

Regional Anaesthesia for Lumbar Laminectomy-Case Series

Idehen HO^{1*}, Agbonkheshe G¹, Obeta EC² and Imarengiaye CO¹

¹Department of Anaesthesiology, University of Benin Teaching Hospital Benin City, Edo State, Nigeria

²Department of Neurosurgery, University of Benin Teaching Hospital Benin City, Edo State, Nigeria

***Corresponding author:** Idehen HO, Department of Anaesthesiology, University of Benin Teaching Hospital, Benin City, Edo State, Nigeria, Tel: +2348033850091, E-mail: idehenhanson@yahoo.com

Citation: Idehen HO, Agbonkheshe G, Obeta EC, Imarengiaye CO (2019) Regional Anaesthesia for Lumbar Laminectomy-Case Series. SAJ Case Report 6: 103

Article history: Received: 06 February 2019, Accepted: 27 March 2019, Published: 29 March 2019

Abstract

The use of central neuraxial anaesthesia for lumbar laminectomy is evolving in our centre with its attendant advantages like decrease in intraoperative blood loss, peri-operative cardiac ischemic incidents, postoperative hypoxic episodes, arterial and venous thrombosis, and it provides longer/ adequate postoperative pain control. Nonetheless, blindness a possible complication under general anaesthesia is preventable with regional anaesthesia, this is because patient is awake and there is no restriction in neck movement. This case series helps to provide feasibility of lumbar laminectomy under central neuraxial anaesthesia (spinal, epidural and combined spinal epidural anaesthesia).

Keywords: Central Neuraxial Block; Laminectomy; Lumbar

Introduction

Lumbar laminectomy a neurosurgical/ orthopaedic procedure usually performed for spondylotic canal stenosis, degenerative/ traumatic disease and tumours of the spine. It is routinely carried out in our centre under general anaesthesia because of the prone position of patient for surgery. General anesthesia has the advantage of being adaptable for carrying out prolonged surgeries in the prone position without airway compromise and some surgeons and anaesthesiologist prefer using it [1]. Anecdotal practice avoids regional anaesthesia particularly in patients with pre-existing disease of the central nervous system, Regional anaesthesia for laminectomy is not a common anaesthetic option because of the presence of pre-existing disease of the nervous system, awkward surgical position and the likely use of the lumbar space as point of surgical intervention may have been limiting factors [2]. However, the superiority of general anaesthesia over regional anaesthesia for lumbar laminectomy is still controversial. These case series will help to reinforce the benefit of regional anaesthesia for lumbar laminectomy as it is not contraindicated for the procedure.

Lately, with capacity building workshop and subspecialty development in regional anaesthesia in our centre, there was compelling need to expand the anaesthetic options for laminectomy. Specifically, central neuraxial block like spinal or epidural anaesthesia are noted for decreasing intraoperative blood loss perioperative ischaemic events, thrombotic incidence, haemodynamic stability without increasing adverse side effects and enhancing good post operative pain control [3-7]. Blindness, pressure necrosis to the face, brachial plexus injury which is a complication under general anaesthesia is preventable because patient can position themselves when awake. Pulmonary complications such as atelectasis are fewer with regional anaesthesia and outcomes are also better under regional [8,9]. An excellent anesthetic must decrease recovery room stay at the same time reduce postoperative pain, nausea, vomiting, and need for additional analgesics [10].

Thus, we report our experience with the anaesthetic management of laminectomy using regional anaesthesia in four patients. It is hoped that the successful outcome in these patients may engender widespread consideration of regional anaesthesia for lumbar laminectomy.

Case One

An 80 years old trader, scheduled for lumbar laminectomy on account of lumbar canal stenosis had a ten years history of low back pain. Pain has progressively worsens over time. There was a history of neurogenic claudication characterized by cramps in both lower limbs when walking, relieved by rest, radiates down to both lower limbs. Patient also has paraesthesia/dysesthesia in

both limbs and all over the body. She reported constipation but no urinary sphincter problem. She had a fall while carrying heavy load on her head many years ago but was only briefly hospitalized. There is no anterior neck swelling breast lump or any swelling elsewhere.

There is a history of chronic cough for more than 40y but no associated weight loss. No haemoptysis, occasionally improved by inhalers and produces mucoid yellowish sputum.

Examination revealed an elderly woman, chronically ill looking, coughing, afebrile, not pale or cyanosed, nil pedal oedema and not dehydrated. Central nervous system; her Glasgow Coma Scale was 15 with normal mental state and cranial nerves but with bilateral immature cataract. Cardiovascular system; pulse rate 80beats per with minute normal volume, blood pressure (BP) 145/80mmHg, heart sounds 1 and 2 heard but no murmur. Respiratory system; respiratory rate 17cycles per minute, not dyspnoeic, trachea central, breath sounds vesicular but with crepitations in both the right middle lung zones and left lower lung zones. Airway; good neck flexion and extension, adequate mouth opening, Mallampatti 2. Back; there was no rash, swelling, scar or deviations of the spine. A diagnosis of COPD with superimposed chest infection in a patient with lumbar canal stenosis with caudal equina compression was made.

Laboratory results; Hct-33%, ECG revealed no abnormality while Echocardiography showed an ejection fraction of -66%, Lumbosacral spine MRI revealed L₂/3, L₃/4, L₄/5, L₅/S₁ posterior disc bulges with ligamentum flavum hypertrophy at same level but worse at L₃/4, L₄/5. Resulting in canal stenosis and thecal sac compression with lateral recess stenosis and exit foramina stenosis.

Patient's chest X-ray revealed basal pulmonary changes suggestive of non-kock's infection while sputum culture yielded no growth. Patient was subsequently placed on tabs levofloxacin 500mg daily for 10 days, seretide inhaler 1 puff (200µg) morning and evening. Patient was to be reviewed after the above treatment for fitness for anaesthesia and surgery. After 10 days of treatment, the cough had stopped and the chest was clinically clear.

In the theatre, baseline vital signs were taken and recorded, the heart rate was 86beats per minute, blood pressure 134/70mmHg, and SpO₂ 97% in room air. The laminectomy was to be done using combined spinal epidural anaesthesia using two needle techniques. Intravenous access secured using 16G cannula and preloaded the circulation with 500ml of normal saline. With the patient in sitting position on the trolley, lower back was aseptically cleaned. L₁, L₂ intervertebral space was located and infiltrated with 2ml of 1% lidocaine, epidural space located using loss of resistance to air technique with a size 18G Tuohy needle and 2cm of the epidural catheter was left in the epidural space. Spinal anaesthesia was done at L₄L₅ intervetebral space using 2.0ml of 0.5% bupivacaine and 2mg dexamethasone. Patient was placed supine for 10minutes for the spinal anaesthesia to reach its maximum block height. Monitoring was done every minute for the first 5 minutes and subsequently every five minutes. Maximum block height reached was of T₈ before she was repositioned prone on the operating table with the thoracic and pelvic support to encourage venous return.

Surgery commenced and 90minutes into surgery, epidural was activated with 5ml aliquot and a total 10ml of 0.5% plain bupivacaine and 10mg pethidine was administered. Surgery lasted about 2hours 10min and was well tolerated by the patient. No complain of intraoperative discomfort by the patient. The estimated blood loss was 350ml, patient received about 2.5liters of crystalloid. Intraoperatively vital signs pulse rate ranged between 66-101bpm, blood pressure 80-140/60-95mmHg, SpO₂ 98-100%. At the end of surgery, patient was returned to the supine position and 10ml of 0.25% plain bupivacaine and 10mg of pethidine was administered via the epidural catheter for post operative analgesia and the epidural catheter was removed. The sensory and motor functions were assessed every hour for the first 12hours. Patient regained full motor function and pain sensation (4hour and 6hour respectively) after the end of surgery.

Case Two

A 55 years old nurse who complained of waist pain of 6 years duration which was sudden in onset and first noticed after clearing the grasses in her compound. Pain is continuous and radiates to the buttock and vulva. There are associated cramps, paresthesia and neurogenic claudication. Her claudication distance is about 50m and there is associated weakness of both lower limbs. No neck pain but has bilateral brachialgia but without clumsy hands. There is no history of chronic coughs or contact with an index case of tuberculosis. No weight loss or constipation or anterior neck swelling, no breast or swelling elsewhere. Symptoms have progressively worsened till date. She is a known hypertensive diagnosed 7 years ago, compliant with medications (amilodipine, lisinopril) and no hospitalization for any complication. She reacts to syrup benylyn with codeine which manifest as restlessness.

On examination of the patient she is a middle age woman, in painful distress, afebrile, not pale or jaundiced. CNS GCS 15, normal mental state and cranial nerves. Clinical impression was that of Tandem Canal Stenosis with cervical radiculopathy and lumbar spondylolisthesis. Central nervous system; patient was conscious and alert, oriented in Time Place Person, no cranial nerve deficit. Cardiovascular system; pulse rate 80bpm normal volume, blood pressure130/80mmHg, heart sound 1 and 2 heard but no murmur. Respiratory system; respiratory rate18cpm not dyspnoeic, trachea central, breath sounds vesicular with added sounds in both lower long zones. Airway; good neck flexion and extension, adequate mouth opening, Mallampatti 2. Lower back; there was no rash, swelling, scar or deviations of the spine.

Laboratory results were Hct of 32%. lumbospinal MRI L₄/5 disc prolapsed with L₄/5 and L₃/L₄ ligamentum flavum hypertrophy.

L_{4/5} spondylolisthesis. Lumbo-spinal X-ray showed L_{4/5} instability. Plan was L_{4/5} decompression with pedicle screw fusion.

In the theatre, ECG leads were applied and baseline vital signs were taken and recorded, heart rate 86bpm, blood pressure 144/99mmHg, SpO₂ 98% in room air. Intravenous access was secured using 16G cannula and the circulation was preloaded with 500ml of normal saline. With the patient in sitting position on the trolley, lower back aseptically cleaned. L₁, L₂ intervertebral space located and infiltrated with 2ml of 1% lidocaine, epidural space located using loss of resistance to air technique with a size 18G Tuohy needle. 2 cm of the epidural catheter was left in the epidural space. Spinal anaesthesia was established using 2ml of 0.5% heavy bupivacaine. Maximum sensory block height was T₈. Intravenous pethidine 10mg was given as patient assumed the prone position.

Surgery commenced and at 105minutes into surgery, epidural was activated with 10ml of 0.5% bupivacaine with two additional topped up. Surgery lasted 4hours and 10min and was well tolerated by the patient; estimated blood loss was 200ml, patient received about 3liters of crystalloid. Intraoperatively vital signs pulse rate which ranged between 86-110bpm, blood pressure 90-150/60-100mmHg, SpO₂ 98-100%. At the end of surgery, patient was returned to the supine position and 10ml of 0.25% of plain bupivacaine and 10mg of pethidine was administered for post operative analgesia and the epidural catheter was removed. The sensory and motor function were assessed every hour for the first 12 hours. Patient regained full motor function and pain sensation (4hour and 8hour respectively) after the end of surgery.

Case Three

Mr EA, a 32 year old male presented with complaints of lower back pains of one month duration. Lower back pain started when he was in a bus that suddenly moved from its stationary position in his sitting position. Pain was severe, sharp in nature, constant, radiated down both lower extremities to the soles of the feet (right>left), worsened by movement, temporarily relieved by rest and analgesics. There was associated constipation and erectile dysfunction but no urinary incontinence. There was associated weakness in both lower limbs which has progressively worsened as he ambulates with a stick. He presented to a private hospital and was referred to our facility. On examination at presentation, an impression of acute cauda equina syndrome secondary to L_{3/4} disc prolapsed was made and he was booked for L_{3/4} micro-disectomy. There was no history of inter-current medical disease. No previous history of anaesthesia or surgery.

On examination, a young man not in any obvious distress, afebrile, not pale, anicteric, acyanosed, not dehydrated and no pedal oedema. Central nervous system examination, patient was conscious and alert, well oriented in Time Place Person with decreased muscle tone and power in the lower limbs. Respiratory system examination revealed a respiratory rate of 18cpm, good air entry bilaterally; breath sounds were vesicular in all lung zones. Airway, good range of neck movement, inter-incisor gap of 6cm, thyromental distance 6cm, sternomental distance 14cm and Mallampatti 1. Abdomen, flat moves with respiration, soft no area of tenderness no organomegally. According to American Society of Anaesthesiologist he was assigned ASA 1. All the investigations were all within normal values (FBC, E/U/Cr). Plan was to group patient's blood and cross match 2 units of screened blood, nil per Os from midnight; patient was counselled on anaesthetic technique (Combined Spinal Epidural anaesthesia)

On the day of surgery, patient was transferred to the theatre lying supine on a trolley with multi-parameter monitor attached. The baseline vital signs were PR 84bpm, BP 146/93mmHg, SpO₂ 100%. Intravenous access was secured using a size 16G cannula on the right arm and another 18G cannula on the left arm and he was preloaded with 15ml/kg of normal saline. In the sitting position lower back aseptically cleaned. Spinal anaesthesia was established at L_{2/3} intervertebral space using 3mls of hyperbaric bupivacaine and 15mg of pethidine. Patient was returned supine slowly and left for 10min. Monitoring was done every minute for the first 5 minutes and subsequently every five minutes. Maximum block height was assessed to be at T₆. Patient was then repositioned and placed in the prone position on the operating theatre Table. Intraoperative vital signs were PR 60-80bpm, BP 100-140/60-90mmHg, SpO₂ on room air 96-100%. Surgery lasted 2 hours with no intraoperative discomfort. Estimated blood loss was 300ml, urinary output of 350mls over 3hours. The patient immediate post operative vital signs were PR 60bpm, BP 118/69mmHg, SpO₂; 98% in room air. He was subsequently repositioned supine on the trolley and transferred to the recovery room. Time to first analgesic request was at the second hour post operatively and regained motor function after 4hours, there was no neurological sequelae.

Case Four

A 48 years old female presented with a 5 months history of right lower limb pain. She assisted in lifting her sick mother before illness started. Pains worsen gradually, insidious in onset; it involved the calf, hamstring and lateral side of the foot. Pain was aggravated by prolonged sitting and walking but relieved by kneeling and lying down. There was associated weakness and cramps of the limb. Patient was not constipated nor retained urine. She was subsequently billed for lumbar laminectomy on account of lumbar canal stenosis.

She is a known hypertensive diagnosed three years ago and has been compliant with her medications. She is currently on both tabs amlodipine 5mg, propranolol 25mg daily. She is a known Gastro-esophageal reflux disease patient on suspension Gestid 10ml TDS and Omeprazole 20mg daily and also on tabs somastatin 20mg daily for hypercholesterolemia.

She had appendectomy done 1985 under GA, Caesarean Sections in 1995 and 2000 respectively both where under GA. Had

myomectomy done in 2009 under GA, Carpal tunnel release done under regional anaesthesia (bier's block)? There were no sequelae under anaesthesia for previous surgeries; she had blood transfusion in the past with no transfusion reaction. There is no loose tooth or use of denture. Patient reacts to fluoroquinolones but no food allergies. She occasionally drinks alcohol but does not use tobacco in any form. There is no history of cough, catarrh, chest pain and fever.

On examination, patient was conscious, afebrile, not pale, anicteric, acyanosed, nil pedal oedema and not dehydrated. Central nervous system; patient was conscious and alert, oriented in TPP, no cranial nerve deficit. Cardiovascular system examination revealed a pulse rate of 80bpm, normal volume. Blood pressure was 130/80mmHg, heart sounds 1 and 2 heard but no murmur. Respiratory system; respiratory rate 18cpm not dyspnoeic, trachea central, breath sounds vesicular with added sounds in both lower lung zones. Airway; good neck flexion and extension, adequate mouth opening, Mallampatti 11. Back; there was no rash, swelling, scar or deviations of the spine.

Laboratory results; Hct-40% ECG revealed borderline abnormality while Echocardiography (normal with EF-57%), Lumbosacral spine MRI done revealed mildly straightened lumbar spine, reduced signal intensity at L₃/L₄/L₅/S₁ intervertebral discs with central herniation posteriorly, spinal canal stenosis and lateral recess stenosis. Chest X-ray (PA) revealed atypical pneumonia. Challenges were hypertensive heart disease, GARD and atypical pneumonia

In the theatre, baseline vital signs were taken and recorded, heart rate 86bpm, blood pressure 144/99mmHg, SpO₂ 98% in room air. Intravenous access secured using 16G cannula and patient circulation preloaded with 500mls of normal saline. With the patient in sitting position on the trolley, lower back was aseptically cleaned. L₁, L₂ intervertebral space located and infiltrated with 2ml of 1% lidocaine, epidural space located using loss of resistance to air with a size 18G Tuohy needle and 2cm of the epidural catheter was left in the epidural space. Epidural was activated with 15ml (5ml aliquot) of 0.5% plain bupivacaine and 8mg of dexamethasone. Sensory block was achieved in 5min and 10mg of intravenous pethidine was given as patient assumed the prone position.

Surgery commenced and after 1 hour 45minutes into surgery, epidural anaesthesia was topped up with 10ml of 0.5% plain bupivacaine and 10mg of pethidine. Surgery lasted about 4hours and 10min and was well tolerated by the patient; estimated blood loss was about 200ml, patient received about 3liters of crystalloid. Intraoperatively vital signs pulse rate 86-110bpm, blood pressure 90-150/60-100mmHg, SpO₂ 98-100%. At the end of surgery, the patient was returned to the supine position and 10ml of 0.25% and 10mg of pethidine were administered for post operative analgesia and the epidural catheter was removed. Patient regained full motor function and pain sensation (4hour and 8hour respectively) after the end of surgery.

Discussion

These case series demonstrates that central neuraxial block (spinal, epidural, combined spinal epidural anaesthesia,) can be used for lumbar laminectomy. However, the use of central neuraxial blocks has not been a common technique in our or other centres in Nigeria. Just as some authority believes that general anaesthesia is the method of choice for spine procedures [9]. Conversely, regional anaesthesia which seem recent/novel have been used for laminectomy as far back as seven decades but the preference for general anaesthesia may either be related to the lack of familiarity with the use of RA in such procedures or may reflect the uncertainty concerning the potential risks and complications incurred when surgeries involving the spine are performed [2,10].

Nevertheless, the choice among the two techniques seems controversial. However, each of the techniques has its own merit/demerit. Central neuraxial blockade is cost effective, reduces postoperative pain, nausea, deep venous thrombosis and blood loss, stable intraoperative hemodynamics and improved patient satisfaction. This is not without its downside, like inability to immediately assess neurological function postoperatively because of residual effect of central neuraxial blockade which may also obscure the signs and symptoms of epidural haematoma.

Nonetheless, epidural anaesthesia alone can be used for laminectomy while monitoring neurological functions. This involves blocking segment of dermatomes that covers the operative site alone while sparing the non-operative sides. This phenomenon has been used for lumbar laminectomy when intra-operative monitoring of the motor and sensory component of the lower extremities is needed [11]. This was possible because T₆-L₂ spinal segments were blocked excluding those of the lower spinal nerves that are caudal to L₂. Intraoperative monitoring of motor component will not be possible with spinal or combined spinal epidural anaesthesia. This is because, it anaesthetises the lower lumbar and sacral segments and the possibility of assessing motor function is lost.

The merits of general anaesthesia are, secures airway in awkward prone position, one can immediately assess neurological function postoperatively. There is no risk of developing spinal hematoma as a result of the anaesthetic technique used and if this occurs the symptoms are not marred. However, it causes elevation of blood pressure and heart rate with the complications associated with endotracheal intubation.

Epidural anaesthesia when compared to general anaesthesia has decreased blood loss during lumbar spine surgery the likely mechanism for these reduced blood loss in spinal anaesthesia is by sympathetic blockade which results in vasodilatation and hypotension [12,13].

Secondly, because patient is breathing spontaneously, this result in lower intra-thoracic pressure and less distension of the epidural

veins with resultant decrease in blood loss. Finally, preloading with crystalloids helps to reduce the number of red blood cell loss because of haemo-dilution. The decreased blood loss during SA contributes to the lower surgical time because of clearer operating field.

There is a usually less significant haemodynamic change with regional technique, Atari, *et al.* compared spinal and general anesthesia for spinal surgeries in 72 patients and found that intra-operative mean arterial pressure changes and heart rate changes were significantly less in spinal anesthesia group. Surgeon's satisfaction was significantly more in the spinal anesthesia group [6].

Other authors have also found that regional technique reduces the side effect profile and better patient satisfaction. In a retrospective study, Greenberg, *et al.* showed the superiority of epidural anaesthesia over general anaesthesia for spine surgery because of lower injectable narcotic requirement, incidence of post operative urinary retention, provided satisfactory anaesthesia and allowed test of lower extremity motor function [12]. They concluded that epidural bupivacaine anesthesia is an effective, well tolerated technique with several potential advantages, and an acceptable incidence of complications, as compared with general anesthesia with endotracheal intubation.

Works by Sadrolsadat, *et al.* is one of the few studies that observed that surgeon's satisfaction was better when using general anaesthesia compared with spinal anaesthesia for herniated lumbar disk surgery [14]. Surgeon's satisfaction was assessed using the amount of blood in the surgical field, patient's muscular relaxation and the possibility of assessing neurologic status immediately after the operation. The tool used for assessing surgeons satisfaction was skewed in favour of patients undergoing general anaesthesia, since the motor function following spinal anaesthesia might not have fully recovered as at the time the assessment was done. It is pertinent to note that a different outcome could have been seen if general anaesthesia was compared with epidural anaesthesia because epidural causes limited motor blockade.

In these case series, patients were particularly satisfied because they were not put to sleep. Despite the evidence provided by this series that lumbar laminectomy can be done using regional technique. Some surgeons are not comfortable for any particular reason in using this technique for laminectomy in our setting. One would have thought that their previous experience with the operating conditions with regional technique might have influenced their decision, however this is not the case.

In choosing regional technique for laminectomy, there are factors that will influence the type; these are duration of surgery, type of procedure, speed of surgeons and consent or request of the patient. Surgeries lasting less than 2 hours are best suited for spinal anaesthesia, which has an accurate end point or high success rate but with limited post operative analgesic effect when compared to epidural [8]. Type of surgery has a direct relationship to duration of surgery for example single vertebra laminectomy or discectomy can be successfully done using spinal anaesthesia. Nevertheless, procedures like multiple vertebral laminectomies with or without stabilization are best done with epidural anaesthesia or combined spinal epidural, because of the possibility of exceeding the duration of spinal anaesthesia. Finally, patient decision should be respected; patient's morbid fear of general anaesthesia can be another indication for the use of regional technique

The different central neuraxial anaesthesia techniques for lumbar laminectomy are associated with some differences in clinical outcome. Combined spinal anaesthesia (CSE) or spinal anaesthesia alone has the advantage of providing a dense form of block compared to epidural anaesthesia alone that blocks mainly sensory modality with minimal motor effect. Patients under epidural anaesthesia may experience some form of discomfort during extreme retraction of para-spinal muscles, which is most unlikely under CSE and spinal anaesthesia.

The significance of regional anaesthesia cannot be over emphasized particularly when epidural was combined with general anaesthesia; the combination of epidural and general anaesthesia was superior to general anaesthesia alone for elective lumbar spine surgery [10]. Despite these, it is imperative to note that regional anaesthesia still has some challenges but they are few which can be a failed block, patient discomfort. Failed block can be managed by assessing the level of block/ adequacy before patient is placed prone before the commencement of surgery. Secondly, positional discomfort can be managed with low dose intravenous opioids, as demonstrated in this case series. It is therefore our desire, that regional anaesthesia for laminectomy is adopted as the first choice technique if there are no contraindications. It isn't a new technique; one of the earliest reports was in 1959 [2]. However, patient selection is important in choosing who will benefit maximally from the use of it.

Conclusion

This is a case series that showed the use of different central neuraxial techniques singly or in combination for lumbar laminectomy. Regional anaesthesia should therefore be encouraged and considered as an alternative to general anaesthesia because of its satisfactory results.

References

1. Cucchiara RF, Michenfelder JD (1990) Clinical Neuroanesthesia. London: Churchill Livingstone; Vertebral column and spinal cord surgery; pp. 325-50.
2. Ditzler JW, Dumke PR, Harrington JJ, Fox JD (1959) Should spinal anaesthesia be used in surgery for herniated intervertebral disk? *Anesth Analg* 38: 118-24.
3. Pierce JT, Kosiratna G, Attiah MA, Kallan MJ, Koenigsberg R, et al. (2017) Efficiency of spinal anesthesia versus general anesthesia for lumbar spinal surgery: a retrospective analysis of 544 patients. *Local Reg Anesth* 10: 91-8.

4. Tetzlaff JE, Dilger JA, Kody M, Yoon HJ, Bell GR et al. (1998) Spinal anaesthesia for elective lumbar spine surgery. *J Clin Anesth* 10: 666-9.
5. De Rojas JO, Syre P, Welch WC (2014) Regional anaesthesia versus general anaesthesia on the lumbar spine for surgery on the lumbar spine: A review of the modern literature. *Clin Neurol Neurosurg* 119: 39-43.
6. Attari MA, Mirhosseini SA, Honarmand A, Safavi MR (2011) Spinal anaesthesia versus general anaesthesia for elective lumbar spine surgery: A randomized clinical trial. *J Res Med Sci* 16: 524-9.
7. Düger C, Gürsoy S, Karadağ O, Kol İÖ, Kaygusuz K, et al. (2012) Anaesthetic and analgesic effects in patients undergoing a lumbar laminectomy of spinal, epidural or combine spinal epidural anaesthesia block with addition of morphine. *J Clin Neurosci* 19: 406-10.
8. Jellish WS, Thalji Z, Stevenson K, Shea J (1996) 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* 83: 559-64.
9. Horlocker TT, Cucchiara RF, Ebersold MJ (1990) Vertebral column and spinal cord surgery. In: Cucchiara RF, Michenfelder JD, eds. *Clinical neuroanesthesia*. New York:Churchill Livingstone 1990: 325-50.
10. Mohammad RK, Mohammad AA, Abbas A (2013) General anaesthesia versus combined epidural/general anaesthesia for elective lumbar spine disc surgery. A randomized clinical trial comparing the impact of the two methods upon the outcome variable. *Surg Neurol Int* 4: 105.
11. Kiran LV, Radhika KS, Parthasarathy S (2014) Lumbar laminectomy with segmental continuous epidural anaesthesia. *Anesth Essays Res* 8: 236-8.
12. Greenbarg PE, Brown MD, Pallares VS, Tompkins JS, Mann NH, et al. (1988) Epidural anaesthesia for lumbar spine surgery. *J spinal Disord* 1: 139-43.
13. Covino BG (1989) Rational for spinal anesthesia. *Int Anesthesiol Clin* 27: 8-12.
14. Sadrolsadat SH, Mahdavi AR, Moharari RS, Khajavi MR, Khashayar P, et al. (2009) A prospective randomized trial comparing the technique of spinal and general anesthesia for lumbar disk surgery: a study of 100 cases. *Surg Neurol* 71: 60-5.