is the maximum score of 20.

In this study, a modification of the Cleveland Clinic Continence Score was used, with 4 questions asked instead of 5 questions (see Table 3.1.1). The question on pad use for faecal incontinence was excluded as continence pads are not commonly used in this region due to lack of availability of pads and the costs of pads being prohibitive where low income and poverty is endemic. The maximum score was therefore 16 instead of 20, with a score of 0 again indicating perfect anal continence.

The interviews were performed by 2 experienced fistula nurses in the local language of the patients. The responses were documented in English. The follow-up interviews were performed over the telephone by one of the experienced fistula nurses. The women were again asked to respond to the modified 4 question Cleveland Clinic Continence Score.

Surgical technique

Bowel preparation was undertaken pre-operatively with laxatives. Oral bisacodyl was taken by the women 1-2 days prior to surgery. All of the surgeries were performed under spinal anaesthesia with the woman in lithotomy position. Prophylactic antibiotics were used routinely in all cases. There were no cases where bowel diversion was indicated or performed. All surgeries were undertaken by or under the supervision of 2 urogynaecologists including myself.

All women enrolled in the study had an unrepaired 4th degree perineal tear with a resulting cloacal deformity (see figure 3.1.1 A).

With the commencement of surgery, infiltration of the tissues with a vasoconstrictor was used as diathermy was not routinely available. The torn edges of the vaginal introitus and the torn edges of the anal verge were grasped with Allis forceps to delineate the landmarks of the dissection (see figure 3.1.1 B and C). The proposed anal size is checked to ensure it will not be narrowed. The fistula edges are then incised where the anorectal and vaginal mucosa and perineal skin have fused and dissection undertaken. The anorectum is mobilised off the vagina and perineal skin. The torn edges of the external anal sphincter are identified and mobilised. Once adequate dissection and mobilisation has been completed, the rectum (mucosa and muscularis) is repaired in 2 layers using an absorbable suture (2/0 or 3/0 polyglactin) (see figure 3.1.1 D). In these cases of chronic 4th-degree obstetric tear, the internal sphincter cannot be identified as a separate structure. The external anal sphincter is then repaired using an overlapping technique. Delayed absorbable sutures (2/0 polydioxanone) are utilised in order to try to achieve an effective repair (see figure 3.1.1 E). The vaginal mucosa is then repaired using an absorbable suture (2/0 polyglactin), with a continuous locking suture from its apex to the introitus. Finally the perineal body is reconstructed using interrupted absorbable sutures, and then the perineal skin is closed (see figure 3.1.1 F).

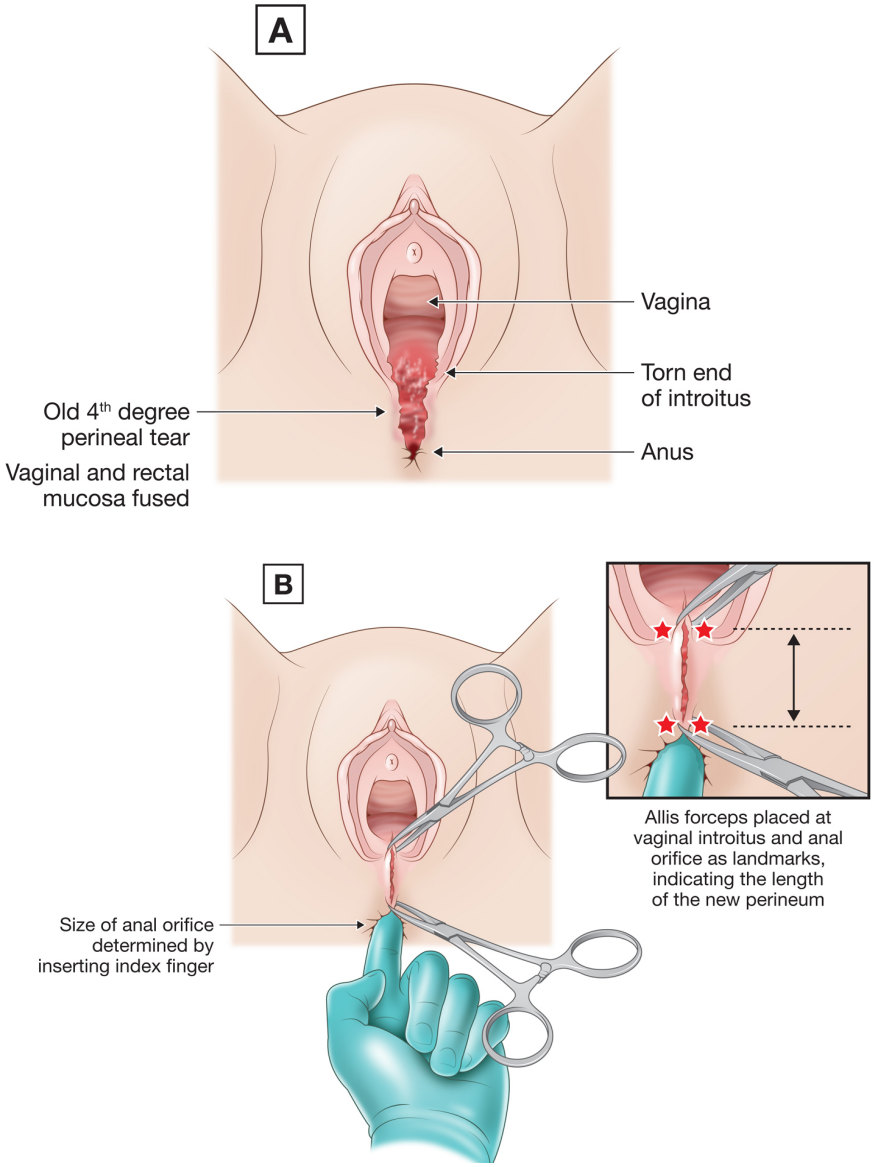
At the conclusion of the procedure, a vaginal pack and indwelling urethral catheter are placed and these are removed after 2 days.

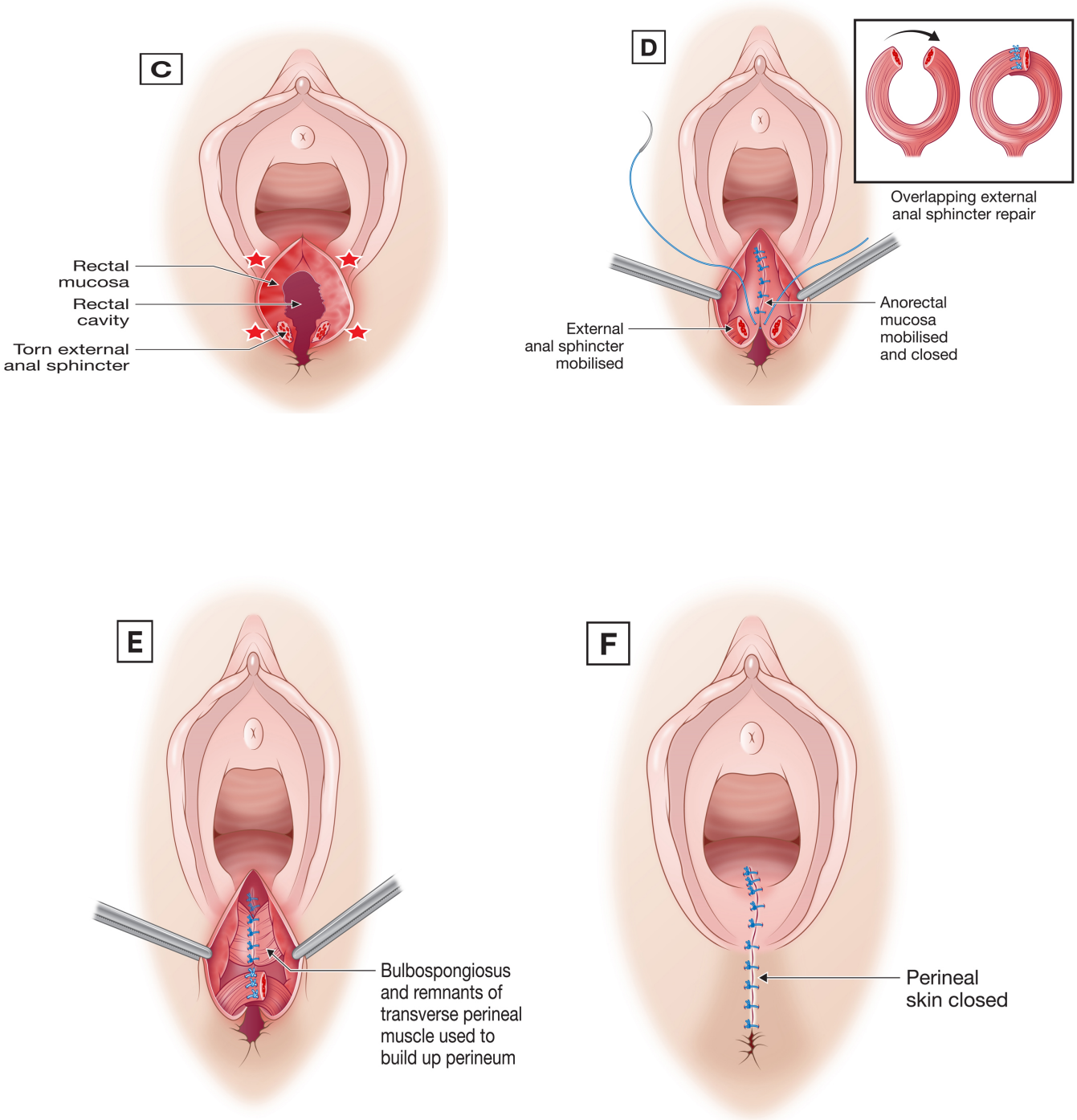
Post-operative management included placing the women on a fluid only diet for 2 days prior to returning to their normal diet. A bowel action was expected by day 3 post-operatively, and if this did not occur, oral laxatives were given. Post-operative care also included a daily perineal wash and inspection by the ward nurses.

Prior to discharge from the ward, all women had to have successfully moved their bowels, and they were examined vaginally to ensure the repair remained intact. The patients were usually discharged between 5-7 days post-operatively. However, the patients overall stay in the hospital was often longer as they had to wait for appropriate and available transportation back to their village.

Illustration 3.1.1 A-F

Repair of 4th degree perineal tear





RESULTS

All of the invited eligible women who presented with unrepaired 4th degree perineal tear agreed to participate in the study. A total of 68 women were enrolled in the study during the 2 surgical fistula camps in December 2013 and October 2015. In December

2013, 23 women with unrepaired 4th degree perineal tears presented for surgical repair, and in October 2015, 45 women presented for repair. Of the total of 68 women who enrolled in the study, only the 23 women from the first camp in December 2013 were eligible for 12 months follow-up at the time of review.

The mean age of the women with unrepaired 4th degree perineal tear at presentation was 33.7 years (range 18-80, median 30). When taking a history which includes the age of the woman, it is clear that the women often do not know their true age or birth date, and they often estimate their age according to important life events. Thus in these settings, the accuracy of a woman's age is relative. The mean parity of the women at presentation was 4.9 (range 1-10, median 5). The mean age of the women at their first delivery was 17.9 years (range 14-25). Three women were unable to recall this information. The average length of time from occurrence of the 4th degree obstetric tear to presentation at the surgical camps was 10.1 years (range 2 months – 58 years, median 8 years). In 54% of the women, the 4th degree obstetric tear occurred at the time of their first delivery. The remaining 46% of the women had their tear occur at a subsequent delivery (range 2-9th delivery, mean 4.9).

Three of the 68 women were widowed. Of the remaining 65 women, 32 (49%) identified family dysfunction as a significant issue including social stigmatization and isolation by their husband or partner, and family. Faeces being in the vagina and the vagina being "too wide", was the most common complaint by 41% of their husbands/partners.

With regard to sexual function, 46 women responded to that question. 22 of the women who responded were not sexually active, and 3 of these attributed this to pain. 24 of the women were sexually active, and 13 (54%) of these women described dyspareunia as a problem. Of the 24 women who were sexually active, their mean age was 39.7 years, and the mean age of those women not sexually active was 39 years. The mean age of those with dyspareunia was 38.1 years.

Three of the 68 women spontaneously volunteered that they had experienced sexual abuse at home by their husband/partner. 5 of the women complained of violence at

home. The women attributed the sexual abuse and violence to their unrepaired 4th degree perineal tear. Without any specific questioning therefore, nearly 12% of the women suffering with unrepaired 4th degree perineal tear spontaneously volunteered the information that they were either physically or sexually abused by their husbands/partners at home, and they believed that this was because of their unrepaired 4th degree perineal tear.

Women were asked whether or not they had previously sought treatment for their 4th degree perineal tear. Out of the 68 women, 39 (57%) had not sought previous treatment for their 4th degree perineal tear. Lack of finances was cited as the reason for not seeking treatment for 25 of these women. Another 11 women did not seek treatment as they were not aware of any treatment being available. Two women stated that the distance to travel was too far, and 1 was afraid of hospitals. 29 of the women had sought treatment previously. 2 of these women had seen a traditional healer and purchased herbs. The remaining 27 had attended a health centre but 17 were told no treatment was available. 1 of the women who attended a health centre was given medications, and the remaining 9 women had a procedure of some sort. The women were unable to explain which procedure was performed however it was not surgery in the vagina/ perineum.

All of the surgeries to repair unrepaired 4th degree perineal tear in this study were performed under spinal anaesthesia. No flaps were used and no graft augmentation was required. No bowel diversions were performed. In all of the women, the perineal body was reconstructed and the perineal skin completely closed at time of surgery. Post-operatively all women had a daily perineal wash and inspection of the perineum by the ward nurses until discharge. Following removal of the vaginal pack and indwelling catheter, all women had their vagina and perineum assessed by 1 of the 2 surgeons prior to discharge. Of the 68 women, there was 1 perineal breakdown on day 2 post-operatively, and this patient was returned to theatre for re-suturing the wound. This repair then healed completely with no further concerns or breakdown.

The Cleveland Clinic Continence Score was utilised, however in a modified form using only 4 of the 5 questions as the local environment was one where the use of

continence pads was not achievable for the women suffering with faecal incontinence. The maximum score in this study was 16 rather than 20 as only 4 of the 5 questions were utilised. At presentation, all of the 68 women with chronic 4th degree obstetric tear complained of incontinence to solid stool (see table 3.1.1). The women would generally spontaneously try to keep their stool firm/hard to reduce stool leakage, however solid stool leakage still occurred in 100% of the women. Solid stool leakage occurring daily was reported by 59% of the women. The pre-operative mean Continence Score was 14.7 (range 10 – 16).

Following the surgery, 61 of the 68 women were able to be contacted and questioned at 4-6 weeks post-operatively. Again the 4 question Cleveland Clinic Continence Score was utilised. All of the 61 women had a Continence Score of 0, indicating perfect anal continence. There was a statistically significant difference in the pre- and post-operative Continence Scores ($p < 0.001$, paired t-test). At the initial surgical camp in December 2013, 23 women had surgical repair of their chronic 4th degree obstetric tear. The remaining 45 women had their surgery in December 2015. Only 9 of the initial 23 women who were eligible for 12 months follow-up were able to be contacted. Of these 9 women, 8 described perfect anal continence with a Continence Score of 0, while 1 woman was symptomatic with a Continence Score of 10. The main problem that this woman complained of was flatal incontinence ("usually"). This woman was the 1 woman who had a breakdown of her repair on day 2 post-operatively requiring re-suturing.

DISCUSSION

The occurrence of significant perineal tears associated with vaginal delivery is common worldwide, affecting up to 9% of vaginal deliveries (Power et al., 2006, Marsh et al., 2011). Where the 3rd degree obstetric tear involves the perineum and anal sphincter complex, the 4th degree obstetric tear is when the injury also extends to the anal/ anorectal epithelium. Generally the literature will quote 3rd and 4th degree obstetric tears together, and therefore the incidence of 4th degree tear alone is not commonly quoted. However some studies have documented the rates of 4th degree obstetric tear at between 0.03% - 0.2% of all vaginal deliveries, and out of all the significant perineal tears, the 4th degree obstetric tear accounts for 4.4%-12.9% of cases (Groutz et al.,

2011, Kumar, 2012, Lindqvist & Jemetz, 2010, Ramalingam & Monga, 2013). In communities which are resource-poor and where health care facilities are not readily available, in particular in rural and remote areas, most deliveries are undertaken by untrained village birth attendants, and therefore any obstetric tears are not repaired at time of delivery. The perineal tears are not repaired and therefore heal by secondary intension. In the cases of 4th degree tears, the torn edges of the vagina and anorectum fuse with the divided anal sphincter remaining completely separate and functionless.

Krause et al (2014) described a cohort of 24 women living in rural Uganda with chronic 4th degree obstetric tears. This study identified that the 4th degree obstetric tear was associated with social stigmatization and abandonment. In this current study with 68 women living with chronic 4th degree obstetric tear, social abandonment was present with nearly 50% of the women being rejected by their husband/partner, which was even more prevalent than in the previous study. Most commonly, the reasons the women described as causing the abandonment were faeces in the vagina and vaginal laxity. In this current study, no questions were asked regarding the woman's safety at her home, in particular, whether or not domestic violence was present. However, 8 of the 68 women with chronic 4th degree obstetric tears spontaneously volunteered the information that they had suffered from domestic violence at home and they believed this was because of their chronic 4th degree obstetric tear.

Many factors lead to a woman not seeking assistance for health issues. Commonly the lack of social status given to women, a lack of family support, and a lack of income to pay for transportation and treatment, results in a woman's inability to seek assistance. This study also identified that when women did seek help from a health care facility, they were told that no help was available. Therefore significant emphasis needs to be placed on the need to educate local health workers regarding this obstetric injury, and to provide effective training in management.

In this series of 68 women, multiparous women were also identified as being at risk for 4th degree obstetric tears, with 46% of this group being multiparous. This is similar to previously published studies (Hollingshead, 2009).

The women presenting to the surgical camps in this study all complained of anal incontinence. Post-operatively and in the short-term, there were significant improvements in the Cleveland Clinic Continence Scores. While longer term follow-up is important, there are numerous challenges in this setting which can be limiting. The rural and remote locations where these women live can limit their ability to return to the hospital for a follow-up review due to limited transportation options and fear of personal safety during the long journey back to the hospital. In addition, poverty and low income can be a barrier to returning for follow-up, not just because of the funds needed for transportation, but also the loss of income while the woman returns to the hospital. The subordinate position of women in some societies mean that the woman may require permission from her husband/partner or family to make the journey. In this study, women were asked for a contact telephone number when they presented for surgery. The women were contacted via telephone 4-6 weeks post-operatively and at 12 moths post-operatively. At 4-6 weeks post-operatively 61 of the 68 women were able to be contacted. However at the 12 month follow-up, limited numbers of women could be contacted as their telephone numbers were no longer connected or active. With no effective postal system in these regions and with many women having no formal addresses in rural areas, and with a high rate of illiteracy among these women, the use of posted survey forms is not practical.

This study has described a surgical technique well suited to areas of low-resources. Specifically the avoidance of faecal diversion is important as it would increase the morbidity of surgery, and there is a lack of stoma equipment in these regions. Women in general of course prefer to avoid a stoma, however in many areas it is also socially unacceptable. This study agrees with other authors (Vankatesh, 1989, Abcarian, 1989) that diversion is not necessary in the management of obstetric injuries. Indeed there is no evidence that diversions improve surgical outcomes (Hollingshead, 2009).

A number of techniques have been described for the repair of chronic 4th degree obstetric tears which result in a cloacal-like deformity. Most of these descriptions are within small case series or breakdowns following primary repairs of obstetric tears. This study is the first large series describing the surgical management of the primary

delayed closure of chronic 4th degree obstetric tears. Some authors promote leaving an opening in the perineal skin, usually centrally, to allow for drainage (Hollinshead, 2009, Kaiser, 2008). This series has demonstrated that this is not necessary, as minimal complications were encountered with the complete closure of the perineal skin.

This study also describes primary closure of all chronic 4th degree obstetric tear defects without the need for flaps. Other authors (Valente, 2012, Altomare, 2007) have described the use of cutaneous flaps to repair and reconstruct the defect, which results in much more complex surgery. Not all authors however promote the use of flaps, with Hollingshead (2009) stating that a flap is not required because at the time of the initial injury there is no tissue lost. When a 4th degree obstetric tear occurs, the perineal tissues and anal sphincter ruptures, however this results in lateral displacement of the structures rather than any tissue loss. These structures therefore require good mobilization and repair without the need for flaps.

The main points of surgical technique that this study emphasizes is the avoidance of faecal diversion, the avoidance of any flaps used in reconstruction, and the complete closure of the perineal skin at completion of the surgery.

A limitation of this study is the lack of long-term results. The initial short-term results are robust, however effectively contacting women for follow-up 12 months post-operatively proved challenging. This study highlights the difficulties of long-term follow-up with reasons including lack of a postal system and illiteracy which limits the possibility of postal questionnaire follow-up, and personal return to the hospital for follow-up limited by transport availability and costs and personal safety concerns. These challenges are magnified in areas of poor infrastructure including roads and where low-income and poverty restricts activities. This study aimed to follow-up women post-operatively via mobile telephone. There are no land-lines in the regions where these women live. Most women were able to provide a contact number (often belonging to a neighbour or other community member). However, 12 months later most of these telephone numbers were disconnected or not active, thus limiting follow-up. The reasons for this would include financial restrictions meaning there was no money available on the phone card to keep it active, the telephone may not be charged due to lack of electricity, or the phone may have been sold or lost or no longer

working. Grid electricity in general is confined to larger towns, with rural areas and small villages having no mains electricity. Small business owners will often set up a generator to generate electricity where the locals can pay to charge up their mobile telephones. In this study, at 12 months post-operatively, only 9 women could be contacted out of a total of 23 women eligible for 12 month follow-up, which highlights this issue. The longer-term follow-up therefore needs to be interpreted with caution.

The Cleveland Clinic Continence Score has been widely validated and is used commonly in many western countries. However there is limited data on its use in Uganda. The questionnaire is straightforward and easy to use. The local nurses in this study found the Cleveland Clinic Continence Score simple and were able to administer it effectively. The Score was modified to exclude the question about the use of continence pads for faecal incontinence, as continence pads are not available or used in many low-income areas including this study site in western Uganda. The cost of pads is a major factor in these settings with very low incomes preventing such purchases. The average family income can be as low as US1-2 dollars a day. The total maximum score was therefore 16 instead of 20 with the exclusion of the question on pad use, and the minimum score remained at 0. Therefore, the worst possible score was 16, and a score of 0 indicated perfect continence.

In this study, there was a significant improvement in continence scores post-operatively in the short-term in all women, with most describing perfect continence. This compares favourably with other studies demonstrating excellent outcomes in the short-term (Venkatesh, 1989, Kaiser, 2008). At a median follow-up of 5 years, Hollingshead (2009) demonstrated a maintenance of anorectal function in their series of 29 patients, where 20 were available for questioning. Other studies (Abcarian, 1989, Kaiser, 2008) have described surgery for cloacal deformities following breakdown of primary repair of 4th degree obstetric tears and these studies have also confirmed longer-term outcomes for anal continence and sexual function.

An area of uncertainty in the literature is whether the longer-term outcomes following repair of chronic injuries is better or worse than the outcomes achieved following closure of acute 4th degree obstetric tear injuries. Some studies have described that

the improvement in anal continence in women with cloacal-type deformities where the anatomical defect is extensive, is often sustained, which is in contrast to results following-up women after repair of acute obstetric 4th degree obstetric tears (Hollingshead, 2009, Venkatesh, 1989). Abbott (2010) reviewed outcomes after acute anal sphincter injuries, and in that review only 60-80% of women were asymptomatic at 12 months. This study which repairs chronic 4th degree obstetric tears, has found excellent short-term outcomes which is similar to other studies. The reasons behind any variation in outcomes depending on whether or not the injury is acute or chronic are uncertain. If indeed the outcomes are better in the cohorts of women who have received delayed primary repairs of chronic 4th degree obstetric tears compared to acute primary repairs, the reason may be related to the nerve function of the pelvic floor. In cases of chronic 4th degree obstetric tears where a significant time has elapsed from injury to time of repair, any pelvic neuropraxia from the vaginal delivery would have time to fully recover and hence the pelvic floor would be functioning at its capacity.

In summary then, in this series of 68 women suffering with chronic 4th degree obstetric tear, all were closed using the above described method with no significant complications. There was no difficulty with adequate mobilisation of the tissue and no difficulty with achieving a repair. Apart from 1 very early breakdown which subsequently healed well following re-suturing, there were no further breakdowns with this technique which included complete closure the perineal skin at surgery.

ADDITIONAL SURGERIES AND FOLLOW-UP OF POST-OPERATIVE WOMEN

Subsequent to the above surgeries and follow-up, additional women underwent surgical repair of their unrepaired 4th degree perineal tear at Kagando hospital, Kasese district, western Uganda following the surgical camp in October 2015, up until March 2018, giving a total of 115 women who completed the pre-operative Cleveland Clinic Continence Scores in this final cohort. An additional 50 women were operated upon during the December 2016 surgical camp however these were not included as the Cleveland Clinic Continence Scores were not performed pre-operatively due to staff shortages following a bloody local coup in the district in November 2016. Rebel fighters killed a police officer on the street outside Kagando hospital triggering a

hospital shut-down and several hours of shooting while an army response unit cleared the rebel fighters and secured the town. The ongoing recruitment of patients remained within the initial Ethics Committee approval.

There were 99 women eligible for follow-up at 12 months post-surgery, of whom 48 were able to be contacted for this study. Sadly 1 woman said she had been subsequently diagnosed with terminal bowel cancer and had marked faecal incontinence and therefore had a score of 16. The remaining 47 women answered the modified Cleveland Clinic Continence score, with 39 (83%) having a score of 0. The remaining 8 women had a score of ≥1 – solid stool leakage 4 women, faecal soiling 4 women, flatal incontinence 6 women, lifestyle restriction 4 women.

67 women were eligible for 3 year follow-up, with 25 of these women contactable. 3 of these women had subsequent vaginal deliveries without any complications. Of these 25 women, 21 scored a modified Cleveland Clinic Continence score of 0. The remaining 4 complained of faecal soiling, including 3 reporting flatal incontinence. Only 1 said this restricted her lifestyle. None of the women suffered with any solid fecal incontinence. At 4 years follow-up following surgery to repair chronic 4th degree perineal tear, 22 women were eligible for follow-up with 8 of those women able to be traced. 6 of the 8 women had a Cleveland Continence Clinic score of 0, with 1 woman complaining of fecal soiling and 1 woman complaining of flatal incontinence. None of the women complained of solid fecal incontinence or lifestyle restriction.

Finally at the 5 year follow-up point, 22 women were eligible for follow-up with 7 of these women reached and able to answer the modified Cleveland Clinic Continence score. 4 of these women had score of 0. Of the remaining 3 women, 2 women scored 2 and 1 woman scored 4. Out of these 3 women, 2 reported rarely having fecal soiling, 2 sometimes noted flatal incontinence, and 1 woman always suffered with flatal incontinence. None of the women reported any solid fecal incontinence.

While there are a large number of women lost to follow-up over the 5 years, it is remarkable that significant numbers of women were still contactable. In this rural district in western Uganda, being able to contact women via telephone over a long

period of time is often difficult as firstly not all women have access to a telephone. Secondly, their original contact number may well change over time for many reasons, and their mobile telephone may not always be active if it is not charged or does not have credit. There was a 59.4% follow-up rate at 12 months, 37.3% rate at 3 years, 36.4% rate at 4 years and at 5 years 31.8% of eligible women were contactable. Of the women who were able to be reached for review over the telephone, the majority had minimal symptoms and this continued for up to 5 years of follow-up. A Cleveland Clinic Continence score of 0 (perfect score) was reported in 85.5% at 12 months, 84% at 3 years, 75% at 4 years and 57.1% at 5 years following surgery for repair of unrepaired 4th degree perineal tear. At 3, 4, and 5 year follow-up, there were no women complaining of any solid stool leakage. Those women with symptoms mainly complained of flatal incontinence or occasional fecal soiling.

In conclusion, the surgical repair of unrepaired (chronic) 4th degree perineal tear described here, has shown good efficacy with minimal anorectal symptoms of bother at follow-up out to 5 years, within the confines of this study and difficulties encountered with follow-up. Ongoing longer-term follow-up is required to further assess the benefits of this surgical technique.

Table 3.1.1 Modified Cleveland Clinic Continence Score - preoperative

N = 68	Never	Rarely < 1x/month	Sometimes < 1x/week	Usually < 1x/day	Always everyday
Solid stool leakage	0	0	11	17	40
Liquid stool leakage	0	0	1	3	64
Gas leakage	0	0	1	8	59
Lifestyle restriction	0	0	4	14	50

3.2 PESSARY USE FOR PELVIC ORGAN PROLAPSE

Paper submitted:

Goh JTW, Thayalan K, Krause HG. Introduction of pessaries for pelvic organ prolapse in western Uganda: a pilot study. ANZCJ

Pelvic organ prolapse (POP) is a common problem affecting women worldwide, in both high- and low-income countries (Walker & Gunasekera, 2011). In low-income countries women often suffer with very severe symptoms of POP which are exacerbated by performing heavy work such as lifting fire-wood/water and performing heavy manual work in the fields. The consequences of pelvic organ prolapse in terms of affecting quality of life and activities of daily living are often very pronounced in these women. Women with significant pelvic organ prolapse also suffer from family breakdown and abandonment due to their untreated symptoms of pelvic organ prolapse (Krause et al., 2014).

Vaginal pessaries for management of POP are not widely used in low-income countries (Walker & Gunasekera, 2011) and there are few papers relating to the use of pessaries in low-income countries in the literature. A lack of availability of pessaries, along with the cost of pessaries, in conjunction with a lack of training in the use of pessaries have contributed to this situation. Until now vaginal pessaries for the management of POP have not been utilised at the Kagando Hospital, Kasese district, western Uganda due to lack of availability of pessaries and lack of training of health personnel in their use. Kagando hospital is the major referral hospital in Kasese district. This following study aimed to introduce pessaries as an alternative management for POP in western Uganda. It also aimed to assess the feasibility of women's acceptance of the pessary and self-management of pessaries. Additionally by reducing severe POP including procidentia with vaginal pessaries for a few days prior to surgery, there is often some surgical benefit with reduction in oedema and congestion in the POP.

METHODS

This research was undertaken during 2 fistula and prolapse camps in September 2017 and March 2018 at the Kagando Hospital and St Pauls hospital, Kasese district, western Uganda. The study received Ethics Committee approval.

All of the women attending the camps with pelvic organ prolapse were invited to participate in the study in addition to them receiving all of the appropriate care that they required. All information that was obtained was collected prospectively and the local nursing staff interpreted for the women in their local dialect. The health care workers were educated regarding the use of pessaries as pessaries for POP had never been used in this area previously. This education included information regarding pessaries, instruction on the use of pessaries including removal/ insertion/ cleaning/ care and a formal lecture.

The women attending the surgical camps were expecting surgery for the management of their prolapse as vaginal pessaries for the management of POP had not previously been offered in this district. When the women were assessed for POP and elected to trial a pessary, they were also booked for prolapse surgery if indicated and medically fit, as that was their expectation and request. As this was the first time the option of vaginal pessary use for the conservative management of POP was offered in this hospital, booking the women for surgery at their request reassured the women that they would not be excluded from surgery even though they elected to trial a pessary while they awaited surgery.

All of the women who consented to the pessary had a vaginal silicone pessary (C-POP or S-POP, manufacturer Gynaecologic, Parkville, Victoria, Australia)(Figure 3.2.1) inserted at the first outpatient examination. At initial examination the prolapse was assessed and recorded using the pelvic organ quantification (POP-Q) system. The 9 POP-Q measurements (6 defined point measurements and 3 measured lengths) and the POP-Q stage of prolapse documented. The type and size of the vaginal pessary which was inserted was recorded. All of the women with a vaginal pessary inserted were then reviewed on a daily basis at the outpatients clinic until discharge or until they had surgery. Each day the women were interviewed and assessed and a

questionnaire was completed (Table 3.2.1). Information recorded included whether the pessary had stayed in or had fallen out, and whether the pessary was comfortable or uncomfortable. If the pessary was uncomfortable or had fallen out, the pessary size and/or type was changed.

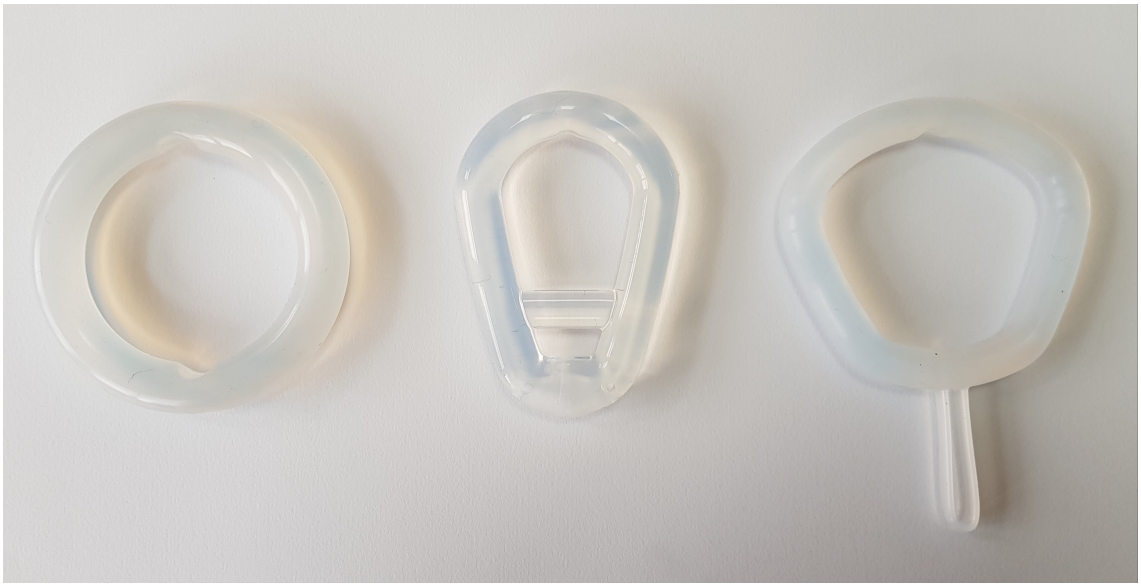
Pessaries can be utilised as a permanent solution for women who are unfit for surgery. Pessaries are the best option for women desiring future fertility, as surgery should be delayed until a woman's family is complete. Additionally many women may choose a non-surgical option for their symptomatic prolapse for other reasons such as not having adequate time to allocate to their recovery due to family or work commitments, or just a preference to avoid surgery.

The women electing to continue with the pessary for various reasons were discharged a minimum of 3 days after they had had made their final decision to continue with a pessary. These women who were discharged with the plan to continue with conservative management of their POP with pessaries, were only discharged if their pessaries were comfortable, relieving their prolapse symptoms, and staying in-situ. They also needed to be confident in self-managing the pessary which included being able to comfortably remove, clean, and reinsert the pessary themselves. The women who were discharged self-managing their own pessary were given follow-up appointments at 3 and 6 months. In addition, the telephone number of a local nurse was given to them if case they had any concerns regarding the pessary in the interim. They were reassured that if they changed their minds about continuing with the pessary or found that it didn't suit them then they could return to the hospital at future surgical camps to receive prolapse surgery. The follow-up at 3 months was performed by an experienced local nurse who had been trained at the camp in pessary management and the local general surgeon who had also attended the pessary management lecture. The 6 month follow-up was performed at the 2nd surgical camp at Kagando hospital in March 2018.

The same procedure with the fitting of the pessaries during screening and reviewing the pessaries daily was repeated at the 2nd surgical camp at Kagando hospital in March 2018 and also at St Pauls hospital, Kasese, where an outreach prolapse camp was run

in conjunction with the camp at Kagando. The St Pauls camp performed prolapse surgeries for only 4 days, and only 1 patient who was unsuitable for surgery was taught self-management of her pessary.

Figure 3.2.1 Vaginal silicone pessaries: r-pop (left), s-pop (centre), c-pop (right)



RESULTS

There were a total of 95 women with prolapse who attended the prolapse and fistula camps in September 2017 and March 2018. 82 were seen at Kagando hospital (42 in September 2017 and 40 in March 2018) and 13 at St Pauls hospital in March 2018. Only 2 woman with prolapse were excluded from the pessary trial, one with a concomitant unrepaired 4th degree tear (cloacal defect) extending 4 cm up the rectovaginal septum which therefore would prevent a pessary being retained and one whose surgery was planned for the same day that she was first screened and therefore did not have time to trial a pessary.

The remaining 93 women with pelvic organ prolapse were invited to participate in the study and all consented for a trial of pessary. Of these women trialling a pessary, the average age at presentation was 57 years (range 23-90 years), and average parity was 7.97 (range 2-14). The mean duration of having the condition of POP was 7.6 years (range 1 month-30 years). The average age of their first childbirth was 18.1 years (range 12-30, 6 women did not know the age of their first delivery). The women were asked if they were currently sexually active with 24 women stating they were sexually

active and 69 women were not sexually active. Of the 69 women who were not sexually active, 21 were widowed, and 23 women stated their husbands had rejected them because of the prolapse. Therefore, out of the 72 women who were not widowed, 23 (32%) of them had suffered from rejection and abandonment by their husbands because of the prolapse.

Out of the 93 women, 48 women had previously sought treatment for their symptoms of prolapse. Of these 48 women, 9 had previous surgery (8 had an abdominal hysterectomy alone without any prolapse repair), 10 women tried traditional herbs, 5 went to a hospital but were not offered any treatment, and 7 were given medications at the health centre. 17 women were unable to afford the treatment advised at their previous hospital/health centre. With regard to this camp that these women attended for treatment of their POP, all treatment options including surgery and pessary, and also transportation to and from the hospital and all meals, were provided without cost to the women.

Of the 93 women, 56 women were diagnosed with stage 4 POP (POP-Q staging system), and 37 were stage 3 POP. Using the POP-Q system assessment of their prolapse, the mean Ba was + 4.5 cm; Bp +3.3 cm; C +6 cm, GH 6.5 cm and PB 2.2 cm. Of the 93 women participating in the trial of pessary use, the mean genital hiatus/total vaginal length (GH/TVL) ratio was 0.8 with 28 women having a ratio of less than 0.8. The pessary was trialled by the 93 women for 1 to 11 days (with an average duration of 4.3 days) prior to either having surgery or being discharged home to continue with self-management of the pessary. Of the 93 women, 59 women (63.4%) were successfully fitted at the first attempt. There were 24 women for whom the pessary fell out especially when squatting with defecation (20 women). These women were then reassessed and refitted with a different pessary type or size. 22 women had more than 1 pessary fitted as the original was not comfortable. The GH/TVL ratio of women with initial success first fitting was similar to those who were refitted (ratio 0.80 vs 0.80). There were 3 women for whom a suitable pessary was unable to be found despite several attempts. 2 of these women had complete procidentia and another had a very bulky cervix that was distorting the vaginal walls and preventing the retention of a pessary.

Out of the 93 women with POP, 65 women trialled the pessaries for longer than 2 days and 66 of the 93 women were taught to self-manage their pessary within the time frames of their planned surgeries. All of the women who were taught self-management of their pessaries were successful with their self-management. 83% of the women who were taught self-management described it as easy and had high confidence in repeating the procedure, with the remaining 17% reporting moderate difficulty initially. This improved significantly with repetitive attempts. No new urinary symptoms were reported with the use of the pessaries.

Throughout the 2 camps including the satellite camp at St Pauls, 27 women (out of the total 93) were discharged with pessaries. At the September 2017 camp, 12 women were discharged with a pessary - 3 of these women wanted more children, including I woman whose pregnancy was diagnosed at the camp, 4 were medically unfit for surgery and 5 elected to continue with the pessary by choice. At the March 2018 camp there were 15 women who were discharged with a pessary – 1 woman was medically unfit for surgery and the remaining 14 by choice. The average time to making the decision to cancel their surgery and continue with the pessary was 2.1 days. Throughout the camps, health care personnel were trained and became competent in the management of pessaries. They were able to counsel the women (in the local language), fit pessaries, remove and insert pessaries and clean pessaries.

Follow-up of the 12 patients discharged with a pessary from the first camp was performed at 3 months by the local staff, and again at 6 months at the 2nd surgical camp. The follow-up rate was 75% with the same 3 women lost to follow-up at both 3 and 6 months (see table 3.2.2). Of the 9 women who returned for follow-up at both 3 and 6 months, all of them had continued with the pessary and planned to continue with the pessary indefinitely. At the 6 month review with clinical examination, 2 women were noted to have some minor vaginal epithelial abrasions. As there is no topical vaginal oestrogen available to these women, they were encouraged to leave their pessary out for a few days to allow healing of the abrasion prior to reinsertion.

DISCUSSION

POP is common worldwide and is seen frequently in low-income countries. Risk factors for POP includes increasing parity, increasing maternal age at first delivery, obesity, and instrumental deliveries (Vergeldt et al., 2015), However in this population of women in western Uganda, increasing parity is common, however the other documented risk factors are not relevant. Typically women in many low-income counties have their first delivery as a teenager, are not overweight and are not delivered by instrumental delivery as they often deliver unassisted at home. Another documented risk factor for POP is prolonged second stage of labour (Kearney et al., 2006). Certainly this is a possibility in low-income regions where women deliver at home, as a small percentage of them do have obstructed labours resulting in obstetric fistulas and perhaps some have quite prolonged labours without the development of OF but with an increased risk of future POP. It is also possible that nutrition and heavy work may contribute to risk of POP (Nyaard & Shaw, 2016) and commonly there can be compromise in nutrition and food security in low-income areas, along with the necessity for heavy work.

There is a paucity of literature on the use of pessaries in low-income countries in Africa, despite their widespread use worldwide (de Albuquerque Coelho et al., 2016). This study is the first to our knowledge, to trial pessary use for POP in the Kasese district Uganda. In 2012, the population of the Kasese district was reported at over 700000, with Kagando hospital being the largest hospital in the district, servicing over half of its population (Uganda Bureau of Statistics, 2018).

Pessaries have been utilised as mechanical supports for POP for over 2000 years. Herbs have also been used to scar the vagina “detract the uterus from expelling out of the vagina” (Shah et al., 2006). It was noted in the patient histories that some of the women with POP attending these camps had also used herbs without success. Pessaries are successful in 85% of women in providing relief of POP symptoms (Albuquerque et al., 2016).

POP in low-income countries appears to be common despite only scattered published literature on the topic. In Nepal, Robert et al (2017) trialled pessaries for POP. In that

paper it is unclear whether or not the Nepalese women were taught to self-manage their pessaries. It would be ideal to adequately educate women in low-income areas regarding the self-management of their pessary, as this would allow for reducing the costs of travel if frequent reviews were necessary. In Kagando, the women from the first cohort receiving pessaries for their POP were requested to return for review at 3 and 6 months mainly to reassure the women that help was available if they had any concerns, and also that they could change their mind and choose surgery if they wished in the future if surgery was indicated.

There are several possible advantages for the use of pessaries for POP in low-income countries. Often health care in not free and the cost of surgery is often well beyond the means of the average family in the area. Potentially if pessaries were made available and were inexpensive compared to surgery, then the pessary option may become available to many women who otherwise have no access to any treatment for their POP.

There are a high proportion of subsistence crop farmers in the Kasese district in western Uganda (Uganda Bureau of Statistics, 2018), with over 70% of the population aged 14-64 working as subsistence crop farmers. In addition, over 80% utilise firewood for cooking and thus women have to carry heavy firewood, water and dig in the fields daily. These factors may impact on a woman's ability to "rest" for several weeks after her POP surgery due to family expectations and financial reasons. It is likely that women have to return to work at home and in the fields within a few weeks of their POP surgical repair, carrying heavy loads of water and firewood over long distances. A possible future use for pessaries, would be as a post-operative support device while the repair is healing and strengthening. Currently there are such post-surgical support pessaries available, however they are not widely used following the majority of POP surgeries.

Another advantage of having pessaries available as a treatment option for women with POP, is for young women who have not necessarily completed their family and desire further children. It is not uncommon to see young women in western Uganda and other low-income areas with significant POP. In these cases the pessary is able to

alleviate their POP symptoms until a time when they have completed their family and find it suitable to undertake POP surgery. In this study there were 3 women with POP who wanted further children, and they were all able to be fitted successfully with a pessary.

Women who are not medically fit for surgery are able to utilise the non-surgical option of pessaries. During these camps there were 5 women who were not medically fit for surgery. Once again we were able to fit them all with pessaries which relieved their symptoms. Geffrion et al (2013) reported that successful pessary fitting was lower with a genital hiatus to total vaginal length ratio of over 0.8. However, we did not find the ratio to affect the success of the pessary fitting. This may be due to our small study group, short follow-up or new design of the pessaries.

This study was able to confirm the previous study finding that women with significant pelvic organ prolapse in western Uganda suffer from social stigmatisation and abandonment (Krause et al., 2014). Just over one-third of the women whose husbands were still alive, suffered from rejection by their husbands that was attributed to the prolapse. Krause et al (2014) identified that 36% of women whose husbands were still alive were abandoned by their husbands.

All 65 women in our study over the 2 camps, who had the pessaries for 2 days or more, could self-manage and 19 of these women cancelled their surgery and chose to continue with the pessary rather than to pursue a surgical option. This was a new method of POP management being trialled in this region and therefore the women with POP and the health care workers had not previously been educated in this option. Despite this, we were pleasantly surprised that the women and staff were so accepting and enthusiastic of this new management strategy. In particular at the second camp in March 2018, the women and staff were again very receptive to the use of pessaries which had been introduced 6 months earlier as a non-surgical option for symptomatic pelvic organ prolapse, with several women again cancelling their surgeries to pursue this conservative option.

There was a large proportion of high-grade POP where 100% were grade 3 or 4 POP.

It was noted that education of patients was vital to allow acceptance of the pessary as a potential long-term management option for POP in low-income areas. Patients were given instructions on markers of concern and how to seek help. When women were given the knowledge on how to manage their pessary with removal and reinsertion, cleaning and expected long-term outcomes for management of prolapse symptoms, these were key determinants in the decision of patients to elect for pessary.

This was the first trial of pessaries as a management option for POP in western Uganda. Neither the women presenting with POP nor the hospital staff were previously familiar with pessaries, however the women with POP readily accepted it as a treatment option for their POP and had no difficulty with self management of their pessaries. Many women cancelled their planned POP surgery as they preferred to utilise a non-surgical option for their POP. Several other women were able to benefit from the use of a pessary to control their POP symptoms, and would otherwise have been given no other option of management as they were unfit for surgery. The health care workers at the hospital were also very enthusiastic about the introduction of this new management strategy for POP.

Despite this being a fairly small trial of pessary use for POP in rural western Uganda, the results clearly indicate that this option is acceptable to both women suffering with POP and health care workers, with the necessary component of teaching pessary care and self-management of the pessary easily completed. Ongoing follow-up of these initial cohorts of women utilising pessaries for their POP will provide an ongoing understanding of the feasibility of using pessaries in a rural low-income setting. In addition, ongoing provision and use of pessaries at future surgical camps will help to establish pessaries as a non-surgical option for POP in western Uganda. Potentially pessaries may become available to provide women with immediate relief of their POP symptoms year round, with local hospital staff providing a pessary management service. This then allows for empowering of the local community with skills which do not rely upon volunteer surgical aid from overseas.

Table 3.2.1 Daily questionnaire for women with pessary

	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6
Comfortable Y/N						
Fell out Y/N • If Y, when ?squatting, bowels						
If fell out Another inserted? Y/N						
If yes Type Size						
Self managing Y/N If yes, confident? Y/N						

Table 3.2.2 Women discharged with pessary

	Age	POPQ stage (reference point C)	Parity	Type pessary discharged	Days review	Reason for pessary	3 months	6 months
1	23	4 (C +10)	4	CPOP medium	6	Diagnosed pregnancy		
2	25	3 (C+4)	2	CPOP large	7	Desires more children	Failed to attend	Failed to attend
3	25	4 (C+12)	2	CPOP large	6	Desires more children		
4	87	4 (C+10)	7	SPOP medium	7	Unfit for surgery	Failed to attend	Failed to attend
5	60	3 (C+3)	9	SPOP small	7	Unfit for surgery		
6	67	4 (C+10)	5	CPOP large	7	Unfit for surgery	Failed to attend	Failed to attend
7	69	4 (C+10)	8	CPOP large	7	Unfit for surgery		
8	71	4 (C+9)	9	SPOP large	7	Elected to cancel surgery		
9	47	4 (C+8)	7	Ring	7	Elected to cancel surgery		
10	65	3 (C+6)	11	CPOP medium	7	Elected to cancel surgery		
11	57	4 (C+10)	11	SPOP large	6	Elected to cancel surgery		
12	48	3 (C+6)	10	CPOP large	6	Elected to cancel surgery		

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CHAPTER 4

RISK FACTORS FOR DEVELOPMENT OF OBSTETRIC FISTULA - METHODS, RESULTS, DISCUSSION

The rates of occurrence of obstetric fistula in resource-poor settings do vary in studies from as low as 9 to 124 per 100 000 deliveries (Adler et al., 2013, Vangeenderhuysen et al., 2001). A number of risk factors for the development of obstetric fistula have been proposed and presented in the literature. Delay in seeking care during labour and delay in arriving at a health care facility during labour where effective emergency obstetric services are functioning and a delay in the provision of services by the health care facility are known to contribute to the occurrence of obstetric fistula (Norman et al., 2007). Maternal risk factors including early age of marriage/childbirth, maternal height, maternal education and poverty have also been associated with the development of obstetric fistula (Norman et al., 2007, Ahmad et al., 2005, Barageine et al., 2014, Browning et al., 2014, Holme et al., 2007, Melah et al., 2007). When reviewing the studies identifying a short stature as being a risk factor for OF, these women with OF are usually compared to national averages instead of the comparable regional and tribal demographics. It is therefore unclear whether these statistics are an accurate reflection on the risk of a shorter height for the development of OF. In addition, some studies have documented the heights of women with OF and stated that they are short, without comparing them to any other group of women without OF (Ahmad et al., 2005, Tebeu et al., 2012).

In Uganda there is a high rate of fistula occurrence. The 2011 Ugandan Demographic and Health Survey identified 2% of women aged 15-49 years having symptoms of genital tract fistula (Ugandan Demographic and Health Survey, 2011). This 2011 survey describes a variation in rates of OF between the regions, with the highest rate of OF identified in western Uganda. There is a 4% rate of women in the reproductive age group who responded positive to the question of “constant leakage of urine or stool from your vagina day and night” in western Uganda (Ugandan Demographic and Health Survey, 2011). Western Uganda is therefore home to significant numbers of women suffering with OF.

The following study aimed to assess whether or not western Ugandan women with OF resulting from obstructed labour were younger at age of first delivery or shorter than women also in western Uganda who had a vaginal delivery without obstruction or development of OF.

METHODS

This study was conducted during fistula and prolapse camps from 2013-2015 in the Kasese district in western Uganda. These surgical camps treated women with genital tract fistula and pelvic organ prolapse at Kagando Hospital and St Paul's Health Care Centre. Ethics approval was obtained.

This was a prospective study with all women attending the fistula and prolapse camps invited to participate in the study. The information was collected prospectively with height documented as a part of the routine examination and age of first delivery also a routine question in the history. In order to be able to compare the women suffering with OF more comprehensively with other local women who did not develop OF, during the camps women having a spontaneous vaginal delivery without development of OF in the maternity unit were also invited to participate in the study. The study therefore comprises of 4 groups of women, all from the Kasese district:

1) women with a history of obstructed labour/fistula (OF)
2) women without a history of obstructed labour but with Stage 3 or 4 POP-Q pelvic organ prolapse (severe POP)
3) women without a history of obstructed labour but with unrepaired 4th degree perineal tear (tears)
4) women without a history of obstructed labour but recently had a spontaneous vaginal delivery (SVD)

Statistical analysis

With statistical analysis, all results are expressed as mean and standard deviation. The one-way analysis of variance (ANOVA) test was utilized to make comparisons of height and age of first delivery between the four groups. In the situations where the overall difference between groups was significant, Tukey's post-hoc multiple comparison tests

were used to identify specific differences between groups. To compare the differences in height and age of first delivery between the fistula group and the combined (severe POP, tears, SVD) group, 2-sample t-test was used. Binary logistic regression was used to able to identify the association between the height of women and the risk of fistula. This was done after adjusting for age at first delivery. In order to examine if a height of less than 150 cm was a risk for OF, data was analyzed by categorizing height using a cut-off of 150 cm (Ahmad et al., 2005, Holme et al., 2007, Melah et al., 2007). Pearson's chi-square test was utilized to assess differences in proportion of height less than 150cm between the two groups. The results were considered statistically significant when $p < 0.05$. The data analyses were performed using IBM SPSS-23 (IBM, Chicago, IL).

RESULTS

For this prospective study, all of the eligible women agreed to participate. In total, 523 women were recruited. Of these 523 women, 187 had a genital tract fistula secondary to obstructed labour, 89 women were parous with grade 3 or 4 severe pelvic organ prolapse, 82 women had an unrepaired 4th degree perineal tear following a vaginal delivery and 165 women recently had a spontaneous vaginal delivery.

When documenting the ages of women in this district (and also in other resource poor regions), occasionally the age provided by the woman is not accurate as the women often do not know their birth date. They often may estimate their age according to important events in their lives. At presentation, the mean age of the women with OF was 28.2 years (range 14-65), with severe POP was 52 (25-80), unrepaired 4th degree perineal tear 33.8 (18-80) and recent vaginal delivery was 28.5. The women in the POP, tear and SVD groups only had a history of vaginal deliveries without developing an obstructed labour fistula.

When comparing women with OF with the other groups, the women with OF had the condition for an average of 60 months (range 1-540) compared to severe pelvic organ prolapse 87.5 months (2-360 months) and unrepaired 4th degree perineal tears 106.4 months (1-696 months).

The heights of the 4 groups of women are documented in Table 4.1 below.

Within the OF group, 15 women did not have their height recorded. In the 4th degree perineal tear group, 12 women did not have their height recorded.

Figure 4.1 presents the boxplots of the height of the 4 groups of women. The height of women in the fistula group (mean height 152.2 cm) was significantly shorter than the height of those in the unrepaired 4th degree perineal tear group (mean height 157.5 cm); difference of 5.3 cm (95% CI: 2.3-8.3 cm; $p < 0.001$). When comparing the OF group with the severe POP group there was no difference in heights ($p=0.279$) and also when comparing the OF group with the SVD group there was no difference in heights ($p=0.989$). The women in the SVD group (mean height 152.5 cm) were in fact significantly shorter than those in the unrepaired 4th degree perineal tear group; difference of 5.0 cm (95% CI: 1.9-8.1 cm; $p < 0.001$).

Table 4.2 depicts the heights of women in the fistula group compared to the combined groups.

All of the women in the severe POP, tear and SVD groups had a history of spontaneous vaginal deliveries without any obstructed labours. The women with OF were an average 1.9 cm shorter than the combined group. This pooled vaginal delivery data (severe POP, tears, SVD) resulted in a statistically significant difference in the height of women with fistula and those without obstructed labour (95% CI: 0.5-3.4 cm; $p = 0.007$).

Table 4.3 documents the proportions of women with height <150 cm or ≥150 cm between the fistula group and the combined group. When using a Chi-square test, a height of 150 cm is not significantly associated with a risk for OF (chi-square statistic = 0.367; $p = 0.545$).

In women with OF, the mean age at first delivery was 17.7 years. In the severe POP group the mean age at first delivery was 17.3 years. In women with tears the mean age was 17.9 years and 18.8 years in the recent SVD group (Table 4.4).

In the OF group compared to the tears group, the age at first delivery was not statistically significant (p = 0.947). Also there was no statistical significance when comparing age at first delivery in the OF group compared to the severe POP group (p = 0.710). There was a statistically significant difference in age at first delivery between the OF group compared to the SVD group; difference of 1.1 years (95% CI: 0.2-2.0 years; p=0.011). The OF group was younger. However, when all of the non-obstructed vaginal delivery groups were combined (severe POP, tears, SVD) there was no statistically significant difference in the age of this combined group (mean age of 18 years) compared to the OF group (p = 0.247).

DISCUSSION

The published literature continues to present conflicting information regarding the risk factors for obstetric fistula. Barageine et al (2014) suggested antenatal care did not predict the development of a fistula whereas Tebu et al (2012) associated obstetric fistula with lack of antenatal care. It therefore remains unclear whether or not receiving antenatal care is protective against fistula development. Other authors have suggested that the socio-cultural status of women which may directly result in the woman's delay in decision making to seek help, may be a most significant and important risk factor for the development of obstetric fistula (Barageine et al., 2014, Audu et al., 2008).

With regard to maternal height and age at first delivery, these factors are often quoted as significant risk factors for obstructed labour and the subsequent development of obstetric fistula (Barageine et al., 2014, Browning et al., 2014, Holme et al., 2007, Melah et al., 2007, Tebeu et al., 2012). However, in relation to maternal height, these studies have usually compared the heights of women with obstetric fistula with national averages, or the women where the study was performed were not from the same district or of similar ethnic or tribal background (Browning et al., 2014, Holme et al., 2007, Tebeu et al., 2012).

In the region of western Uganda where this study was undertaken, 4% of women have symptoms of a genital tract fistula (Ugandan Demographic and Health Survey, 2011).

This study compared 4 groups of women, in the same time period and in the same district (Kasese district, western Uganda). The 4 groups of women were those women with OF from obstructed labour, women with severe POP, women with unrepaired 4th degree perineal tears after a spontaneous delivery and women who had recently had a spontaneous vaginal delivery. While the OF group was shorter than their unrepaired 4th degree perineal tear counterparts, OF group was not shorter than the severe POP or SVD groups. The unrepaired 4th degree perineal tears group was 5 cm taller than the OF and SVD group. This taller tears group therefore did increase the mean height of the combined group of non-obstructed labours (ie severe POP, SVD, and tears). See Table 4.2.

There is no clear explanation as to why there is a significant difference in height between the tears and other groups. The women with tears presented to the fistula camps along with all the OF women, as there are no separate camps for women with unrepaired 4th degree perineal tears. The women with tears and OF were screened and had observations taken in the same way and at the same time as each other. They were all accommodated in the same wards and cared for by the same group of nurses. Therefore if any errors did occur, these errors should have occurred equally with the OF group of women. The data obtained here appears to infer that taller women appear to be at a higher risk of 4th degree perineal tears, however this is difficult to explain. The birth weights of the babies born to the women with 4th degree perineal tears are unknown, as these women all delivered in their villages where measuring scales for the infant is not available, and neither is the personnel or facility to repair their perineal injuries following delivery. Raisanen et al (2013) did show in a previous study that an increase in maternal height was protective against obstetric anal sphincter injury. They identified a 2% reduction in injuries with every 1cm increase in maternal height (Raisanen et al., 2013).

The national average height of women in Uganda is 159.2 cm (Subramanian et al., 2011). Other published literature have used national height averages to conclude that women suffering with obstetric fistula are short. Certainly all our groups of women, including those who recently had a normal vaginal delivery in western Uganda, are shorter than the national average. The unrepaired 4th degree perineal tear group

which is the tallest of our 4 groups of women (157.5 cm), is still shorter than the national average. The fistula group (152.2 cm) and SVD group (152.5 cm) are both significantly shorter than the national average. Using national average heights would therefore potentially be misleading when comparing the heights of women who develop obstetric fistula from obstructed labour with those women delivering normally with no obstruction.

A number of studies have identified a maternal height of less than 150 cm as a significant risk factor of development of obstetric fistula (Barageine et al., 2014, Melah et al., 2007, Tebeu et al., 2012). This study did not confirm those findings, with this study not associating a height of less than 150cm as a risk factor for obstetric fistula from obstructed labour.

An earlier maternal age at time of first delivery (and age at marriage) has been implicated in the development of obstetric fistula. Some papers have identified a young maternal age at time of first delivery as a risk factor for OF (Holme et al., 2007, Melah et al., 2007) however others have not agreed (Barageine et al., 2014, Audu et al., 2008). In Uganda, the Ugandan Bureau of Statistics (Ugandan Demographic and Health Survey, 2011) report the median age of first marriage at 17.9 years, with this statistic being unchanged over 30 years. Regional differences in age of marriage are also evident in the survey, with 16.9 years in the north and 18.1 years in the west. Again there are differences between regions in Uganda in relation to age at first birth, with the median maternal age at first birth 17.9 years in the north and 18.8 years in western Uganda. In extrapolating the Ugandan survey data, with an earlier age of marriage in the north and an earlier age of maternal age at first birth in the north, if age of marriage and maternal age at first birth were indicators of VVF, then there should be a higher rate of VVF in the north of Uganda. However, the survey instead identified a rate of 2.3% of women in the north suffering with obstetric fistula compared to a much higher rate of 4% in the west who have experienced obstetric fistula (Ugandan Demographic and Health Survey, 2011). The results of this study undertaken in western Uganda concluded that the mean age at first delivery was not a risk factor for the development of OF.

This study does demonstrate that women with fistula are shorter than the average national height, however within a particular district this may be misleading. Certainly the mean heights for all our 4 groups were less than the national average, in particular the OF group and SVD group. In fact the OF group and the SVD group had nearly identical mean heights (OF mean height 152.2 cm and SVD mean height 152.5 cm). There is no clear explanation however, as to why the tears group was taller than all the other groups. This study also revealed no difference in the maternal age at first delivery between the fistula group and the combined vaginal delivery groups. These findings were in agreement with the data from the Ugandan Bureau of Statistics that demonstrated a younger age of first marriage and delivery in the northern district compared to the western district. However the western district had a higher fistula rate (Ugandan Demographic and Health Survey, 2011).

In conclusion, this study comparing women in western Uganda with obstetric fistula from obstructed labour with women having a spontaneous vaginal delivery, demonstrated that the maternal age at first delivery is not a risk factor for the development of obstetric fistula. Importantly all of the women in this study were from the same district and all groups were shorter than the national average height. The group of women with obstetric fistula were the same height as women with severe pelvic organ prolapse and women with a recent spontaneous vaginal delivery. However, the group of women presenting with unrepaired 4th degree perineal tears were taller than the other groups, but were still shorter than the national average. In this study a height of less than 150 cm was not a risk factor for development of obstetric fistula.

Table 4.1 Comparing the height of women in all 4 groups

Group (number of women)	Mean (SD) height cm
Obstetric fistula (n= 187)	152.2 (6.8)
Pelvic organ prolapse (n= 89)	154.2 (11.8)
4th degree tears (n= 82)	157.5 (8.1)
Vaginal delivery (n=165)	152.5 (9.3)

Figure 4.1 Boxplots of the height of women in the four groups

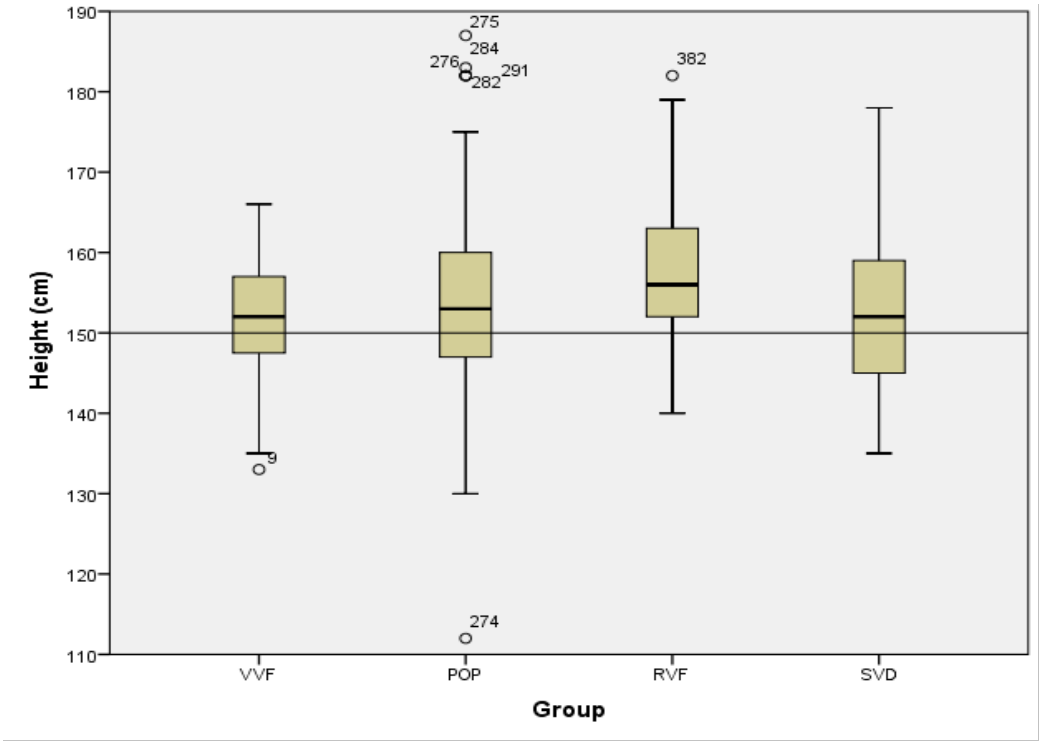

Table 4.2 Comparing height of women who had fistula (OF) and combined vaginal delivery group (severe pelvic organ prolapse + 4th degree perineal tear + spontaneous vaginal delivery).

Group (number of women)	Mean (SD) height cm
OF (n= 187)	152.2 (6.8)
Combined vaginal delivery (n= 336)	154.1 (9.9)

p-value (t-test, 2-sided) = 0.007

Table 4.3 Categorization of height using a cut-off of 150 cm

Group	Height <150 cm	Height ≥150 cm	Total
OF	57 (30.5%)	130 (69.5%)	187
Combined vaginal delivery	94 (28.0%)	242 (72.0%)	336
Total	151	372	523

Table 4.4. Age at first delivery of women in all 4 groups

Group (number of women)	Mean (SD) age of first delivery
OF (n= 152)	17.7 (2.3)
POP (n= 82)	17.3 (3.2)
Tear (n= 82)	17.9 (2.6)
SVD (n=87)	18.8 (2.7)

Obstetric fistula (OF); Pelvic organ prolapse (POP); 4th degree tear (tear); Spontaneous vaginal delivery (SVD)

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CHAPTER 5

PELVIC FLOOR IMAGING

- METHODS, RESULTS, DISCUSSION

5.1 NULLIPAROUS UGANDAN WOMEN

Published paper:

Shek KL, KrauseHG, Wong V, Goh J, Dietz HP. Is pelvic organ support different between young nulliparous African and Caucasian women? Ultrasound Obstet Gynecol 2016; 47: 774-778

Pelvic floor characteristics of women both pre- and post-childbirth have been studied in increasing detail with the introduction of 3D/4D ultrasound and MRI pelvic floor imaging over the last couple of decades. While there have been a number of studies published on the pelvic floor ultrasound characteristics of nulliparous Chinese and Caucasian women (Kruger et al., 2007, Dietz et al., 2005, Dietz et al., 2005, Yang et al., 2006), similar studies specifically on imaging the pelvic floor in African women are lacking.

In order to understand the pelvic floor injuries and dysfunction experienced by parous women, the normal nulliparous pelvic floor needs accurate evaluation. The occurrence of gynaecological injuries secondary to childbirth in the African population has been documented in the literature for many years. The injuries reported have usually been related to the occurrence of obstetric genital tract fistulae (Goh et al., 2008, Browning & Menber, 2008). In more recent times other gynaecological pathologies including pelvic organ prolapse and unrepaired anal sphincter tears have been studied (Krause et al., 2014).

This research aimed to describe the pelvic floor characteristics of nulliparous Ugandan women and compare these findings with data of nulliparous non-pregnant Caucasian women seen in the context of a previously published study. Once this baseline has been established, it may then be possible to evaluate the pelvic floor ultrasound

findings of Ugandan women with pelvic floor dysfunction including obstetric related sequelae.

METHODS

This study was undertaken with Ethics approval. During 2 fistula camps (April 2011 and July 2012) at the Kagando Hospital in western Uganda, healthy nulliparous non-pregnant volunteers were recruited for pelvic floor ultrasound scans. The volunteers were attending the local nursing school and were given information on the procedure prior to obtaining consent. There were no monetary incentives for the volunteers to participate in the study.

Data collected included age, significant past medical history, incontinence, height, weight and 4D transperineal ultrasound findings. All volunteers underwent a simple physician-administered questionnaire. Transperineal ultrasound was performed using GE Voluson-I system with RAB 4-8MHz transducer (GE Kretz Ultrasound, Zipf, Austria) and 3D/4D capabilities. All volunteers were assessed in the supine position after bladder empting, using the same methodology as the previously published studiy of Caucasian women used for comparison (Dietz et al., 2005). Volumes were acquired at rest, on maximum Valsalva and with pelvic floor muscle contraction (PFMC). A minimum of 3 ultrasound volumes on Valsalva were acquired, and the volume on maximum Valsalva (the volume demonstrating the most noticeable pelvic organ descent) was used for analysis of parameters on Valsalva (Dietz, 2004). Offline analysis of ultrasound volumes for hiatal dimensions, levator morphobiometry and pelvic organ descent were conducted at a later time, using proprietary software, 4D view Version 10.0 (GE Medical Ultrasound Kretz GmbH, Zipf, Austria).

Hiatal diameters and areas were measured at the plane of minimal hiatal dimension as defined in the mid-sagittal plane. This is evident as the minimal distance between the hyper-echogenic posterior aspect of the pubic symphysis and the hyper-echogenic anterior border of the levator ani muscle just posterior to the anorectal muscularis. This plane is defined as the mid-sagittal orthogonal plane. This plane then represents the exact cross-section of the volume in the axial plane for measurement of hiatal dimensions. Maximum levator muscle thickness and area were determined using

volume acquired at rest. This measurement is achieved by moving the plane of minimal hiatal dimensions cranially slowly until the plane of maximal thickness of the pubovisceral muscle is reached. In the axial view, the maximum diameters of the pubovisceral muscle in two locations bilaterally were measured and the muscle area was determined by tracing its outline (Dietz et al., 2005). Pelvic organ descent was measured on maximum Valsalva manoeuvre relative to the postero-inferior margin of the pubic bone in the midsagittal view as previously described (Dietz, 2004).

The archived ultrasound volume data of a previously published study on nulliparous non-pregnant Caucasians (Dietz et al., 2005) was assessed in the same manner as described above. Volume data was acquired using the same method as the current study except that imaging was not performed on PFMC in the earlier publication. This data was then compared to the measurements of the Ugandan group of women.

The statistical analysis was performed after normality testing using Kolmogorov – Smirnov testing, with the Minitab version 13 (Minitab Inc., State College, PA, USA). A Student's t-test was performed for continuous variables. Chi-square test analysis was performed for categorical variables. Pearson correlation to evaluate the correlation between hiatal areas and pelvic organ descent was utilised. When the P-value was <0.05, it was considered to be statistically significant.

RESULTS

A total of 76 Ugandan nulliparous women were recruited and included in this study. The mean age of the participants was 21.2 (range 17.2-36) years. The mean body mass index was 22.61 (range 16.4-30.3). None of the volunteers had any of any urinary incontinence. In addition, none of these women had a history of pelvic floor surgery or intervention for a pelvic floor disorder.

The archived datasets of 51 nulliparous Caucasian women reviewed in the context of the previously published study (Dietz et al., 2005) were identified. Of these, 2 were excluded from analysis because of missing volumes leaving 49 available for review. The demographic characteristics, measures of levator muscle bulk, hiatal dimensions and pelvic organ descent of the 2 groups Uganda and Caucasian women were compared in

Table 5.1.1. In the analysis of the nulliparous Caucasian women (Dietz et al., 2005) there were 7 with urinary symptoms. Exclusion of these women in the data analysis did not alter the results. All of the measures of hiatal dimensions and pelvic organ descent on Valsalva were significantly higher in the Ugandan group compared to the Caucasian group (all $p \leq 0.01$). However this was not the case between the 2 groups for measures of muscle bulk where muscle thickness and area were not significantly different. A significant correlation was found between hiatal area at rest and on Valsalva and also the pelvic organ descent in all 3 compartments (all $p<0.001$). There were no cases of levator muscle defects identified in this group of nulliparous Ugandan women nor in the Caucasian women.

DISCUSSION

This study has characterised the pelvic floor ultrasound biometric measures of non-pregnant nulliparous Ugandan women. While there are many similarities in measurements compared to non-pregnant nulliparous Caucasian women, some significant differences were identified.

The Ugandan group were found to have a significantly larger levator hiatus compared to the Caucasian group. In addition they have greater pelvic organ descent on Valsalva. Hiatal distensibility as determined by average hiatal area on Valsalva was found to be more than one standard deviation (23.15 vs 15.72 cm2) higher in the Ugandan women compared to the Caucasian women. Differences of a similar magnitude were found for pelvic organ mobility. This may imply a greater distensibility of the levator ani muscles and may also imply higher elasticity of the fascial support structures in the pelvis. This could imply genetic factors playing a role in pelvic organ support. Previous assessment of nulliparous Caucasian women demonstrated that bladder and urethral mobility was partly determined genetically (Dietz et al., 2005), however lifestyle and environmental factors may also be important.

In general there may be more likelihood of heavy lifting in the daily life of girls growing up in Uganda, especially in rural areas. Water and wood for household use are often carried over significant distances by children. The effect of such prolonged elevated intra-abdominal pressures on pelvic floor support during developmental years is

uncertain. Nutrition may also be a factor in areas where childhood nutrition is compromised. If lifestyle factors are important, it may be a relevant finding which may affect women worldwide if their pelvic floors are subjected to chronic strain, not just from heavy lifting for household or employment requirements, but also from recreational activities such as weight-lifting and gym workouts. Kruger et al (2007) did identify a larger hiatal area and greater bladder descent on Valsalva for elite Caucasian nulliparous athletes who undertake high impact sporting activities. In that group the mean diameter of the pubovisceral muscle was higher, which was not a finding of our study.

This assessment of Ugandan women is consistent with previous published data from Caucasian nulliparous women (Dietz et al., 2005) where significant correlations exist between hiatal area and pelvic organ descent. The levator ani anatomy and levator hiatal dimensions appear to contribute independently to pelvic organ support (Dietz et al., 2012).

In this study assessing nulliparous Ugandan women, there was no difference in the thickness of levator ani muscle compared to the levator thickness of Caucasian nulliparous women. In a study comparing the biometry of the pubovisceral muscle and levator hiatus of nulliparous Chinese women from Taiwan with nulliparous Caucasian women, the Chinese women had a significantly higher mean pubovisceral muscle thickness than did the Caucasian women (Yang et al., 2006). The Ugandan women assessed in this paper had a muscle thickness less than the Chinese women and similar to the Caucasian women (Yang et al., 2006). The relevance of this finding is uncertain. If pelvic organ mobility is lower in Chinese women (Dietz, 2003, Zacharin, 1977), one may postulate that the thicker pubovisceral muscle may be a contributor to pelvic organ support. However in the study by Kruger et al (2007) the group of women engaged in high impact sporting activities were found having higher mean diameter of the pubovisceral muscle but greater pelvic organ mobility as well, arguing against the above hypothesis. Other factors including differences in the bony pelvis (Chun et al., 1964) and connective tissue properties (Zacharin, 1977) in Chinese women may be important in these ethnic differences identified in pelvic organ support. Environmental and lifestyle factors may also be relevant to the thicker pubovisceral muscle in Chinese

women, with the observation that Chinese women spend more time squatting than Caucasian or Ugandan women. The action of squatting frequently may result in an increase in the thickness of the pubovisceral muscle.

The recent body of evidence with pelvic floor ultrasound scanning confirms that excessive distensibility (ballooning) of the levator hiatus is associated with pelvic organ prolapse (Dietz et al., 2008). With the finding of an increase in hiatal dimensions and pelvic organ descent in the nulliparous Ugandan women compared to nulliparous Caucasian women, comes the question whether this predisposes them to more or less pelvic organ prolapse following childbirth and child-birth related trauma. To date, data assessing incidence or prevalence of pelvic organ prolapse in many African populations including Uganda is limited. A community-based survey in West Africa (Scherf et al., 2002) did demonstrate a high prevalence of pelvic organ prolapse in the community. Further large epidemiological studies are needed to identify the prevalence of pelvic organ prolapse and the degree of symptoms encountered by African women of different ethnic origins, in order to compare prevalence with other ethnic groups including Caucasian and Asian women.

This current study adds to the literature by showing baseline biometric measures of nulliparous Ugandan women. Further pelvic floor ultrasound scanning on parous Ugandan women with gynaecological conditions related to childbirth such as obstetric fistula and prolapse may result in a more detailed understanding of these anatomical pathologies. The ultrasound methodology used in the current study has demonstrated good consistency in volume acquisition (Siafarikas et al., 2013) and good repeatability of ultrasound measures (Siafarikas et al., 2013, Chan et al., 2014, Van Veelen et al., 2013) and is a strength of the study.

Substantial differences between Caucasian and Ugandan non-pregnant nulliparous women were identified in this study comparing functional pelvic floor anatomy. The Ugandan cohort of non-pregnant nulliparous women was found to have larger hiatal dimensions and greater pelvic organ descent. There was no significant difference in levator ani muscle thickness and area between the 2 study populations. These findings

implies a greater distensilbility of the levator ani muscle and poosibly higher elasticity of the fascial support structures.

In conclusion, pelvic floor imaging and its interpretation have progressed exponentially in the last few decades. While a clear understanding of the asymptomatic nulliparous pelvic floor will allow comparisons with women suffering pelvic floor dysfunction following childbirth, it has become evident that there are differences in the normal pelvic floor dimensions depending on ethnicity. Thus in order to evaluate Ugandan women with pelvic floor dysfunction, an understanding of the nulliparous pelvic floor of Ugandan women is also necessary. These differences may result in a differing incidence and prevalence of the varying components of pelvic floor dysfunction in Ugandan women compared to Caucasian or Asian women.

Table 5.1.1

	Caucasian women (n=49)	**Ugandan women (n=76)**	**P value**
Age (years)	20.5 (1.5)	21.2 (3.7)	0.11
BMI	23.6 (3.9)	22.61 (3.0)	0.14
Anteroposterior hiatal diameter at rest (cm)	4.55 (0.69)	5.73 (0.73)	<0.001
Lateral hiatal diameter at rest (cm)	3.55 (0.45)	3.78 (0.55)	0.01
Anteroposterior hiatal diameter on Valsalva (cm)	4.81 (0.87)	6.53 (1.15)	<0.001
Lateral hiatal diameter on Valsalva (cm)	3.96 (0.60)	4.40 (0.75)	0.001
Hiatal area at rest (cm^2)	11.39 (2.46)	15.66 (3.27)	<0.001
Hiatal area on Valsalva (cm^2)	14.67 (5.69)	22.76 (7.72)	<0.001
Maximum muscle thickness at rest (mm)	7.86 (1.34)	6.34 (1.22)	0.25
Maximum muscle area at rest (cm^2)	6.50 (1.33)	7.02 (1.66)	0.05
Bladder neck descent (mm)	13.2 (10.8)	24.7 (8.7)	<0.001
Bladder descent (mm)	16.75 (9.45)	3.07 (9.1)	<0.001
Uterine descent (mm)	41.5 (11.5)	27.8 (20.4)	<0.001
Rectal descent (mm)	15(17.9)	-8.0 (12.5)	<0.001

Table 5.1.1: Demographic data and sonographic measures of functional pelvic floor anatomy. Values are mean (SD). Bladder neck descent is a measure of bladder neck mobility. Bladder/uterine/rectal descent indicates position of the respective organ relative to the symphysis pubis. A negative value signifies position below the symphysis

5.2 UGANDAN WOMEN WITH OBSTETRIC FISTULA, PELVIC ORGAN PROLAPSE, AND CHRONIC 4TH DEGREE OBSTETRIC TEARS

Submitted paper:

Krause HG, Wong V, Ng S, Tan GI, Goh JTW. Pelvic floor ultrasound findings in Ugandan women with obstetric fistula, unrepaired 4th degree obstetric tera, and pelvic organ prolapse. ANZJOG.

Obstructed labour is the most common cause of obstetric genital tract fistula world-wide. Obstetric fistula (OF) is a serious gynaecological condition affecting more than 2 million women globally (Wall, 2006). It is estimated that 2% of Ugandan women suffer from symptoms of this debilitating condition (Ugandan Demographic and Health Survey, 2011). The most common mode of delivery for women who suffer genital tract fistulae from obstructed labour is indicated as vaginal delivery in earlier literature (Tahzib, 1983, Kelly & Kwast, 1993, Hilton & Ward, 1998), however more recent surveys demonstrate high rates of caesarean section deliveries for these women who develop fistulae (Krause et al., 2014, Barageine et al., 2014, Loposso Nkumu et al., 2014). Despite their delivery by caesarean section, most women with OF deliver stillborn babies (Loposso Nkumu et al., 2014, Barageine et al., 2014, Goh et al., 2008).

In order to determine what pelvic floor anatomical injuries may occur in obstructed labour, in addition to pressure necrosis causing fistulas, the purpose of this study was to assess the pelvic floor of women suffering OF with 4D transperineal pelvic floor ultrasound scan. There are limited published pelvic floor ultrasound data to date comparing the pelvic floor injuries of parous women with and without OF in particular within the same population group having similar health care availability.

This study therefore aimed to determine whether obstructed labour resulting in OF causes more levator muscle defects compared to parous women without a history of obstructed labour. In the setting of surgical camps in Uganda where women with POP (pelvic organ prolapse) and unrepaired 4th degree perineal tears were also accessing treatment, these women who were parous and delivered vaginally without the development of OF were considered to be a suitable comparative group. In addition

the ultrasound assessment of the pelvic floor of women with POP and unrepaired 4th degree perineal tears was also likely to provide additional information on pelvic floor and levator morphobiometry to assist with understanding pelvic floor dysfunction in general.

METHODS

This study was a prospective study conducted in April 2011 and July 2012, during 2 fistula and prolapse camps in Kagando, western Uganda. Ethics committee approval for the study was received. Prior to undergoing surgery, all women with OF, stage 3 or 4 POPQ (Bump et al., 1996) POP and unrepaired 4th degree perineal tears were invited to participate in a pelvic floor ultrasound scan.

The past medical history and demographic information of the women were obtained. Routine data collected included age, parity, mode of deliveries, significant past medical history and presenting complaint. All women suffering with OF were graded using the Goh classification (Goh, 2004) which is routinely used at this location.

All patients who consented to the study, either with OF or without OF (either with POP or unrepaired 4th degree perineal tear) had a transperineal ultrasound scan performed prior to surgery using a GE Voluson-I system with RAB 4-8MHz transducer. The scan was performed with the patient in supine position. The ultrasound volumes were acquired at rest, on pelvic floor muscle contraction and on Valsalva. The levator hiatal areas were assessed according to methods previously described (Dietz et al., 2011). Levator muscle defects were diagnosed with tomographic ultrasound imaging (TUI) using the minimal diagnostic criteria (Dietz et al., 2011), in which case a complete levator defect was diagnosed if all three central slices showed an abnormal muscle insertion. Partial levator muscle defects were also documented. The term “complete levator muscle defect” used here is equivalent to “levator muscle avulsion” (one of the more original terms used to describe this defect of the levator muscle diagnosed on pelvic floor ultrasound scan). The term avulsion does imply an understanding of the mechanism of the trauma resulting in the defect, however the timing and factors causing the injury have not yet been confirmed.

The statistical analyses were performed using IBM SPSS-24 (IBM, Chicago, IL). One-way analysis of variance (ANOVA) was used to test comparisons of age, parity, and hiatal area on Valsalva between the three groups. When the overall difference between groups was significant, Tukey's post-hoc multiple comparison tests were adopted to identify specific differences between groups. Two-sample t-test was adopted to compare the difference in hiatal area on Valsalva between OF and non-OF groups. Assessment of the differences in proportion of levator muscle defects (various types) among the three groups, as well as between OF and non-OF groups was done using Pearson's chi-square test. A Mann-Whitney test was used to compare parity between women with any levator muscle defects and those without any defects. The results were considered to be statistically significant when $p<0.05$.

RESULTS

82 Ugandan women who underwent surgery for OF (43 women), POP (20 women), and unrepaired 4th degree perineal tear (19 women) were included in this study. Demographic characteristics between the groups were statistically different. The mean age of women with OF was 26.7 years (SD 7.3) (range 15-45), POP was 53.2 (SD 14.6) (range 20-80), and unrepaired 4th degree perineal tear was 32.5 (SD 12.6) (range19-66). The differences in ages were significantly different ($p<0.001$). The ages of women suffering with POP were significantly higher than those with OF and unrepaired 4th degree perineal tears ($p<0.001$). Of the 82 women, 81 women were parous. Only 1 woman was nulliparous and aged 20 with a grade 3 (POPQ) POP who underwent a sacrospinous hysteropexy. When comparing number of deliveries, there were significant differences in parity with the OF mean 3.4 deliveries (SD 2.5), POP 8.2 deliveries (SD 3.1) and unrepaired 4th degree perineal tears 4.2 deliveries (SD 2.8) with $p<0.001$. Compared to women with OF, women with POP had a significantly higher parity ($p<0.001$) and also women with POP had a significantly higher parity compared to unrepaired 4th degree perineal tears ($p<0.001$). See table 5.2.1.

High proportions of the women with OF had moderate to severe scarring (Goh classification)(Goh 2004), with 70% (28/40) documented as having moderate to severe scarring at time of surgery. A previous history of OF surgery was noted in 39.5% of women with OF (17/43), ranging from 1 to 4 previous attempts at closure.

In the OF group, the rate of caesarean section was 74.4% (32/43), with 71.4% (10/14) of the primiparous women with OF having a caesarean section. Only 7.9% (3/38) of the non-OF group had a caesarean section delivery.

These women were all assessed with pelvic floor ultrasound scan which identified that women with OF had a significantly higher proportion of any levator muscle defects (partial or complete) (66.7%) compared to the women with no OF (POP and unrepaired 4th degree perineal tears) (44.7%) with p=0.048. There was a significantly higher proportion of right-side levator muscle defects (57.1%) in women with OF compared to the non-OF group (34.2%) (p=0.040). No difference was observed between the OF and non-OF groups when assessing proportions of left-sided levator muscle defects. With assessment for complete levator muscle defects, there was no significant differences between the OF group (28.6%) or the non-OF group (23.7%) (p=0.620). See table 5.2.2.

The incidence of levator muscle defects in each of the 3 surgical groups individually (OF, POP and unrepaired 4th degree perineal tears) was calculated. There were no significant differences in proportions of any levator muscle defects (OF 66.7%, POP 36.8%, RVF 52.6%)(p=0.088) when comparing OF, POP and unrepaired 4th degree perineal tears. In addition, there were no significant differences between OF, POP and unrepaired 4th degree perineal tears in right-sided defects (p=0.075) or left-sided defects (p=0.105). When identifying complete levator muscle defects, there were no significant differences when comparing between the 3 groups (OF 28.6%, POP 21.1%, unrepaired 4th degree tear 26.3%) (p=0.826).

The hiatal areas on Valsalva were significantly different between the 3 surgical groups – OF mean 21.45 cm2 (SD 6.0 cm2); POP mean 33.63 cm2 (SD 10.6 cm2); unrepaired 4th degree perineal tear mean 27.24 cm2 (SD 6.9 cm2); with p<0.001 (ANOVA). The OF group had a significantly smaller hiatal area compared to the POP group (mean difference 12.18 cm2, 95% CI 7.2 to 17.2 cm2, p<0.001) and the unrepaired 4th degree perineal tear group (mean difference 5.79 cm2, 95% CI :0.8 to 10.8 cm2, p=0.019) on post-hoc tests. In addition, compared to the POP group, the unrepaired 4th degree perineal tear group had a significantly smaller hiatal area (mean difference 6.39 cm2,

95% CI 0.5 to 12.2 cm2, p=0.029).

Women with OF had a significantly smaller hiatal area on Valsalva (mean 21.45 cm2; SD 6.0 cm2) compared to the non-OF women overall (mean 30.44 cm2; SD 9.4 cm2)($p<0.001$). In the OF group there were 14 primiparous women and there were 2 primiparous women in the non-OF group. The primiparous women with OF all delivered stillborn babies.

Out of the 82 women, there were 13 women delivered by caesarean section only with no vaginal deliveries. Levator muscle defects were identified on ultrasound in 8 out of the 13 women with a history of caesarean section only (61.5%). Within the OF group where 14 women were primiparous, 10 had a caesarean section for obstructed labour and the remaining 4 delivered vaginally. Complete bilateral levator muscle defects were identified in 3 women out of the 10 primiparous women with OF who delivered by caesarean section. No significant differences were found in the proportions of any levator muscle defects between OF women with caesarean section only (61.5%) and those OF women having a vaginal delivery (69.0%) (p=0.637).

When comparing women with any levator muscle defects (median parity 4, IQR 4) with no defects (median parity 4.5, IQR 6), there were no differences in parity (p=0.431) (p=0.431).

DISCUSSION

The pelvic floor anatomical outcomes of women with obstructed labour resulting in OF, have been compared in this study to the findings of women without OF who have pelvic organ prolapse (POP) or unrepaired 4th degree perineal tears. The group of women with POP or unrepaired 4th degree perineal tears are all parous and have had at least one vaginal delivery with no occurrence of OF. It is however acknowledged that this group will not all have normal anatomy for comparison.

Obstructed labour is a well known cause of OF. It is therefore essential to have provision of the timely skilled use of caesarean section or instrumental delivery in order to reduce the occurrence of OF. Previously most publications describing OF have

documented very low rates of caesarean section in the women developing OF (Tahzib, 1983, Kelly and Kwast, 1993, Hilton and Ward, 1998). These rates of caesarean section in general have now increased with women accessing healthcare more frequently. The rates of caesarean section in women suffering OF are currently high reaching well over 50% (Krause et al., 2014, Holme et al., 2007). This study has highlighted this shift in practice, with this group of women who suffer with OF having a caesarian section rate of 74.4%. Stillbirth in over 70% of cases (Barageine et al., 2014, Holme et al., 2007) is still however the most frequent outcome for women with OF despite these extremely high rates of caesarean section. In addition, OF from pressure necrosis persists. Not only are livebirth rates not improved by the provision of caesarean section in women developing OF, bladder and ureteric injury secondary to the surgery itself is now frequently seen (Barageine et al., 2014), adding to the burden of OF. The reasons that these complications continue to occur is that the majority of these caesarean sections are performed in a time-frame where pressure necrosis has already occurred prior to the caesarean section and where the training and experience of many of the caesarean section providers is limited. In addition, the bladder and ureters are vulnerable to injury during the emergency caesarean section performed for prolonged obstructed labour. Such caesarean sections can be the most challenging to perform, and often the most junior doctors or medical students are the service-providers in these instances. Therefore the availability and access of women to obstetric care, the training of health care providers in management of labour and delivery, and the skilling of surgeons who are performing caesarean sections, are all necessary components in order to reduce rates of OF.

This study has identified significant differences in levator muscle trauma in parous women with and without OF. An overall rate of 56.3% for levator muscle defects in this cohort was found, with partial or complete levator muscle defects a finding in 66.7% of the women with OF and in 44.7% of the women with non-OF. There was no significant difference in the rates of complete levator muscle defects between OF and non-OF women– OF 28.6% and non-OF 23.7 A previous study assessing women in Ethiopia described OF patients having a rate of complete levator defects of 28% (Dietz et al., 2012). The findings in this study of complete levator muscle defects in women with OF of 28.6% are consistent with the previous published literature. When assessing the

rate of complete levator muscle defects in parous women without OF delivered vaginally, the rate of complete levator muscle defects is commonly thought to be 20% (DeLancey et al., 2003). Other studies however have identified rates of complete levator muscle defects from 2-36% (Turel et al., 2017, Dietz & Lanzarone, 2005).

There were 10 primiparous women who delivered by cesarean section for obstructed labour, and among them there were 3 women with bilateral complete levator muscle defects. It is uncommon for complete levator muscle defects to occur following cesarean sections even in women who labored (Chan et al., 2012, Shek & Dietz, 2010), according to current literature. Therefore this was an unexpected finding. However there have been previous descriptions of levator muscle defects following emergency caesarean section (Albrich et al., 2012). It is therefore likely that the significant obstructed labour which results in pressure necrosis OF also causes significant levator muscle trauma.

When studying women with POP, there is a documented association of complete levator muscle defects with POP (Dietz et al., 2012). Despite this not all women symptomatic of prolapse have evidence of levator muscle defects. Other risk factors may therefore be important including hiatal enlargement (Dietz et al., 2012, Dietz et al., 2008) and possible environmental and genetic factors. In this study the complete levator muscle defect rate in women with stage 3 and 4 (POPQ) POP was 21.1%. The combined rate of partial or complete levator muscle defects was 36.8%. There are clearly therefore other factors important in the development of POP as the majority of the women had intact levator muscles. Another interesting finding was the women with OF demonstrated an equally high rate of complete levator muscle defects (28.6%), however none of the women with OF had any POP >stage 1 (POPQ).

Women with POP and unrepaired 4th degree perineal tear more commonly had an increased hiatal area on Valsalva compared to women with OF. Previously it has been documented that a widened hiatal area is commonly found in women who have had vaginal deliveries (Sanozidis et al., 2018). A number of studies have described an association with hiatal area and levator muscle defects (Otcenasek et al., 2007) and also an increase in risk of POP in association with enlarged hiatal areas (Dietz et al.,

2008). It has also been found that pregnancy itself is a risk factor for hiatal enlargement. Significant enlargement of the levator hiatus in pregnant nulliparous women has been found compared to non-pregnant nulliparous women (Dietz et al., 2005). Here this study found that the Valsalva hiatal area of women with OF (mean 21.45cm^2) was similar to a previous study assessing the pelvic floor of nulliparous Ugandan women (22.76cm^2) (Shek et al., 2016). In this group of parous women with OF, the hiatal areas were not enlarged despite the occurrence of levator muscle defects. This was again an unexpected finding as it is in contrast to the non-OF parous women assessed here with POP and unrepaired 4th degree perineal tears with a finding of larger hiatal areas. There are a number of possible explanations for the smaller hiatal areas of the OF women. It may be due to a reduced number of vaginal deliveries (mean parity 3.4) in the OF group compared to the non-OF group (mean parity 6.2) in this study. Chan et al (2018) demonstrated that hiatal area increases with increasing number of deliveries. In addition, obstructed labour resulting in pressure necrosis increases the risk of vaginal scarring in women with OF, and also previous surgical attempts at fistula closure increase vaginal scarring, and these factors may also restrict hiatal enlargement. Certainly in this cohort of women with OF, most of the women had significant vaginal scarring and many had a history of previous unsuccessful OF surgery.

There are limitations of this study which includes the non-uniformity of the non-OF group. Despite this, the non-OF group (incorporating women with POP and unrepaired 4th degree perineal tears) are all parous, have all been delivered by spontaneous vaginal delivery, and have not developed a fistula. A further valuable comparison for women with OF would be to assess parous Ugandan women with no current pelvic floor concerns.

The pelvic floor ultrasound scan findings of Ugandan women suffering with OF, POP and unrepaired 4th degree perineal tears have been described in this study. Out of a total of 82 women there were over 43% of the women having had 1 or more caesarean sections. This included 71.4% of the primiparous women with OF. These numbers indicate a significant shift in current practices with extremely high rates of caesarean sections observed. However even with such a high rate of caesarean sections, all of the

primiparous women with OF delivered a stillborn baby. Levator muscle defects were very common with overall 66.7% of the women with OF having partial or complete levator muscle defects. This included a rate of 28.6% of women with OF with complete levator muscle defects. There were 3 primiparous women who were delivered by caesarean section also diagnosed with complete levator muscle defects. The cause and timing of levator muscle injuries may need to be reassessed in cases of prolonged obstructed labour resulting in OF, as clearly in the cases of caesarean section delivery, the levator muscle trauma is not caused with the actual delivery of the head as previously conjectured. Hiatal area is commonly enlarged following vaginal deliveries. However this study has identified significantly smaller hiatal areas in women with OF, compared to non-OF, whereby 73.2% of women with OF (all of whom had experienced a prolonged obstructed labour) had a normal hiatal area (<25cm^2). Factors which may limit such hiatal enlargement includes scarring occurring secondary to pressure necrosis.

Ugandan women suffering with OF, POP, and unrepaired 4th degree tears are subject to significant pelvic floor injuries which are evident on pelvic floor ultrasound scanning. This study highlights the pelvic floor injuries which are not clinically evident.

Table 5.2.1 Demographics

	OF (N=43) Mean (SD)	Non-OF (N=37) Mean (SD)	*p-value*
Age at presentation	26.7 (7.3)	42.6 (17.0)	p<0.001
Parity	3.4 (2.5)	6.2 (3.6)	p<0.001

Table 5.2.2 Ultrasound findings

	OF (N=43)	Non- OF (N=39)	*p-value*
Any levator muscle defect (N)	28	17	p=0.048
Complete levator muscle defect (N)	12	9	p=0.620
Hiatal area on Valsalva mean cm2 (SD)	21.45 (6.0)	30.44 (9.4)	p<0.001

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CHAPTER 6

SOCIAL SEQUELAE, MENTAL HEALTH DYSFUNCTION AND RISK OF DOMESTIC VIOLENCE

- METHODS, RESULTS AND DISCUSSION

6.1 SOCIAL SEQUELAE

Published paper:

Krause HG, Natukunda H, Singasi I, Hicks SSW, Goh JTW. Treatment-seeking behaviour and social status of women with pelvic organ prolapse, 4th degree obstetric tears and obstetric fistula in western Uganda. Int Urogynecol J 2014; 25:1555–1559

To evaluate the social sequelae of pelvic floor injury and dysfunction in low-income environment such western Uganda, this study was designed to look at a trilogy of women's health issues including severe pelvic organ prolapse, unrepaired 4th degree perineal tears and obstetric fistula, all of which can cause significant suffering in the life of women and their families.

This study aimed to obtain an understanding of women's perception of the cause of their pelvic organ prolapse, 4th degree perineal tear or obstetric fistula, and subsequent acceptance by their families. It also explores the reasons why women may not have sought previous treatment, and what treatment is available.

This is the first study to look at these issues in women with pelvic organ prolapse and unrepaired 4th degree perineal tears in a developing country.

METHODS

The following study to assess the social sequelae of pelvic floor injury and dysfunction has received Ethics committee approval. A total of 150 women underwent surgery for pelvic organ prolapse, genital tract fistula or repair of unrepaired 4th degree perineal tear at 3 separate camps at the Kagando Hospital, western Uganda between April 2011 and July 2012. Women were notified of the availability of assessment and surgery via

radio announcements in local languages. All surgery including the cost of transportation, medications, investigations, hospital stay and food, was free of charge to the patient.

All women were invited to participate in the study of which 150 women agreed. These women agreed to answer a survey following surgery, during their inpatient post-operative period. One of 2 nurses experienced in fistula care questioned the women in their local language and documented the responses in English. The survey (Table 6.1.1) focused on the women's perception of what caused their condition, and the subsequent impact on their social situation and sexual activity. Women were also asked whether they had sought previous treatment. Demographics on the women were also obtained.

RESULTS

Of the 150 women, 69 women were diagnosed with genito-urinary fistula, 25 with faecal incontinence only (including 24 with unrepaired 4th degree perineal tear) and 56 women with pelvic organ prolapse.

Obstetric fistula

69 women underwent surgery for repair of genito-urinary fistula (VVF), with 4 of these women having a concomitant rectovaginal fistula (RVF). The average age of these women at presentation was 26.9 years (16-45, median 28). 2 of the women did not recall their age at first delivery, however out of the remaining 67 women, the average age at first delivery was 17.1 years (13-25, median 16). The stated age is often inaccurate as many women are not aware of their birth date. Instead they use life events as a guide to their estimated age.

The average number of deliveries for each woman was 3.4 (1-10, median 2), with the number of live births 1.6 (1-8, median 1). 44 (64%) women had a caesarean section (including 2 who underwent a caesarean hysterectomy), and 25 (36%) had vaginal deliveries (including 1 vacuum delivery). The mean duration of their VVF was 13.3 months (1-144, median 3).

The VVF were classified intra-operatively (Table 6.1.2) using the Goh classification (Goh, 2004). This classification system has been shown to demonstrate a better ability to predict successful fistula closure compared to another commonly used classification system (Capes et al., 2012). The fistula classification type and mode of delivery are included in Table 6.1.3. 7 were circumferential fistulas. One woman had a ureteric fistula requiring reimplantation. Of those women delivered vaginally, 4 had circumferential VVF and 1 had a vacuum extraction. A circumferential fistula is one where there is transection of the urethra or complete dislocation of the distal urethral portion from the proximal part.

Vaginal closure of the VVF was possible in 66 (96%) of the women, with 1 closure abandoned due lack of bladder tissue. 2 of these women had vaginal reimplantation of the ureter during fistula repair. Another 2 women required an abdominal procedure for closure of their fistula, including 1 requiring an abdominal ureteric reimplantation. Most of the women (90%) identified labour/childbirth as the cause of their VVF, with 6 believing their caesarean section caused the VVF, and 1 woman not knowing the cause of her VVF.

36 (52%) of the women remained supported by their husband, while 29 (42%) had been rejected by their husband. Of those whose husband no longer accepted them, 10 had been divorced and 4 of them had husbands who had taken another wife. 4 women had no partner at the time of her delivery. Of the 69 women, 32 (46%) were sexually active despite their VVF, and 37 (54%) were not sexually active.

29 women (42%) stated that they had received previous treatment for their VVF with 21 (30%) having a documented history of previous unsuccessful fistula surgery. Of the 40 women who had not had previous treatment, 11 (16%) women were seeking treatment when they heard the radio announcement and therefore attended the hospital. 10 (15%) women had sought treatment at other health care facilities however were told there was no treatment available. 7 (10%) women identified lack of money as the reason they could not access treatment, and 7 (10%) were unaware of any treatment being available. 3 women stated they lived in very remote areas and therefore could not access health care, and 2 women had been scared to travel.

Unrepaired 4th degree perineal tears

25 women presented with faecal incontinence only which included 1 woman with a low isolated RVF, and 24 women with unrepaired 4th degree perineal tears. Of the women with 4th degree perineal tears only, the mean age at presentation was 30 years (19-66, median 29), and the mean age at first delivery was 17.7 years (14-23, median 18). The average number of deliveries was 3.6 (1-12, median 3), with a mean of 3.3 (1-10, median 3) live births. All were delivered vaginally.

The average time interval from 4th degree perineal tear to presentation was 25.5 months (1-372, median 4). 21 (88%) women identified the labour as causing the faecal incontinence, while 2 women said they were cut by the traditional birth attendant and 1 woman did not know what caused her condition.

18 women (75%) said their husband accepted their condition. 3 women had been divorced by their husbands due to the condition, while 2 had not told their husband of their problem. 1 woman was single (Table 6.1.4). 17 of the 24 women (71%) were currently sexually active.

20 (83%) of the women had not received any previous treatment for their 4th degree perineal tear. 7 (29%) had been told by their health care facility that there was no treatment available. 5 (21%) could not afford treatment, 2 were unaware that any treatment was available, 1 woman was too scared to seek treatment, 1 was afraid to tell her husband and 1 woman was in a remote location. 3 of the women had recent injuries.

Pelvic organ prolapse

56 women were treated surgically for pelvic organ prolapse. The average age at presentation was 55.9 years (20-100, median 53). As mentioned previously, many women do not know their correct age. 31 (55%) women had stage 3 pelvic organ prolapse (POPQ) (Bump et al., 1996), 25 (45%) had stage 4 pelvic organ prolapse, and 1 woman had a concomitant unrepaired 4th degree tear. A 20 year old woman was nulliparous with a stage 3 uterine prolapse. The average parity of the 56 women was

7.9 (0-19, median 8), with the average number of live children 4.7 (0-12, median 5). The majority of women were delivered vaginally, with only 2 women having at least 1 caesarean section. 1 woman (para 9) had 1 caesarean section, and 1 woman (para 10) had 2 caesarean sections.

The average time that women had been symptomatic of pelvic organ prolapse was 13.4 years (1-50, median 10) however 1 woman did not know how long she had had the condition.

While 16 (29%) women did not know what might have caused their condition, 22 (39%) women thought that their labour and childbirth was the cause, and 11 (20%) women blamed digging and heavy work for their pelvic organ prolapse. 1 woman thought it was due to her advanced age. Other reasons included intestinal worms, HIV or STD's, a train accident, or an illness in their uterus.

Of the 56 women with prolapse, the nulliparous woman was not married and 16 (29%) of the women were widowed. 14 of the remaining 39 women with pelvic organ prolapse stated that their husband did not accept their condition. This included 9 women who said they were divorced due to their prolapse. The other 25 women said that their husbands did accept them (Table 6.1.4). 20 (36%) of the women remained sexually active. Of the 29 women who were not sexually active, only 5 said that was due to the prolapse and another 2 said their husbands were impotent.

36 (64%) of the women had sought prior treatment for their pelvic organ prolapse. Only 6 of these had undergone previous surgery elsewhere. 18 women had used local herbs (traditional healer) and 1 had sought assistance from witchcraft. 8 had been dispensed tablets at a health care facility for treatment of the prolapse, and 2 had been told they had cancer and were prescribed some form of cancer treatment for their pelvic organ prolapse. 7 women had sought help at a health care facility and were told there was no treatment available, and 6 of these women subsequently used local herbs. Of the 20 women (36%) who had not previously sought treatment, 10 had been unaware of any treatment options, 7 could not afford any treatment, and 3 were from very remote areas.

DISCUSSION

The results of this survey have provided new awareness of the perceptions of women suffering from pelvic organ prolapse, obstetric fistula, and unrepaired 4th degree perineal tears. It also provides additional information on demographics and types or grades of obstetric fistula and pelvic organ prolapse on women presenting to the Kagando hospital, Uganda.

All groups of women were exposed to abandonment by their families due to their conditions. 42% of women suffering with obstetric fistula were not accepted by their husband. This is consistent with another Ugandan study identifying over 52% of women with obstetric fistula being divorced from their husband (Bangser et al., 2011). In Nigeria, over 73% of women were divorced after acquiring their fistula (Melah et al., 2007). In contrast, in a long term follow up of women following fistula repair in rural western Ethiopia, only 5% were divorced while suffering from fistula (Nielsen et al., 2009). Over 20% of women with unrepaired 4th degree perineal tears were not accepted by their husbands, and 25% of women with severe pelvic organ prolapse were also rejected by their husbands. Thus women suffering from unrepaired 4th degree perineal tear and severe pelvic organ prolapse are exposed to significant social stresses with the loss of their family cohesion which they attribute to their obstetric injury or prolapse.

All of the women interviewed desired a curative treatment, and most attempted to seek help within the confines of their finances and available options. Of the women suffering with prolapse, 64% had received ineffective treatments from either health care facilities, traditional healers or through witchcraft. In addition, from their experience, many were unaware of any treatments being available or could not afford what treatment was available. While many of the women suffering with prolapse did use local herbs from their traditional healer with no effect, there are cases documented where the insertion of caustic herb suppositories into the vagina cause fistulae (Tahzib, 1983).

An alarming number of women did seek help from a health care facility but did not receive appropriate care. Some were even told they had cancer, and some others were told there was no cure. It is therefore clear that if the suffering of women from pelvic organ prolapse is to be reduced, education on multiple levels, especially for health care workers, is required.

42% of the women with VVF had a history of a previous attempt at surgical repair, and were therefore more familiar with the available treatment options. The women who had not had previous surgery were often unaware of any treatment option or unable to afford treatment. Nearly 16% were actively seeking treatment when they heard the radio announcement.

Most of the women (over 89%) knew that their labour and childbirth was responsible for their fistula. In a Nigerian study (Hassan & Ekele, 2009) only 70% of the women correctly attributed their fistula to the prolonged labour. Around 9% of women in our study also thought that the treatment (caesarean section) for the delivery of the baby caused the fistula. In contrast, Bangser et al (2011) identified 84% of women perceived that their fistula was caused by their health care providers. In agreement with Kazaura et al (2011) comments, widespread community education is required regarding pregnancy and childbirth or else the women will not seek assistance from a hospital in future.

This study also exposed a large group of women who have unrepaired 4th degree perineal tears and subsequent faecal incontinence. This is a group of women not previously studied, and who also suffer significantly with rejection by their husband (over 20%) and the social stigmas of faecal incontinence. Most of these women were either told by their health care facility that no treatment was available, they were unaware of the availability of treatment or they were unable to afford treatment. With an incidence of overt obstetric anal sphincter injury in the literature of 1.7% (Harkin et al., 2003), and limited access to health care, it can be expected that there is an enormous volume of women suffering with unrepaired 4th degree perineal tears, in such areas where health systems are unable to meet its reproductive and women's health needs.

Compared to other areas where caesarean section rates only reach 18% (Goh et al., 2008), the caesarean section rate in this study was very high (around 64%) in the group of women with VVF. In this study, all of the women with VVF and a history of caesarean section had evidence of obstructed labour as the cause for their fistula. Personal communications with obstetric practitioners in the region including eastern Congo identified the lack of use of instrumental deliveries. In other words, the woman had to either push the baby out unassisted or the delivery was by caesarean section. This obviously results in some very difficult caesarean sections with the foetal presenting part well down in the maternal pelvis. The difficult caesarean sections may result in further maternal injuries and delay in the delivery of the baby. Training in obstetric instrumental deliveries is vital in these areas.

Many health care facilities in Uganda are staffed by doctors without specialty training in obstetrics and gynaecology. The management of high risk and complex labours, difficult caesarean sections, and repair of obstetric anal sphincter injuries, is often the responsibility of junior doctors with no supervising specialist available. While assisted vaginal deliveries are very common accounting for 12% of births (Department of Health, 2005) in countries with excellent maternal health systems and low maternal and perinatal morbidity and mortality rates, the use of instruments to expediate delivery are not available in many other regions. There is a great need for further training of local doctors in the management of labour and obstetric skills. This plea of course echoes the recommendations of many other health care professionals who advocate prevention and subsequent acute management of obstetric-related pelvic floor injury (Norman et al., 2007).

The cost of surgery is usually in excess of what is affordable in regions of subsistence living and significant poverty. External sources of funding are often needed to allow these women to gain access to these treatment options.

The main limitation of this study is the lack of available validated questionnaires in the many local languages that are spoken in regions such as western Uganda. The questions used in this survey were designed to be as clear as possible.

This study confirms the social stigma in OF women in western Uganda. It also highlights the social stigma in women suffering from severe POP and unrepaired 4th degree perineal tears.

Women suffering with OF, POP and unrepaired 4th degree perineal tears were exposed to abandonment by their partner and were unable to access effective treatment for their conditions. Many with OF had previous failed surgical attempts to close their fistula. Lack of finances also prevented many women from obtaining any relief from their symptoms. A high rate of caesarean section (64%) in the OF group highlighted deficiencies in obstetric care provision and training of health professionals, as the timing and delivery of the caesarean sections did not prevent the occurrence of their fistulas. In addition, the low rate of instrumental deliveries in the region likely contributes to prolonged 2nd stage of labour increasing risk of development of OF.

Table 6.1.1

Table 1: Questionnaire

1. How many babies have you had?
2. How many are alive?
3. How old were you when you had the first baby?
4. Delivery method – vaginal delivery: caesarean section:
5. How long have you had this condition?
6. What do you think caused your condition?
7. Does your husband accept this condition?
8. Have you been sexually active since having this condition?
9. Have you ever had treatment for this condition? Yes / No
   If "yes" please provide details of previous treatment

   If "No" please provide reason

Table 6.1.2 Classification of genito-urinary fistula Type (Goh 2004)

Fistula Type	Description
Type 1	Distal edge of fistula > 3.5 cm from external urinary meatus
Type 2	Distal edge of fistula 2.5 – 3.5 cm from external urinary meatus
Type 3	Distal edge of fistula 1.5 - < 2.5 cm from external urinary meatus
Type 4	Distal edge of fistula < 1.5 cm from external urinary meatus

Table 6.1.3 Mode of delivery and fistula classification type (Goh 2004)

Fistula Type	Cesarean section (n = 43)	Vaginal delivery (n = 25)
Type 1	13	6
Type 2	13	9
Type 3	12	8
Type 4	5*	2 (including vacuum)

* Excluding 1 woman with a ureteric fistula

Table 6.1.4 Acceptance of condition by husbands in the different groups of women *

Husbands	VVF (n=69)	4th degree tear Only (n = 24)	Prolapse (n = 56)
Accept	36 (52%)	18 (75%)	25 (44%)
Reject	29 (42)	5 (21%)	14 (25%)
No husband	4 (6%)	1 (4%)	1 (2%)
Died	0 (0%)	0 (0%)	16 (29%)

* 1 woman with isolated RVF only: not accepted by husband

6.2 MENTAL HEALTH

Published paper:

Krause HG, Hall BA, Ng SK, Natukunda H, Singasi I, Goh JTW. Mental health screening in women with severe pelvic organ prolapse, chronic 4th-degree obstetric tear and genital tract fistula in Western Uganda. Int Urogynecol J 2017;28: 893-897

The aim of this component of research was to use the General Health Questionnaire-28 (GHQ-28) to screen women in western Uganda with severe pelvic organ prolapse, unrepaired 4thdegree perineal tear and obstetric fistula for risk of mental health dysfunction.

METHODS

Women in western Uganda presenting to Kagando hospital, Kagando and St Pauls health centre, Kasese with severe pelvic organ prolapse (POP), chronic 4thdegree perineal tear and obstetric fistula (OF) requiring surgery were invited to participate in this prospective observational study to assess their mental health risks (October 2015). These women live in rural communities in the Rwenzori foothills and surrounds. The controls for the questionnaires were other women attending the Kagando hospital for any reason who were not patients. This study received Ethics committee approval.

The screening tool used was the General Health Questionnaire-28 which is a shortened and validated version of the General Health Questionnaire (Goldberg & Hillier, 1979, Ustun & Sartoria, 1995). The GHQ-28 has been used in numerous countries worldwide (McDowell & Newell, 1996). It consists of a total of 28 questions, with 7 questions in each of 4 domains. The 4 domains are somatic symptoms, anxiety and insomnia, social dysfunction and severe depression.

In view of the high illiteracy rate, the questionnaires were administered by a nurse in each location. The questions were translated by the nurse into the local language and the responses documented. Women with a total score of 5 or more (out of possible score of 0-28) demonstrate positive screening for mental health dysfunction.

RESULTS

A total of 125 women completed the GHQ-28 questionnaire, including 22 women with severe POP, 47 women with unrepaired 4thdegree perineal tear, 21 women with OF and 35 women who were controls. The ages of the women with severe POP, unrepaired 4th degree perineal tear and OF did differ significantly. The mean age for the severe POP group was 52.27 years (SD 13.86) (median 50) which was significantly higher compared to the women with unrepaired 4th degree perineal tear who had a mean age of 33.70 years (SD 13.43) (median 32), and women with OF whose mean age was 32.48 years (SD12.27) (median 30).

The GHQ-28 in these women with serious gynaecological issues identified a positive screening test (score of 5 or more) in 100% (22 out of 22 women) of women with severe POP, 97.9% (46 out of 47 women) of women with unrepaired 4th degree perineal tear, and in 95.2% (20 out of 21 women) of women with OF. There was no significant difference in these scores between these 3 groups. Of the controls, 40% (14 out of 35 women) screened positive, with the control group scoring significantly lower compared to the 3 groups with serious gynaecological issues (see table 6.2.1). The mean and median scores are shown in table 6.2.2.

When comparing the scores within each of the 4 domains, the controls did have a significantly lower mean and median score compared to the other 3 groups of women with severe POP, unrepaired 4th degree perineal tear and OF. In the domains assessing somatic symptoms and anxiety/insomnia, there was no statistically significant difference in mean or median scores between the women with severe POP, unrepaired 4th degree perineal tear and OF. In the domain assessing social dysfunction, again there was no significant difference in mean scores between the 3 groups, however there was a difference in the median scores with the severe pelvic organ prolapse group having a lower but still significant score.

The 4th domain assesses for symptoms of severe depression. These questions include whether the women had “thought of the possibility of killing yourself” and “found that the idea of taking your own life kept coming into your mind”. In this domain there were significant differences between the 3 groups with severe gynaecological issues,

with the women with unrepaired 4th degree perineal tear and OF scoring higher than women with severe POP. The mean score out of a possible maximum score of 7 in this domain for women with severe POP was 2.41 (SD 2.87) (median 0.5) compared to 4.13 (SD2.58) (median 4) for women with unrepaired 4th degree perineal tear and 4.52 (SD2.91) (median 7) for women with OF (see table 6.2.3).

DISCUSSION

While previously published papers have documented the significantly high rates of positive screening for mental health dysfunction in women with genital tract fistula (Goh et al., 2005, Weston, 2011, Wilson, 2015), this is the first paper to document equally high rates of positive screening for mental health dysfunction in women suffering with unrepaired 4th degree perineal tears in a resource poor country. Severe POP has also been identified as putting women at a high risk for mental health dysfunction in a country where resources available for health care are limited.

Goh et al (2005) first used the GHQ-28 in Bangladesh and Ethiopia to screen women with OF for mental health dysfunction. 97% of these women with OF screened positive compared to 32% of the controls. Subsequently Weston et al (2011) used the Patient Health Questionnaire-9 to screen for depression among women with OF in Kenya and identified 72.9% of that population suffering depression. In Tanzania (Wilson et al., 2015) high levels of psychological distress was also identified in obstetric fistula patients, with the OF patients reporting significantly more severe psychological distress than other gynaecology outpatients.

This survey using the GHQ-28 reported a baseline rate of screening positive for mental health dysfunction of 40% in controls. It is estimated that between 24-40% of women who screen positive for mental health dysfunction will have major depression (US Preventative Services Task Force, 2002). Thus this study indicates a prevalence of major depression of between 9.6- 16% in controls. Other surveys (Goh et al., 2005) have estimated the prevalence of major depression in their control population to be 8-13%. In Western populations clinically diagnosed major depression occurs in up to 10% of adults (US Preventative Task Force, 2002). The women presenting with severe POP, unrepaired 4th degree perineal tear and OF almost all (95.2-100%) screened positive

for risk of mental health dysfunction and therefore the presumed prevalence of major depression in these women with serious gynaecological issues could be up to 40%.

A potential limitation of this study is that the controls were visitors to the hospital (not necessarily relatives) and were not current inpatients of the hospital. It is possible that being an inpatient for any reason may increase the risk of mental health dysfunction. Therefore a control group of gynaecological inpatients with a different condition may exclude that potential confounder. However in this setting there were no other elective gynaecological admissions and therefore such a control group was not possible. In addition, repeating the questionnaire several months later in this setting was not possible due to issues such as Ebola outbreaks, personal safety and financial constraints limiting patient movements in this area of western Uganda.

Case identification of mental health dysfunction is the first step in providing a service to assist women whose physical injury or illness is complicated by mental health issues. With the publication of findings of high rates of mental health dysfunction in women with OF in recent years, targeted mental health interventions are being developed and trialled (Watt et al., 2015). Such interventions have been based on theories of cognitive behavioural therapy and coping models (Watt et al., 2015).

Worldwide, pelvic floor dysfunction in general is very common, and the symptoms experienced can negatively affect women socially, psychologically, sexually and physically (Rogers et al., 2001, Lowder et al., 2011). The association between depression and urinary incontinence is well supported in the literature (Nyaard et al., 2003, Zorn et al., 1999, Melville et al., 2005). There is however much less documented regarding the association of depression with POP. Ghetti et al (2015) aimed to qualitatively describe the emotional burden experienced by women seeking treatment for prolapse. Prolapse was identified as significantly impacting women's emotional health and subjective well-being. In low income and resource-poor settings where effective care is unavailable, the burden of severe POP may be even more marked. Zeleke et al (2013) in Ethiopia did identify 67.7% of their cohort with advanced POP as having symptoms of depression according to the Beck's Depression Inventory. Krause et al (2014) did identify a high rate of social stigma and isolation faced by women with

POP in western Uganda. Therefore there is an urgent need to provide treatment options for these women.

The incidence of anal sphincter injuries (3rd-and 4th-degree tears) in the literature are often quoted together. Fourth-degree tears include injury to the perineum with disruption of the anal sphincter complex and extension to the anal epithelium. The rates of 4th degree tears vary between 0.03-0.2% of all vaginal deliveries (Groutz et al., 2011, Kumar, 2012, Lindqvist & Jernetz, 2010, Ramalingam & Monga, 2013). Timely repair of these tears are the usual standard in countries with adequate resources available for health care. In resource-poor countries women do not have access to health care that would allow for the post-partum repair of their 4th degree perineal tear. Therefore the numbers of women living with this injury must be enormous and yet has been poorly acknowledged in the world literature. A recent publication (Krause et al., 2014) did highlight the presence of women with unrepaired 4th degree perineal tears in western Uganda and documented the social isolation and loss of family cohesion that they face.

This paper has identified a significant risk of mental health dysfunction associated with this trilogy of women's health issues including severe POP, unrepaired 4th degree perineal tear and OF. While OF has received some attention in recent times with funding available in many low income and resource-poor areas for surgical camps, ongoing attention is needed to assist these women with concurrent mental ill-health. Severe POP and unrepaired 4th degree perineal tears in areas of low income and lacking resources have now also been identified as resulting in a high risk of mental health dysfunction. New strategies need to be developed in order to provide appropriate management options for these women. Time must be invested into the up-skilling of local medical staff to identify and effectively treat obstetric anal sphincter injuries and severe POP.

The significance of the high rates of risk of mental health dysfunction suffered by women with severe POP, unrepaired 4th degree perineal tears and OF must be acknowledged, and treatment strategies to support mental health should be incorporated to provide comprehensive and effective management programs.

Table 6.2.1 GHQ-28: positive screening for mental health dysfunction

Group (number of women)	Number (%) of women at risk of mental health dysfunction
VVF (n= 21)	20 (95.2%)
RVF (n= 47)	46 (97.9%)
POP (n= 22)	22 (100%)
Control (n=35)	14 (40%)

p-value (chi-square test, overall) < 0.001

p-value (chi-square test, among the disease groups) = 0.57 (non-significant)

Table 6.2.2 GHQ-28: mean and median scores for positive screening

Group (number of women)	Mean (std. deviation)	Median (interquartile range; range)
VVF (n= 21)	20.52 (7.35)	22 (8; 26)
RVF (n= 47)	19.94 (6.16)	21 (8; 26)
POP (n= 22)	19.55 (4.55)	19 (7; 15)
Control (n=35)	4.91 (5.61)	2 (9; 22)

p-value (ANOVA, overall) < 0.001

p-value (ANOVA, among the disease groups) = 0.87 (non-significant)

Table 6.2.3 GHQ-28: positive screening for symptoms of severe depression

Group (number of women)	Mean (std. deviation)	Median (interquartile range; range)
VVF (n= 21)	4.52 (2.91)	7 (5; 7)
RVF (n= 47)	4.13 (2.58)	4 (5; 7)
POP (n= 22)	2.41 (2.87)	0.5 (5; 7)
Control (n=35)	0.14 (0.55)	0 (0; 3)

p-value (ANOVA, overall) < 0.001

p-value (ANOVA, among the disease groups) = 0.023 (significant)

6.3 DOMESTIC VIOLENCE

Paper accepted:

Krause H, Ng S, Singasi I, Kabugho E, Natukunda H, Goh J. The incidence of intimate partner violence among Ugandan women with pelvic floor dysfunction. IJGO.

Domestic violence is a global health problem which violates human rights. It affects 1 in 3 women internationally (WHO, 2013). Domestic violence refers to all acts of physical, sexual, psychological or economic violence that are committed by family members or intimate partners. Intimate partner violence (IPV) is domestic violence which is perpetrated by an intimate partner. The intimate partner may include a spouse or a partner in an intimate relationship, The violence may include physical, sexual, psychological (verbal, emotional) and economic abuse, and the partner may be a current intimate partner or a former intimate partner.

There are numerous IPV screening tools however the ones which have been most studied and assessed in the literature include the Hurt/Insult/Threaten/Scream (HITS) tool, Women Abuse screening Tool (WAST) and WAST-Short-Form (WAST-SF), Partner Violence Screen (PVS), and Abuse Assessment Screen (AAS).

As the HITS and WAST tools are both indicated in the outpatient setting, they were therefore chosen as screening tools for this study of women presenting to hospital with obstetric fistula, unrepaired obstetric anal sphincter injuries, and stage 3 or 4 POP-Q (Bump et al., 1996) pelvic organ prolapse. It has been identified previously that women with these 3 serious gynaecological conditions suffer high levels of social stigma including social isolation (Krause et al., 2014). Therefore this study aimed to screen women with obstetric fistula, unrepaired obstetric anal sphincter injuries, and stage 3 or 4 POP-Q pelvic organ prolapse, for risk of intimate partner violence. This study also screened women who were not actively seeking health care in the same region for risk of intimate partner violence as a comparison.

METHODS

This study assessing risk of IPV was undertaken at Kagando hospital, western Uganda during 3 separate surgical camps between July 2016 and September 2017. During these camps, there were a total of 304 women who underwent treatment or surgery for obstetric fistula (OF), unrepaired obstetric anal sphincter injuries (OASIS), and stage 3 or 4 POP-Q (severe) pelvic organ prolapse (POP). The women acting as controls consisted of women who were not admitted to the hospital and not seeking treatment at the hospital, but were visiting the hospital also during those camps. Ethics committee approval was obtained.

Women in the regions surrounding Kagando hospital were notified of the upcoming surgical camps by radio announcements. Other forms of outreach also occurred including nurses travelling to various centres to allow women suffering with these conditions to access this information. The women were invited to attend the hospital to access assessment and treatment including surgery for their OF, unrepaired OASIS, and severe POP. All of the treatment provided including the cost of transportation, medications, investigations, hospital fees and food was free of charge to the patients. The intention of this study was for all women attending the camps to be invited to participate in the study. However some of the women undergoing treatment or surgery for their OF, OASIS or POP were not invited due to time constraints on the staff who were performing the questionnaire. Despite this, 214 out of the 304 women who underwent treatment or surgery were able to be included in this study. There were 312 women (which included 214 women receiving treatment or surgery plus 98 controls) with a current intimate partner who agreed to answer the questionnaire. One of 3 nurses who are all experienced in fistula and gynaecological surgery questioned the women in their local language and documented the responses to the questionnaire in English. In addition, the same 3 nurses invited women who were visiting the hospital for any reason and who were not seeking medical care, to participate in the same questionnaire. The demographics and obstetric and gynaecological history of the women seeking treatment for obstetric fistula, unrepaired OASIS, and severe POP were obtained and they were also asked for their perception on what caused their condition and the subsequent impact on their social situation and sexual activity. The women were then screened with the HITS tool and

WAST questions. The control group of women were interviewed to obtain their HITS and WAST scores. Both the WAST and HITS screening tests were performed consecutively for each woman at the one sitting.

The HITS tool includes the following questions – How often does your partner – 1) physically hurt you? 2) insult you or talk down to you? 3) threaten you with harm? 4) scream or curse at you? Answer: never (1), rarely (2), sometimes (3), fairly often (4), frequently (5). Scoring is from 4-20 points. A score of 10.5 or more indicates a positive screen for IPV (Sherin et al, 1998). See Table 6.3.1.

The WAST includes the following questions – 1) In general, how would you describe your relationship – a lot of tension, some tension, no tension? 2) Do you and your partner work out arguments -with great difficulty, some difficulty or no difficulty? (questions 3-7 response options: often, sometimes, never) 3) Do arguments ever result in you feeling down or bad about yourself? 4) Do arguments ever result in hitting, kicking or pushing? 5) Do you ever feel frightened by what your partner says or does? 6) Has your partner ever abused you physically? 7) Has your partner ever abused you emotionally? 8) Has your partner ever abused you sexually?
Score 3 for "a lot of tension", "great difficulty", and "often". The scoring is between 8-24. The standard cut-off score for positive screening is 13 (Brown et al 2000). See table 6.3.2. The WAST was initially designed as a 2 part screening tool. If the woman answered "a lot of tension" or "great difficulty" with the first 2 questions, then the screener would complete the other 6 WAST items. Thus the first 2 items alone are the WAST-SF (short form).

RESULTS

There were a total of 312 women with a current intimate partner who were screened to assess for risk of exposure to domestic violence. The screened women suffering with pelvic floor dysfunction (PFD) included 75 women with OF, 85 with unrepaired OASIS, 54 with stage 3 or 4 POP-Q POP and 98 women were controls. Women were only given the WAST and HITS tool questionnaires and included in the study if they were currently living with their partner.

The average age of the women with OF was 31.76 years (range 16-67) (SD11.17), unrepaired OASIS 34.39 years (range 18-63) (SD9.64), severe POP 50.54 years (range 23-77) (SD12.94) and controls 34.32 years (range 18-55) (SD9.97). There were significant differences in age amongst the 4 groups ($p<0.001$). Post-hoc Tukey tests indicated that women with severe POP were significantly older than those with OF (mean difference: 18.8 years; 95% CI: 13.8-23.7; $p<0.001$), unrepaired OASIS (mean difference: 16.1 years; 95% CI: 11.3-21.0; $p<0.001$), and controls (mean difference: 16.2 years; 95% CI: 11.5-21.0; $p<0.001$).

Women with OF had a mean of 4.3 deliveries (range 1-12), with mean age at first delivery 18.2 years (range 13-25). Women with OASIS had a mean of 4.7 deliveries (range 1-11), with mean age of first delivery 18.6 years (range 13-29). In the group of women diagnosed with severe POP, the mean age of first delivery was 18.3 years (range 12-26), with a mean of 7.3 deliveries (range 1-14).

The standard WAST utilised here was considered a positive screen with a cut-off of 13 (Brown et al, 2000). A cut-off of 10.5 was used for the standard HITS to be positive (Sherin et al, 1998). The incidence of a positive screen for IPV using the standard WAST/ HITS tool was as follows: OF 36.0%/ 17.3%, OASIS 34.1%/ 20.0%, POP 31.5%/ 16.7%, control 44.9%/ 16.3%. The frequency of screening positive for either or both standard WAST or standard HITS tool was as follows: OF 37.3%, OASIS 35.3%, POP 31.5%, and control 44.9%. The standard WAST and standard HITS tool were both positive for OF 16.0%, OASIS 18.8%, POP 16.7%, and controls 16.3%. (Table 6.3.1)

There were no significant differences in incidence of positive screening for IPV between the 4 groups using the standard WAST test ($p=0.307$), standard HITS tool test ($p=0.923$) or when either standard WAST or standard HITS tool was positive ($p=0.431$), based on a chi-squared test. There was also no difference in incidence between the 2 groups ($p=0.068$) when comparing the incidence of positive screening in women with pelvic floor dysfunction (PFD) (OF, OASIS and POP) (34.1%) compared to controls (44.9%), using the standard WAST and based on a chi-squared test. No significant difference in incidence was found between the 2 groups when using the standard HITS tool ($p=0.683$) or when either standard WAST or standard HITS were positive

(p=0.090).

Some authors have proposed using a reduced WAST cut-off score of 10 (Iskander et al, 2015). When a reduced WAST cut-off score of 10 was used, the incidence of a positive score for IPV was 58.7% for OF, 61.2% for OASIS, 42.6% for POP, and 80.6% for controls. There was a significant difference in incidence between the 4 groups ($p<0.01$) with the incidence of positive screening for IPV with OF, OASIS, and POP being less than controls ($p<0.01$), based on a chi-square test. When the reduced WAST scores (cut-off score 10) and standard HITS scores (cut-off 11) are combined, the frequency of screening positive for IPV with either or both tools was OF 58.7%, OASIS 61.2%, POP 42.6% and controls 80.6%. Once again when the change in cut-off level for positive screening in WAST (cut-off 10) was utilised, there was a significant difference in incidence between the 4 groups ($p<0.001$). In this case, the documented incidence of positive screening for IPV for OF, OASIS, and POP were all significantly fewer than controls ($p<0.01$).

When comparing PFD (OF, OASIS, and POP) against controls using the reduced WAST (cut-off score of 10), a significant difference in incidence of risk of IPV between the 2 groups (PFD 55.6%, controls 80.6%)($p<0.001$) was identified. In addition, when combining a positive score of either the reduced WAST and/or standard HITS, there is a significant difference between the 2 groups (PFD 55.6%, controls 80.6%)($p<0.001$) again seen.

DISCUSSION

There is much controversy surrounding the benefits of IPV screening with many major medical organisations performing and recommending routine screening. However the US Preventative Services Task Force advises that there is insufficient evidence to determine whether its usefulness outweighs any potential harm (Rabin et al 2009). The concerns which have been raised previously in relation to IPV screening includes risk of reprisal violence, psychological distress, family disruption, and the risk of child protective services removing a child from the family environment if domestic violence is exposed (MacMillan et al., 2009). MacMillan et al (2009) screened 3271 women attending medical services and were unable to conclude whether IPV screening in

health care settings was effective. In a recent Cochrane data review, O'Doherty et al (2015) reviewed 10 studies which included 10074 women. They identified that screening did increase the clinical identification of women who were experiencing IPV in healthcare settings (OR 2.95, 95% CI 1.79-4.87). They did not find any evidence of an effect for other outcomes including harm arising from screening. There remained insufficient evidence to justify general IPV screening in healthcare settings. There are numerous implementation challenges which may be a significant barrier when building effective screening programs. There are current recommendations for screening which includes and emphasizes confidential, in-person assessment when performing IPV screening with a normalising framing statement, and a clear protocol for referral (Ramachandran et al., 2013).

There are various IPV screening tools available. The development of these IPV screening tools has been by comparing them to more lengthy and detailed assessments including the Revised Conflict Tactics Scale (CTS-2). The CTS-2 is a very widely adopted scale measuring prevalence, chronicity, and severity of intimate partner conflicts and is often referred to as the "gold standard".

The HITS scale was developed for outpatient clinical settings as a short domestic violence screening tool (Sherin et al., 1998). The HITS scale consists of only 4 items, 2 each that address verbal and physical aggression. Sherin et al (1998) advocate the tool for its brevity. It is also an easily remembered acronym. The assessment of this tool by Sherin et al (1998) demonstrated that the HITS scale showed good internal consistency and concurrent validity with the CTS verbal and physical aggression items. A score of 10.5 or more was utilised to indicate that the individual was suffering from IPV. A recent study by Iverson et al (2013) surveyed female veterans with both the four-item HITS and 39-item Revised Conflict Tactics Scales (CTS-2). The HITS score was able to demonstrate good clinical utility. When a cut-off score of 6 on the four-item HITS tool was used, it accurately detected 78% of women who had been identified as abused within the past year by the more comprehensive CTS-2. More commonly however, a cut-off score of 10.5 has been utilised to screen for risk of IPV. In our study the standard cut-off of 10.5 was utilised. Using this cut-off level, the incidence of positive screening was less than for the WAST. However as other studies have demonstrated, a

higher incidence of positive screening would be expected with a lower cut-off score such as 6.

When using the WAST for screening for risk of IPV, there is also some disagreement with the cut-off scoring for a positive screen. Some authors suggest a reduced cut-off of 10 rather than 13 which they feel would result in improved sensitivity but less specificity (Iskandar, 2014). In Canada the WAST was found to be a reliable and valid measure of abuse in the family practice setting. Both the patients and the physicians reported comfort with including the WAST as a part of the consultation (Brown et al., 2000). In our study here where a standard cut-off of 13 was used, a very high incidence of screening positive for IPV was identified for all groups of women. When changing the cut-off to 10 instead of 13 as recommended by other authors, the incidence of positive screening increased to up to 80.6% for controls, 58.7% for OF, 61.2% for unrepaired OASIS and 42.6% for severe POP (compared to 44.9%, 36.0%, 34.1% and 31.5% for WAST cut-off 13 respectively).

Rabin et al (2009) performed a systematic review of IPV screening tools. They concluded that no single IPV screening tool had well-established psychometric properties. There were few studies assessing the use of even the most frequently evaluated screening tools. There was a wide variation in sensitivities and specificities within and between the screening tools (Rabin et al., 2009).

IPV prevalence between regions and countries does vary. WHO performed a multi-country study on women's health and domestic violence against women at over 15 sites and estimated a lifetime prevalence of physical or sexual violence between 15% and 71% (Garcia-Moreno et al., 2006). IPV screening using a modified Abuse Assessment Screening tool in a hospital outpatient department in Tanzania, identified 78% of women having experienced emotional, physical or sexual violence (Laisser et al., 2011). The 2011 Uganda Demographics and Health Survey (UBOS and ICF, International: Uganda Demographic and Health Survey, 2011) identified and reported that the overall prevalence of intimate partner physical violence (IPPV) in Uganda was 41%. This report included physical violence being experienced by 25% and sexual violence being experienced by 21% within the 12 months prior to the survey.

The term interpersonal violence is another broader term which refers to violence between family members and intimate partners and also includes violence between acquaintances and strangers. In a Caribbean study (Le Franc E et al., 2008), 70.9% of respondents reported having been a victim of interpersonal violence that was most commonly caused by a relationship partner (62.8%). In a study from Brazil, Ribeiro-Silva et al (2015) identified that physical intimate partner violence was associated with food insecurity of households. In that paper there was a very high prevalence of food insecurity identified at 62.5%. The authors therefore suggest that due to the intimate partner violence that occurs, the couples' capacity to organise their domestic environment and manage their financial resources in order to guarantee the food security of their family may be affected. There are of course likely to be many other relevant factors which need further evaluation.

The 2011 Uganda Demographic and Health Survey data was analysed by Kwagala et al (2013) for empowerment, partner's behaviours and intimate partner physical violence (IPPV) among married women in Uganda. The conclusions they made were that women's empowerment had limited mitigating effects on IPPV due to partners' negative behaviours and with a history of witnessing parental violence. Empowerment is a vague entity to clearly define, however it is a personal phenomenon and a multidimensional process that requires autonomy, power, and status (Kasturirangan, 2008). Autonomy is the ability for an individual to make and put into effect their choices (Kabeer, 2005). Kwagala et al (2013) concludes and advises that to reduce IPPV in Uganda, there is the need to target men to address excessive alcohol intake, and raise awareness of the prevalence of IPPV and instil security in relationships. These features (excess intake of alcohol, lack of awareness of the presence of IPPV in a relationship and insecurities in a relationship) are indications of disempowerment. It is therefore important that empowerment programs address both men and women.

Whether women suffering with pelvic floor dysfunction in rural African communities are subject to the national average for IPV or are at a higher risk of IPV is unknown with no previously published data available.

This study has clearly identified and confirmed that there is a high incidence of IPV in western Uganda, affecting all women whether or not suffering with pelvic floor dysfunction. Women identified as suffering with pelvic floor dysfunction including OF, unrepaired OASIS and severe POP recorded high rates of positive screening for IPV (either WAST or HITS tool positive 35.0%). The same high risk of IPV (either WAST or HITS tool positive 44.9%) was recorded in the women in the control group. While it may have been anticipated that women suffering with pelvic floor dysfunction (OF, unrepaired OASIS and severe POP) would experience higher rates of IPV than controls, this was not the case, with the controls experiencing the same high levels of IPV. When compared to the 2011 Uganda demographic and Health Survey (UBOS) statistics which identified 41% of women in Uganda suffering with intimate partner physical violence, these overall rates are consistent. When using the standard cut-off levels for WAST and HITS there were no statistical differences in incidence between all the groups, however when using the reduced cut-off WAST, there were significant differences in incidence of positive screening for IPV with controls having a higher risk of IPV than the pelvic floor dysfunction group. This was statistically significant when comparing controls with either OF, OASIS, or POP or comparing controls with the combined PFD group.

There are a number of possible reasons that women suffering with the pelvic floor dysfunction described here are not at a higher risk of IPV compared to controls. Firstly, the risk of IPV identified is extremely high in both groups and thus urgent attention is needed to address this problem community-wide. It is likely that the women suffering with pelvic floor dysfunction are more isolated from their partners due to their condition, and are thus subject to no more than the already high rate of IPV prevalent in the population. In addition, partners who have remained with these women who are suffering with OF, unrepaired OASIS and severe POP and have often had these conditions for many years, have chosen to do so despite the difficulties they are facing as a couple or family. This may therefore be a positive aspect within their relationship.

This chapter has identified extremely high rates of intimate partner violence being experienced by women living in western Uganda, whether or not they are currently suffering with pelvic floor dysfunction. Intimate partner violence does result in

numerous adverse acute and long-term physical and emotional sequelae. Vigorous community awareness and education regarding domestic violence and strategies to reduce the incidence of domestic violence is urgently needed in order to reduce such high rates of IPV.

Table 6.3.1 Hurt, Insult, Threaten and Scream (HITS) (Sherin et al, 1998)

How often does your partner physically hurt you				
1. Never	2. Rarely	3. Sometimes	4. Fairly often	5. Frequently
How often does your partner insult or talk down to you?				
1. Never	2. Rarely	3. Sometimes	4. Fairly often	5. Frequently
How often does your partner threaten you with harm?				
1. Never	2. Rarely	3. Sometimes	4. Fairly often	5. Frequently
How often does your partner scream or curse at you?				
1. Never	2. Rarely	3. Sometimes	4. Fairly often	5. Frequently

Scoring is from 4-20 points. A score of 10.5 or more indicates a positive screen for IPV

Table 6.3.2 Woman Abuse Screening Tool (WAST) (Brown et al, 2000)

In general how would you describer your relationship with your partner		
1. No tension	2. Some tension	3. A lot tension
Do you and your partner work out arguments with		
1. No difficulty	2. Some difficulty	3. Great difficulty
Do arguments ever result in you feeling down or bad about yourself		
1. Never	2. Sometimes	3. Often
Do arguments ever result in hitting, kicking or pushing		
1. Never	2. Sometimes	3. Often
Do you ever feel frightened by what your partner says or does?		
1. Never	2. Sometimes	3. Often
Has your partner ever abused you physically?		
1. Never	2. Sometimes	3. Often
Has your partner ever abused you emotionally		
1. Never	2. Sometimes	3. Often
Has your partner ever abused you sexually		
1. Never	2. Sometimes	3. Often

Score 3 for “a lot of tension”, “great difficulty”, and “often”. The scoring is between 8-24. The standard cut-off score for positive screening is 13 .The WAST was initially designed as a 2 part screening tool. If the woman answered “a lot of tension” or “great difficulty” with the first 2 questions, then the screener would complete the other 6 WAST items. Thus the first 2 items alone are the WAST-SF.

Table 6.3.3 Incidence (%) of IPV among groups of women using different criteria

Criterion	OF	OASIS	POP	Control	PFD
WAST (13)	27 (36.0%)	29 (34.1%)	17 (31.5%)	44 (44.9%)	73 (34.1%)
HITS (10.5)	13 (17.3%)	17 (20.0%)	9 (16.7%)	16 (16.3%)	39 (18.2%)
WAST (13) or HITS (10.5)	28 (37.3%)	30 (35.3%)	17 (31.5%)	44 (44.9%)	75 (35.0%)
WAST (13) and HITS (10.5)	12 (16.0%)	16 (18.8%)	9 (16.7%)	16 (16.3%)	37 (17.3%)
WAST (10)	44 (58.7%)	52 (61.2%)	23 (42.6%)	79 (80.6%)	119 (55.6%)

Notes:
The criterion “WAST (13) or HITS (10.5)” is positive if either or both standard WAST or standard HITS tool is positive.
The criterion “WAST (13) and HITS (10.5)” is positive when both standard WAST and standard HITS tool are positive.
PFD includes OF, OASIS, and POP.

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CHAPTER 7

SUMMARY, IMPLICATIONS, LIMITATIONS, FUTURE RESEARCH

7.1 SUMMARY

The preceding chapters have described pelvic floor dysfunction and subsequent social and mental health sequelae and risk of domestic violence in eastern and central Africa. In particular the aetiologies and management options for women suffering with obstetric fistula (OF), severe pelvic organ prolapse (POP) and unrepaired 4th degree perineal tears have been detailed. While OF and unrepaired 4th degree perineal tears are infrequently seen in countries well resourced for health care, POP occurs commonly irrespective of available resources. However where health care provision is well resourced, these pelvic floor pathologies all attract swift and effective treatment options. Where health care resources are lacking, women suffer indefinitely with these conditions (Krause et al., 2014). Social status and support suffers with chronic pelvic floor pathologies (Krause et al., 2014). Also mental health dysfunction becomes more common in combination with the lack of any mental health support programs (Krause et al., 2017). Risk of domestic violence is also concerning.

Post-fistula bladder dysfunction is a common problem following successful OF closure (Goh et al., 2008). The causes of post-fistula closure bladder dysfunction include urodynamic stress incontinence, detrusor overactivity, and voiding dysfunction (Goh et al., 2013). Management options for women suffering from these problems includes conservative management with pelvic floor rehabilitation such as bladder retraining, pelvic floor exercises and voiding techniques, the use of clean intermittent self catheterisation for severe voiding difficulty, medication for detrusor overactivity, and surgical options for urinary stress incontinence. Unavailability of pelvic floor physiotherapists and continence nurses in resource-poor countries limit the access of women to these treatment options. Also medications which may be useful in the treatment of detrusor overactivity, are often unavailable or unaffordable.

Post-fistula bladder dysfunction therefore needs to be identified as an entity and the following investigations and management options made available:

- Urodynamics for diagnosis of bladder symptoms.
- Pelvic floor physiotherapy/ continence nurse support to train women in pelvic floor rehabilitation including pelvic floor exercises, bladder retraining and voiding techniques is necessary to provide conservative therapies as effective treatment options.
- Medications for treatment of detrusor overactivity, including anticholinergic medications and beta-3 adrenoreceptor agonists, need to be available and affordable for women with detrusor overactivity.

To date the documented surgical options for managing post-fistula urinary stress incontinence have not demonstrated high levels of successful outcomes (Hamlin & Nicholson, 1969, Browning, 2004, Carey et al., 2002, Ascher-Walsh et al., 2010). In addition, many of the surgical techniques have required high levels of surgical skill and training in order to maximise safety and success and minimise complications (Carey et al., 2002). Many fistula surgeons may not have experience in the management of women with urinary incontinence and can only offer limited operative procedures. Operative procedures for stress urinary incontinence are likely to worsen overflow incontinence and overactive bladder symptoms. In addition, many fistula surgeons may not have kept abreast with newer continence management options and may still employ less effective surgeries such as anterior repairs with/without urethral plication. Here we have introduced a bulking agent as an established surgical management option for proven urinary stress incontinence, for use in women with post-fistula closure urinary stress incontinence (Krause et al., 2014). This procedure has minimal safety concerns and technically requires a low level of surgical skill. Initial results with a small number of women have proven encouraging. The main current limitation of promoting the widespread use of bulking agents for this indication is the high cost of the product. However if the overall cost of lifelong urinary stress incontinence following successful fistula repair, perhaps with the inclusion of the costs of other less effective and more invasive surgical options, are compared with the cost of the bulking agent injectable, then it is possible that cost-effectiveness may be in favour of the bulking agents. Larger studies of the use and effectiveness of bulking agents in women with post-fistula repair stress urinary incontinence is necessary to provide a foundation for arguing for funding of this surgical technique.

There are many women worldwide living with unrepaired 4th degree perineal tears. Women report social abandonment and violence at home because of the tear (Krause et al., 2014). There is a need to educate and up-skill health care professionals, especially in rural low-income areas, in the management of significant obstetric perineal trauma. The survey of women suffering with chronic 4th degree perineal tears identified that many women were given medications or herbs were used inappropriately in an attempt to treat their tear (Krause et al., 2014). Health care professionals must be educated to identify these tears, and refer women on to centres skilled in the acute repair of 4th degree perineal tears, in order that the tears do not become chronic and therefore result in prolonged symptoms and suffering. Additionally health care professionals must be able to identify and diagnose unrepaired 4th degree perineal tears and have guidelines as to onward referral to centres skilled in the repair of the chronic 4th degree perineal tear.

A technique of delayed primary repair of 4th degree obstetric perineal tear under spinal anaesthesia, without faecal diversion and without surgical flaps, is described above (Goh et al., 2016). This technique, performed on 68 consecutive women had few complications and promising short-term results. Most of the women presenting with unrepaired 4th degree perineal tears had delivered in their villages with no access to professional health care workers. Therefore these women also need access to education in order to become aware of possible available treatment options.

Previously a young age at first delivery and being short in stature have been thought to be significant risk factors for developing OF (Barageine et al., 2014, Browning et al., 2014, Holme et al., 2007, Melah et al., 2007, Tebeu et al., 2012). When comparing women in western Uganda with OF from obstructed labour with women having had a spontaneous vaginal delivery without obstruction, the maternal age at first delivery was not a risk factor for the development of obstetric fistula. The OF group age at first delivery was 17.7 years compared to 18 years for women having had a vaginal delivery without the development of OF (POP, unrepaired 4th degree perineal tears and normal vaginal deliveries combined) with no statistically significant difference between the 2 groups. Heights of women presenting with OF, unrepaired 4th degree perineal tear and

severe pelvic organ prolapse (POP) were measured, along with women who presented with a normal unobstructed vaginal delivery. All of the women assessed were from the same districts and all groups of women assessed were shorter than the national average height (159.2 cm). The group of women with fistula (152.2 cm) were the same height as women with severe pelvic organ prolapse (154.2 cm) and women with a recent spontaneous normal vaginal delivery (152.5 cm). However, the group of women presenting with unrepaired 4th degree perineal tears (157.5 cm) were taller than the other groups, but were still shorter than the national average. This study demonstrated that having a height of less than 150 cm was not a risk factor for development of obstetric fistula within a community where the average height is below the national average. Therefore previous statements on early age and shortened height as risk factors for the development of obstetric fistula need to be reconsidered.

Pelvic floor imaging and its interpretation has progressed exceptionally rapidly in the last few decades. While a clear understanding of the asymptomatic nulliparous pelvic floor will allow comparisons with women suffering pelvic floor dysfunction following childbirth, it has become evident that there are differences in the normal pelvic floor dimensions depending on ethnicity (Shek et al., 2016). Thus in order to evaluate Ugandan women with pelvic floor dysfunction, an understanding of the nulliparous pelvic floor of Ugandan women is also necessary. The differences between ethnicities may result in a differing incidence and prevalence of the varying components of pelvic floor dysfunction in Ugandan women when compared to Caucasian or Asian women. When comparing functional pelvic floor anantomy with 4D pelvic floor ultrasound scanning, substantial differences between Caucasian and Ugandan non-pregnant nulliparous women were in fact identified in this study (Shek et al., 2016). The Ugandan cohort of non-pregnant nulliparous women were found to have larger levator hiatal dimensions and greater pelvic organ descent. These findings do seem to imply a greater distensilbility of the levator ani muscles and greater elasticity of fascial support structures in the Ugandan women. However there were no significant differences in levator ani muscle thickness and area between the 2 study populations. Whether the underlying differences in pelvic floor anatomy between ethnicities alter future risks of pelvic floor dysfunction is yet to be determined. Further research may identify pelvic

floor antomical features as promoting or reducing future risks of occurrence of OF, obstetric anal sphincter injuries (OASIS) or POP within different populations. However it is most likely that the causes of pelvic floor dysfunction are multifactorial and very modifiable with good obstetric care.

Imaging the pelvic floor of women with pelvic floor dysfunction has identified 2 main areas of abnormailty. Firstly levator hiatal areas are measured with a normal area less than 25 cm^2. Women with POP and unrepaired 4^{th} degree perineal tears had enlarged levator hiatal areas – POP mean 33.63 cm^2 and unrepaired 4^{th} degree perineal tears mean 27.24 cm^2. These findings are unsurprising as they have all delivered infants vaginally which is a risk factor for an increased levator hiatal area. However the women with OF were identified as having a significantly smaller levator hiatal area measuring mean 21.45 cm^2. This was an unexpected finding as these women do have high rates of complete levator muscle defects which is usually associated with widened levator hiatal areas. There may be additional factors impacting on these findings relating to the pressure necrosis of the pelvic floor which occurs in obstructed labour resulting in OF. It is likely that the obstructed labour resulting in pressure necrosis also causes significant scarring within the pelvis and pelvic floor tissues. Certainly on clinical examination of these women with OF, there is a high rate of moderate to severe scarring in the vagina identified and documented using the Goh classification. The marked lack of any POP in women suffering with OF is perhaps another indication of significant scarring which may negate any increased risk of POP due to levator muscle defects.

The second anatomical abnormality noted on pelvic floor ultrasound scan in women with pelvic floor dysfunction is levator muscle defects. On average a rate of 20% complete levator muscle defects in women following vaginal delivery has previously been reported (DeLancey et al., 2003). The rates of partial levator muscle defects are not always included in the published studies. Currently the relevance of partial levator muscle defects is uncertain, with only the complete levator muscle defects being found to correlate with pelvic floor dysfunction such as POP. It would be expected however that all trauma involving the levator muscles resulting in any degree of defect, either partial or complete, would impact the function of the pelvic floor and increase the risk

of future pelvic floor dysfunction. This study did identify high rates of partial and complete levator muscle defects in all 3 surgical groups – OF, POP, unrepaired 4th degree perineal tears. The rates of partial defects were OF 66.7%, POP 36.8%, and unrepaired 4th degree perineal tears 52.6%. Complete defects were present in OF 28.6%, POP 21.1%, unrepaired 4th degree perineal tears 26.3%. While our understanding of the relevance of partial defects is incomplete, the rates of complete levator muscle defects are consistent with world literature findings. The non-OF group (POP and unrepaired 4th degree perineal tears) all had a history of vaginal deliveries and their rate of complete levator muscle defects of 23.7% is consistent with many previous reports on similar cohorts of women in higher-income countries. The women studied here with OF had rates of complete levator muscle avulsion (28.6%) very similar to a published cohort of OF women in Ethiopia (Dietz et al., 2012).

The ultrasound findings which do not correlate with our current understanding and expectations of pelvic floor assessment includes:

i. The lack of enlargement of levator hiatal areas in women with OF. This is despite the finding of high rates of complete levator muscle defects
ii. The high rate of levator muscle defects including complete defects in women with OF who have not delivered vaginally. These rates in women with OF are equally as high as women with POP and unrepaired 4th degree perineal tears who have all delivered vaginally
iii. There was no difference in parity between women with levator muscle defects compared to those with no defects. There are currently conflicting reports in the literature on the possible correlation of parity with levator muscle defects.

Additional pelvic floor ultrasound assessment of parous women from the same region with the same health-care availability who are not currently suffering with any pelvic floor dysfunction may add to our understanding of pelvic floor outcomes following vaginal birth or caesarean section.

Our study comparing the pelvic floor ultrasound characteristics of women with OF, POP and unrepaired 4th degree perineal tears, also looked at their mode of delivery which would be expected to modify outcomes of pelvic floor dysfunction and foetal

outcomes. Out of the 82 Ugandan women evaluated, over 43% of women had a history of 1 or more caesarean sections. Of the 43 OF women, over 74% of them had a caesarean section for the delivery that resulted in OF, however there were no live-born infants. These figures are now typically seen in surgical camps treating women with OF (Krause et al., 2014, Barageine et al., 2014, Loposso Nkumu et al., 2015), which is in significant contrast to previous decades where the caesarean section rate in women with OF was very low (Tahzib, 1983, Kelly & Kwast, 1993, Hilton & Ward, 1998). The devastating lack of any reduction in stillbirth rate for women developing OF over the years despite the utilisation of caesarean deliveries, is distressing. These women developing OF in their obstructed labour are subject to a caesarean section in a time-frame precluding the survival of their infant, often by inexperienced doctors, resulting in more extensive fistulas and risking ureteric injuries due to the surgical delivery adding trauma to the already necrotic tissues.

Stage 3 and 4 POPQ pelvic organ prolapse is a very debilitating condition resulting in significant symptoms of discomfort and limitations in activities of daily living. While surgical repair of POP is usually effective, there remains risks related to anaesthesia and surgical complications. There is also risk of recurrence of prolapse in the future (Olsen et al., 1997). Non-surgical management options for POP with the use of pessaries are widely available and well utilised in well-resourced countries, where women are given a choice of management options (de Albuquerque Coelho et al., 2016, Bugge et al., 2013). This study has introduced pessaries as a management option for POP in a low-resource setting. Pessaries were found to be very effective in relieving symptoms of POP and were retained in the majority of patients. Both patients and staff were very receptive to this option of management for POP. All women with POP who were medically fit for surgery were booked for POP surgery after clinical assessment at the camps as that was their expectation and request. All agreed to have a pessary inserted immediately following the clinical examination. The patients were then able to trial the pessary while awaiting their scheduled surgery, and as documented earlier, a total of 19 women cancelled their own surgery as they preferred to be discharged with the pessary instead. The women were easily taught to self-manage their pessary, and follow-up of the initial small cohort of women choosing

pessary for management of their POP has been very successful. Education of health care professionals in pessary use and care is necessary to make this conservative option available for the large number of women worldwide suffering with symptomatic POP. The cost of pessaries needs to be low in order for this option to be available to women in low-resource communities.

It would be anticipated that if pessaries were readily available in low-resource areas and the local health care professionals were experienced in the fitting and ongoing management of pessaries, then many women would appreciate and benefit from this management option for their POP. Even where women are requesting a surgical solution for their POP, pessaries are likely to be an effective short- to medium-term option as they await for a surgical camp in their region or finances to fund their own surgery if no such funded-camps are available. Further studies with larger patient cohorts would be valuable to confirm the ability of women to easily self-manage their pessaries and to obtain their satisfaction rates with this mode of treatment. In addition, longer term follow-up is needed to assess for any complications of pessary use in low-income settings. Follow-up of women from remote rural low-income locations can be challenging due to safety concerns and limited infrastructure making transportation difficult. Also if funds are not available to allow travel back to the hospital/ health care centre for review, then women are unable to comply with such requested reviews. This does highlight the importance of teaching women effective self-management techniques to minimise their need to return for regular pessary checks. They are advised to have a review of their pessary annually, and of course will need a new pessary every 1-2 years or whenever their pessary requires replacement.

The studies in this research above confirm the social stigma faced by women with OF in western Uganda (Krause et al., 2014). These studies also highlight the social stigma in women suffering from severe POP and unrepaired 4th degree perineal tears (Krause et al., 2014). Many of these women suffered abandonment by their families and therefore were experiencing significant social stresses. Prevention of these injuries with access to safe and effective obstetric care, and access to gynaecological services, would help to prevent and alleviate these significant social stresses causing loss of family cohesion. High proportions of the women questioned with OF, POP and

unrepaired 4th degree perineal tears had experienced abandonment by their partner which they attributed to their gynaecological condition. Many had also unsuccessfully sought treatment without success or had been unable to afford whatever treatment options that were available. The high caesarean section rates and low instrumental delivery rates in women who have developed OF emphasize the unavailability of effective antenatal and intrapartum obstetric care. Caesarean sections performed after the development of pressure necrosis in an obstructed labour are likely to extend the injuries which have already occurred and put the ureters at additional risk of injury, in particular in the absence of very experienced surgeons. Intra-peritoneal surgery done at a time when prolonged labour has caused intrauterine foetal death and pressure necrosis, with infection ensuing, gives a high risk of intra-peritoneal infection which may result in future secondary infertility, bowel obstruction and chronic pain.

This paper has also identified a significant risk of mental health dysfunction associated with this trilogy of women's health issues including severe POP, unrepaired 4th degree perineal tear and OF (Krause et al., 2017). While OF has received some attention in recent times with funding available in many low-income and resource-poor areas for surgical camps, ongoing attention is needed to assist these women with concurrent mental ill-health. Severe POP and unrepaired 4th degree perineal tears in areas of low-income and lacking resources have now also been identified as resulting in a high risk of mental health dysfunction (Krause et al., 2017). New strategies need to be developed in order to provide appropriate management options for these women. Time must be invested into the up-skilling of local medical staff to identify and effectively treat OASIS and severe POP. The significance of the high rates of risk of mental health dysfunction suffered by women with severe POP, unrepaired 4th degree perineal tears and OF must be acknowledged and acted upon. There needs to be the development of treatment strategies to support the mental health of these women and these strategies should be incorporated to provide comprehensive and effective management programs.

Domestic violence is widespread in communities worldwide (WHO, 2013). Ugandan statistics have reported a rate of 41% overall prevalence of intimate partner physical violence (UBOS and ICF International: Uganda Demographic and Health Survey, 2011).

Intimate partner violence (IPV) can be defined as domestic violence which is perpetrated by an intimate partner (WHO, 2013). This research assessing women suffering with pelvic floor dysfunction and women attending the hospital for reasons other than seeking medical care, identified similar high rates of intimate partner violence in screening for risk of IPV. It is known that domestic violence results in many acute and long-term physical, psychological and social sequelae which can be life-altering. Community-wide education and support is needed to address this serious issue of domestic violence.

7.2 IMPLICATIONS

EFFECTIVE OBSTETRIC CARE

The importance of available and effective obstetric care cannot be overstated. Without such obstetric care during pregnancy, labour, childbirth and in the postpartum period, numerous acute and chronic complications and sequelae may occur. These complications and sequelae include OF and unrepaired 4^{th} degree perineal tears. Such pathology if left unrepaired may result in a lifetime of physical, social and mental distress.

Effective obstetric care includes antenatal evaluation and education, and identification of complications or risk factors during the pregnancy which may increase intrapartum risks. Where indicated, elective caesarean sections may be necessary to improve foetal and maternal outcomes. During labour, effective monitoring of the progress of labour is vital in order to favourably modify outcomes when obstructed labour occurs or when foetal compromise is imminent. When obstructed labour or foetal compromise is diagnosed despite active management of the labour, then timely delivery with instrumental delivery or emergency caesarean section is required. Mode of delivery will depend on the position and descent of the foetus in the birth canal. Emergency caesarean sections can be very challenging especially when the foetal head is impacted deep in the pelvis. Doctors or other health professional including students still undergoing training, who are providing caesarean section services, are not always experienced and skilled in this potentially complicated surgery (Barageine et al., 2014). All caesarean section service providers need to be well trained to identify women

requiring a caesarean section and the time-frame that it should be undertaken in, and also be technically competent in completing the surgery.

When women are unable to labour in a supervised health care facility and present in obstructed labour with foetal compromise or death, then her management planning must be urgent with experienced obstetric care providers aware of the significant risks associated with her delivery (either vaginally or by caesarean section). When caesarean section is undertaken, extreme care must be taken to try to avoid worsening the developing OF or causing iatrogenic injury to the ureters. Post-delivery, a catheter should be placed and left in-situ for up to 6 weeks to try to prevent or treat an OF, and antibiotics will help to treat infection which may result in tubal and endometrial scarring causing secondary infertility.

Education and awareness that these conditions including OF and unrepaired 4th degree perineal tears can be treated is necessary and a co-ordinated referral service to centres that perform these surgeries must be developed with accuracy and kept updated.

SURGICAL TRAINING

The training of health professionals in the timely repair of obstetric fistula and 4th degree perineal tears is necessary, as in many cases women with these conditions seek help however there are no skilled health professionals available to perform the necessary surgery. In addition, due to the limited number of health care professionals in low-resource areas, their time is largely occupied with the emergency medical, obstetric and surgical management of patients. Thus women suffering with conditions which are deemed elective including severe POP, are not prioritised and are usually left without access to timely or effective treatment options. In fact, women suffering with all of these 3 serious gynaecological conditions – OF, POP, and unrepaired 4th degree perineal tears, usually find that effective access to treatment is unavailable and unaffordable. They often suffer with symptoms of these conditions for many years, if not a lifetime.

FINANCES AND EDUCATION

Lack of finances is often a reason for women to be unable to access medical treatments. Funding must be provided to allow women to access good obstetric care and also to access treatment for any post-obstetric pathology including OF and unrepaired 4th degree perineal tears. Many women deliver in their villages far from any professional health care workers (Barageine et al., 2014), and therefore when complications arise during their labour and delivery, mortality or serious morbidity can be the result. Education regarding the importance of being able to access good obstetric care during pregnancy and childbirth is necessary throughout the communities, as social and cultural norms as well as lack of finances prevent women seeking assistance during their pregnancy and labour.

Each community must therefore identify what services are available, and strive to ensure all women have access to safe and effective obstetric care. Once these services are available, the morbidity and mortality related to female reproduction can be significantly reduced.

The most common cause of OF worldwide is prolonged obstructed labour. OF results in continuous urinary and/or faecal leakage through the vagina. Numerous physical, social and mental health sequelae arise from this condition. When effective obstetric care is readily available, the incidence of OF can be minimised. With all cases of vaginal childbirth there is a risk of perineal tears which may be 4th degree perineal tears. When these are not repaired, faecal incontinence results and further physical, social and mental health problems occur. The timely and skilled repair of 4thdegree perineal tears are necessary to reduce such morbidity.

POST-FISTULA CLOSURE BLADDER DYSFUNCTION MANAGEMENT

Female urinary incontinence is very common worldwide with much resources utilised to help reduce the suffering these women face. However in low-resource settings, female urinary incontinence goes untreated due to lack of finances and expertise. Following obstetric fistula repair, ongoing urinary incontinence is very common (Goh et al., 2008). These women require thorough assessment and clinical examination and appropriate investigations to understand and diagnose the cause of their urinary

incontinence. Depending on the diagnosis, supervised pelvic floor rehabilitation, medications and surgery may be required to achieve a successful result. Education and training of health care professionals is necessary to develop capacity in identifying and offering management options for these women. Ongoing research into how to optimise treatment outcomes is also required.

RISK FACTORS FOR OBSTETRIC FISTULA

When reviewing cases of women suffering with OF, a number of risk factors have been identified. A reduced height of the woman has always been thought to be one such risk factor for the development of OF (Ahmad et al., 2005, Browning et al., 2014, Holme et al., 2007, Tebeu et al., 2012). However these women have usually been compared to the national average heights for women and not their local counterparts who have delivered their children without the development of a genital tract fistula. This research has identified that height is not necessarily a factor that increases the risk of OF. There was no statistically significant difference between the average height of women with OF compared to either the POP group or normal vaginal delivery group, however the unrepaired 4th degree perineal group were taller than the OF group. In particular, a height of less than 150 cm was not a risk factor for development of OF. In addition, early age of first childbirth has been considered a risk factor for development of OF. This research clearly demonstrates that in western Uganda, maternal age at first delivery is not a risk factor for OF. It is important that we are accurate in identifying risk factors for obstetric fistula in order to be able to educate health care professionals to effectively offer treatment and manage women who are at a higher risk of developing OF.

UNDERSTANDING PELVIC FLOOR ANATOMY

There are many variations in anatomy worldwide depending on racial origins. When assessing gynaecological pathologies, an understanding of the normal female anatomy and racial variations is important. With the advancement in technology, significant improvements in medical imaging have become available. The 4-D pelvic floor ultrasound scan has allowed detailed vision of the pelvic floor muscles and their attachments. Many studies have identified abnormalities of the pelvic floor including levator muscle defects and widened levator hiatal areas following vaginal childbirth

and in women suffering pelvic floor dysfunction (DeLancey et al., 2003). To understand the importance of these pathological findings, the normal anatomy of nulliparous women of different races must be studied to establish a baseline for what constitutes normal pelvic floor anatomy.

Further evaluation and imaging of women in low-income areas where OF, POP and unrepaired 4th degree perineal tears are prevalent will help to further understand pelvic floor anatomy and the pathological changes in pelvic floor anatomy seen in women with these serious gynaecological conditions. Understanding these injuries may allow preventative measures to be recommended to modify women's future health outcomes.

SUPPORT FOR SOCIAL AND MENTAL HEALTH DYSFUNCTION; DOMESTIC VIOLENCE AWARENESS AND PREVENTION

In general there is a high incidence of social and mental health concerns within our communities. However when chronic ill health is also a factor, the risk of social and mental health dysfunction increases (Mitchell et al., 2011, Wilhelm et al., 2003). Women who face long-term chronic ill health with OF and its sequelae, unrepaired 4th degree perineal tears, and severe POP, are exposed to even higher risks of social and mental health complications. Firstly, these social and mental health complications need to be acknowledged as they often result in significant morbidity. Then appropriate support and treatment is required for women suffering with social and mental health dysfunction.

Domestic violence occurs commonly in all communities worldwide (WHO 2013). An awareness of domestic violence is first necessary for communities to be able to build strategies to help reduce its incidence. According to Ugandan statistics (UBOS and ICF International: Uganda Demographic and Health Survey, 2011), intimate partner violence is very prevalent throughout the community affecting women from all walks of life. This research using IPV screening tools has identified high rates of risk of IPV within the population of women attending Kagando hospital suffering with pelvic floor dysfunction. Interestingly it has identified equal or even higher rates of risk of IPV in the general community of women living in and around Kagando, Uganda. Possibly the

stigma associated with these conditions results in some separation from their intimate partner and thus prevents an even higher rate of risk of IPV. In addition when women are suffering with chronic conditions such as OF, chronic 4th degree perineal tears and POP, their current partners may have elected to remain with the woman and thus put her at a slightly lower risk of IPV.

7.3 LIMITATIONS

When assessing and comparing the occurrence and outcomes of childbirth injuries and pelvic floor dysfunction in women in any given location, identifying the overall incidence and prevalence of those issues at that location is important. In low-income and resource-poor regions, often obtaining such data is fraught with danger and difficulty. Certainly in D.R. Congo and western Uganda there are significant safety concerns relating to political and regional conflicts. Often data collection on a community-wide scale is suboptimal due to safety concerns, and in addition there is poor access to more remote areas. There is often no effective postal service and telecommunication is limited by access to the network, cost of acquiring and maintaining a handset and restricted electricity supply.

Thus when we identify women presenting to the hospitals with pelvic floor dysfunction, it is not possible to estimate the overall incidence of these conditions.

Accurate and effective follow-up of patients post-surgery and treatment is again limited by the social structures and infrastructures available in the communities and regions. There is difficulty in patients returning for routine follow-up due to issues such as safety with travelling, cost to travel, cost of losing their usual income generating activity while journeying to and from the hospital, and lack of infrastructure and transport to return to the hospital. As there is no effective postal services available in these resource-poor communities, postal follow-up is not an option. In addition, many in the community are illiterate and therefore would be unable to read and give a written response to a survey. Many women do initially have a mobile phone number of a relative or friend that they have access to when they first receive treatment at the hospital. However by the time a follow-up phone call may be attempted to check on

outcome, many of these numbers are no longer functioning. This is often due to the phone being out of credit, or the phone itself is no longer functioning.

7.4 FUTURE RESEARCH

1. **Post-fistula closure bladder dysfunction**

Post-fistula repair bladder dysfunction has been poorly studied up until now. Only recently has urodynamics testing been employed to help understand and diagnose the reasons for bladder dysfunction following genital tract fistula closure. Much larger studies are required to assess treatment options for women with post-fistula closure bladder dysfunction. In particular, the use of bulking agents to treat post-fistula closure urinary stress incontinence needs further assessment with more participants and long-term follow-up.

- Urodynamics – larger studies to delineate diagnoses of ongoing bladder dysfunction following OF repair
- Bulking agents – larger cohorts with follow-up of outcomes

2. **Unrepaired 4th degree perineal tear**

An effective technique for the repair of chronic 4th degree perineal tears has been described here. Short-term follow-up has identified safety and good functional outcomes following surgery. Much longer-term follow-up is required to establish the long-term functional outcomes of this technique.

- Long-term functional outcomes of repair of OASIS - ongoing clinical review and questionnaires

3. **Risk factors for obstetric fistula**

Many risk factors for the development of OF has been quoted in the literature. A young age at time of first delivery has long been assumed to put women at a higher risk of the development of an obstetric fistula due to obstructed labour. In addition, women who are short have also been thought to have a higher risk of developing OF. However this study has not shown any differences in age between women with OF and those delivering normally in the same location in Uganda. Also there was no significant difference in height between women with obstetric fistula and those delivering

normally in the same region. Therefore further studies with larger numbers are needed comparing women with obstetric fistula and those delivering normally without obstructed labour in the same location. Nationwide statistics should not be used as there are significant differences in height documented in different regions within the same country.

It is important to be aware that if the focus on prevention is on delaying age of marriage/childbirth, then the need for availability for safe and emergency obstetric services may be overlooked.

- Larger studies comparing the ages and heights of women with OF versus women delivering normally in the same geographical locations, to assess whether age or height are risk factors for OF.

4. Pelvic floor anatomy

These studies have taken the initiative to use 4D-pelvic floor ultrasound scanning to try to assess and establish a baseline for normal pelvic floor anatomy in women from western Uganda. In addition, women suffering with OF, chronic 4th degree perineal tears and severe POP have been assessed to try to identify any anatomical features which might be relevant to their presenting pathology.

Larger studies are needed assessing women both with and without pelvic floor pathology to establish a larger baseline for anatomy in this population of Ugandan women. A more detailed understanding of normal anatomy and the pathological findings within the pelvic floors of women suffering with these conditions may help in the development of future treatment options. An increase in our understanding of the anatomy in all women with pelvic floor dysfunction may elicit new risk factors, which in turn may be used to avoid or reduce the onset of pelvic floor pathology.

The incidental finding of levator muscle trauma including complete levator muscle defects (avulsion) in women following caesarean section without any vaginal deliveries requires further research, and may add to our understanding on the causes of levator

muscle trauma, especially in women with obstructed labours. Much larger population studies are needed to identify any statistically significant findings.

- Further 4D-pelvic floor ultrasound scanning is required to compare anatomical findings of parous women with and without pelvic floor dysfunction.
- Assessing for levator muscle trauma in women with OF who have never delivered vaginally may help to identify further options of pathogenesis for levator muscle trauma.

5. Social and mental health support; domestic violence awareness and prevention

Social and mental health dysfunction has been identified to be of significant prevalence and concern for women suffering OF, chronic 4th degree perineal tears and severe POP. Timely and effective treatment options will help reduce the social disruption women face with these chronic gynaecological issues. Mental health support programs need to be developed, advanced and evaluated to help alleviate the significant distress caused. Severe mental ill health must be identified and treated appropriately. Further research should provide content for such programs and identify sources of financial support to enable these programs to be developed and promoted. Education of the health care professionals providing the support and counselling and treatment within these programs must be prioritised. Domestic violence is very prevalent amongst women suffering with pelvic floor dysfunction, in addition to all women community-wide. Strategies must be devised which result in a reduction of this problem.

- Treatment options for mental health dysfunction need to be evaluated to determine how to combine identification and treatment of mental health dysfunction with the provision of management options for women suffering with OF, chronic 4th degree perineal tears and severe POP.
- Strategies available for community-wide management of domestic violence need to be identified and evaluated for effectiveness.

6. The use of pessaries for POP

Pessaries have successfully been introduced into a remote area in western Uganda, where pessaries have not previously been utilised for treatment of POP. Women were

taught to self-manage their pessaries which is an effective way to reduce their need for regular medical review whilst minimising risks of pessary use. Health care professionals were educated in pessary insertion, care and management and were keen to pursue this treatment option for women with POP in their region.

- Larger cohorts of women wanting to utilise a pessary for their prolapse is needed, with longer-term follow-up assessing women's satisfaction with the pessary and their competence with self-management.
- Long-term follow-up of any complications associated with pessary usage in resource-poor communities.
- Further comparative trials on different pessary types and styles, assessing likelihood of pessary retention and durability of the product.

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CONCLUSION

As we strive to improve women's and reproductive health worldwide, it is obvious that the availability of up-to-date and effective healthcare varies widely depending on location, funding and resources. Conditions such as obstetric fistula and its sequelae which are now rarely seen in countries well-resourced for health care provision, no longer attract intense research or the determination needed for prevention or treatment. Obstetric anal sphincter injuries which occur with vaginal deliveries irrespective of availability of health care funding, are immediately repaired with effective protocols for treatment in communities which are well-resourced in health care provision. The unavailability of even conservative management options for severe pelvic organ prolapse in countries lacking healthcare availability results in women living with significant symptoms affecting their activities of daily living.

Where women do not have access to effective healthcare, conditions such as obstetric fistula, unrepaired 4th degree perineal tears and severe pelvic organ prolapse, result in lifelong suffering with significant symptoms without even the universal availability of sanitary products or running water. Many of the women evaluated and treated in these studies have lived with their condition for decades before treatment options became available. Chronic diseases increase the likelihood of mental health dysfunction, and conditions causing continuous urinary and faecal incontinence results in social isolation.

This research has demonstrated the occurrence of pelvic floor dysfunction in eastern and central Africa in regions under-resourced for healthcare provision. Diagnostic clinical evaluation and surgical techniques have been described, as well as detailed pelvic floor imaging to gain an understanding of the underlying morphobiometry of the pelvic floor. Social and mental health dysfunction is of critical concern with advice to develop management strategies given.

APPENDICES

ETHICS APPROVAL

There were several research components to this thesis, with all topics receiving clearance from the relevant ethics committees.

1. Chapter 2: Periurethral injections: HEAL Africa ethics approval, Goma, DR Congo.
2. Chapter 2: Urinary symptoms and urodynamics: AAFH ethics approval, Addis Ababa, Ethiopia
3. Chapter 3.1: Unrepaired 4th degree tears: Greenslopes Private hospital Protocol 13/46 and Kagando hospital administration. ACTRN 12617001520325.
4. Chapter 3.2: Pelvic Organ Prolapse and Pessary Use: Greenslopes Private hospital Protocol 17/31 and Kagando hospital administration. ACTRN 12617001076369p
5. Chapter 4: Height/ Age: Greenslopes Private hospital Protocol 13/73 and Kagando hospital administration. ACTRN 12617001072303
6. Chapter 5.1 and 5.2: Pelvic floor imaging: Greenslopes Private hospital Protocol 11/09 and Kagando hospital administration. ACTRN 12618000587202
7. Chapter 6: Treatment-seeking behavior and social status: Greenslopes Private hospital Protocol 11/09 and Kagando hospital administration.
8. Chapter 6: Mental health screening: Greenslopes Private hospital Protocol 15/38 and Kagando hospital administration.
9. Chapter 6: Domestic Violence: Greenslopes Private hospital Protocol 16/13 and Kagando hospital administration. ACTRN 12617001073392.

Australian New Zealand Clinical Trial Registry (ANZCTR)
Registraion number (ACTRN)

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