General Versus Spinal Anesthesia: Which is a Risk Factor for Octogenarian Hip Fracture Repair Patients?

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SUMMARY

Background: Most studies have shown no difference between the two types of anesthesia administered to hip fracture patients. This study compared postoperative morbidity and mortality in octogenarian patients who received either general or spinal anesthesia for hip fracture repair.
Methods: We retrospectively analyzed the hospital records of 335 octogenarian patients who received hip fracture repair in our teaching hospital between 2002 and 2006. A total of 167 and 168 patients received general and spinal anesthesia, respectively. Morbidity, mortality, and intraoperative and preoperative variables were compared between groups.
Results: There were no mortality differences between spinal and general anesthesia groups. However, the overall morbidity was greater in the general anesthesia group than in the spinal anesthesia group (21/167 [12.6%] vs. 9/168 [5.4%]; $p=0.02$). Respiratory system-related morbidity was also higher in the general anesthesia group than in the spinal anesthesia group (11/167 [6.6%] vs. 3/168 [1.8%]; $p=0.03$). Logistic regression analysis revealed two significant predictors of postoperative morbidity: anesthesia type (general; odds ratio, 2.39) and preexisting respiratory diseases (odds ratio, 3.38).
Conclusion: General anesthesia increased the risk of postoperative morbidity in octogenarian patients after hip fracture repair, and patients with preexisting respiratory diseases were especially vulnerable. Spinal anesthesia is strongly recommended in such individuals. [International Journal of Gerontology 2010; 4(1): 37–42]

Key Words: elderly, general anesthesia, hip fracture, spinal anesthesia

Introduction

Hip fractures in elderly patients can lead to life-threatening complications and increased mortality[1,2]. The geriatric population in Taiwan, comprising almost 10% of the whole population in 2008, is progressively increasing[3]. Although recovery is slow, surgery is generally very effective for the repair of hip fractures. General and spinal anesthesia are the predominant forms of anesthesia employed for this type of surgery. Extensive procedures typically use general anesthesia; these gaseous or intravenous medications achieve central neurologic depression, and can suppress all protective reflexes, such as coughing and even breathing. In contrast, spinal anesthesia is induced by injecting a

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drug solution into the spinal fluid. This leads to numbness and usually muscular weakness in the lower part of the body, but the patient remains conscious during the procedure, similar to epidural anesthesia.

Numerous reports have compared anesthesia methods and outcomes in hip fracture surgery patients, but no definite consensus has yet arisen as to whether mortality and morbidity can be improved using spinal anesthesia instead of general anesthesia. Several hip fracture repair studies (with various end points) found no differences between spinal and general anesthesia on the outcome of patient morbidity and mortality[4–7]. Conversely, other studies found that regional anesthesia (spinal or epidural) was associated with decreased negative outcomes after hip fracture repair[8], total hip replacement[9] or surgical procedures in general[10].

In our institution, we have noted that the older patients tend to be given spinal anesthesia by anesthesiologists during routine surgical procedures. A previous multicenter retrospective study compared the outcome of hip fracture patients given spinal or general anesthesia and found no difference between these two groups, but the observation that older patients tend to be given spinal anesthesia by anesthesiologists was noted accidentally[7]. This finding implies that most studies show no difference between the two types of anesthesia in hip fracture patients, but in very old patients, most anesthesiologists still prefer to use spinal anesthesia. Therefore, this study aimed to assess whether spinal anesthesia is indeed superior to general anesthesia by causing lower morbidity and mortality in very old patients (≥80 years) undergoing hip fracture repair.

Patients and Methods

Patients

The study was conducted in a university-affiliated, teaching tertiary care center in middle Taiwan. A total of 421 octogenarian patients underwent hip fracture repair in the teaching medical center between 2002 and 2006. Patients with multiple fractures (46 cases), with pathologic fractures (three cases), with other acute diseases when admitted (13 cases), or with patient-controlled analgesia (four cases), were excluded from analysis. Patients who received both spinal and general anesthesia (21 cases) were also excluded. The resulting study population included 335 patients (189 men and 146 women), with an age range from 80 to 99 years.

Variables

Preoperative risk factors for surgery were recorded, including age, sex, underlying diseases, and American Society of Anesthesiologists physical classification (a scale with six designations ranging from a normal healthy patient to a declared brain-dead patient whose organs were removed for donation). Underlying diseases included hypertension, diabetes mellitus, heart disease (congestive heart disease, coronary artery disease, history of myocardial infarction, valvular heart disease, hypertrophic obstructive cardiomyopathy, complete atrioventricular block, atrial fibrillation, sick sinus syndrome, and paroxysmal sinus ventricular tachycardia), respiratory disease (chronic obstructive pulmonary disease, pulmonary tuberculosis, and asthma), history of cerebrovascular accident, and parkinsonism. Intraoperative variables, including blood loss and operation time, were also noted. Procedure-related mortality and morbidity were reviewed and recorded. Perioperative death was defined as deaths that occurred in the hospital due to underlying disease or complications. Morbidity was defined as any perioperative complication that occurred before discharge, including pneumonia, respiratory failure, pleural effusion, delirium, cerebrovascular accident, gastrointestinal bleeding, exacerbated chronic obstructive pulmonary disease, acute renal failure, and cardiac events. Cardiac events were defined as any type of arrhythmia, angina, myocardial infarction, and congestive heart failure.

Spinal anesthesia and general anesthesia

After evaluating the patient conditions of the 335 patients enrolled, the anesthesiologists determined whether the procedure called for general or spinal anesthesia. In total, 167 patients received general anesthesia and 168 patients received spinal anesthesia. Spinal and general anesthesia were induced following standard procedures. Briefly, for spinal anesthesia, lumbar puncture was performed using a 25-gauge needle. When free flow of cerebrospinal fluid was evident, 8–15 mg of bupivacaine was injected. For general anesthesia, patients received intravenous thiopental, a muscle relaxant (atracurium), and narcotic (fentanyl). Mechanical ventilation and inhalation anesthetics were delivered through an endotracheal tube. Central venous pressure was monitored in patients with cardiovascular or lung diseases. During the period of anesthesia for surgical intervention, relevant patient conditions and related events were recorded.

Statistical analysis

Continuous and categorical variables were compared using Student *t* test and χ^2 or Fisher exact test, respectively. Nonparametric data (operation time, blood loss, hospital stay, and creatinine and albumin concentrations) were compared using the Mann-Whitney *U* test. Logistic regression was employed to analyze the odds ratio for age and significant risk factors ($p < 0.2$ in univariate analysis) associated with morbidity. All statistical analyses were performed using SPSS version 15.0 (SPSS Inc., Chicago, IL, USA). A *p* value of < 0.05 was considered to indicate statistical significance.

Results

A total of 335 patients enrolled in our series, including 167 patients receiving general anesthesia and 168 patients receiving spinal anesthesia. Descriptive statistics for preoperative variables in patients who received general or spinal anesthesia are shown in Table 1. Interestingly, patients in the spinal anesthesia group were relatively older than those in the general anesthesia group ($p = 0.02$). Compared with the spinal anesthesia group, the general anesthesia group had more patients with hypertension (111/167 [66.5%] vs. 86/168 [51.2%]; $p = 0.004$) and diabetes mellitus (31/167 [18.6%] vs. 18/168 [10.7%]; $p = 0.04$). The remaining underlying diseases, including heart disease, respiratory disease, parkinsonism, history of cerebrovascular accident and malignancy, were not statistically different between the anesthetic groups. The American Society of Anesthesiologists physical classification, as shown in Table 1, were not significant different between the groups.

Intraoperative and postoperative variables, and morbidity and mortality analysis, are presented in Table 2. When compared with spinal anesthesia operations, general anesthesia operations had longer durations (165 minutes vs. 150 minutes; $p < 0.001$), greater blood loss (250 mL vs. 200 mL; $p = 0.01$), and longer hospital stay (9 days vs. 8 days; $p = 0.04$). Overall mortality was not different between the general and spinal anesthesia groups (5/167 [3.0%] vs. 2/168 [1.2%]; $p = 0.25$). However, the overall morbidity was more than twofold higher in the general anesthesia group compared with the spinal anesthesia group (21/167 [12.6%] vs. 9/168 [5.4%]; $p = 0.02$). The main postoperative complications are shown in Table 3. The most frequent postoperative

Table 1. *Preoperative characteristics of the general and spinal anesthesia groups**

Variable	General anesthesia group ($n = 167$)	Spinal anesthesia group ($n = 168$)	$p^\dagger$
Age, mean ± SD (yr)	83.96 ± 3.71	84.93 ± 4.04	0.02
Sex			
Male	95 (56.9)	94 (56.0)	0.86
Female	72 (43.1)	74 (44.0)	
Hypertension	111 (66.5)	86 (51.2)	0.004
Diabetes mellitus	31 (18.6)	18 (10.7)	0.04
Heart disease	51 (30.5)	50 (29.8)	0.88
Respiratory disease	132 (79.0)	128 (76.2)	0.53
Parkinsonism	7 (4.2)	12 (7.1)	0.24
History of CVA	23 (13.8)	22 (13.1)	0.86
Malignancy	5 (3.0)	3 (1.8)	0.50
ASA physical classification			
Class 2‡	47 (28.8)	45 (26.9)	0.80
Class 3§	115 (70.6)	120 (71.9)	
Class 4‖	1 (0.6)	2 (1.2)	

**Data are presented as n (%); †Mann-Whitney U test for continuous variable, and χ^2 test or Fisher exact test for categorical variables; ‡mild systemic disease; §severe systemic disease, but not incapacitating; ‖severe systemic disease that is a constant threat to life. SD = standard deviation; CVA = cerebrovascular accident; ASA = American Society of Anesthesiologists.*

Table 2.	*Intraoperative and postoperative variables in the general and spinal anesthesia groups*		
Variable	General anesthesia group ($n = 167$)	Spinal anesthesia group ($n = 168$)	p*
Operation duration, median (range), min	165 (85–512)	150 (80–295)	<0.001
Blood loss, median (range), mL	250 (0–1,600)	200 (0–1,200)	0.01
Hospital stay, median (range), d	9 (4–45)	8 (2–92)	0.04
Morbidity†, n (%)	21 (12.6)	9 (5.4)	0.02
Respiratory	11 (6.6)	3 (1.8)	0.03
Mortality, n (%)	5 (3.0)	2 (1.2)	0.25

**Mann-Whitney U test for continuous variable, and χ^2 test or Fisher exact test for categorical variables; †pneumonia, pleural effusion, respiratory failure, delirium, cerebrovascular accident, gastrointestinal bleeding, chronic obstructive pulmonary disease exacerbation, acute renal failure, cardiac event, and renal failure.*

Table 3.	*Number of cases of postoperative complications*		
Postoperative complication	General anesthesia	Spinal anesthesia	Total*
Pneumonia	9	3	12
Delirium	6	1	7
Gastrointestinal bleeding	4	3	7
Acute renal failure	2	1	3
Cardiac event	0	2	2
CVA/stroke	1	0	1
Acute exacerbation of COPD	1	0	1
Respiratory failure	1	0	1
Pleural effusion	0	1	1

**Total does not equal the number of patients with a postoperative complication because some patients had more than one complication. CVA = cerebrovascular accident; COPD = chronic obstructive pulmonary disease.*

Table 4.	*Results from logistic regression analysis of morbidity risk factors*		
Variable	Odds ratio	95% confidence interval	p
Age	1.06	0.97–1.17	0.21
Operation time	1.01	1.00–1.01	0.20
Hypertension	1.71	0.71–4.16	0.23
Heart disease	1.69	0.75–3.79	0.20
Respiratory disease	3.38	1.48–7.71	0.004
Anesthesia type			
Spinal	1.00		
General	2.39	1.00–5.67	0.049

complications were pneumonia ($n = 9$), delirium ($n = 6$), and gastrointestinal bleeding ($n = 4$) in the general anesthesia group. There were only three cases of pneumonia and three cases of gastrointestinal bleeding in the spinal anesthesia group. Respiratory-specific morbidity, including pneumonia, acute exacerbation of chronic obstructive pulmonary disease and respiratory failure, were more than threefold higher in the general anesthesia group than in the spinal anesthesia group (11/167 [6.6%] vs. 3/168 [1.8%]; $p = 0.03$), as shown in Table 2.

Table 5.	*Results from logistic regression analysis of respiratory morbidity risk factors*		
Variable	Odds ratio	95% confidence interval	p
Male sex	2.42	0.63–9.27	0.20
Age	1.03	0.90–1.19	0.69
Respiratory disease	4.93	1.60–15.23	0.006
Anesthesia type			
Spinal	1.00		
General	4.75	1.25–18.03	0.02

Tables 4 and 5 show the results from the logistic regression analysis pertaining to overall and respiratory-specific morbidity. Preexisting respiratory disease and anesthesia type (general) were significant predictors of morbidity ($p = 0.004$ and $p = 0.049$, respectively; Table 4). Unsurprisingly, preexisting respiratory disease was a significant risk factor for postoperative respiratory morbidity, as was general anesthesia ($p = 0.006$ and $p = 0.02$, respectively; Table 5).

Discussion

Several recent reports, with various end points, indicated that the method of anesthesia did not influence morbidity or mortality following surgery[4–7]. In 2006, a systematic review[11] comparing mortality and morbidity after hip fracture surgery conducted under either regional or general anesthesia showed that regional anesthesia significantly reduced the 1-month mortality, deep venous thrombosis, blood loss, and postoperative confusion. However, when the oldest trial (with high mortality) was excluded, the difference in 1-month mortality was no longer significant. In newer studies[12,13], once modern thromboprophylaxis was used, the protective effect of regional anesthesia against thromboembolic events became less obvious. Improvements in perioperative management have increased the safety of operative procedures to the extent that any benefit attributable to anesthetic intervention is no longer obvious[12,13]. Therefore, even large trials may not have enough power to detect differences in outcomes between regional and general anesthesia[5,7].

In a large trial (6,206 patients) by O'Hara and colleagues[7], which found no difference in outcomes between general and spinal anesthesia, the patient age was 60 years or older. The same result was seen by Koval et al.[4] when the patient age was 65 years or older. By contrast, our study focused on patients 80 years and older. Such elderly patients typically have a higher incidence of existing medical problems and a reduced capacity for physiologic compensation[6]. Hence, any influence, even a slight one, of the anesthesia method upon recovery would likely be exacerbated in such individuals. That likely explains why our results showed a difference of morbidity between the two types of anesthesia techniques, when other studies could not. We found that surgery duration and intraoperative blood losses were significantly decreased in spinal anesthesia patients. These findings are consistent with those from another study[11], and may in part explain the decreased morbidity in the spinal anesthesia group. The length of hospital stay is surprisingly not longer in the general anesthesia group, because the mortality (even though not significant) and morbidity was increased in the general anesthesia group.

In our series, the incidences of preexisting hypertension and diabetes mellitus were higher in general anesthesia patients, but the patients who received spinal anesthesia were older. Evidently, patient characteristics and underlying diseases may have influenced the method of anesthesia employed by the anesthesiologist.

Logistic regression analysis revealed that anesthesia type and a history of respiratory disease were significant predictors of both overall and respiratory-specific postoperative morbidity. Preexisting respiratory disease obviously should predict postoperative respiratory complications; however, it is interesting that anesthesia type also affected respiratory morbidity. The increased respiratory morbidity in general anesthesia patients, as opposed to spinal anesthesia patients, may be related to the endotracheal intubations required for general anesthesia. Indeed, it has been reported that a relatively high percentage of patients who received intubation/mechanical ventilation suffer from associated respiratory complications, namely pneumonia[14]. Adverse pulmonary outcomes after anesthesia and surgery are often attributed to anesthesia care. Perioperative pulmonary complications are a significant concern for anesthesia caregivers, because anesthesiology drugs and techniques can temporarily decrease lung volume, impair airway reflexes, limit immune function, and depress secretion mobilization[15].

This study had several limitations. First, the surgical complexity (type of fracture) was not evaluated. This may have impacted the operation duration and blood loss. A second limitation was the small sample size. Although we excluded some postoperative complications that theoretically should not be related to anesthesia, such as wound infection and urinary tract infections, several of the included complications may not have been directly related to the anesthesia method. Furthermore, this study was retrospective in nature. Therefore, the patient characteristics could not be controlled, which may have impacted the outcome. Further studies with larger patient populations and more detailed analysis of postoperative complications are warranted.

In summary, our findings suggest that general anesthesia during hip fracture repair increases the risk of overall and respiratory-specific postoperative complications in octogenarian patients. To our knowledge, no definitive studies have yet indicated that general anesthesia confers benefits over spinal anesthesia in such elderly patients undergoing hip fracture repair. Therefore, taken together with our and others' findings, the use of spinal anesthesia in such elderly patients might be the safer option.

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References

1. Parker M, Johansen A. Hip fractures. BMJ 2006; 333: 27–30.
2. Söderqvist A, Ekström W, Ponzer S, et al. Prediction of mortality in elderly patients with hip fractures: a two-year prospective study of 1,944 patients. Gerontology 2009; 55: 496–504.
3. Chang WH, Huang CH, Tsai CH. Survey of elderly trauma patients with prolonged emergency department stays. Int J Gerontol 2008; 2: 215–21.
4. Koval KJ, Aharonoff GB, Rosenberg AD, et al. Hip fracture in the elderly: the effect of anesthetic technique. Orthopedics 1999; 22: 31–4.
5. Sutcliffe AJ, Parker M. Mortality after spinal and general anaesthesia for surgical fixation of hip fractures. Anaesthesia 1994; 49: 237–40.
6. Gilbert TB, Hawkes WG, Hebel JR, et al. Spinal anesthesia versus general anesthesia for hip fracture repair: a longitudinal observation of 741 elderly patients during 2-year follow-up. Am J Orthop 2000; 29: 25–35.
7. O'Hara DA, Duff A, Berlin JA, et al. The effect of anesthetic technique on postoperative outcomes in hip fracture repair. Anesthesiology 2000; 92: 947–57.
8. Urwin SC, Parker MJ, Griffiths R. General versus regional anaesthesia for hip fracture surgery: a meta-analysis of randomized trials. Br J Anaesth 2000; 84: 450–5.
9. Rodgers A, Walker N, Schug S, et al. Reduction of postoperative mortality and morbidity with epidural or spinal anaesthesia: results from overview of randomised trials. BMJ 2000; 321: 1493–7.
10. Mauermann WJ, Shilling AM, Zuo Z. A comparison of neuraxial block versus general anesthesia for elective total hip replacement: a meta-analysis. Anesth Analg 2006; 103: 1018–25.
11. Parker MJ, Handoll HH, Griffiths R. Anaesthesia for hip fracture surgery in adults. Cochrane Database Syst Rev 2004; (4): CD000521.
12. Gulur P, Nishimori M, Ballantyne JC. Regional anaesthesia versus general anaesthesia, morbidity and mortality. Best Pract Res Clin Anaesthesiol 2006; 20: 249–63.
13. Bajaj P. Regional anesthesia versus general anesthesia: is there an impact on outcome after major surgery? Indian J Anaesth 2005; 51: 153–4.
14. Hunter JD. Ventilator associated pneumonia. Postgrad Med J 2006; 82: 172–8.
15. Watson CB. Respiratory complications associated with anesthesia. Anesthesiol Clin North America 2002; 20: 513–37.