Implementation of a policy of universal cystoscopy at the time of hysterectomy for benign indications: A retrospective comparative study

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ORIGINAL ARTICLE

Implementation of a policy of universal cystoscopy at the time of hysterectomy for benign indications: A retrospective comparative study

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Background: Lower urinary tract injury (LUTI) is a serious complication of major gynaecologic surgery. Although intra-operative cystoscopy can facilitate timely diagnosis and treatment of LUTI, the optimal approach to cystoscopy at the time of benign hysterectomy remains debatable.

Aims: To assess whether implementation of a policy of universal cystoscopy at the time of benign hysterectomy was associated with a difference in intra-operative detection and rates of LUTI.

Materials and Methods: Retrospective cohort study at a large regional teaching hospital where a policy of universal cystoscopy at the time of benign hysterectomy was implemented on 30 September 2019. Hysterectomies performed from 1 November 2016 to 31 March 2021 were included and categorised into the 'pre-policy' and 'post-policy' groups. Primary outcomes included the intra-operative detection and overall rates of LUTI. Secondary outcome was the policy adherence rate. Multivariate analysis was used to examine the effect of this policy on the outcomes.

Results: There were 584 hysterectomies identified, including 325 in the pre-policy group and 259 in the post-policy group. Cystoscopy was performed in 55.1% in the pre-policy group and 97.7% in the post-policy group ($P < 0.01$). Adjusted for age, indication and route of hysterectomy, there were no significant differences in the intra-operative cystoscopic detection of LUTI (42.9% vs 25.0%, $P = 0.55$) or the rate of LUTI (2.2% vs 1.5%, $P = 0.25$) after implementation of the policy.

Conclusions: The practice of universal cystoscopy at the time of benign hysterectomy has not been associated with a significant change in the intra-operative detection and rates of LUTI at our institution.

KEYWORDS

hysterectomy, lower urinary tract injury, routine cystoscopy

INTRODUCTION

Lower urinary tract injury (LUTI) is a rare but recognised complication of hysterectomy. The risk of such injuries varies widely in the published literature; however, recent analyses using large population databases report a 1.8% overall urinary tract injury rate and 0.78% ureteral injury rate.[1,2] These injuries are one of the main causes of significant morbidity after hysterectomy, especially when diagnosis and treatment are delayed.[3] Cystoscopy is a low-risk low-cost procedure that can improve intra-operative detection of LUTIs,[3] allowing for immediate repair, thus reducing complications due to delayed diagnosis. With up to 75% of urinary tract injuries occurring during uncomplicated hysterectomies without identifiable risk factors, universal cystoscopy allows detection of otherwise unsuspected injuries being missed with selective or no cystoscopy.[4]

The main arguments against universal cystoscopy is the overall low prevalence of urinary tract injuries, additional surgical time and cost involved with cystoscopy.[5] Even with a high sensitivity,[3] universal cystoscopy can still miss some injuries, potentially those caused by delayed thermal effect or defects too small to be visually identified.[6] On the other hand, it has been suggested that some injuries are asymptomatic and will spontaneously resolve, hence universal cystoscopy can lead to overdiagnosis and unnecessary interventions that may pose additional risks to patients.[7]

There is no consensus regarding the optimal approach to cystoscopy at the time of hysterectomy for benign indications. While the American College of Obstetricians and Gynecologists (ACOG) guidelines recommends routine cystoscopy to be considered at the time of laparoscopic total hysterectomy and high-risk procedures (such as prolapse repairs and continence procedures),[8,9] there are no specific recommendations regarding hysterectomies performed for other benign indications or operative routes. With limited local published data and guidelines, the approach to cystoscopy at the time of hysterectomy remains inconsistent among gynaecologists in Australia.

At our institution, a policy of universal cystoscopy at the time of benign hysterectomy was introduced in September 2019. The primary aim of this study was to investigate whether implementation of this policy was associated with an increase in intra-operative detection and decrease in the rates of LUTI. The secondary aim was to evaluate the adherence rate to this policy.

MATERIALS AND METHODS

This is a retrospective cohort study of all hysterectomies performed for benign indications at the Nambour General Hospital from 1 November 2016 to 31 March 2017 and Sunshine Coast University Hospital (the Gynaecology Unit relocated to a newly built hospital location during the study period) from 1 April 2017 to 31 March 2021. The start date was selected as this is when electronic medical records were initiated at the institution, and the end date reflects the time when data collection began. The Sunshine Coast University Hospital Gynaecology Unit is a large regional teaching unit in Australia, led by ten general obstetrician-gynaecologists who perform hysterectomies by various operative routes in routine and complicated cases.

A policy for universal cystoscopy to be performed at the time of all hysterectomies was implemented at our institution on 30 September 2019. Prior to that, cystoscopy was selectively performed at the time of hysterectomy based on surgeons' discretion. Hysterectomies were categorised as the ‘pre-policy’ group if performed between 1 November 2016 to 30 September 2019, and as the ‘post-policy’ group if performed between 1 October 2019 to 31 March 2021. Rigid cystoscopy was performed either by the attending gynaecologist or training registrar (with supervision) at the end of every hysterectomy. A 70-degree cystoscope with water irrigation is used for initial assessment of bladder wall and efflux of urine from ureteric orifices. If sluggish or absent flow of urine from either ureteric orifice was noted, intravenous fluid bolus or indigo-carmine dye would be administered. Persistent absence of ureteric jet would prompt the passage of ureteric catheter on the affected side by the attending gynaecologist or urologist.

The hospitals' electronic medical records, including Medicare Benefits Schedule (MBS) coding data, were used to identify hysterectomy cases, as well as to extract baseline and peri-operative characteristics including age, body mass index (BMI), indication for hysterectomy, route of hysterectomy, concomitant procedures, intra-operative use of cystoscopy, surgical time, primary surgeon and length of hospital stay. Route of hysterectomy included abdominal, laparoscopic and vaginal (including laparoscopic-assisted vaginal hysterectomy). LUTIs were categorised as intra-operative bladder, intra-operative ureteral or delayed (if injuries were detected only after the patient had left the operating theatre after the hysterectomy). Surgical and post-operative complications were identified using MBS coding data and chart review of all hysterectomy cases included in the review. File review confirmed the accuracy of the MBS search, and identified complications that do not have a MBS code. Presentations and admissions to other public hospitals within the state would be identified. However, presentations to general practitioners, private hospitals or hospitals in other states were not included. This research was granted exemption from full ethics approval by The Prince Charles Hospital Human Research Ethics Committee (LNR/2021/QPCH/75878).

A database was created on Microsoft Excel (Microsoft Corp, Redmond, WA, USA) and statistical analysis performed using R Statistical Package (R Development Core Team, Vienna, Austria). Continuous variables with a normal distribution were analysed using Student's *t*-test while those non-normally distributed were assessed with Mann–Whitney *U*-test. Categorical variables were analysed using Fisher's exact test. The outcomes were compared between the two groups using multivariate logistic regression models. *P*-values <0.05 were considered significant.

RESULTS

Between 1 November 2016 and 31 March 2021, there were 594 hysterectomies performed. Ten hysterectomies were excluded for indications of cervical malignancy and peripartum indications – seven from the pre-policy group and three from the post-policy group. Therefore, 584 hysterectomies were included in the final analysis, which included 325 in the pre-policy group and 259 in the post-policy group.

Demographic and peri-operative characteristics of both groups are shown in Table 1. There were no significant differences in BMI and length of stay. Mean age of patients, rates of abdominal hysterectomy and estimated blood loss were increased in the post-policy group compared with the pre-policy group. There were more hysterectomies performed for fibroids, and fewer performed for abnormal uterine bleeding in the post-policy group. Fewer continence surgeries were concomitantly performed in the post-policy group. Median surgical time was increased by 17 min in the post-policy group. More hysterectomies were documented as performed by a training registrar in the post-policy group. Cystoscopy was performed in 97.7% of cases in the post-policy group, which is significantly increased from 55.1% in the pre-policy group. No hospital readmissions or complications related to cystoscopy use were identified in either group.

The overall rate of LUTI was 1.9%, with each case of injury corresponding to one patient. The pre-policy group had a LUTI

TABLE 1 Baseline and peri-operative characteristics of hysterectomies before and after implementation of policy

	Pre-policy (*N* = 325)	Post-policy (*N* = 259)	*P*
Age, years	46.6 ± 10.5	49.2 ± 11.0	**0.004**
Body mass index, kg/m^2	28.6 ± 6.5	28.2 ± 6.2	0.518
Cystoscopy performed	179 (55.1)	253 (97.7)	**<0.001**
Indication for hysterectomy			
Adnexal mass	1 (0.3)	1 (0.4)	0.872
Abnormal uterine bleeding	176 (54.2)	111 (42.9)	**0.008**
Cervical dysplasia	15 (4.6)	17 (6.6)	0.361
Endometrial hyperplasia	5 (1.5)	1 (0.4)	0.234
Endometriosis	7 (2.2)	5 (1.9)	0.850
Fibroids	13 (4.0)	25 (9.7)	**0.007**
Pelvic pain	28 (8.6)	21 (8.1)	0.881
Prolapse	74 (22.8)	68 (26.3)	0.334
Risk reduction	6 (1.8)	8 (3.1)	0.417
Others	0	2† (0.8)	0.196
Route of hysterectomy			
Abdominal	23 (7.1)	56 (21.6)	**<0.001**
Laparoscopic	155 (47.7)	116 (44.8)	0.505
Vaginal	147 (45.2)	87 (33.6)	**0.005**
Concomitant procedures			
None	229 (70.5)	165 (63.7)	0.091
Continence surgery	8 (2.5)	1 (0.4)	0.048
Vagina repair – any	70 (21.5)	66 (25.5)	0.279
Vagina repair – anterior	62 (19.1)	60 (23.2)	0.259
Oopherectomy	27 (8.3)	32 (12.4)	0.128
Others	2‡ (0.6)	1§ (0.4)	0.700
Estimated blood loss, mL	244.8 ± 221.1	306.1 ± 310.4	**0.008**
Surgical time, minutes	120 (90–140)	137 (119–160)	**<0.001**
Length of stay, days	2 (1–2)	2 (1–3)	0.092
Primary surgeon			
Registrar	191 (58.8)	198 (76.4)	**<0.001**
Consultant	134 (41.2)	61 (23.6)	**<0.001**

Data reported as mean ± *SD*, median (interquartile range) or *n* (%).
Bold values indicate *P*-values that were statistically significant < 0.05.
†Both cases were gender-affirming surgeries.
‡One case of removal of broad ligament fibroid, one case of Bartholin's gland cyst excision.
§One case of abdominal wall hernia repair.

rate of 2.2% and the post-policy group had a rate of 1.5%. Using multivariate logistic analysis, adjusted for patient age, indication and route of hysterectomy, this difference was statistically non-significant (odds ratio (OR) 0.45, 95% CI 0.11–1.67, $P = 0.25$) (Table 2).

Taking into account the LUTIs that were identified with direct visualisation prior to performing cystoscopy, there was no significant difference in the cystoscopy detection rates between groups. In the pre-policy group, cystoscopy detected three of the four remaining LUTIs and in the post-policy group, cystoscopy detected one of the two remaining LUTIs.

Peri-operative characteristics of the cases with LUTI in both groups are reported in Table 3. Cystoscopy was performed in 85.7% of LUTI cases in the pre-policy group and in all the cases of the post-policy group. Intra-operative bladder injury, in particular cystostomy, was the most common LUTI in both groups. There were no significant differences between groups in terms of types of LUTI, route of hysterectomy, surgical time and primary surgeon. Table 4 details the 11 cases of LUTI in both groups.

DISCUSSION

This is the first Australian study examining the effects of an institutional policy of universal cystoscopy at the time of benign

TABLE 2 Rates and types of lower urinary tract injuries before and after implementation of policy

	Pre-policy (*N* = 325)	Post-policy (*N* = 259)	*P*	OR (95% CI)
Any lower urinary tract injury	7 (2.2)	4 (1.5)	0.249	0.45 (0.11–1.67)
Intra-operative bladder	5 (1.5)	3 (1.2)	0.267	0.41 (0.07–1.91)
Intra-operative ureteral	1 (0.3)	0	0.997	†
Delayed	1 (0.3)	1 (0.4)	0.812	1.41 (0.05–3.62)
Injuries not already detected by direct visualisation	4 (1.2)	2 (0.8)	0.571	0.60 (0.08–3.27)

Data reported as *n* (%).
†Test may not be valid due to low expected cell counts in some categories.

TABLE 3 Characteristics of lower urinary tract injuries before and after implementation of policy

	Pre-policy (*N* = 7)	Post-policy (*N* = 4)	*P*
Cystoscopy performed	6 (85.7)	4 (100)	0.428
Injury detected with direct visualisation	3 (42.9)	2 (50.0)	0.819
Injury detected with cystoscopy	3 (42.9)	1 (25.0)	0.554
Intra-operative bladder injury	5 (71.4)	3 (75.0)	0.898
Cystotomy	4	3	
Sutures in bladder	1	0	
Intra-operative ureteral injury	1 (14.3)	0	0.428
Kinking	1		
Transection	0		
Ligation	0		
Delayed injury/complications	1 (14.3)	1 (25.0)	0.658
Ureteral obstruction	1	0	
Cystotomy	0	1	
Fistula	0	0	
Route of hysterectomy			
Abdominal	2 (28.6)	3 (75.0)	0.137
Laparoscopic	4 (57.1)	1 (25.0)	0.303
Vaginal	1 (14.3)	0	0.428
Surgical time, minutes	165 (145–210)	180 (165–190)	0.956
Primary surgeon			
Registrar	2 (28.6)	3 (75.0)	0.137
Consultant	5 (71.4)	1 (25.0)	0.137

Data reported as median (interquartile range) or *n* (%).

hysterectomy. Overall, the implementation of the policy was not associated with a significant increase in intra-operative detection of LUTI or difference in the rates of LUTI. These findings are contrary to earlier studies which showed that universal cystoscopy increases intra-operative detection of LUTI[3,4,10] with one retrospective cohort study of 2822 hysterectomies suggesting that it is also associated with a decrease in delayed urologic complications.[5] On the other hand, a recent systemic review which included 79 studies and 41 482 hysterectomies, found that while universal cystoscopy increases intra-operative detection of LUTI by up to five-fold, it does not appear to have much effect on the post-operative injury rate.[3]

The overall prevalence of LUTI associated with benign hysterectomy in our study was consistent with that published in contemporary literature. Although earlier studies which looked at selective cystoscopy at time of hysterectomy reported much lower rates of LUTI, less than 1%,[7,11] these are likely underestimated due to very low rates of cystoscopy use and lack of long-term post-operative follow-up.[5]

The LUTI detection rate using cystoscopy in our study was slightly lower than previously reported at 83–97%.[3,4,12] Of note, in the case of the delayed LUTI in the post-policy group (Table 4, case 10), the patient presented with abnormal vaginal discharge 17 days after surgery and was later diagnosed with cystotomy and urinoma despite an initial intra-operative cystoscopy showing no bladder or ureteric injuries. This highlights the imperfect sensitivity of cystoscopy and difficulty with diagnosing LUTI, particularly injuries secondary to thermal effect, devascularisation or suture necrosis.[3] Additionally, with increasing use of minimally invasive surgery, it is possible that thermal injuries become a more prevalent mechanism of injury,[13] which intra-operative cystoscopy may have limited ability to detect.

In addition to the clinical implications, a common question regarding universal cystoscopy at the time of benign hysterectomy is the cost-effectiveness. The first cost–benefit analysis published in 2001 concluded that universal cystoscopy would be cost saving when incidence of ureteral injury at the time of hysterectomy exceeds 1.5–2.0%.[11] In stark contrast, Cadish et al. in 2019 estimated that universal cystoscopy would only be cost saving if the risk of bladder injury exceeds 20.59–47.24% and ureteral injury 27.22–37.72%, thus suggesting that selective cystoscopy is the preferred approach.[14] More recently, Luchristt et al. in 2021 suggest that universal cystoscopy for laparoscopic hysterectomy would achieve cost efficacy when either the ureteral injury rate alone exceeds 0.25%, bladder injury rate exceeds 1.1% or overall LUTI rate exceeds 0.80%.[15] The different decision analysis models, variation in data used, as well as changes in clinical practice over the decade (such as surgical approach to hysterectomy and treatment of LUTI), has likely contributed to these disparate findings. No doubt, an analysis using local data would be warranted to accurately evaluate the cost-effectiveness of universal cystoscopy at the time of benign hysterectomy in Australia.

There were several significant differences in the peri-operative characteristics of the pre- and post-policy groups. More

TABLE 4 Description of cases with lower urinary tract injuries

Case	Policy	Route of hysterectomy	Indication for hysterectomy	Cystoscopy performed	Injury diagnosed with cystoscopy	Type of injury	Time to injury detection	Treatment
1	Pre	Abdominal	AUB	Yes	No	Cystotomy	Intra-op	Primary repair
2	Pre	Laparoscopic	Fibroids	No	-	Transection of ureter	Day 6	Re-implantation of right ureter by urologist
3	Pre	Laparoscopic	AUB	Yes	Yes	Kinking of ureter	Intra-op	Insertion of right ureteric stent by urologist
4	Pre	Abdominal	Endometriosis	Yes	No	Cystotomy	Intra-op	Primary repair
5	Pre	Vaginal	Prolapse	Yes	Yes	Cystotomy by RPR sling	Intra-op	IDC
6	Pre	Laparoscopic	AUB	Yes	Yes	Cystostomy by suprapubic trocar	Intra-op	Primary repair
7	Pre	Laparoscopic	AUB	Yes	No	Cystotomy	Intra-op	Primary repair
8	Post	Abdominal	Fibroids	Yes	No	Cystotomy	Intra-op	Primary repair
9	Post	Abdominal	AUB	Yes	Yes	Cystotomy	Intra-op	Primary repair and insertion of bilateral ureteric stents by urologist
10	Post	Laparoscopic	AUB	Yes	No	Cystotomy and formation of urinoma	Day 17	Primary repair and insertion of bilateral ureteric stents by urologist
11	Post	Abdominal	AUB	Yes	No	Cystotomy	Intra-op	Primary repair

AUB, abnormal uterine bleeding; IDC, indwelling urinary catheter; RPR, retropubic route.

hysterectomies performed for uterine fibroids in the post-policy group could have resulted in the increased number of hysterectomies performed via the abdominal approach. While it is expected that LUTI rates would increase with more complex surgeries, this was not seen in our study, likely related to the small sample size. The decrease in concomitant continence procedures in the post-policy group is likely reflective of the change in general gynaecology practice after the nationwide introduction of a comprehensive credentialing process in 2018 for health practitioners who undertake transvaginal mesh surgery for stress urinary incontinence and an observed reduction in demand for mesh procedures driven by public perception of the same.

At our institution, the use of cystoscopy at the time of benign hysterectomy is relatively common, with cystoscopy being performed for 55% of the cases even prior to the implementation of policy. This is higher than the reported 20–39% cystoscopy use in studies looking at the selective cystoscopy approach.[12,13,16] The majority of the hysterectomies in our study were performed by low to moderate volume surgeons (<13–20 hysterectomies annually), thus the threshold to perform a cystoscopy may be lower. In addition, cystoscopy may have been intentionally utilised to allow training registrars to gain experience and confidence in the procedure. With increased registrar involvement and higher rates of cystoscopy use in the post-policy group, it is reasonable that surgical time was slightly increased as a result. Nevertheless, there was no evidence of patient harm or complications directly associated with the routine use of cystoscopy in our study.

Limitations of this study include its retrospective nature and potential underestimation of the rate of LUTI if patients presented to other institutions for treatment. The shorter follow-up period of the post-policy group (minimum of six months) may limit our ability to detect delayed urologic complications in this cohort. Due to the sample size and overall low prevalence of LUTI, our study is underpowered to detect a small benefit of universal cystoscopy, although it does provide a snapshot of the trend of LUTI with the implementation of the policy at our institution.

In conclusion, the implementation of a policy of universal cystoscopy at the time of benign hysterectomy has not been associated with a significant change in the intra-operative detection and rates of LUTI at our institution. These findings do not support the use of routine cystoscopy at time of benign hysterectomy. However, we recognise that the majority of LUTIs were diagnosed intra-operatively with the use of cystoscopy. Thus if a policy of universal cystoscopy is not adopted, surgeons need to assess patients for predisposing factors to LUTI, such as enlarged fibroids, endometriosis and history of complicated pelvic surgeries. These patients with distorted anatomy or increased surgical complexity are likely to have the most to gain from undergoing intra-operative cystoscopy. Meticulous surgical technique and sound knowledge of anatomy are other key strategies to reducing the incidence of LUTI and its associated complications.

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