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A Comparison of General and Spinal Anaestheia for Elective Lower Lumbar Spine Surgeries in Lateral Position

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Abstract

Introduction: General anesthesia (GA) is the common mode of anesthesia for spine surgery. However, with spine surgeries being increasingly performed in lateral, as against prone position, spinal anaesthesia (SA) is becoming more acceptable. This study was conducted to compare general and spinal anaesthesia in lumbar spine surgeries performed in lateral position. *Materials and Methods:* Patients with ASA I-II, planned to undergo single level lumbar laminectomy in lateral position were randomized into GA and SA group by computer generated random numbers. The former were given GA with endotracheal intubation as per standard protocols and latter were given SA with 3.2mL 0.5% hyperbaric bupivacaine. Surgery was performed in lateral position. Intra-operative hemodynamic events, post-operative sedation score, pain status, surgeon satisfaction, total time and complications were recorded and analysed. *Results:* 79 patients were studied. Mean heart rate and blood pressure were lower in SA group at various stages during surgery. Total time in operation room was 119 minutes in GA while only 94 minutes in SA group. VAS score was higher in GA group at 2 and 12 hrs post-operatively (5.2 v/s 2.4 and 4.0 v/s 2.7 respectively). Total consumption of tramadol in 24 hrs was higher in GA as compared to SA group, (mean ampoules, 3.12 v/s 2.19). Sedation score (mean grade, 1.18 v/s 0.06) and blood loss > 400 mL were higher and surgeon satisfaction lower in GA group. *Conclusion:* Spinal anaesthesia is a better alternative to general anaesthesia for lower lumbar spine surgeries when operated in lateral position.

Keywords: Spinal Anaesthesia; Spine Surgery in Lateral Position.

Introduction

General Anaesthesia (GA) has been the usual mode of anesthesia for spine surgeries, but regional anaesthesia is lately being evaluated as a possible alternative for lower lumbar spine surgeries [1,2]. Hence, choice of anaesthesia has become a topic of intense debate [3]. In a vast majority of patients, spinal anaesthesia (SA) would compare favorably with GA on several parameters. Hemodynamic stability, low intra and post-operative cardiac events, low blood loss and better post-operative pain control are some of the obvious advantages of SA over GA. Other advantages of SA is the ability for the patient to reposition their extremities and chest as needed to avoid nerve injury, brachial plexus palsy or pressure necrosis to the face and pressure over the eye.

Yet, a need for prone position is the main concern against the use of SA. Incikara et al [4] feels that even though anaesthesiologists would consider SA more preferable, experience shows that prolonged operations in prone position under SA increases anaesthesiologist's stress. Particularly owing to potential challenges in the event of an apnea, providing airway access and placing an ETT which are extremely difficult in prone position.

In recent times however, surgeons themselves are preferring lateral position for lumbar spine surgeries. Suhail Afzal [5] et al explained the

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advantages they gain as surgeons by operating in lateral position: Lateral position is favorable for both anterior and posterior approach to spine, less pressure on anterior abdominal wall and reduced venous engorgement resulting in reduced bleeding, easy change of positions between kyphosis and lordosis just by altering hip and knee positions etc. In addition, the complications often encountered with prone positions [6,7] are avoided. Compression of abdomen and inferior venacava resulting in hemodynamic changes, pressure necrosis, brachial plexopathy, ophthalmic complications including permanent blindness are some of the more dreaded complications that can be avoided by resorting to SA. These complications are more frequent and far more severe in prone as compared to complications that are specific to lateral position.

This changing scenario of spine surgeries being increasingly performed in lateral positions [5,8] is thus an opportunity to make good use of regional anesthesia and exploit all its advantages over GA. For that, it is hence necessary to evaluate if SA is acceptable or even more desirable as compared to GA in objective terms as applied to both the anesthesiologist and surgeon's view. Despite there being numerous studies [9-15] that have compared GA with SA in spine surgeries, the same in exclusively lateral position has not been undertaken. It is common understanding that conditions vary considerably while operating in lateral position, with respect to operative ease, hemodynamic stability, complications and risk factors. Hence, the present study was conducted to compare SA and GA in lower lumbar surgeries when performed in lateral position.

Materials and Methods

Study Design

The study was conducted in a tertiary care teaching hospital in northern India. The study design was a non-blinded prospective randomized control trial. Ethical committee clearance was taken. Written informed consent was taken from all the patients. All procedures were performed by same surgeon; anesthesia was managed by anesthesiologists of a single unit working on a common protocol.

Sample Size Estimation

A pilot study conducted at our institute in patients undergoing spinal surgery under general anaesthesia revealed a 24 hr postoperative VAS score of 6.5 with a standard deviation of 2.34. We postulated that a VAS at 2 hr will be reduced to 4.5 by using central neuraxial blockade. For the study to have a power of 90% with an alpha- error of <0.05, a minimum of 29 patients were to be registered in each group. To compensate for the dropouts, we decided to take around fourty patients in each group.

Inclusion/ Exclusion Criteria

Consecutive willing patients between 18 and 60 years of age who were scheduled for single level lumbar laminectomy with or without discectomy at levels L2 and below were selected. Only ASA-PS I or II were included. Patients with history of seizure, intracranial hypertension, contraindication for spinal anesthesia (patient refusal, coagulopathy, infection at site of needling, hypovolemia), severe spinal stenosis, infectious process, patients with hepatic or renal disease, severe cardiac disease, or bleeding abnormalities, drug or alcohol abuse were excluded. Also those undergoing revision surgery or requiring surgical stabilization or fusion were excluded from the study.

Group Allocation

Group GA: Patients were given General Anaesthesia with Endotracheal Intubation as per standard protocols.

Group SA: Patients were given Spinal Anaesthesia with 3.2 cc 0.5% hyperbaric bupivacaine

Tecnique of Anaesthesia

Patient profile, diagnosis, plan of treatment, ASA grade and patient neurological deficits were recorded. Patients were randomized using computer generated random numbers into two groups. In GA group, all patients received as premedication a intravenous dose of midazolam 1.5 mg , glycopyrolate 0.2 mg, ondansetron 4 mg and fentanyl 2mcg.kg^{-1}. Patients were induced on the operating table with IV propofol 2mg.kg^{-1}. Endotracheal intubation was facilitated with rocuronium (0.9 mg.kg^{-1} IV). Anesthesia was maintained with dial setting of 1 vol% sevoflurane and nitrous oxide 50% in oxygen. Subsequently, the patients were placed in lateral position, with pillow in between the arms to protect them from brachial plexus injury. For prevention of pressure on globe of the eyes and ears, the head was placed on a soft pad.

The heart rate, mean arterial non invasive blood pressure and oxygen saturation were monitored every 15 minutes during surgery using ECG, noninvasive blood pressure monitoring and pulse oximetry. After termination of operation, patient was returned to supine position. Anesthetic drugs were discontinued and 100% oxygen was given. Neuromuscular blockade was reversed with neostigmine (0.05mg.kg^{-1}) and glycopyrrolate (0.01mg.kg^{-1}). Extubation was done and the patient transferred to the postanesthesia care unit (PACU) after ensuring spontaneous respiration, oxygen saturation of 95% or more, end-tidal carbon dioxide 35-40 mmHg, respiratory rate less than 30 per minutes, and tidal volume more than 5 mL.kg^{-1} .

In SA group, patients were preloaded with 10 mL.kg^{-1} lactated ringer's solution over 10-15 minutes. Sub-arachnoid block was performed using a 25-gauge Quinke spinal needle at either the L2-L3 or L3-L4 interspace. After observing spinal fluid, 3.2 mL 0.5% bupivacaine in an 8.5% dextrose solution was administered into intrathecal space and patients were placed in supine position. Establishment of spinal level of block (which usually occurred between T-6 and T-10), was tested for a loss of pin-prick sensation. Five minutes later, patients were placed into lateral position and were allowed to keep their arms at ease by placing a pillow between them. Oxygen at 5L.min^{-1} via venti-mask was administered during the surgery. At the start of the surgery, midazolam 1.5mg i.v and ondansetron 4mg was administered intravenously.

During surgery, any bradycardia (HR<50 per minutes) or hypotension (MBP<60 mmHg) were managed with atropine 0.5 mg and mephentera-mine 5 mg intravenous respectively. At the end of surgery, the patient was turned from lateral position to supine, hemodynamic stability was confirmed and the patient was transferred to the PACU. In group GA, when patients were awake and had no pain, nausea, vomiting, or hemodynamic instability, they were shifted out from PACU. In group SA, when patients had no pain, nausea, vomiting, and at least two segment regression of spinal block, they were shifted out.

Outcome Assessment

Throughout the administration of anesthetics, changes in maximum heart rate and mean arterial blood pressure as compared to the baseline were recorded. Blood loss was monitored and recorded by calculating the volume of blood suctioned from the surgical field and sponge count. Blood loss >400mL was considered as major blood loss for spine surgery.

The operating surgeon was asked to record 'surgeon satisfaction' as a dichotomized factor immediately after the procedure while he was removing the gloves. He was asked to mentally compare the present surgery with his past experience with respect to but not limited to factors like oozing in the surgical field, being motionless, muscular relaxation and overall impression and comment if he was satisfied in 'Yes' or 'No'. Total time in the Operating Room (OR) (the time from the entry of patient into the OR till the patient is shifted out of operating room), the time taken for induction, positioning (turning into lateral position), pre-op preparation (scrubbing, painting and draping), duration of surgery (incision to skin closure), and exit time (end of surgery to leaving the OR) were recorded. In both the groups, patients were observed for 30 minutes in the recovery room. Anaesthesia time excluding the surgical time was also noted.

Sedation score was measured in all patients, as soon as they enter the recovery room, using a 4-point sedation score [16],

Grade 0- Awake

Grade1-Drowsy

Grade2-Sleeping but arousable on verbal commands

Grade 3-sleeping but arousable on tactile stimulation

Over the next 24 hrs, severity of pain was assessed using VAS score [17] at 2, 6, 12, 18 and 24 hrs in both groups. If the VAS score was more than 4, tramadol 100mg was given intravenously and, and the total ampoules of tramadol consumed in 24 hrs was recorded. In addition, the incidence of nausea was recorded. Intravenous metoclopramide at 0.1 mg.kg^{-1} IV was administered to patients with vomiting and for nausea if lasted for more than 10 minutes.

Any case with failure of anesthesia or inability to adhere to the study protocol was excluded from the study.

Statistical Analysis

Continuous data were presented as mean±SD and categorical data were presented as percentage within the group. The mean values of two groups in the former variables were compared using Student t-test and latter by Pearson Chi-square test and Fisher's exact test when needed. P-value < 0.05 was considered statistically significant. All statistical analyses were done using SPSS version 16.

Results

A total of 79 patients were randomized. There were 40 patients in GA group (Group I) and 39 in SA group (Group II). Two patients from SA group were later converted to general anesthesia and hence were dropped from the analysis (Fig 1. Consort Diagram). Demographic characteristics like age, sex, weight and ASA status are tabulated and were found to be comparable between the two groups (Table 1).

Baseline mean HR was comparable in both the groups, mean HR and MBP were lower in SA group during surgery as compared to GA group, which is statistically significant throughout the surgery. (Table 2).

VAS Score (Table 3) was higher in GA group at 2 hrs (5.2±0.6) and 12 hrs (5.6±0.67)and in SA group at 6 hrs(4.84±0.89) which were statistically significant ($p<0.001$). Overall the mean number of doses or ampoules of Inj. tramadol consumption(100 mg/ ampoule) was higher in GA group (3.12±0.33) as compared to SA group (2.19±0.40) ($p<0.001$)

Time in the OR was compared between the 2 groups (Table 4). Most of the time recordings were higher in GA group as compared to SA group with statistically significant difference. Overall 25 min was less in SA group as compared to GA group.

Both the groups were observed for 30 min in the recovery room, and we found that overall sedation score was higher in GA group (1.18±0.38) compared to SA group (0.06±0.002) with $p<0.001$.

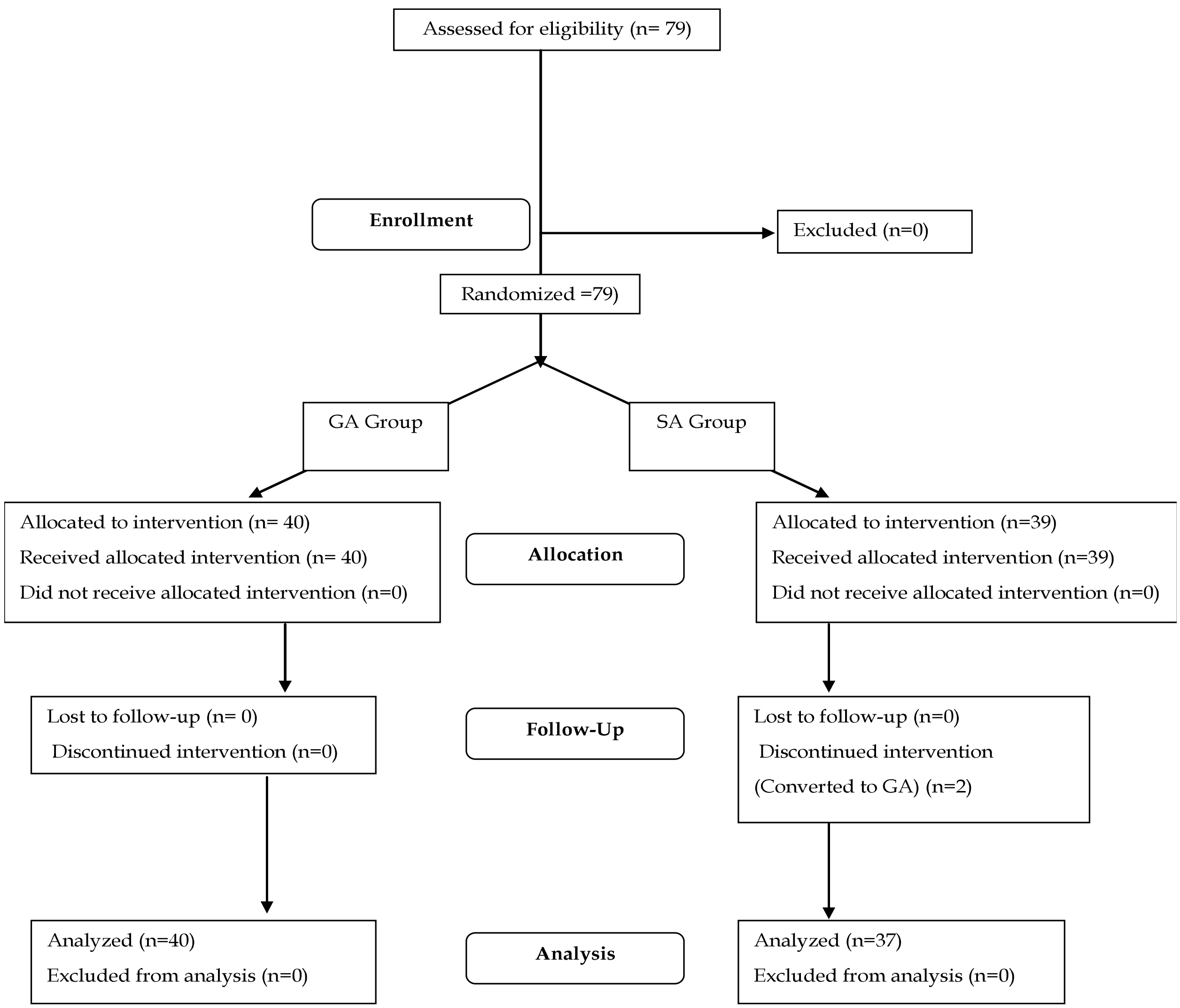

Fig. 1: Consort Diagram

Table 1: Demographic characteristics

Demographic Characteristics		GA	SA
AGE (years) (Mean ± SD)		49.50±8,73	50.95±10.11
SEX n (%)	M	24 (60%)	22 (59.5%)
	F	16 (40%)	15 (40.5%)
WEIGHT (Kg) (Mean ± SD)		63.70±6.32	66.24±8
ASA (number of patients)	I	28	21
	II	12	16

Table 2: Haemodynamic variations(Data are presented as mean ± SD)

Minutes		0	15	30	45	60	75	90
HR (BPM)	GA	87±4.17	92.70±3.1	87.50±50	85.10±3.6	85.40±6.2	90.1±6.2	91.3±4.4
	SA	87.9±4.4	84.9±6.1	81.86±7	79.95±5.7	78.65±5.4	75.68±5.17	76.4±4.8
	p-value	0.35	0.000	0.000	0.000	0.000	0.000	0.000
MBP (mm Hg)	GA	67.8±3.9	70.2±3.8	73.9±2.3	72.8±3.8	74.5±8.7	74.4±4	75.3±5.3
	SA	70.2±3.8	68 ±4.2	66.41±4.6	65.2±2.5	63.9±2.9	64.32±2.4	63.73±2
	p-value	0.008	0.000	0.000	0.000	0.000	0.000	0.000

Table 3: VAS Score (Data are presented as mean±SD)

	VAS-2 hours	VAS-6 hours	VAS-12 hours	VAS-18 hours	VAS-24 hours
GA	5.2±0.60	2.50±0.50	4±1.60	2.40±0.54	2.70±0.648
SA	2.38±0.49	4.84±0.89	2.65±0.48	2.38±0.54	2.49±0.50
p-value	<0.001	<0.001	<0.001	0.862	0.114

Table 4: Duration in the OR (in minutes) (Data are presented as mean±SD)

Duration (min)	Induction	Positioning	Pre-op prep	Surgery	Exit	Total Time	Anaesthesia Time
GA	11.70±0.68	4.60±0.49	5.40±0.49	50±2.9	15.7±0.79	119.2±6	89.20±6
SA	8.68±0.68	3.38±0.63	5.41±0.49	44.30±4.30	4.65±0.58	94.24±4.9	65.32±6.6
p	0.000	0.000	0.962	0.000	0.000	0.000	0.000

Surgeon satisfaction in SA group was 78.4% compared to GA group in which surgeon was satisfied in only 30% of the cases. (p<0.001). Blood loss> 400mL was seen in 67.5% in GA group which was higher compared to SA group where blood loss >400mL was seen in 18.9% of cases (p<0.001).

Nausea and vomiting occurred in 28 (70%) patients in GA group compared to only 2 (5.4%) patients in SA group. Three patients in SA group had episodes of hypotension and 1 patient in SA group had bradycardia. Three patients in SA group and 3 patients in GA group had urinary retention post-operatively. None of the patients in our study had episodes of desaturation and all patients maintained oxygen saturation > 95% throughout the surgery till shifting out from the recovery room

In SA group, two patients had discomfort after 15 minutes of spinal puncture and were promptly converted to GA with ETT. They were not included in the study. No other patient of SA complained of pain, anxiety or discomfort during the procedure.

Discussion

The study on many counts showed that, SA is actually better than GA for lower lumbar spine surgeries operated in lateral position. Intraoperative and postoperative hemodynamics were more stable in SA group compared to GA group. GA group showed episodes of hypertension and tachycardia. They were mainly due to laryngoscopy-intubation response, during extubation and immediate post-operative pain. Similar phenomenon were noted by Attari et al [9] and Jellish et al [18] studying regional and general anesthesia in spine surgeries.

Although there are studies [4, 8-12] which support that SA is more acceptable for lower lumbar spine surgeries, other authors contradict [15,19] the same. With respect to spine surgery in particular, the safety of SA was questioned by Hebl et al [19] who felt that pre-existing spinal canal pathology have higher incidence of neurological complications after neuraxial blockade than that previously reported for patients without such underlying pathology. However, Reynolds et al [20] in his study concluded that patients with spine pathology who were operated under epidural anaesthesia, neurological deficits improved at the same rate as those operated on by the same surgeon under general anaesthesia.

Blood loss was found to be less in the SA group. Serkan [21] and Incikara [4] had similar findings, although the latter did not find statistical significance in the difference. It is generally thought to be due to two mechanisms. Sympathetic blockade by SA causes vasodilation leading to hypotension. Hence the bleeding is less vigorous and easily controllable. Secondly GA increases intrathoracic pressure due to assisted breathing. The paravertebral vessels thus get engorged leading to increased bleeding. It has also been explained by Reynolds et al [20] , in epidural anaesthesia for spine surgeries. We also feel that increased fluctuations of blood pressure noted in GA group also contributed to an increased bleeding in that group. Less bleeding also contributed to lower surgical time observed in SA group as it would facilitate dissection and removal of disc and result in less time needed to effect hemostasis prior to surgical closure.

In addition to a reduction in surgical time, SA group also showed significantly less time for induction, positioning, surgical time and exit as compared to GA. Around 25 minutes could be saved in SA group as compared to GA group. This is essentially a difference in the conduct of the two types of anesthesia. The same was also the finding by Helene Singeisen et al [22], who compared spine surgeries under both the anesthesias. Time factor becomes important in improving the efficiency of the operating room and the hospital. Agarwal et al[23] studied the cost analysis in GA and SA for spine surgeries and concluded that SA is less costly when used in patients undergoing lumbar discectomy and laminectomy. Singeisen et al [22] also found that reduction of time in OR also resulted in marked reduction in hospital costs.

Perhaps owing mainly to these reasons, overall surgeon satisfaction was greater in SA group as compared to GA in our study. Although Attari et al [8] and Incikara et al [4] also found similar result in their study in prone position, Sadroldadat et al [15] found it otherwise.

GA group with higher sedation, needed to be given oxygen through ventimask post-operatively and SA group patients were awake and did not require post-operative oxygen. The higher sedation scores in GA group could be attributed to the GA drugs and inhalational anaesthetics. This was also observed in study conducted by Attari et al [9] which showed, reduction in the duration of recovery stay.

Though not specific about patient position, McLain et al [10] reported that regional and general anaesthesia have similar effectiveness for performing elective lumbar surgeries and also regional anaesthesia showed some advantages over GA, including improved perioperative hemodynamic stability, decreased analgesic requirement, and decreased occurrence of postoperative nausea. The same co-related with our study. Hassi et al [14] also had similar results, but he said SA cannot be recommended in all cases, particularly in patients, where the surgical time may get prolonged since in his paper, patients were operated in prone position.

Lower postoperative VAS scores at 2 hours in SA group may be explained by the fact that SA group patients had preemptive analgesia by preventing afferent nociceptive sensitization pathway. They might also have had some residual sensory block. This also led to a lower analgesic consumption in 24 hrs which was also seen in Mehrebanian et al [23] and incikara et al [4] and Serkan et al [21].

In our study, overall nausea and vomiting was found to be higher in GA group compared to SA group. This could be attributed to the general anaesthetic drugs used, nitrous oxide, narcotic analgesics and post-operative pain as seen by Papadopoulos et al [1].

Other authors have experienced urinary retention to be associated with SA more than GA. In our study, we found no such difference between the groups. This may be due to the fact that we did not use subarachnoid opiods intrathecally. No neurological deficits were seen in SA group contrary to that observed by Hebl et al [19].

None of our patients had position related injuries in either group. Nevertheless, it is our observation that, since patients were allowed to position themselves comfortably under SA, position related injuries could be avoided more effectively as compared to GA group as noted by Susan Black et al [25] and Inci kara et al [4].

Two patients in SA group, had signs of inadequate block, and required conversion to GA with ETT intra-operatively. Since the patients were being operated in lateral position, endotracheal intubation could be done without difficulty unlike in prone position. This ease of converting to GA allows even bolder use of SA in lateral position.

Performing spine surgeries in lateral position has several more advantages other than anesthetic and surgeon factors discussed. Chang SH et al [26] studied the incidence of perioperative ischemic optic neuropathy(POION) in spine surgeries and concluded that POION is a rare but potentially devastating and untreatable complication of spine surgery, particularly that performed with patients in prone position. This catastrophe is averted by avoiding a prone position.

Papadopoulos et al [1], Reynolds e al [19] and Lakkam et al [27] concluded that epidural anaesthesia is a better alternative to GA for lumbar laminectomies. However on the downside, immediate postoperative assessment of the patient's neurological status to detect spinal cord injury or evolving cord compression is not possible with SA [28]. Although applicable only to lower lumbar surgeries, the study fairly conclusively demonstrates advantages of SA over GA in lateral positions. However, validation of the inference of the study is limited to some extent by a lack of blinding and also varying spine characteristics and difficulty level that can never be standardized!

Conclusion

Spinal anaesthesia is a suitable and perhaps better alternative to general anaesthesia for lower lumbar spine surgeries when being operated in lateral position, leading to better hemodynamic stability, low incidence of nausea and vomiting, reduced time in the operating room and better post-operative analgesia.

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