석 사 학 위 논 문

Spinal Surgery under Spinal Anesthesia for Patients over Mean 80 Years Old

계 명 대 학 교 대 학 원

의 학 과

윤 문 열

지도교수 손 은 석

2 0 2 1 년 2 월

Spinal Surgery under Spinal Anesthesia for Patients over Mean 80 Years Old

지도교수 손 은 석

이 논문을 석사학위 논문으로 제출함

2021년 2월

계 명 대 학 교 대 학 원

의학과 정형외과학 전공

윤 문 열

윤문열의 석사학위 논문을 인준함

주 심 배 기 철

부 심 손 은 석

부 심 박 기 범

계 명 대 학 교 대 학 원

2 0 2 1 년 2 월

Acknowledgement

본 논문을 제출하기까지 부족한 저에게 바쁘신 일정 중에서도 많은 가르침을 주신 손은석 교수님께 진심으로 감사의 인사를 드리고 싶습니다. 그리고 논문 심사에 신경써주시고 지도 해주신 배기철 교수님, 박기범 교수님께 또한 감사의 마음을 드립니다. 또한 정형외과 전공의 생활에 가르침을 주신 모든 교수님들께 감사드리며, 연구의 진행을 위해 긴 시간 도와주신 정형외과 가족 분들께도 감사드립니다.

항상 응원해주시고 믿어주신 어머니와 동생, 그리고 장인, 장모님께도 무한한 감사를 드립니다.

언제나 저에게 힘이 되어주는 사랑하는 아내에게 이 논문을 바칩니다.

2021년 2월

윤 문 열

Table of Contents

List of Tables

1. Introduction

Both general and spinal anesthesia is used to anesthetize the patients during lumbar spine surgery, but general anesthesia has been much more widely used technique. This may be due to the various reasons such as, availability to perform longer surgeries or multi-level spinal surgeries, capacity for secure airway establishment in the prone position and surgeon preference (1,2). On the other hand, for the patients with old age or comorbidities, general anesthesia itself can be a risk (3). For this reason, when deciding the anesthetic method in elderly patients undergoing lumbar spine surgery, spinal anesthesia is increasingly considered as a reasonable alternative to general anesthesia (1,4,5). However, the clinical outcomes of spinal anesthesia for lumbar decompression and combined procedures of fusion and decompression in elderly patients are limited in the literature. The aim of this study was to report the experience and good clinical outcomes using spinal anesthesia in elderly patients mean aged 80 and older undergoing lumbar spine surgery.

2. Materials and Methods

2.1. Patient Population:

This study was reviewed and approved by the Institutional Review Board of Keimyung university Dongsan Medical Center (IRB No. 2020-01-005). Elderly patients mean aged 80.38 (range, 72 to 93 years) who underwent lumbar spine surgery under spinal anesthesia between April 2018 and November 2019 were enrolled retrospectively. Total 18 patients were enrolled in this study excluding the patients with infection, valvular heart disease, or using thrombolytic agent. The study performed lumbar decompression or discectomy on 12 patients and combined procedures of fusion and decompression on 6 patients. A standardized spinal anesthesia technique was performed for all patients. Spinal puncture was done at L3-4 level on every patients. 0.5% heavy bupivacaine and fentanyl citrate were injected for spinal anesthesia in every patients. Dose of bupivacaine was 10.4 ± 1.2 mg and dose of fentanyl was 37.3 ± 14.6 ug. Dose of two drugs was decided relative height of patients. 13 of them were injected midazolam for sedation. According to Classification of American Society of Anesthesiologists (ASA), 5 of the patients were classified as ASA Ⅲ, and 12 were classified as ASA Ⅱ (6). All patients had one or more comorbidities including hypertension, diabetes, cardiovascular disease, cerebrovascular disease, lung disease, hip or knee osteoarthritis and cancer etc (Table 1-3).

2.2. Post-operative Assessment:

Postoperatively, the study monitored the incidence of delirium, urinary retention after de-cannulation of foley catheter that inserted just before the surgery, nausea, pulmonary complications such as atelectasis, pneumonia and pulmonary effusion which are the most common complications followed by general anesthesia (3). Because every patient enrolled in this research was elderly and had one or more comorbidities, the study checked if there were documented severe complications including acute myocardial infarction, stroke, permanent loss of function, or pulmonary embolism and mortality etc. In addition, time spent from bed rest after surgery to ambulation were documented. Also, average time spent for each operation and whole anesthesia time were documented.

Through telephone survey, patients were asked whether the anxiety of them before the surgery was primarily about the surgery itself or the risk followed by the general anesthesia. Patient satisfaction after surgery was also assessed by 'top box score'. Definition of the top-box score is the percentage of the most positive response to the questions, while the average score is the mean of the every response. In calculating the top-box score, responses of "highly satisfied" and 5 were given a score of 1 and other responses such as "rather satisfied," "rather dissatisfied," "dissatisfied," and 0-4 were given a score of 0 (7).

Table 1. Demographic Data 1

Variable	Value
Age, years, mean (range)	80.38 (72-93)
Sex, male / female	7 / 11

Table 2. Demographic Data 2

No.	Sex	Age	Diagnosis	Operation	Date	Comorbidity
1	F	79	HNP L3-4	Discectomy	180430	HTN
2	M	93	Spinal stenosis L4-5	Decompression	180618	HTN, CVA
3	M	88	Spinal stenosis L4-5	Decompression	180627	HTN, IPF, UA s/p PCI, CKD
4	M	76	Recurred HNP L4-5	Discectomy	180702	A.fib, ASDH s/p operation, BPH, Lt. subclvian a. stenosis s/p stent insertion
5	F	74	Spinal stenosis L4-5	Decompression	180806	HTN, HVB carrier
6	F	74	Spinal stenosis L4-5-S1	Decompression	180829	HTN, Hyperlipidemia
7	F	83	HNP L3-4	Discectomy	181123	HTN
8	M	79	Spinal stenosis L3-4-5	Decompression	181203	HTN
9	F	72	Spinal stenosis L4-5	Decompression	190130	Gastric cancer s/p subtotal gastrectomy
10	M	83	Spinal stenosis L4-5	Decompression	190508	HTN, SSS s/p PMK insertion
11	F	89	Spinal stenosis L3-4 with SPLT	L3-4 bilateral TLIF	190515	A.fib, HTN, DM
12	F	84	Spinal stenosis L4-5	L4-5 PLIF	190515	Asthma, Dementia
13	F	76	Spinal stenosis L4-5	Rt. L4-5 MIS TLIF	190527	HTN, A.fib s/p ablation, breast cancer s/p op, s/p #6 CTx
14	F	79	Spinal stenosis L4-5 with SPLT	Decompression	190826	HTN, PTE, Adrenal insufficiency
15	F	79	Spinal stenosis L4-5	Lt. L4-5 MIS TLIF	190916	HTN
16	M	80	Rt. L4-5 facet cyst	Rt. L4-5 facet cyst exsion & L4-5 MIS TLIF	191014	HTN, DM
17	M	80	Spinal stenosis L3-4	Decompression	191120	BPH
18	F	79	Spinal stenosis L3-4 with SPLT	L3-4 PLIF	191118	HTN, DM

A.fib: Atrial fibrillation; ASDH: Acute subdural hemorrhage; BPH: Benign prostatic hyperplasia; CKD: Chronic kidney disease; CTx: Chemotherapy; CVA: Cerebrovascular accident; DM: Diabetes mellitus; HNP: Herniated nucleus pulposus; HTN: Hypertension; HVB: Hepatitis virus B; IPF: Idiopathic pulmonary fibrosis; L: Lumbar; MIS: Minimally invasive spine surgery; PCI: Percutaneous coronary intervention; PLIF: Posterior lumber interbody fusion; PMK: Pacemaker; PTE: Pulmonary thromboembolism; s/p: Status post; SPLT: Spondylolisthesis; SSS: Sick sinus syndrome; TLIF: Transforaminal lumbar interbody fusion. UA; Unstable angina.

Table 3. Surgical Procedures

Variable	Value
Single-level decompression	10
Multiple-level decompression	2
Single-level fusion	6

3. Results

None of the patients had pulmonary complications postoperatively including lung atelectasis which is the single most common complication after general anesthesia. Even the patient with known interstitial pulmonary fibrosis or asthma did not complained of dyspnea. No mortality and severe complications such as acute myocardial infarction, stroke, permanent loss of function, or pulmonary embolism occurred. Only 2 patient (11.1%) developed delirium and consulted to department of psychiatry. And this patient was fully recovered from delirium before discharge. All patients were elderly, so preoperative urinary cannulation was done just before surgery except only 1 patient who had 1 level decompression, and de-cannulation was done after ambulation. Only 2 patients (11.1%) developed urinary retention after urinary de-cannulation. 3 patients (16.6%) were undergone post-operative nausea (Table 4). 15 patients (83.3%) were ambulatory on at least 2 days after surgery starting from using a shoulder walker (Table 5). Mean operation time was 1 hour and 55 minutes. Mean anesthesia time was 2 hours and 35 minutes. None of the cases required conversion to general anesthesia. Ephedrine 4-12 mg was used for increasing blood pressure after 40% of case within 15 mintues after intrathecal bupivacaine injection. But after ephedrine injection, blood pressure and heart rate were stable except one case which need phenylephrine 100 ug for increasing blood pressure. Patients reported a high level of satisfaction after the procedure. Scoring 94.1 yielded through 'Top box score' (Table 6). Every patient answered that they would like to recommend the spinal anesthesia during lumbar spine surgery to other people.

Table 4. Postoperative Complications

Variable	Value
Post op delirium	2
Post op constipation	7
Post op nausea	3
Post op urinary retention	2
Post op pulmonary complication	0
Post op severe complication	0

op: operation.

Table 5. Ambulation Onset

Variable	Value
POD 1	5
POD 2	9
POD 3	3
POD 4	1

POD: Postoperative day.

Table 6. Patients Satisfaction

Variable	Value
Highly satisfied patients (5)	16
Rather satisfied patients (4)	1
Rather dissatisfied patients (2-3)	0
Dissatisfied patients (0-1)	0
No response	1 ; due to expiration 9 months after surgery due to CVA
Top box score	94.1

CVA: Cerebrovascular accident.

4. Discussion

Lumbar spinal surgery is commonly performed under general anesthesia due to several reasons (1,2). However, general anesthesia is associated with several perioperative complications, including lung atelectasis, pulmonary aspiration, cardiovascular collapse, respiratory depression. For this reason, the patients with old age or comorbidities, may not tolerate the general anesthesia (3). On the contrary, spinal anesthesia has lower incidence of the complications mentioned above and this is reported by several studies done before this research (1,4,5,8-11).

In 2019, Patil et al. (12) discussed the outcomes of lumbar spine surgery with spinal anesthesia in 18 high-risk patients aged between 68-84 (mean, 72). Microdiscectomy was performed on 10 patients, and canal & lateral recess decompression was performed on 8 patients. No surgical or anesthetic complications were observed. Pain relief after operation was remarkable. None of the patients developed postoperative urinary retention or vomiting. 2 of the patients (11.11%) had nausea postoperatively.

In 2017, concurrent with this study, Lessing et al. (13) discussed the 56 cases of patients aged between 70-91 (mean, 77) who underwent the lumbar spine surgery under spinal anesthesia; decompression was performed on 27 patients (48%) and combined procedures of fusion and decompression were performed on 29 patients (52%). The 21% (12 of 56) of the patients developed postoperative nausea. The average length of hospitalization after surgery was 2.4 days (range, 1 to 6 days). No severe complications including mortality occurred.

Also, in 2015, Erbas et al. (14) discussed the 497 cases of patients who underwent the lumbar spine surgery under spinal anesthesia. 119 of

these patients were between 71 to 84 years old. Cardiopulmonary complications or spinal headaches were not observed, and the mean length of hospitalization after surgery was 2 days. These results demonstrated that, especially in elderly, high-risk patients, spinal anesthesia is an effective and safe anesthetic method for lumbar spine surgery.

In 2011, Chen et al. (11) reported the outcomes of spine surgery on 123 patients aged between 18-61 (mean, 39) that there is no difference of morbidity, mortality, or long-term complication rates between spinal and general anesthesia. However, on this research, elderly patients were not included.

The literature has suggested that spinal anesthesia may offer lower rate of postoperative complication such as nausea (4,8,10,15) and urinary retention (4,10). Unfortunately, it is uncertain that these advantages can be applied to elderly. In this research, however, 3 elderly patients (21.4%) were undergone post-operative nausea within 2 days after operation. This study performed preoperative urinary cannulation just before surgery except 1 patient who had 1 level decompression, and de-cannulation was done after ambulation. After urinary de-cannulation, only 2 elderly patients (11.11%) developed urinary retention.

Lung atelectasis is the single most common post-operative complication after general anesthesia (3). In this research, none of the patients experienced dyspnea combined with fever, which is the main symptom of the lung atelectasis. Resulting in the decrease of the need for use of antipyretic drugs which can commonly cause the damage to the kidney.

No mortality occurred and also no severe complication was found in the patients post-operatively. Severe complications including acute myocardial infarction, stroke, permanent loss of function, or pulmonary embolism can cause an unfavorable result in patients undergone general anesthesia (3). Other pulmonary complications such as aspiration pneu-

monia and respiratory depression should always be concerned before the general anesthesia due to endotracheal intubation (3). However, needless of endotracheal intubation, spinal anesthesia is safer from the pulmonary complications mentioned above.

Delirium which is associated with cognitive decline is the major psychiatric complication in elderly patients post-operatively (3,16). It can cause the low cooperation to the post-operative care which can result in the bad outcomes after lumbar spine surgery. Therefore, preventing post-operative delirium is important for both deterring onset of cognitive dysfunction in elderly patients and post-operative managing. In this research, only one patients who had gone through one-level lumbar decompression developed delirium.

Total 14 of 18 patients (77.7%) were ambulatory on at least 2 days after surgery starting from using a shoulder walker.

Erbas et al. (14) also reported the incidence of early complications after spine surgery in their cases under both general and spinal anesthesia. Their noted complications included bleeding, neurological deficit, infection, cerebrospinal fluid fistula, pulmonary problems, allergy and death. 2 of their patients had a bleeding problem in operation wound. 2 of them had cerebrospinal fluid fistula and 5 of them had allergic reaction after surgery. In this cases, which were performed under only spinal anesthesia, none of the mentioned complication occurred.

As mentioned previously, it is available to perform longer surgeries under general anesthesia. On the contrary, anesthetic time is limited under spinal anesthesia (1,2,13). However, in this cases, none of the patients required conversion to general anesthesia immediate after spinal anesthesia. This suggests that the anesthetic time given under spinal anesthesia is enough for the one or two level lumbar decompression and one level lumbar fusion surgery.

Hemodynamic parameter is more stable in spinal anesthesia more than general anesthesia (17). But this study showed that ephedrine 4-12 mg was used for increasing blood pressure after 40% of case within 15 mintues after intrathecal bupivacaine injection. The study guessed that reasons are height of patients and intrathecal injection volume. Height and injection volume are important factors for spinal level. Average height of this study was 158.9 ± 8.3 cm. Average volume of intrathecal heavy bupivacaine with fentanyl was 2.83 ± 0.3 ml with sitting position at L3-4 puncture site. This study suggested it might be lager volume relative their height. In other paper, hypotension was more common in spinal anesthesia rather than general anesthesia (9). This result is similar to this study. But after ephedrine injection, blood pressure and heart rate were stable except one case which need phenylephrine 100 ug for increasing blood pressure.

The study demonstrated telephone survey and every patient answered except one patient who expired due to pneumonia after 9 months from the surgery. Through the telephone survey, 9 of 17 patients answered that they had concerning issues before the surgery. Among them, 8 patients' major concern was about general anesthesia. Patients reported a high level of satisfaction after the procedure. Scoring 94.1 yielded through top-box score (7). Every patient answered that they would like to recommend the spinal anesthesia during lumbar spine surgery to other people. Furthermore, every patient answered that if they need to get another spine surgery, they wound prefer spinal anesthesia to general anesthesia. On the aspect of a high level of satisfaction of patients' after operation, Dagher et al. (15) and Patil et al. (12) made a similar observation

There are also imitations to this present study. As focusing on the perioperative assessment of spinal anesthesia for lumbar spine proce-

dures in elderly patients, long-term outcomes of surgery were not evaluated. In addition, there were no selected control group which is the group of elderly patients who underwent lumbar spine surgery under general anesthesia. This is due to the fact that spinal surgery is rarely performed in elderly patients over 80 years of age on average, and therefore the number of cases itself is not sufficient.

5. Summary

This study was conducted to report the experience and good clinical outcomes using spinal anesthesia in elderly patients mean aged 80 and older undergoing lumbar spine surgery. Elderly patients mean aged 80.38 (range, 72 to 93 years) were evaluated as the ultimate subjects. None of the patients had pulmonary complications. Only 2 patient (11.1%) developed delirium. Only 2 patients (11.1%) developed urinary retention after urinary de-cannulation. 3 patients (16.6%) were undergone post-operative nausea. 14 patients (77.7%) were ambulatory on at least 2 days after surgery. No mortality and severe complications occurred. Every case did not required conversion to general anesthesia. Patients reported a high level of satisfaction after the procedure. This study provides additional evidence that for elderly patients 80 years and older undergoing lumbar spine surgery, spinal anesthesia is a safe, viable and satisfactory method of anesthesia.

References

1. Demirel CB, Kalayci M, Ozkocak I, Altunkaya H, Ozer Y, Acikgoz B: A prospective randomized study comparing perioperative outcome variables after epidural or general anesthesia for lumbar disc surgery. J Neurosurg Anesthesiol 2003; 15: 185-92.

2. De Rojas JO, Syre P, Welch WC: Regional anesthesia versus general anesthesia for surgery on the lumbar spine: a review of the modern literature. Clin Neurol Neurosurg 2014; 119: 39-43.

3. Harris M, Chung F: Complications of general anesthesia. Clin Plast Surg 2013; 40: 503-13.

4. McLain RF, Kalfas I, Bell GR, Tetzlaff JE, Yoon HJ, Rana M: Comparison of spinal and general anesthesia in lumbar laminectomy surgery: a case-controlled analysis of 400 patients. J Neurosurg Spine 2005; 2: 17-22.

5. Attari MA, Mirhosseini SA, Honarmand A, Safavi MR: Spinal anesthesia versus general anesthesia for elective lumbar spine surgery: A randomized clinical trial. J Res Med Sci 2011; 16: 524-9.

6. Doyle DJ, Goyal AD, Bansal PK, Garmon EH: American Society of Anesthesiologists Classification. Treasure Island (FL): StatPearls Publishing. 2019.

7. Bedeir YH, Grawe BM: Patient factors influencing outpatient sat-

isfaction in patients presenting with shoulder pain. J Shoulder Elbow Surg 2018; 27: e367-e71.

8. Jellish WS, Thalji Z, Stevenson K, Shea J: A prospective randomized study comparing short- and intermediate-term perioperative outcome variables after spinal or general anesthesia for lumbar disk and laminectomy surgery. Anesth Analg 1996; 83: 559-64.

9. Tetzlaff JE, Dilger JA, Kodsy M, al-Bataineh J, Yoon HJ, Bell GR: Spinal anesthesia for elective lumbar spine surgery. J Clin Anesth 1998; 10: 666-9.

10. McLain RF, Tetzlaff JE, Bell GR, Uwe-Lewandrowski K, Yoon HJ, Rana M: Microdiscectomy: spinal anesthesia offers optimal results in general patient population. J Surg Orthop Adv 2007; 16: 5-11.

11. Chen HT, Tsai CH, Chao SC, Kao TH, Chen YJ, Hsu HC, et al.: Endoscopic discectomy of L5-S1 disc herniation via an interlaminar approach: Prospective controlled study under local and general anesthesia. Surg Neurol Int 2011; 2: 93.

12. Patil H, Garg N, Navakar D, Banabokade L: Lumbar Spine Surgeries Under Spinal Anesthesia in High-Risk Patients: A Retrospective Analysis. World Neurosurg 2019; 124: e779-e82.

13. Lessing NL, Edwards CC 2nd, Dean CL, Waxter OH, Lin C, Brown CH, 4th, et al.: Spinal Anesthesia in Elderly Patients Undergoing Lumbar Spine Surgery. Orthopedics 2017; 40: e317-e22.

14. Erbas YC, Pusat S, Yilmaz E, Bengisun ZK, Erdogan E: Posterior Lumbar Stabilization Surgery under Spinal Anesthesia for High-Risk Patients with Degenerative Spondylolisthesis, Spinal Stenosis and Lumbar Compression Fracture. Turk Neurosurg 2015; 25: 771-5.

15. Dagher C, Naccache N, Narchi P, Hage P, Antakly MC: [Regional anesthesia for lumbar microdiscectomy]. J Med Liban 2002; 50: 206-10.

16. Saczynski JS, Marcantonio ER, Quach L, Fong TG, Gross A, Inouye SK, et al.: Cognitive trajectories after postoperative delirium. N Engl J Med 2012; 367: 30-9.

17. Finsterwald M, Muster M, Farshad M, Saporito A, Brada M, Aguirre JA: Spinal versus general anesthesia for lumbar spine surgery in high risk patients: Perioperative hemodynamic stability, complications and costs. J Clin Anesth 2018; 46: 3-7.

Spinal Surgery under Spinal Anesthesia for Patients over Mean 80 Years Old

Youn, Moon Yul

Department of Orthopedic Surgery
Graduate School

Keimyung University

(Supervised by Professor Son, Eun-Seok)

(Abstract)

The aim of this study was to report the experience and good clinical outcomes using spinal anesthesia in elderly patients mean aged 80 and older undergoing lumbar spine surgery. Elderly patients mean aged 80.38 (range, 72 to 93 years) who underwent lumbar spine surgery under spinal anesthesia between April 2018 and November 2019 were enrolled retrospectively. Postoperatively, incidence of delirium, urinary retention, nausea, pulmonary complications, severe complications, mortality and time spent from bed rest after surgery to ambulation were documented. Time spent for each operation was documented. Patient satisfaction was also assessed by top box score. None of the patients had pulmonary complications. Only 2 patient (11.1%) developed delirium. Only 2 patients (11.1%) developed urinary retention after urinary de-cannulation. 3 pa-

tients (16.6%) were undergone post-operative nausea. 14 patients (77.7%) were ambulatory on at least 2 days after surgery. No mortality and severe complications occurred. Every case did not required conversion to general anesthesia. Patients reported a high level of satisfaction after the procedure. This research shows that for elderly patients undergoing lumbar spine surgery, spinal anesthesia is a safe, viable and satisfactory method of anesthesia.

평균 80세 이상의 환자에서의 척추마취 하 척추수술

윤 문 열
계명대학교 대학원
의학과 정형외과학 전공
(지도교수 손 은 석)

(초록)

이 연구의 목적은 요추 수술을 위해 척추마취를 받은 80세 이상의 노령 환자를 대상으로 진행한 연구에서 관찰한 내용과 좋은 임상 결과를 보고하기 위함이다. 2018년 4월부터 2019년 11월 사이에 척추마취 하 요추 수술을 받은 평균 80.38세(72-93세)의 노령 환자들을 후향적으로 조사하였다. 술후에 섬망, 요 정체, 구역, 호흡기계 합병증과 중증 합병증의 발생률, 사망률, 그리고 환자가 수술 직후부터 보행하기 전까지 침상에서 지낸 시간을 기록하였다. 또한, 각 수술에 소요된 시간을 기록하였다. 환자의 만족도는 top box score를 통해 평가하였다. 술 후 호흡기계 합병증을 보인 환자는 없었다. 2명의 환자(11.1%) 만이 섬망 소견을 보였다. 도뇨관을 제거한 후 환자 2명(11.1%)에서만 요 정체가 발생했다. 환자 3명(16.6%)은 술 후 구역을 겪었다. 수술 후 적어도 2일차에 14명(77.7%)의 환자들은 보행이 가능했다. 사망이나 중증 합병증은 발생하지 않았다. 모든 증례는 전신마취로 전환할 필요가 없었다. 수술 후 조사된 환자들의 만족도는 높게 조사되었다.

이 연구는 요추 수술을 받는 노령환자에서 척추 마취가 안전하고 실행 가능하며 만족도가 높은 마취 방법인 것을 보여준다.