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Lumbar Spine Surgery Outcome: Effect of Regional Anaesthesia

By Dr. Vishal Moudgil & Dr. B.S. Bajwa
Punjab Institute of Medical Sciences, India

Abstract- Either general or regional anesthesia can be used for spine surgery. Spine surgery involves acomplex procedure. The aim of a spine surgeon for doing a good surgery requires a clear and bloodless field especially in procedures done under microscope. As the working space is less a small epidural bleed can cause further complications in surgery. Another aspect is to take care of post operative analgesia which is better achieved with regional anaesthesia. Regional anaesthesiahas many benefits, namely less time, lower incidence of nausea and vomiting ,general hazards of general anaesthesia can be avoided and cost effectiveness. This article reviews effect of regional anaesthesia on lumbar spine surgery.

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Lumbar Spine Surgery Outcome: Effect of Regional Anaesthesia

Dr. Vishal Moudgil [α] & Dr. B.S. Bajwa [σ]

Abstract- Either general or regional anesthesia can be used for spine surgery. Spine surgery involves acomplex procedure. The aim of a spine surgeon for doing a good surgery requires a clear and bloodless field especially in procedures done under microscope. As the working space is less a small epidural bleed can cause further complications in surgery. Another aspect is to take care of post operative analgesia which is better achieved with regional anaesthesia. Regional anaesthesiahas many benefits ,namely less time , lower incidence of nausea and vomiting ,general hazards of general anaesthesia can be avoided and cost effectiveness. This article reviews effect of regional anaesthesia on lumbar spine surgery.

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I. Introduction

An acceptable anesthetic technique must have characteristics such as rapid onset and reversal of effects, it must maintain stable hemodynamic during operation without need to increase blood transfusion and an excellent anesthetic must decrease recovery room stay while reduce postoperative pain, nausea, vomiting, and requirement for additional analgesics.

Surgery on lumbar spine can be safely performed under general or regional anesthesia. Patient's satisfaction and the ability to carry out prolonged operations in the prone position without airway compromise are advantages of using general anesthesia (GA). Alternatively, the most important advantages of regional anesthesia are the decrease in intraoperative blood loss and consequently improving operating conditions, the decrease in perioperative cardiac ischemic incidents, postoperative hypoxic episodes, arterial and venous thrombosis, and to provide proper postoperative pain control. Additionally, in order to prevent brachial plexus injury and pressure necrosis of face, it is better if patients can position themselves while they are awake. This is possible only with spinal anesthesia (SA).

Reviewing the medical literature, there are controversies whether regional or general anaesthesia offers these advantages for lumbar spinal surgery. Sadrolsadat et al2 conducted a prospective study and showed that in contrast to the previous studies that revealed spinal anaesthesia was better than general anaesthesia for patients lumbar spine surgery, spinal anaesthesia had no advantages over generalan-aesthesia. Their prospective study showed that general anaesthesia has many advantages over spinal anesthesia. However, they recommend further studies for elucidating the advantages of each technique. Scott et al 1showed, pulmonary complications were more common in patients underwent GA compared with regional anesthesia. Two retrospective studies shown that SA resulted in better outcome compared with GA in patients underwent surgeries on lumbar spine[1,3],.

In our clinical experience, it seems that patients who underwent lumbar spine surgery with regional anaesthesia have less adverse effects and has more advantages as compared with general anaesthesia. This is in accordance with the most previous studies but is opposite to Sadrolsadat et al study.

A, little overview of lumbar spine disorders and various surgeries done for them is covered below.

II. Clinical Features of Spinal Disorders

a) *Intervertebral disc lesions*

Prolapsed discs: lumbar backache is one of the most common causes of chronic debility. Acute lumbar disc prolapse or chronic degeneration with disc-space narrowing at L4/5 or L5/S1 are the most common pathologies[3].The annual incidence of low back pain is estimated at 5%, but only 1% develops radiculopathy.[4] In acute prolapse, the disc may bulge beneath the posterior longitudinal ligament in the mid line (central disc) or posterolaterally with consequent distortion of the spinal canal or nerve-root compression. Local oedema may exacerbate the problem. Symptoms result from distortion of the posterior longitudinal ligament (chronic pain), pressure on the nerve-root sheath (sciatica) and compression of the nerve itself (muscle weakness, numbness and paraesthesia). Caudaequina com-pression may cause urinary retention, but is relatively uncommon. Management includes rest, analgesia and physiotherapy, epidural injections of steroid and local anaesthetics appear to help some patients and a prospective, randomised, controlled, double-blinded study has shown theefficacy of selective nerve root blocks of patients with lumbar radiculopathy and/or

Author α: A.P. Orthopaedics, PIMS.
e-mail: vishalmoudgil1980@gmail.com
Author σ: A.P. Anaesthesia, PIMS. e-mail: baljitbajwa7@gmail.com

stenosis. Less than 2% of symptomatic patients undergo operative treatment5.Surgical intervention is best directed at those with unremitting nerve root symptoms. Urgent surgical intervention is required in those with acute caudaequina compression or significant acute motor deficit (e.g. foot drop). However, urgent decompression once urinary retention and overflow incontinence has occurred seems to confer little benefit.6

Spondylosis: Recuurent disc prolapses can lead to lumbar disc degeneration resulting in flattening of the disc, facet-joint displacement, and a degree of instability with limited and painful movement. In addition to disc flattening, bony spurs may grow at the margins of the vertebral bodies, impinging on nerve roots and producing symptoms. Physiotherapy[7] is the mainstay of treatment, but in severe or refractory cases anterior spinal fusion may be the definitive option.

Spondylolisthesis: Following osteoarthritic changes, dysplasia or fractures of intervertebral facet joints may lead to forwards lipping of one vertebral body on the other. Levels commonly involved are L4/5 and L5/S1. Mostly asymptomatic, but the resultant loss of canal and foraminal diameter can both precipitate and accentuate symptoms of compression due to the other causes. Surgical treatment is based around decompression of the affected nerve roots. However, where instability is evident on standing flexion/extension plain lateral radiographs or anticipated, fusion may be undertaken. Spinal fusion provides stabalization and may be necessary for symptomatic relief. Minimally invasive surgical (MIS) techniques isused to achieve lumbar interbody fusion. The advantages of minimally invasive spinal instrumentation techniques are less soft tissue injury, reduced blood loss, less postoperative pain and shorter hospital stay while achieving clinical outcomes comparable with equivalent open procedure..[8]

Spinal stenosis: Congenital or narrowing of spinal canal following spondylolisthesis. Neurological symptoms may appear consequent to progressive narrowing on disc degeneration and osteoarthrosis, which may be unilateral (root canal stenosis). Spinal decompression is indicated if symptoms are severe.

b) Surgical procedures for lumbar diseases

Microdiscectomyis the gold standard operative treatment for lumbar disc prolapse. The standard approach is through a midline incision over the affected interspace with intraoperative radiographs to confirm the operative level. A fenestration of the ligamentumflavum and, if indicated minimal laminotomy exposes the thecal sac and transiting nerve root. Medial retraction of the root permits identification of the disc space and prolapse and subsequent discectomy. The patient is placed prone or kneeling.

There are various names and terms used for the numerous surgical procedures used to achieve surgical decompression by removal of the offending tissue whilst maintaining stability from facet joint or ligament-tumflavum hypertrophy. However, people who have had either standard discectomy or micro-discectomy have reported similar improvements one year after surgery.[9]

Lumbar laminotomy and laminectomy: laminotomy (partial removal of vertebral lamina) or laminectomy (complete removal of spinous process and bilateral lamina and removal of underlying ligamentumflavum) are performed to decompress the spinal cord and/or nerve roots via a posterior approach with the patient lying prone. Discectomy may also be necessary, the dura is retracted to one side and the disc removed piecemeal. Extension of bony removal to include upto 1/3 rd of the medial aspect of the facet joint (thus maintaining stability) will additionally decompress the transiting nerve root in lateral recess performed alone and unilaterally .This latter decompression is often called medial facetectomy. In general, laminectomy/ laminotomy, with or without discectomy, is performed if there are signs of nerve root compression; it is expected that the individual's symptoms will improve when pressure on the nerve root is relieved.[10]During these procedures there is a risk of damage to both the dura and retroperitoneal structures (e.g. major vessels). The extent of the procedure depends on the underlying problem and may vary from simple laminotomy for single nerve-root compression to decompression over several segments for spinal canal narrowing. In such cases, a stabilization or fusion procedure (e.g. plate and screws) lemay also be required (where multiple levels decompression and concern regarding post operative stability)

Vertebroplasty and kyphoplasty are similar medical spinal procedures in which bone cement is injected through a small hole in the skin (percutaneously) into a fractured vertebra with the goal of relieving back pain caused by vertebral compression fractures. It was found not to be effective in treating osteoporosis-related compression fractures of the spine in the only two placebo controlled and randomized clinical trials[11]The patients in both the experimental and placebo groups of the blinded study reported improvement in their pain, suggesting that the clinical benefit noted in unblinded trials is related to the placebo effect. It is a minimally invasive procedure and patients usually go home the same or next day as the procedure. Patients are given local anesthesia and light sedation for the procedure, though it can be performed using only local anesthetic for patients with medical problems who cannot tolerate sedatives well. During the procedure, bone cement is injected with a biopsy needle into the collapsed or fractured vertebra. The needle is placed with fluoroscopic x-ray guidance. The cement (most

commonly PMMA, although more modern cements are used as well) quickly hardens and forms a support structure within the vertebra that provide stabilization and strength. The needle makes a small puncture in the patient's skin that is easily covered with a small bandage after the procedure.

Percutaneous interspinous device Interspinous process decompression (IPD) techniques may offer a less invasive alternative for microsurgical decompressive surgery in lumbar spinal stenosis. Several implants have been introduced in the market. The In-space (Synthes, Umkirch, Germany) is a new implant strictly designed for percutaneous implantation with short operating times. Regional anaesthesia is better suited for this procedure.

c) Anaesthetic considerationslumbar procedures (excluding corrective surgery)

Regional anesthesia and general anesthesia are both applicable anesthestic techniques for spine surgeries. A retrospective analysis by Tetzlaff et al. [12]demonstrated that spinal anesthesia was a safe and effective alternative to general anesthesia for elective lumbar spine surgery with reduced perioperative complication rates. They concluded that spinal anesthesia could be an excellent choice for lumbar spine surgery. A review article by De rojas et al[13] concluded that both RA and GA are safe and effective techniques for lumbar spine surgery and that RA may prove a better alternative than GA for healthy patients undergoing simple lumbar decompression procedures or for patients who are at high risk for general anesthetic complications.

Preoperative: surgical procedures on the lumbar spine for disc problems are common. Any preoperative neurological deficit should be recorded in the patient's notes, especially if a regional technique is considered. Generally, these patients are otherwise healthy and no special investigations are normally required.

Intraoperative: it is possible to perform simple lumbar procedures under local or regional (spinal or epidural) anaesthesia. McLain et al.[14] reported that regional and general anesthesia have similar effectiveness for performing elective lumbar decompression surgeries, and also regional anesthesia showed some advantages over general anesthesia, including improved perioperative hemodynamic stability, decreased analgesic requirement, and decreased occurance of postoperative nausea.

Several studies comparing spinal anesthesia and general anesthesia in lumbar disc surgery have reported spinal anesthesia as the preferred method for lumbar spine surgery.[12-16] In relation, some centers have been routinely performing regional anesthesia for lumbar laminectomy and discectomy. However, this is seldom done in practice because of medico-legal concerns that any new postoperative neurological deficit may be blamed on the anaesthetic technique. A general anaesthetic technique involving intubation and mechanical ventilation is more usual. For all posterior spinal procedures the patient is placed prone or in the knee–elbow position. It is therefore advisable to use an armoured tracheal tube to minimize the risk of kinking and to ensure that the tube is well secured before and after turning the patient. Potential problems with the prone position are summarized in Table 1. Sukhen N Shetty et al [17]suggests that spinal anaesthesia can be given for prone surgeries and is as safe as for supine surgeries.

Any standard maintenance regimen is acceptable. However, blood pressure control is important, balancing the need to ensure spinal cord perfusion with the requirement to produce a bloodless surgical field. Sodium nitroprusside and esmolol infusions have been widely used for this purpose, though remifentanil is becoming popular. Blood loss is usually minimal from simple procedures, though if extensive laminectomies and fusions are performed, cross-matched blood should be available. A recent randomized clinical trial by Attari et al[18] revealed that spinal anesthesia has adequate advantages over general anesthesia in providing postoperative analgesia and decreased blood loss by preserving a better hemodynamic stability. These factors results in higher satisfaction rates for the surgeon and patients. Spinal anesthesia may lead to a reduction in blood loss associated with vasodilation and hypotension produced by sympathetic blockade and less distension of epidural veins resulting from lower intrathoracic pressure

Additionally, reduced surgical time and blood loss in spinal anesthesia were reported by Jellish et al.[19] in a prospective study. Standard monitoring is appropriate for simpler procedures. However, invasive blood pressure monitoring, a central venous pressure line and a urinary catheter should be considered if deliberate hypotension is used or if the procedure is likely to be prolonged and involve large fluid shifts.

Table 1

Problems with prone position
Potential problems comments

Eyes	
Corneal abrasion Optic neuropathy Retinal vascular occlusion	Tape eyes shut Increased IOP leads to decreased perfusion pressure. reduce by pressure by decreasing compression on the eye, hypotension and low hematocrit Avoid pressure on the eyes
Head and neck	
Venous and lymphatic obstruction Skull fixation	Careful positioning of the patient to decrease venous pressure Insertion of pins in the skull can lead to hypertensive crisis which is difficult to control
Abdominal compression	
Impaired ventilation	Avoid pressure on abdomen as it can lead to impaired ventilation
Decreased cardiac output	Bean bags and pillows are better than supportive frames or knee chest position
Damage to blood vessels	
Aorta or inferior vena cava Major iliac vessels	

Postoperative-(1) Pain: most spinal surgeries are painful and good postoperative analgesia is important. Local anaesthetic and opioid drugs can be instilled into the epidural space before closing. More usually, however, a regimen including patient-controlled analgesia (PCA) combined with regular oral/rectal analgesics is successful., Regional anaesthesia improved postoperative conditions of patients due to decreasing pain and need to the analgesia. Hassi et al[20]showed that patient satisfaction was high with a low level of complications in SA. Nevertheless, their study was retrospective and did not compare it with the other anesthetic techniques Two different mechanisms[21] can explain decreasing postoperative analgesic use in the regional Anaesthesia. First mechanism is the preemptive effect of regionalanasthesia that reduces the pain severity by preventing afferent nociceptive sensitization pathway. The second mechanism is probably existence of some residual sensory blockade in regional anaesthesia. This is due to lagging of sensory recovery behind motor recovery.

(2) Nausea and vomiting: Various studies have also shown that spinal anesthesia provided shorter anesthesia durations, decreased nausea incidence and analgesic consumption, blood loss and was associated with fewer total side effects in different orthopaedic sugeries[22-26]. Nausea and vomiting are already common problems that anaesthesiologists must cope with during the postoperative period. These symptoms appear to be associated with many factors such as age, gender, ASA, obesity, duration of anesthesia, use of volatile anaesthetics, nitrous oxide and intraoperative or postoperative opioids.

(3) Neurological deficit: Pre operative documentation is very important (legally also).This could be caused by the regional anaesthesia technique or the surgery itself. Neurological damage during surgery and anaesthesia is not limited to the site of surgery.

- *Poor patient positioning:* Paraplegia and quadriplegia have been reported as a result of poor patient positioning.
- *Site of surgery:* There are reports of patients with spinal disease who have suffered neurological damage either at levels remote from the site of surgery or during surgery unconnected with their spinal disease. However, neurological damage is more likely at or near the site of surgery on the spine. Risk factors and methods for minimizing them are listed below.

d) Risks of spinal cord damage

Risks related to

- Length and type of surgical procedure[27]
- Spinal cord perfusion pressure(SCPP)
- Underlying spinal pathology
- Pressure on neural tissue during surgery

Risk minimized by

- Careful positioning
- Maintaining SCPP

SCPP=MAP-CSFP

CSFP can be reduced by CSF drainage

MAP (mean arterial pressure) manipulated by anaesthetist? keep systolic B.P. >90mm of Hg

- Drugs

Methylprednisone given 8 hours after insult
NMDA antagonist (ketamine, magnesium)

- Prevention of hematoma formation

Careful hemostasis
Stopping antiplatelet therapy before operation
Withold heparin immediately postoperatively

e) Spinal cord monitoring

The 'wake-up test'[27] involves lightening anaesthesia at an appropriate point during the procedure and observing the patient's ability to move to command. The technique requires practice and adds to the duration of surgery. In addition, it provides information at the time of the wake-up only and misses damage occurring at other times.

Neurophysiological monitoring using somatosensory evoked potentials (SEPs) provides a continuous picture and offers a more sophisticated approach. Electrical stimuli are applied to the lower limbs and appropriately placed electrodes can record cortical (SCEP) or spinal (SSEP) evoked potentials. The resulting trace can be analysed for wave amplitude and latency with respect to a reference 'time zero'. SCEPs are affected by anaesthetic induction and inhalational agents, opioids and local anaesthetic drugs, and interpretation requires care and experience. Nevertheless, a decrease in amplitude or latency unrelated to drug administration of 35–50% is thought to be significant and indicate possible cord damage. However, even in skilled hands, interpretation can be difficult and a 'wake-up test' may still be required.

SSEPs can be recorded from electrodes placed into the epidural space either percutaneously or during surgery[28]. SSEPs are affected less by inhalational agents, but are sensitive to temperature changes and local anaesthetic drugs. Their stability during anaesthesia allows them to be used with more confidence during surgery than SCEPs.

Motor evoked potentials can be obtained by stimulating the motor cortex with a transcranial electrode and eliciting a response from the distal spinal cord, peripheral nerves or muscle. They have not been used extensively for spinal cord monitoring because they are more difficult to achieve and are sensitive to inhalational anaesthetic agents.

(4)Other post operative complications: Postoperative complications include persistent hypotension, haemorrhage, urinary retention, nerve root damage, and caudaequina syndrome (urinary/faecal incontinence, perineal sensory loss and lower-limb motor weakness).

III. Summary

Spine surgeries with regional anesthesia have shorter durations in the operating room. This time difference is considered to be a consequence of the elapsed time needed to perform spinal anesthesia, which is conducted in the block room instead of an operating room, and also having no missing time for extubation. In the absence of satisfactory differences between spinal anesthesia and general anesthesia, cost, associated with the duration, could be judged to be an acceptable reason to decide on an optimum option. Surgeons, have typically focused on the single issue of maximizing operating room efficiency and have indicated that reducing waiting times plays an important role in solving this problem. In the absence of satisfactory differences between spinal anesthesia and general anesthesia, cost, associated with the duration, could be judged to be an acceptable reason to decide on an optimum option .It can be speculated that regional anesthesia may lead to greater cost-effectiveness in spine surgeries. However the individual decision process and the multi-disciplinary approach for optimal treatment of the patients.

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