ORIGINAL ARTICLE

Postoperative Recovery Profile Following Posterior Lumbar Laminectomy: A Comparative Study Of General Anaesthesia And Spinal Anaesthesia

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ABSTRACT

Background: Elective lumbar laminectomy can be done under both general and spinal anaesthesia. Many authors have suggested that the choice of anaesthetic technique influences postoperative recovery outcomes. Existing literature provides inconsistent findings regarding which technique offers superior recovery profile. Furthermore, there is paucity of well- designed comparative studies evaluating the recovery profile of patients who had lumbar laminectomy under spinal anaesthesia with those under general anaesthesia. This lack of conclusive evidence underscores need for further research to determine the optimal anaesthetic approach that enhances recovery profile.

Subjects and Methods: Fifty eligible patients were recruited and randomized into two groups (25 each) using block technique. Each group received either general anaesthesia or spinal anaesthesia. The discharge time from post anaesthetic care unit (PACU), pain scores at 4, 8, and 24hrs from the end of surgery, time at first ambulation and time of discharge from the hospital were assessed and recorded. The data were analyzed using Statistical Package for Social Sciences (SPSS) 26 for windows.

Results: The mean duration of PACU stay was comparable (GA.=74.44±3.94 mins, SA=73.56±14.44 mins, p = 0.770). The spinal anaesthesia group had a significantly (p=0.003) lower mean pain scores (3.323.32±0.9) than the general anaesthesia group (4.08±0.81) at 4hr from the end of the surgery, thereafter the pain scores became comparable. The time to first ambulation after surgery (GA=67.92±13.14hrs, SA=62.70±12.60hrs), and the time to hospital discharge (GA=7.56±1.53days, SA=7.16±1.41days) in both groups were comparable with P=0.158, P = 0.340 respectively.

Conclusion: Spinal anaesthesia offered a better early postoperative recovery profile than general anaesthesia, as evidenced by a lower pain score at 4hrs postoperative time.

Keywords: Elective Laminectomy, General Anaesthesia, Lumbar spine, Postoperative Recovery profile, Spinal Anaesthesia.

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INTRODUCTION

Severe pain and surgical stress hamper postoperative recovery following lumbar laminectomy.[1] Laminectomy, also known as posterior spinal decompression, is the surgical removal of the lamina and the spinal canal roof.[1]

Surgery evokes a wide variety of neuroendocrine responses postoperatively. These include increased secretion of adrenocorticotropic hormone (ACTH), antidiuretic hormone (ADH), growth hormone (GH), prolactin from the pituitary, increased outflow from the brainstem autonomic fibres leading to increased catecholamine release, activation of the reninangiotensin-aldosterone system, increase in glucagon secretion and immunosuppression. These neuroendocrine effects result in increased protein catabolism, reduced substrate utilisation, persistent water/sodium retention with associated dilution hyponatremia, and inadequate clearance of metabolic by-products leading to acidosis. Other effects include pain, nausea, vomiting, ileus,impaired pulmonary function,increased cardiac demand and risk of thromboembolism.[2] These negatively affect patients' recovery by increasing morbidity, delaying recovery and prolonging hospital stay.[2] Therefore, modification of endocrine and metabolic responses following surgery is desirable.[3]

Adequate control of postoperative pain enables early mobilisation exercise, attenuates surgical stress and permits early oral nutrition, and goes a long way to improve postoperative outcome.[2] Anaesthetic techniques can influence the stress response to surgery and postoperative pain.[4] There is evidence that anaesthetic management exerts some previously unrecognised long-term postoperative influences. These effects include surgical site infection (SSI), cancer recurrence and metastasis, chronic post-surgical pain, blood transfusion requirement, postoperative myocardial infarction (MI), stroke, neurocognitive effect on the immature brain, and cognitive dysfunction in the elderly.[5]

Lumbar laminectomy can be done under general anaesthesia or spinal anaesthesia[6] and each has possible advantages and disadvantages in the perioperative period.[7,8]

General anaesthesia renders the patient motionless throughout the procedure. It provides a secure airway, although it may lead to haemodynamic instability, greater intraoperative blood loss, greater analgesic requirements, postoperative nausea and vomiting compared to spinal anaesthesia.[9] Spinal anaesthesia requires no airway instrumentation, provides profound analgesia with less surgical blood loss, and thus improved operating conditions;[10] however, reported disadvantages during laminectomy include intraoperative anxiety, cough, hiccups, and movement.[11,12]

It also blocks the efferent autonomic neural pathways to the liver and adrenal medulla thereby inhibiting stress response to surgery and positively influence the postoperative outcome of organ function.[4]

In the study by Gupta et al[13],they reported that spinal anaesthesia is a better option than general anaesthesia in laminectomy as it is economical with a speedy recovery. Also according to Kara and co-workers[14], they documented that spinal anaesthesia could be augmented intraoperatively during lumbar laminectomy via repeated intrathecal injection of local anaesthetic agents under direct vision. Most of the studies compared general anesthesia with spinal anaesthesia during laminectomy by assessing mostly their intraoperative characteristics and postoperative pain profiles and timing, however, there is paucity of studies assessing the recovery profile between general anaesthesia and spinal anaesthesia following laminectomy with conflicting results. Lohchab et al[15] revealed that spinal anaesthesia provided better perioperative outcome than general anaesthesia for posterior spinal decompression, however, Florinella et al[16] reported that spinal and general anaesthesia showed no clinical relevant difference in their perioperative variables during lumbar decompression. Hence, the study is aimed at comparing the recovery profile between general anaesthesia and spinal anaesthesia after lumbar laminectomy.

SUBJECT AND METHODS

Ethical clearance for this prospective, randomized controlled study was obtained from the Research and Ethics Committee of National Orthopaedic Hospital Enugu, with IRB/HEC and Protocol number 5.313/10/202102002 and also an informed written consent from the patients before they were enrolled into the study. Patients aged 18 to 65yrs with ASA I-II scheduled for elective one level/ two levels lumber spine laminectomy for spinal stenosis without instrumentation were recruited. Exclusion criteria included patient's refusal, patients with renal impairment, patients with uncontrolled cardiovascular dysfunction associated with hypotension,valvular defects and hepatic impairment, coagulopathy, previous lumbar surgery and allergy to local anaesthetics. Other exclusion criteria included patients with spinal instability due to intervertebrate disc degeneration, infectious process at the site of spine injection and need for instrumentation. Pre-operative assessment was done at least a day before the surgery and informed consent obtained. Recruited and eligible patients were randomized by block randomization using a computer generated random numbers that was enclosed in a sealed opaque envelope, into group GA to receive general anaesthesia and group SA to receive spinal anaesthesia. Postoperative recovery variables assessed include duration of PACU stay, postoperative pain assessment using VRS, time to ambulation and duration of hospital stay. All the patients received 10mg of oral diazepam at night before the surgery and on the morning of the surgery with a sip of water, and fasting guideline was observed. On arrival at the operating room, monitors were attached, and baseline vital signs were obtained and recorded. Intravenous access was established with two 16-gauge cannulae, and normal saline infusion commenced after completing WHO surgical checklist. End-tidal carbon dioxide monitoring with capnography was done for GA patients. All the patients were anaesthetized by the same anaesthesia team. Two Consultant Orthopaedic spine surgeons operated on all the patients.

All patients in the GA group were positioned supine on the trolley. After pre-oxygenation with 100% oxygen for 3 minutes, they were induced with intravenous propofol 2.5mg/kg and fentanyl 2µg/kg IV and intubated with an appropriately sized armored cuffed endotracheal tube, facilitated with 0.5 mg/kg intravenous atracurium. After confirmation of the correct placement of tube with capnogragh, the tube was secured and the eyes were covered with eye pads to avoid extrinsic pressure on the globes.

The patient was log-rolled from a trolley to a prone position onto a standard soft bolsters placed on a standard operating table with bony prominences padded, and breast in females and testicles in male protected from pressure. Endotracheal tube placement was reconfirmed by auscultation of the chest posteriorly after prone positioning and ventilation was adjusted to maintain an end-tidal $EtCO_2$ of 30–40 mmHg. Anaesthesia was maintained with isoflurane 1-2% MAC in oxygen/medical air combinations at 2/4 litres/min, respectively while muscle relaxation was maintained with intermittent doses of atracurium 0.1 mg/kg when necessary and analgesia with a multimodal analgesic module which included intravenous fentanyl 2µg/kg stat (given at induction), then IV paracetamol 15 mg/kg, intermittent boluses of fentanyl 1µg/kg every 30 minutes, and the infiltration of the site of surgery with 15 ml of 1% lidocaine containing 1 in 200,000 epinephrine before knife-on-skin. Fluid maintenance was with warm normal saline according to 4-2-1 rule[17] while blood loss was assessed and documented. At the end of the surgery, patient was returned to supine position back on the trolley and appropriately recovered from anaesthesia.

In Spinal Anaesthesia (SA) patients, they were preloaded with 15ml/kg of normal saline, after which spinal anaesthesia was instituted at either L_{2-3},L_{3-4}, or L_{4-5} interspace with 25-guage pencil point spinal needle after cleaning the back with antiseptic solution. Following the free back flow of clear CSF through the spinal needle, 15mg of 0.5% heavy marcain with 25µg of fentanyl was injected into the subarachnoid space and patient was subsequently returned to supine position. When the desired level of block up to T_6 was achieved, patient was log-rolled from a trolley to a prone position on bolsters on an operating table with the genitals and bony prominences well padded. All SA patients were given oxygen via nasal prong at 2litres/min with IV paracetamol 15mg/kg to achieve a multimodal analgesia and sedated with intravenous propofol infusion at 25-50µg/kg/min. The surgical site was infiltrated with 15 ml of 1% lidocaine containing 1in 200,000 epinephrine before surgical incisions for each patient. Spinal anaesthesia was augmented during surgery by intrathecal injection of 5mg of heavy bupivacaine when patient complained of discomfort at the surgical site by the researcher after giving 500ml of fluid to prevent hypotension. This was achieved in collaboration with the surgeon under aseptic condition; the intervertebral space L_{3-4} and L_{4-5} was accessed through the surgical field under direct vision and 5mg of heavy marcaine was deposited via spinal needle.

Fluid was maintained with normal saline based on 4-2-1 rule[17] and blood loss was monitored and documented. Intraoperatively, hypotension was defined as systolic blood pressure below 90 mmHg, while bradycardia was defined as HR less than 60 beats per minute.[3,16] Hypotension was treated with aliquots of ephedrine 5mg IV and rapid normal saline or blood transfusion when necessary, while bradycardia was treated with atropine 0.6 mg IV. Hypertension was defined as systolic blood pressure above 140 mmHg, while tachycardia as HR above 100 beats per minute.

At the end of the surgery, patients were log-rolled to supine position onto a trolley. All the patients received intravenous pethidine 1mg/kg and intramuscular diclofenac 1mg/kg and then transfered to post-anaesthetic care unit (PACU). Subsequently, postoperative analgesia was achieved with IV pethidine 1mg/kg 8hourly, IV paracetamol 15mg/kg 6hourly and IM diclofenac 1mg/kg 12hourly. In the PACU, patients' vital signs including pain assessment using verbal rating scale were assessed and recorded. The GA group patients were discharged from PACU fully awake, alert, and responsive, with an Aldrete score of at least 9 while those in the SA group were discharged following Aldrete score of at least 9 with receding of sensory block by four dermatomes (T10), and Bromage score of 3 (able to flex the knee). Comprehensive postoperative evaluation of recovery profile concentrated on recording the duration of PACU stay (time of admission into PACU to the time of discharge from PACU), pain assessment using the verbal rating scale (VRS) at 4, 8, and 24 hours with intravenous pethidine 1mg/kg as rescue analgesia, time to ambulation (end of surgery time to time of the first step after surgery), and duration of hospital stay (day of surgery to the day of discharge).

Sample size was calculated using the formular for comparing two independent groups' mean in an experimental study[18] in a previous study by Finsterwald et al[19] using the PACU time between spinal anaesthesia group and general anaesthesia group. . Data were collected and analyzed using the statistical package for social sciences (SPSS) 26 for windows, and was presented with tables and figures. Continuous variables were presented with means ± standard deviations while categorical data were presented as frequencies and percentages. Continous data were analyzed using independent samples t-test. Categorical data were analyzed using chi-square test. A P-value of less than 0.05 was considered significant.

RESULTS

Fifty patients were recruited and they completed the study. One patient received top up spinal anaesthesia in SA group.

The groups were comparable in the demographic and ASA physical characteristic variables. [Table I]

The mean pain score was significantly (p=0.003) lower in SA group (3.32±0.9) than the GA group (4.08±0.81) in the immediate postoperative period, thereafter it remained comparable (p=0.537, p=0.859) at 8hr and 24hr postoperative respectively. [Table II]

Table III shows that the difference in mean duration of PACU stay between the GA group (74.44 ± 3.94mins) and SA group (73.56 ± 14.22mins) was not significant (p

= 0.77). The mean time to ambulation between GA group (67.92 ± 13.14) and SA group (62.70 ± 12.60) were comparable (p=0.158). [Table III]. Similarly both treatment groups had comparable (p=0.340) mean time to discharge from the hospital. [Table III]

The trend in MAP showed a lower mean MAP in PACU in the SA group than in the GA group. There was no incidence of hypotension or hypertension in both groups.[Fig 1]. The trend in mean PR showed a more stable PR in the SA group (75-82)/mins compared to the GA group (70-86)/mins. [Fig 2]. These differences in mean MAP and mean PR were not significant(p=0.580, p=0.577) respectively.

Table I: Demographic data and ASA physical status between the GA and SA groups

Variables		GA group	SA group	P value
Age		46.92±10.56	49.28±12.85	0.481
BMI		27.45±6.22	29.26±3.99	0.226
ASA	I	9(18%)	10(20%)	0.771
	II	16(32%	15(30%)	

Table II: Comparing the pain scores at specific times among groups GA and SA.

Variables	GA group	SA group	P value
VRS@ 4hr Postop	4.08 ± 0.81	3.32± 0.90	0.003*
VRS@8hr Postop	3.24 ± 0.78	3.36 ± 0.57	0.537
VRS@24hr Postop	0.84 ± 0.75	0.88 ± 0.83	0.859

*= significant value.

Table III: Comparison of mean PACU stay, mean time to ambulation and discharge from hospital between GA group and SA group

Variable	GA group	SA group	P value
Mean PACU time (hrs)	74.44 ± 3.94	73.56 ±14.22	0.77
Mean time to ambulation(hrs)	67.92±13.14	62.70±12.60	0.158
Time to discharge from hospital(days)	7.56 ± 1.53	7.16 ± 1.41days	0.340.

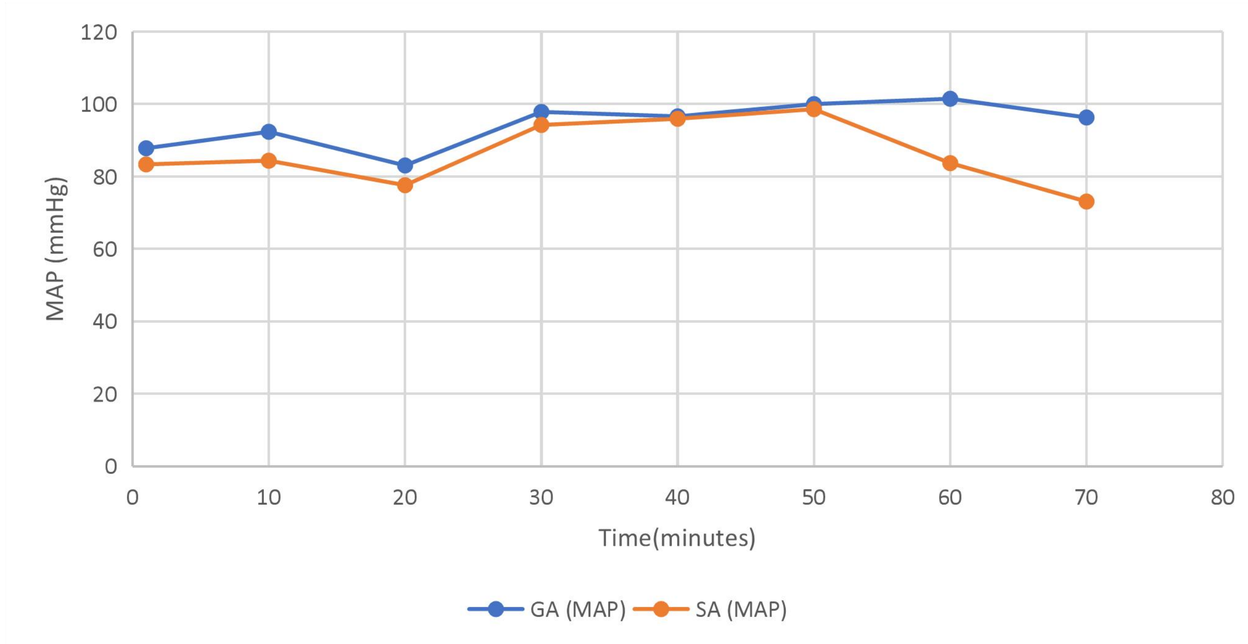

Figure 1: Trend of the post operative MAP from admission into PACU to discharge from PACU among the groups.

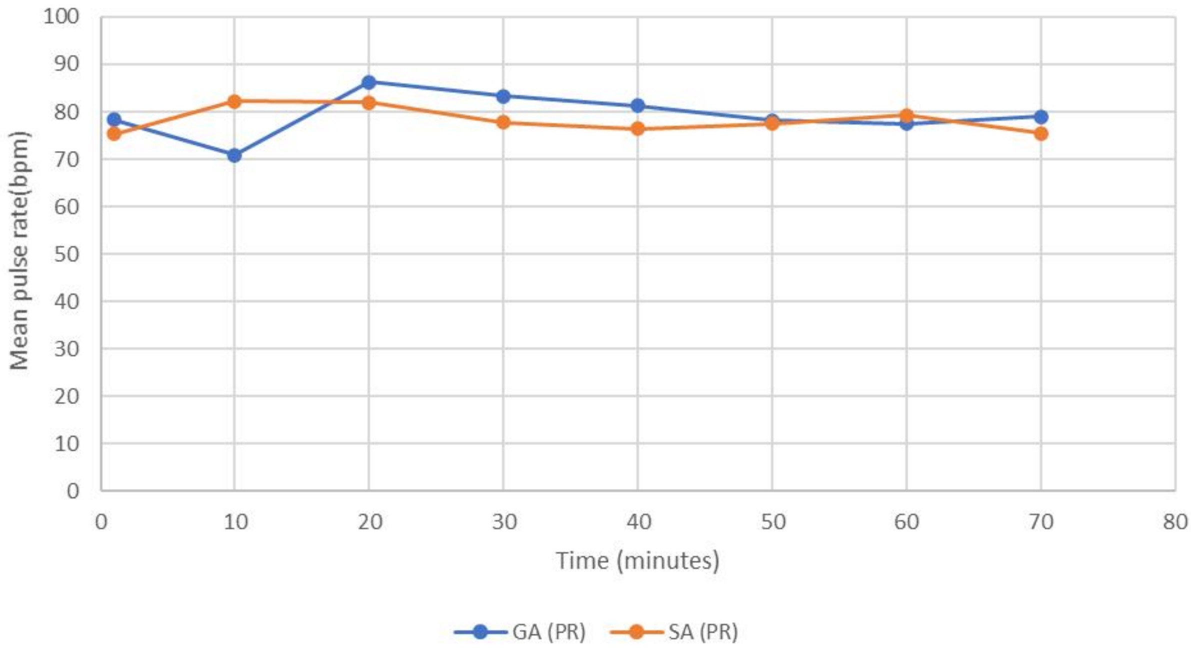

Figure 2: Trend of the postoperative PR from admission into and discharge from PACU between groups GA and SA.

DISCUSSION

The recovery profile after laminectomy done under spinal anaesthesia was superior to general anaesthesia as demonstrated by a lower pain score in the spinal group in the postoperative period

Inadequate pain control, postoperative nausea and vomiting (PONV), and other early postoperative complications have been shown to prolong PACU stay.[20] The index study showed that the mean duration of PACU stay was comparable between the two groups. This is consistent with the findings of Jellish et al.[21] The reason for the similarity can be explained by similar intraoperative drugs and probable similar criteria for discharge from PACU. Similarly, Kahveci et al[22] also found no statistical difference in PACU stay between the GA and SA groups (GA = 20.85 ± 5.20mins, SA = 19.55 ± 4.58mins p = 0.507), however, their patients had lesser stay in PACU compared to the index study.The reason for the disparity in PACU stay between the index study and the study by Kahveci et al[22] can be explained by the difference in the protocol for patients discharge from PACU and pharmacokinetics of intraoperative drugs. The index study discharged the GA group patients from PACU fully awake, alert, and responsive, with an Aldrete score of at least 9 while those in the SA group were discharged following Aldrete score of at least 9, receding of sensory block by four dermatomes (T10), and Bromage score of 3. However, Kahveci et al[22] discharged patients from PACU following an Aldrete score of 8 and patients' ability to move the lower limb, which could be a Bromage score of 1. This lower Aldrete score and possibly lower Bromage score may have contributed to their findings of lesser time of stay in PACU compared to the index study. Also Kahveci et al[22] used sevoflurane to maintain GA, which enables patients to have faster, clear-headed recovery compared to the isoflurane used in the index study. On the contrary, Pierce et al[23] reported a longer PACU stay in the SA group than in the GA group (GA = 116.5mins, SA = 178mins p = < 0.001). The difference between the index and pierce et al[22] may be as a result of their protocol for discharge of patient from PACU and pharmacokinetics of drug used for subarachnoid block. In the index study, patients in the spinal group were discharged from PACU after the spinal sensory block regressed to T10 and Bromage score of three (3), however, Pierce et al [23] allowed complete recovery of SA patients from the block before discharge leading to longer stay in PACU. Also the index study used 0.5% heavy bupivacaine for the subarachnoid block while Pierce et al [23] used 0.75% heavy bupivacaine for SAB. A higher concentration of bupivacaine may have caused the prolonged motor block leading to the SA group spending more time in PACU than the GA group.

The index study showed that the mean pain score was significantly lower in the SA group than in the GA group at 4 hours post-surgery, thereafter the pain scores became comparable. This finding is consistent with the work done by Finsterwald et al [19] despite having lower pain scores in the immediate postoperative period than the index study. The probable reason for the similarity in their report with the index study may be due to the mechanism of pre-emptive analgesia and residual sensory block associated with subarachnoid block in the SA group which may have complemented the postoperative analgesics. The residual sensory block would have completely receded at 24 hour postoperative time, and may be the probable reason for similar pain score at the 24 hour postoperative time between the groups.

Early ambulation aids quick recovery.[24] There was no difference in the average time to ambulation after surgery between the two treatment groups in the index study. This was corroborated by the study conducted by McLain et al[25], although they had lesser time to ambulation compared in the index study. In the index study, the surgery team insisted on the availability of postoperative x-ray before mobilization. This was to confirm the patient's suitability for mobilization. This often took about 24hrs. Even when the patient was ready to be mobilized, the availability of a physiotherapist took an additional 6 to 12hrs. These may have contributed to the prolonged time to ambulation in the index study compared to the study by Mclain et al. [25] In contrast, Rodriguez et al [26] reported that patients in the SA group took significantly less time to walk for the first time after surgery. This difference in the mobilisation time may be explained by the better postoperative pain profile of the patients in SA group postoperatively in their study.

Faster recovery will amount to early hospital discharge. There was no significant difference in the time to hospital discharge in the index study between the SA and GA groups. This is similar to study by Kara et al [14], although their study reported lesser time to discharge compared to the index study. The difference in time of hospital discharge between both studies could be due to difference in the time of mobilization;While kara et al.[14] study started mobilizing on the surgery day (GA = 46.6%, SA = 36.6%), patients in the index study were mobilized from the 2nd postoperative day. Delay in mobilization may have contributed to the delay in hospital discharge in the index study. Also the delay in the hospital discharge in the index study compared to the study by Kara et al[14] can also be explained by the difference in the patient population; While the Kara et al[14] study were patients for discectomy, the index study involved patients with spinal stenosis for laminectomy. Laminectomy for spinal stenosis requires a more extensive surgery compared to discectomy. This may have prolonged recovery and subsequent prolonged hospital stay in the index study. Conversely, Chen et al[27] reported a shorter hospital stay for the regional anaesthesia group than for the general anaesthesia group. The difference in results could be attributed to difference in anaesthesia techniques and surgical procedures studied. While Chen et al[27] compared local anaesthesia with general anaesthesia, they also studied laparoscopic microdiscectomy, a less invasive procedure compared with open laminectomy done in the index study which may contribute to less hospital stay in their study.

CONCLUSION

Lumbar laminectomy can safely be done with spinal or general anaesthesia. However, spinal anaesthesia provided a better early postoperative recovery profile, as evidenced by a reduced pain score in the first 4hours postoperative time compared to general anaesthesia.

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