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碩士學位論文

全身麻醉在接受髋關節骨折復位手術的
老老人是
手術併發症的危險因子

General anesthesia is a risk factor of
morbidity in very old hip fracture repair
patients

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中華民國九十六年七月

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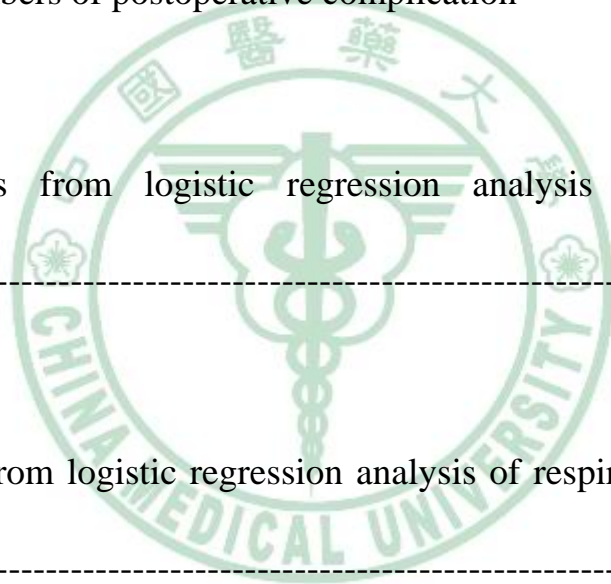
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摘要

實驗目的：本回溯性實驗的目的是要比較在接受髖關節骨折復位手術的八十歲以上老人，接受全身麻醉和脊椎麻醉者其手術後死亡率及併發症比率是否不同。並探討其發生併發症的可能危險因子。

實驗方法：本實驗收集了 2002 至 2006 年間在台中榮總接受髖關節骨折復位手術的八十歲以上老人共 335 人，其中全身麻醉 168 人脊椎麻醉 167 人，比較其死亡率及併發症比率，及術前術中的各項影響因子是否會影響併發症的發生，並分析常見併發症的可能原因。

研究結果：脊椎麻醉組病人平均年齡較老，而全身麻醉組病人較多高血壓及糖尿病病史。兩組死亡率並無差別〔全身麻醉 5 人(3.0%)，脊椎麻醉 2 人(1.2%)〕，但併發症比率全身麻醉明顯較多〔全身麻醉 21 人(12.6%) vs 脊椎麻醉 9 人(5.4%)〕，且多為呼吸道相關併發症，最多的併發症為肺炎 9 人(3.58%)。經邏輯迴歸分析發現，併發症發生的相關危險因子為全身麻醉及呼吸道病史(風險值分別為 2.39 與 3.38)。全身麻醉及呼吸道病史也是呼吸道相關併發症的危險因子。因此全身麻醉較容易引發呼吸道併發症，而呼吸道併發症也是併發症中最常見的一種

研究結論:接受髖關節骨折復位手術的八十歲以上老人，全身麻醉及呼吸道病史會增加手術風險。而脊椎麻醉可以減少手術出血量，縮短手術時間，1並減少呼吸道併發症，可能是較安全的麻醉方式。



ABSTRACT

Purpose: This study compared postoperative morbidity and mortality in elderly patients who received either general or spinal anesthesia for hip fracture repair.

Methods: We retrospectively analyzed the hospital records of 335 elderly patients (> 80 years old) who received hip fracture repair in our 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, surgery duration and blood loss during surgery were significantly greater in general anesthesia patients, which may have contributed to the greater overall morbidity in the general anesthesia group (n = 21 [12.6%] general vs n = 9 [5.4%] spinal, $P = 0.02$). Respiratory-system-related morbidity was also higher in the general anesthesia group (n = 11 [6.6%] general vs n = 3 [1.8%] spinal). Logistic regression analysis revealed two significant predictors of postoperative morbidity: anesthesia type (general, odds ratio 2.39) and pre-existing respiratory diseases (odds ratio 3.38).

Conclusions: General anesthesia increased the occurrence of postoperative morbidity in elderly patients after hip fracture repair, and patients with

preexisting respiratory diseases were especially vulnerable. Therefore, spinal anesthesia may be a better option in such individuals.

Key words: hip fracture, general anesthesia, spinal anesthesia, elderly, morbidity, mortality.



CHAPTER ONE

INTRODUCTION

1.1 Background

At the end of the nineteenth century, August Bier discovered that a class of drugs (local anesthetics) could stop neural transmission and halt sensation in the area of supply of the affected nerves. Regional anesthesia thus became an alternative to general anesthesia . And since that time , the debate over the relative safety of the two techniques has persisted. Nowadays we try to assess safety and efficacy on the basis of valid scientific evidence rather than on personal experience. In the case of the regional versus general anesthesia debate, the broader issue of whether one is safer than the other is not answered.

Hip fractures are a common problem in elderly populations and can lead to life-threatening complications and increasing mortality.¹ 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 neurological depression, and can suppress all protective reflexes, such as coughing and even breathing.

In contrast, spinal anesthesia is induced by injecting a 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 outcome in hip fracture surgery patients, but no definite consensus has yet arisen as to whether mortality and morbidity can be improved by 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.²⁻⁶ Conversely, other studies found that regional anesthesia (spinal or epidural) was associated with decreased negative outcomes after hip fracture repair,⁷ after total hip replacement⁹ or after surgical procedures in general.⁸

1.2 Purpose

In our institution, we have noted that the older patients tend to be given spinal anesthesia during routine surgical procedures, and this practice has been recommended in particular for elderly patients undergoing hip fracture repair.⁶

In the study of O'Hara⁶ , the mortality and morbidity showed no difference between general and spinal anesthesia groups. But he found that the older patients tend to be given spinal anesthesia. That is, most of the anesthesiologist still believed that spinal anesthesia have some benefit in very old patients. Therefore, this study aimed to assess whether general anesthesia is indeed inferior to spinal anesthesia for producing lower morbidity and mortality in elderly patients (> 80 years) undergoing hip fracture repair.



CHAPTER TWO

METHODS

2.1 Materials

2.1.1 Patients

We analyzed the hospital records of 421 elderly patients (> 80 years) who underwent hip fracture repair in the Taichung Veterans General Hospital, Taiwan, between 2002 and 2006. Patients with multiple fractures (46 cases), with pathologic fractures (2 cases), with other acute diseases when admitted (13 cases), or with patient-controlled analgesia (4 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.

2.2 Study design

2.2.1 Variables

Preoperative risk factors for surgery were recorded; these factors included age, gender, underlying diseases, and ASA classification

(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 are being 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, parasymal sinus ventricular tachycardia), respiratory disease (chronic obstructive pulmonary disease, pulmonary tuberculosis, asthma), history of cerebral vascular accident (CVA), 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 when patients died in hospital due to underlying disease or complications. Morbidity was defined as any perioperative complication that occurred before discharge, including pneumonia, delirium, CVA, gastrointestinal bleeding, exacerbated chronic obstructive pulmonary disease (COPD), acute renal failure, and cardiac events.

2.2.2 Spinal anesthesia and general anesthesia

In our enrolled 335 patients, the procedure for general or spinal anesthesia was determined by clinical conditions and anesthesiologists. 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 to 15 mg of marcaine was injected. For general anesthesia, patients received intravenous thiopental, a muscle relaxant (atracurium) and narcotic (Fentanyl). Mechanical ventilation was 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.

2.3 Statistical analysis

Continuous and categorical variables were compared by Student's *t*-test and chi-square or Fisher's exact test, respectively. Non-parametric data (operation time, blood loss) were compared using the Mann-Whitney-U test. Logistics regression was employed to analyze the

odds ratio of age and significant risk factors (whose $P < 0.2$ in univariate analysis) associated with morbidity. All statistical analyses were performed using SPSS 15.0 statistics software (SPSS Inc, Chicago, IL).



CHAPTER THREE

RESULTS

3.1 Descriptive statistical analysis

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 to the spinal anesthesia group, the general anesthesia group had more patients with hypertension (66.5% [111/167] general vs 51.2% [86/168] spinal, $P < 0.01$) and diabetes mellitus (18.6% [31/167] general vs 10.7% [18/168] spinal, $P = 0.04$). The remaining underlying diseases—including heart disease, respiratory disease, parkinsonism, history of CVA, and malignancy—were not statistically different between anesthetic groups. American Society of Anesthesiologists physical classification, as shown in Table 1, had no significant differences between groups.

Intraoperative and postoperative variables, and morbidity and mortality analysis, are presented in Table 2. General anesthesia

operations had longer durations (165 min general vs 150 min spinal, $P < 0.01$) and greater blood loss (250 ml general vs 200 ml spinal, $P = 0.01$). Overall mortality was not different between groups [5 (3.0%) general vs 2 spinal (1.2%), $P = 0.25$]. However, the overall morbidity was more than twofold higher in the general anesthesia group than in the spinal anesthesia group (12.6% [21/167] general vs 5.4% [9/168] spinal, $P = 0.02$). The main postoperative complications are shown in Table 3. The most frequent postoperative complications were pneumonia ($n = 9$), delirium ($n = 6$), and gastrointestinal bleeding ($n = 4$) in the general anesthesia group. There were only 3 cases of pneumonia and 3 cases of gastrointestinal bleeding in the spinal anesthesia group. Respiratory-specific morbidity, including pneumonia, COPD acute exacerbation, and respiratory failure, were more than threefold higher in the general anesthesia group (6.6% [11/167] general vs 1.8% [3/168], $P = 0.03$), as shown in Table 2.

3.2 Inferential statistical analysis

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 ($P < 0.05$ for both). Unsurprisingly, preexisting respiratory disease was a significant risk factor for postoperative respiratory morbidity, as was general anesthesia ($P < 0.05$ for both, Table 5).



CHAPTER FOUR

DISCUSSION

4.1 Neuraxial versus general anaesthesia

When reviewing this question, any analysis , meta-analysis or systemic review is made difficult , by the heterogeneity of the patient population and of the treatment themselves. In some studies, neuraxial anaesthesia is used in conjunction with general anesthesia, in others not. Sole neuraxial anaesthesia is commonly used for extremity, body surface surgery, and non-extensive intraabdominal and pelvic procedures, whereas adjunctive neuraxial anaesthesia is more commonly used for major intraabdominal and intrathoracic procedures and for postoperative analgesia. The dense sympathetic blockade provided by intraoperative neuraxial anaesthesia results in improved lower extremity blood flow, lesser incidence of hypercoagulability, and reduced cardiac work. Hence , the incidence of deep venous thrombosis, pulmonary embolism, and cardiac events may be reduced.

A meta-analysis published by Rodgers et al in 2000¹⁶ strongly supported a reduction in mortality associated with use of neuraxial

anaesthesia. Their overall conclusion was that neuraxial anaesthesia reduced postoperative mortality by about one third. The authors recommended more widespread use of neuraxial anaesthesia. Yet they drew this conclusion from a meta-analysis that included various patients populations using different anaesthesia techniques and undergoing different surgical procedures. They included studies of spinal and epidural anaesthesia, thoracic or lumbar catheter placement, regardless of whether spinal or epidural anaesthesia was used in combination with general anesthesia or not. Their subgroup analysis show, that significant reduction in mortality occurred only in specific patient populations seemed to do better in older studies, with no difference shown by newer studies. Therefore , applying their overall conclusion to every patients can be misleading. Benefit versus risk seeseement should always be population and practice specific.

4.2 Mortality and morbidity of modern anesthesia

Several recent reports, with various end points, indicated that the method of anesthesia did not influence morbidity or mortality following surgery.²⁻⁶ In 2006, a systematic review¹² comparing mortality and

morbidity after hip fracture surgery conducted under either regional or general anesthesia showed that regional anesthesia significantly reduced one-month mortality, deep venous thrombosis, blood loss, and postoperative confusion. However, when the oldest trial (with high mortality) was excluded, the difference in one-month mortality was no longer significant. In newer studies,^{10,11} after modern thromboprophylaxis was used, the protective effect of regional anesthesia against thromboembolic events become 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.^{10,11} Therefore, even large trials may not have enough power to detect differences of outcome between regional and general anesthesia.^{4,6}

4.3 The choice of anesthetic type in aged patients

In a large trial by O'Hara and colleagues(6206 patients), which found no difference in outcome between general and spinal anesthesia, the patient age was 60 years or older.⁶ The same result was seen by Koval,² when the patient age was 65 years or older. In contrast, our study focused

on patients more than 80 years old. Such elderly patients typically have a higher incidence of existing medical problems and a reduced capacity for physiologic compensation.⁵ Hence, any influence—even a slight one—of anesthesia method on recovery would likely be exacerbated in such individuals. That likely explains why our results showed the difference of morbidity between two type of anesthesia techniques, where other studies could not.

4.4 Surgery duration and intraoperative blood loss

We found that surgery duration and intraoperative blood loss were significantly decreased in spinal anesthesia patients. These findings are consistent with those from other studies,^{12,15} and may in part explain the decreased morbidity in the spinal anesthesia group.

4.5 Difference of patients characters

In our series, the incidences of pre-existing hypertension and diabetes mellitus were higher in general anesthesia patients but the age was older in spinal anesthesia patients. Evidently, patient characteristics and

underlying disease may have influenced the method of anesthesia employed by the anesthesiologist.

4.6 Risk factors of morbidity

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 intubation required for general anesthesia. Indeed, it has been reported that a relatively high percentage of patients who receive intubation/mechanical ventilation suffer associated respiratory complications, namely pneumonia.¹³ 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.¹⁴

4.7 Ventilator associated pneumonia

The pneumonia associated with general anesthesia can be aimed as a ventilator associated pneumonia. Intubation and mechanical ventilation is associated with 7- 21 fold increase in the incidence of pneumonia and up to 28% patients receiving mechanical ventilation develop pneumonia. Most case result from aspiration of pathogen colonies in oropharyngeal airway. In healthy adult , the normal cough reflex, the normal immune response may protect them from developing pneumonia. But in very old patients, any pathogen colonies aspirate into airway during general anesthesia may develop pneumonia due to poor cough reflex and immune response. This may partially explain why the respiratory-related morbidity greatly increased in general anesthesia patients in very old patients .

4.8 Limitation of this study

This study had several limitations. Firstly, 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 is a retrospective study; 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.

4.9 Summary

Our findings suggest that general anesthesia during hip fracture repair increases the risk of overall and respiratory-specific postoperative complications in elderly patients. To our knowledge no definitive studies have yet indicated that general anesthesia confers benefits over spinal anesthesia in elderly patients undergoing hip fracture repair. Therefore,

taken together with our and other findings, it would appear that the use of spinal anesthesia in such elderly patients may be the safer option.



CHAPTER FIVE

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Table 1. General and spinal anesthesia group preoperative characteristics.

Variable	General Anesthesia (n=167)	Spinal Anesthesia (n=168)	<i>P</i> -value [†]
Age (years)	83.96±3.71	84.93±4.04	0.02*
Gender			
Male	95 (56.9%)	94 (56.0%)	0.86
Female	72 (43.1%)	74 (44.0%)	
Hypertension	111 (66.5%)	86 (51.2%)	<0.01*
Diabetes mellitus	31 (18.6%)	18 (10.7%)	0.04*
Heart disease	51 (30.5%)	50 (29.8%)	0.88
Respiratory disease	132 (79%)	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 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%)	

CVA: cerebrovascular accident.

ASA classifications: American Society of Anesthesiologists physical classification

Class 1 = Healthy patient, no medical problems; Class 2 = Mild systemic disease; Class 3 = Severe systemic disease, but not incapacitating; Class 4 = Severe systemic disease that is a constant threat to life; Class 5 = Moribund, not expected to live 24 hours irrespective of operation

* Statistically significant, $P < 0.05$.

† Mann-Whitney-U test for continuous variable, and Chi-square test or Fisher's exact test for categorical variables.



Table 2. Intraoperative and postoperative variables in the general and spinal anesthesia groups.

Variable	General Anesthesia (n=167)	Spinal Anesthesia (n=168)	<i>P</i> -value [†]
Operation duration (minutes)	172.89±51.47	154.70±35.25	<0.01*
Blood loss (ml)	307.99±260.76	240.18±195.72	0.01*
Morbidity	21 (12.6%)	9 (5.4%)	0.02*
Morbidity, respiratory	11 (6.6%)	3 (1.8%)	0.03*
Mortality	5 (3.0%)	2 (1.2%)	0.25

Morbidity: pneumonia, delirium, cerebrovascular accident (CVA), gastrointestinal bleeding, chronic obstructive pulmonary disease (COPD) exacerbation, acute renal failure, cardiac event, pleural effusion and renal failure.

* Statistically significant, $P < 0.05$.

[†] Mann-Whitney-U test for continuous variable, and Chi-square test or Fisher's exact test for categorical variables.

Table 3. Case numbers 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
COPD acute exacerbation	1	0	1
Respiratory failure	1	0	1

* Total does not equal the number of patients with a postoperative complication because some patients had more than one complication.

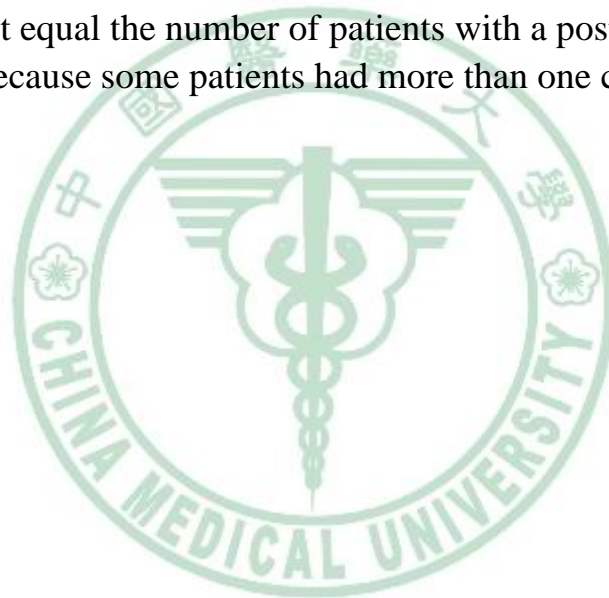


Table 4. Results from logistic regression analysis of morbidity risk factors.

Variable	Odds Ratio	95% confidence interval.	<i>P</i> value
Age	1.06	0.97–1.17	0.211
Operation time	1.01	1.00–1.01	0.195
Hypertension	1.71	0.71–4.16	0.234
Heart disease	1.69	0.75–3.79	0.203
Respiratory disease	3.38	1.48–7.71	0.004*
Anesthesia type			
Spinal	1		
General	2.39	1.00–5.67	0.049*

* Statistically significant, $P < 0.05$.

Table 5. Results from logistic regression analysis of respiratory morbidity risk factors.

Variable	Odds Ratio	95% confidence interval	<i>P</i> value
Gender (Male)	2.42	0.63–9.27	0.199
Age	1.03	0.90–1.19	0.694
Respiratory disease	4.93	1.60–15.23	0.006*
Anesthesia type			
Spinal	1		
General	4.75	1.25–18.03	0.022*

* Statistically significant, $P < 0.05$.