General versus spinal anaesthesia and postoperative delirium in an orthogeriatric population

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ABSTRACT

Aim: Postoperative delirium is common among elderly hip surgery patients. We aimed to pragmatically evaluate whether type of anaesthesia influenced postoperative delirium in an orthogeriatric population following hip fracture.

Method: This observational study comprises prospectively collected data on hip fracture patients admitted between October 2010 and November 2011. Delirium was diagnosed clinically by geriatricians.

Results: Of the 344 patients admitted, seven managed conservatively and 19 with incomplete data were excluded; 318 patients were analysed. Average age was 81.6 (SD 9.8) years; 28% were men and 167 (53%) were administered general anaesthesia. Mean length of stay was 18 (SD 9.4) days. Overall, 172 patients (54%) experienced delirium. There was no apparent difference in postoperative delirium by anaesthetic type (88 vs 84, P = 0.15).

Conclusion: Delirium was common in both general and spinal anaesthetic patients. Further randomised controlled trials would be required to determine whether anaesthesia type influenced delirium rates.

Introduction

Postoperative delirium is common among older hip surgery patients [1]. Hip fracture leads to pain and immobilization, with complications ranging from delirium to functional loss and death [2]. In surgical patients, factors such as age, alcohol abuse, low baseline cognition, severe metabolic derangement, hypoxia, hypotension and type of surgery appear to contribute to postoperative delirium [3]. Anaesthetics, notably anticholinergic drugs and benzodiazepines, increase the risk for delirium [3].

Delirium has been shown to occur less frequently with certain types of anaesthesia [4]. Some studies have shown a tendency towards a lower incidence of delirium and postoperative hypoxia in regional (spinal/epidural) anaesthetic groups com-pared with general anaesthetic groups [4]. Limiting depth of sedation during spinal anaesthesia (SA) with the use of light propofol sedation has been shown to decrease the prevalence of postoperative delirium [5]. Furthermore, the mean number of days of delirium during hospitalisation was also found to be significantly fewer when light sedation was used [5]. However, other studies have found no difference in the effects of general, epidural or spinal anaesthesia on postoperative delirium [3]. A Cochrane review found that regional anaesthesia for hip fracture surgery may reduce acute postoperative delirium and one month (but not long-term) mortality compared with using general anaesthesia (GA) [6]. This review has limitations as the trials included had methodological flaws, in particular regarding concealment of allocation, assessor blinding and intention-to-treat analysis; and many of them did not reflect current anaesthesia practice [6]. Additionally, anaesthetic management has evolved since, with important advances in

safety, suggesting that new research is needed to investigate outcomes following current anaesthesia practices.

The Prince Charles Hospital is a major teaching hospital in Brisbane's north side. The Hip Fracture Unit was established in April 2010 as a single site, co-located partnership between Orthopaedic Surgery and Geriatric Medicine targeting intensive early multidisciplinary rehabilitation for patients with an acute hip fracture. Early geriatrician involvement in medical optimisation of patients, together with theatre accessibility, facilitates early (less than 48 hours) surgical intervention. The multidisciplinary team involvement promotes an early postoperative rehabilitation and discharge from the Unit.

Our aim was to pragmatically evaluate whether the type of anaesthesia in current practice had an influence on the post-operative delirium, other postoperative complications and mortality in a group of orthogeriatric population admitted to the Hip Fracture Unit at the Prince Charles Hospital.

Methods

This observational study investigated the relationship between the type of anaesthesia and incidence of postoperative delirium in hip fracture patients undergoing surgery. Participants were all hip fracture patients admitted over a one-year period between October 2010 and November 2011 to the Hip Fracture Unit at the Prince Charles Hospital.

Data were collected prospectively using a data sheet commenced by the medical registrar on admission to the unit, continued at the weekly multidisciplinary team meeting during the inpatient hospital stay and completed at time of discharge. Data were then entered onto database. Clinical and demographic information collated included patient characteristics such as age, sex, preadmission cognition and comorbidities. Surgical information collated included type of fracture, type of surgery, type of anaesthesia, development of delirium and its duration, and other

postoperative complications. Hospital length of stay, discharge destination and death during the one-year period post-discharge were also collected. The type of surgery and type of anaesthesia used were identified from postoperative and anaesthetic notes, respectively. Where the spinal and general groups were not clearly separated or were mixed, for example combined spinal and GA patients and spinal and sedation patients either with propofol or midazolam, they were collapsed into the GA group. The choice regarding type of anaesthesia was made by the treating anaesthetist and was based, in part, on the preference of the anaesthetist and patient involved, clinical characteristics of the patient such as patient cooperation and tolerance, comorbidities, anatomic and physiologic considerations; medications, availability of equipment for monitoring, and resuscitation and suitability for surgical procedure as per the 30th Annual European Society of Regional Anaesthesia [7]. Postoperatively opioid analgesia was provided to all patients at a dose tolerated and early mobilisation was also encouraged.

The primary outcome of interest was incidence of postoperative delirium occurring during the hospital admission. Delirium was diagnosed at daily visits by treating geriatricians using clinical judgement and a behavioural observation chart based on the Pittsburgh Agitation Scale [8], Verbal Pain Scale [9] and Pain Assessment in Advanced Dementia Scale [10]. The duration of delirium was also discussed and documented at the geriatrician-led weekly multidisciplinary team conference. Secondary outcomes included other postoperative complications including wound infection and deep vein thrombosis. These were assessed clinically and diagnosed with appropriate investigation modalities that included blood tests, urine analysis, x-rays and ultrasound scans. Post-operative complications were also documented at weekly multidisciplinary team conference. Data on post discharge individual patient mortality were accessed through the Department of Justice, Births, Deaths and Marriages.

Ethics approval was obtained from Metro North Human Research Ethics Committee (HREC) to carry out the research. The HREC also approved accessing data on post-discharge individual patient mortality through the Department of Justice, Births, Deaths and Marriages.

Patients managed conservatively and those who had incomplete data were all excluded from the study prior to analysis. The data were analysed using SPSS 21.0 software. Descriptive analyses were conducted for all variables. Between-group differences for type of anaesthesia and incidence of delirium were calculated using $\chi 2$ analysis or parametric equivalent, and a P value of ≤ 0.05 was considered to be statistically significant.

Results

Three hundred and forty-four patients were admitted with a fracture neck of femur to the Hip Fracture Unit. Seven patients who were managed conservatively and 19 patients who had incomplete data were excluded from the study, resulting in a total of 318 patients being analysed. One hundred and sixty-seven patients underwent GA and 151 patients underwent SA. Baseline characteristics of these patients were similar, as shown in Table 1. The average age of the patients was 81.6 (SD 9.8) years, and ranged between 48 and 103.

Baseline characteristics of patients against postoperative delirium are shown in Table 2. Overall, 172 patients (54%) experienced delirium. Patients who experienced postoperative delirium were older, cognitively impaired, and had comorbid dementia, malnutrition or ischaemic heart disease ($P < 0.05$). There was no difference in the type of anaesthesia received for the type of fracture or type of surgery performed.

No difference was noted in patients who experienced postoperative delirium for each type of anaesthesia (84 vs 88, $P = 0.15$). There was no difference between the anaesthesia groups for those who mobilised late (>48 hours) for any complication. The average length of stay was 18 days, with a

range between three and 65 days. Overall, 75 (24%) patients had died at 12 months postoperatively; 20% of the GA cohort and 27% of the SA cohort (P = 0.015).

Discussion

Patients of the Hip Fracture Unit at The Prince Charles Hospital underwent general or spinal anaesthesia for their operation. Statistically, the type of anaesthesia did not influence the incidence of postoperative delirium or one-year mortality in this orthogeriatric population. However, slightly more patients who received SA experienced postoperative delirium (58% vs 50%) and had higher rates of one-year mortality (27% vs 20%) compared with those who received GA. This is a surprising finding given that it perhaps was reasonable to expect that those who received SA may have had lower delirium incidence and mortality rate.

More than half of our patients experienced delirium at some point during their postoperative recovery. This is consistent with that reported for hip fracture surgery patients over 60 years of age in the Australian Clinical Practice Guidelines (40.5–55.9%) [11]. We found that patients who experienced delirium were older, had comorbid physical illnesses with cognitive impairment and were more frequently admitted from a residential aged-care facility. Although we did not find statistically significant differences in these baseline characteristics of our patients, those who received SA were older and were more likely to have cognitive impairment on admission, a diagnosis of dementia, ischaemic heart disease, chronic obstructive pulmonary disease, anxiety and/or depression; malnourished; and from a residential aged-care facility. Perhaps, the cumulative small differences between the two cohorts were sufficient to counter any possible benefit anticipated with the use of SA.

Many of these characteristics have previously been shown to be significant for the development of delirium. These characteristics include lower preoperative cognitive test performance, severe

physical comorbidity [1] and more than four prescribed drugs at admission [12]. Additionally, multivariate analysis has shown that the presence of underlying dementia, duration of surgery more than two and a half hours and preoperative packed cell volume <25 were independent predisposing risk factors that were associated with the development of postoperative delirium [13]. Increasing age, duration of anaesthesia, little education, a second operation, postoperative infections and respiratory complications are identified risk factors for early postoperative delirium [14]. These findings suggest that there are multiple factors that could contribute to postoperative delirium and is difficult to isolate any one as the cause.

However, other factors may also have contributed to our non-significant finding. One such factor may be selection bias demonstrated by the anaesthetists. Detailed reasons for the choice of anaesthesia were not collected. However, it is possible that 'high risk' patients such as those who were older with relevant pre-existing comorbidities were identified and subsequently received SA. Conversely, for patients deemed by the anaesthetist as potentially uncooperative, the choice of GA may have been more likely. Additionally, personal preference may have also influenced anaesthetic choice. There are a number of factors that are considered in patient selection for a type of anaesthesia. The 30th Annual European Society of Regional Anaesthesia stated that making a proper selection of patient for regional anaesthesia must take into account several factors: (i) patient's level of cooperation and tolerance for the procedure; (ii) evaluation of coexisting morbidities like previous neurologic disease, coagulation abnormality, respiratory pathology, diabetic neuropathy, infection at the site of injection and allergy to local anaesthetics; (iii) anatomic and physiologic considerations; (iv) medication taken by the patient; (v) availability of proper equipment for monitoring and resuscitation; and (vi) technique that is suitable for surgical procedure and executed by a skilled anaesthesiologist [7]. Regardless, the clinical decision made by the treating anaesthetists may have contributed to the similar incidence of delirium across the two cohorts.

A multifactorial intervention program based on early, intensified care and supporting treatment has been shown to reduce the incidence of delirium during hospitalization in older hip fracture patients who were lucid at admission [11]. The Hip Fracture Unit at the Prince Charles Hospital endeavours to implement evidence-based practice using a similar approach [11], aiming to optimise outcomes for its patients using a multidisciplinary co-management approach, including medical specialists and rehabilitation, that is thought to maximize patient recovery in older adults with a hip fracture [2]. Therefore, it is possible that the geriatrician coordinated, early, intensive rehabilitation management program minimised any differences in delirium development regardless of anaesthesia type. Caution however, must be exercised in making such observations as this study was pragmatic and not designed to answer such a question. A randomised controlled trial would be required to specifically answer this question, although the ethical issues around providing GA to high-risk groups such as frail older people following hip fracture may limit such a study ever being conducted.

The surgical procedure that the majority of our patients underwent was arthroplasty or fixation with pin and plate. This was similar in both general and spinal anaesthesia cohorts. Surgical intervention is preferable to nonsurgical treatment of fractures in the medically stable patient [15]. Non-surgically treated patients appear to be at higher risk for complications such as pressure areas, pneumonia and deep vein thrombosis [15]. Managing displaced femoral neck fractures with total hip arthroplasty (THA) in the cognitively intact older patient is well supported in the literature [16]. Compared with hemiarthroplasty, THA appears to offer a more durable result and predictable pain relief with better functional outcomes, but with an increased risk of complications, such as dislocation [17]. Non-ambulatory patients and those with very poor mental status are best treated with hemiarthroplasty [17]. The surgeon may take into account the patient's mental status, living arrangement (i.e. home vs care facility), level of independence or activity, and the quality of bone or joint, when choosing between hemiarthroplasty and THA [17]. Younger, more active patients benefit more from THA than older, less active patients [17].

In our study, all patients who underwent GA were administered propofol, midazolam and morphine or fentanyl intravenously. Our SA cohort received bupivacaine with morphine or fentanyl administered intrathecally, together with smaller doses of midazolam, propofol or even ketamine to provide lighter sedation. It is possible that the combination of these medication types influenced the incidence of delirium in our cohort. Sieber et al. found that the prevalence of postoperative delirium was significantly lower in light sedation than in deep sedation [5]. On the other hand, Casati et al. showed that induction and maintenance with sevoflurane provide a rapid emergence from anaesthesia without more depression of post-operative cognition compared with SA [18]. However, several other studies have shown no difference in the effects of general, epidural or spinal anaesthesia on postoperative delirium [3]. It has also been shown that there is no significant difference in the incidence of cognitive dysfunction three months after either general or regional anaesthesia in older patients [16]. The alterations to superior brain functions are thought to be probably related to intra- and postoperative incidents rather than to the type of anaesthesia administered [19]. Our study finding seems to be consistent with this, but both cohorts having had similar drugs, even in smaller doses, might have also negated any individual effect of the anaesthesia type.

It is possible that postoperative delirium may have been influenced by the level of pain relief provided, including the type of medication and route of administration. Postoperatively, all patients in our study were on opioid analgesia. They were given regular doses of paracetamol and oxycontin, together with endone for intermittent pain or prior to mobilising. This may have contributed to postoperative delirium. A systematic search of the PubMed and CINAHL databases identified studies comparing different opioid analgesics on postoperative delirium and cognitive decline, and the current evidence has not shown a significant difference among more frequently used postoperative opioids such as morphine, fentanyl or hydromorphone [20]. As specific data were not available on types and doses of administered postoperative medication a relationship between medication and postoperative delirium cannot be completely ruled out.

Our study found no difference in postoperative complications, length of stay, discharge destination or one-year mortality between the general and spinal anaesthesia groups. In contrast, Urwin et al. showed that there was a tendency towards a lower incidence of myocardial infarction, delirium and postoperative hypoxia in the regional anaesthetic group, and cerebrovascular accident and intra-operative hypotension in the GA group [4]. Rasmussen et al. showed that regional anaesthesia may decrease mortality after surgery [21]. It has also been shown that multiple outcomes, including perioperative complications and length of hospital stay, are positively affected by the choice of neuraxial (spinal and epidural) versus GA [22].

Limitations

This paper reports the outcomes of a purpose-designed Hip Fracture Unit; a unit established with both orthopaedic and geriatric medicine specialty management. Although care protocols and pathways and a detailed patient database were established, not all clinically relevant information was able to be recorded for all patients. Patients, for example, who were delirious on admission, prior to the anaesthesia, were not properly documented in our study. The diagnosis of delirium was made subjectively and no objective tools such as the CAM (confusion assessment method), which is a valid instrument for the diagnosis of delirium [23], were used. However, the behavioural observation chart was used in this Unit to facilitate the diagnosis. The distinction between GA and SA was purely based on documented notes; although the same drugs were administered in both cohorts, there were no data on depth of sedation, and those who had subsequent GA, for example following failed SA, were not identified; SA and GA was not able to be clearly separated during audit data collection. Consequently, the findings here may not truly reflect either SA or GA. Additionally, detailed tracking of clinical decision-making, such as anaesthesia selection and postoperative pain management, was also unable to be collected. These factors pose limitations to definitively examining the association between the type of anaesthesia and postoperative delirium.

This study highlights the complexities of clinical management of older patients following a fractured neck of femur. We found no association between the type of anaesthesia used and the incidence of delirium in this cohort. We believe that a key reason for this finding involves the extensive clinical decision-making regarding surgery and anaesthesia choice, postoperative pain management as well as the multidisciplinary management implemented in this unit. Such pragmatic and real-world clinical care of this frail older people cohort is important to report to inform clinical practice.

Conclusion

The type of anaesthesia used in this Hip Fracture Unit orthogeriatric population did not appear to influence the incidence of postoperative delirium, postoperative complications or one-year mortality. Further prospective randomized studies with defined general and spinal anaesthesia criteria, using objective delirium assessment tools, are needed to confirm these findings.

Acknowledgement

The authors are grateful to Dr Sophie Jayamaha, Consultant Anaesthetist, The Prince Charles Hospital, Brisbane and to the multidisciplinary members of the orthogeriatric service for data collection undertaken within the scope of routine clinical practice.

Key Points

- Following hip fracture, 87% of this orthogeriatric population underwent arthroplasty or pin and plate fixation.
- Delirium is common following hip fracture in frail older people.

- There was no apparent difference in the incidence of delirium when considering basic measures of spinal versus general anaesthesia.

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Table 1: Baseline characteristics and type of anaesthesia

Characteristic	Total (n = 318)	General (n = 167)	Spinal (n = 151)	P
Gender (M/F) *n* (%)	89/229 (28/72)	47/120 (28/72)	42/109 (28/72)	0.95
Age, years Mean (SD)	81.6 (9.8)	81.3 (10.5)	82.1 (9.0)	0.49
Pre admission cognition impaired *n* (%)	152 (48)	76 (46)	76 (50)	0.35
Admission source *n* (%)				0.40
Home	204 (64)	110 (66)	94 (62)	—
Residential aged-care facility	86 (27)	44 (26)	42 (28)	—
Hospital	23 (7)	9 (5)	14 (9)	—
Rehab/interim care/other	5 (2)	4 (2)	1 (1)	—
Comorbid illness *n* (%)				
Ischaemic heart disease	92 (29)	47 (28)	45 (30)	0.74
Congestive cardiac failure	40 (13)	22 (13)	18 (12)	0.76
Atrial fibrillation	44 (14)	28 (17)	16 (11)	0.11
Osteoporosis	97 (31)	49 (29)	48 (32)	0.65
Malignancy	51 (16)	28 (17)	23 (15)	0.66
Diabetes	53 (17)	28 (17)	25 (17)	0.96
Chronic obstructive pulmonary disease	39 (12)	16 (10)	23 (15)	0.12
Stroke	43 (14)	25 (15)	18 (12)	0.43
Dementia	91 (29)	44 (26)	47 (32)	0.36
Neurodegenerative disorder	18 (6)	9 (5)	9 (6)	0.81
Anxiety/depression	64 (20)	31 (19)	33 (22)	0.44
Malnutrition	123 (39)	59 (35)	64 (42)	0.37

Table 2: Baseline characteristics and postoperative delirium

Characteristic	Total (n = 318)	Postoperative delirium present (n = 172)	Postoperative delirium absent (n = 146)	P
Gender (M/F) *n* (%)	89/229 (28/72)	52/120 (30/70)	37/109 (25/75)	0.58
Age, years Mean (SD)	81.6 (9.8)	84.2 (8.7)	78.7 (10.3)	0.00
Pre admission cognition impaired *n* (%)	152 (48)	120 (70)	32 (22)	0.00
Admission source *n* (%)				0.06
Home	204 (64)	97 (56)	107 (73)	—
Residential aged-care facility	86 (27)	60 (35)	26 (18)	—
Hospital	23 (7)	13 (8)	10 (7)	—
Rehab/interim care/other	5 (2)	2 (1)	3 (2)	—
Comorbid illness *n* (%)				
Ischaemic heart disease	92 (29)	60 (35)	32 (22)	0.03
Congestive cardiac failure	40 (13)	26 (15)	14 (10)	0.11
Atrial fibrillation	44 (14)	24 (14)	20 (14)	0.84
Osteoporosis	97 (31)	58 (34)	39 (27)	0.13
Malignancy	51 (16)	29 (17)	22 (15)	0.72
Diabetes	53 (17)	34 (20)	19 (13)	0.1
Chronic obstructive pulmonary disease	39 (12)	20 (12)	19 (13)	0.51
Stroke	43 (14)	28 (16)	15 (10)	0.17
Dementia	91 (29)	74 (43)	17 (12)	0.00
Neurodegenerative disorder	18 (6)	10 (6)	8 (5)	0.80
Anxiety/depression	64 (20)	35 (20)	29 (20)	0.77
Malnutrition	123 (39)	81 (47)	42 (29)	0.00