

Segmental Spinal Anesthesia for Enhancing the Safety Margin in Endoscopic Discectomy: A Feasibility Study

Richa Chandra¹, Gaurav Mishra^{2*}, Pranay T. Vaghela³

¹Department of Anesthesia, Bareilly International University, Uttar Pradesh, India; ²Department of Anesthesia, Mahatma Jyotiba Phule Rohilkhand University, Uttar Pradesh, India; ³Department of Anesthesia, Kejal Lifeline Hospital, Gujrat, India

ABSTRACT

Background: In the present era, a herniated vertebral disc is the most commonly encountered pathology of spine due to multiple lifestyle factors, most common site being L4-L5, L5-S1. Percutaneous endoscopic discectomy has superseded the traditional open discectomy approach for such cases. Regarding the choice of anesthesia for such procedures, general anesthesia was considered Gold standard. With the advent of COVID-19 pandemic, the regional anesthesia techniques gained popularity for a majority of surgical procedures. A novel concept of segmental spinal anesthesia i.e. blockade of selective dermatomes only essential for surgery, using very low dose of local anesthetics take care of surgical pain with intact leg movements decreasing incidence of inadvertent neurological injury. In the present feasibility study, we utilized an approach of segmental spinal anesthesia for endoscopic discectomy.

Material and methods: This study was conducted at a tertiary care center after approval by the Ethical and Research committee, including 38 patients aged 20 to 70 years with ASA physical status I-II scheduled for endoscopic spine discectomy from April 2020 to November 2022. Subarachnoid block was performed at T12-L1 Level with 27 G Quincke Babcock needle using a midline approach in all the patients. Once the free flow of Cerebrospinal Fluid (CSF) was confirmed, 1 ml of isobaric levobupivacaine with 20 mcg of Fentanyl was administered.

Results: In the present study, 37 patients (97.36%) were satisfied with the anesthesia technique and surgeon also accepted it as safe and feasible. There was a single episode of hypotension in 2 patients (5.26%) which responded well to conventional drugs. Paresthesia was observed in 1 patient (2.63%) with no neurological sequelae.

Conclusion: In conclusion, segmental spinal anesthesia can prove to be a beneficial alternative to other modalities in endoscopic discectomy surgery, providing excellent analgesia, sensory and motor block at targeted dermatomal areas. **Keywords:** Spinal anesthesia; Endoscopic discectomy; Subarachnoid block; Mephentermine

INTRODUCTION

In the present era, a herniated vertebral disc is the most commonly encountered pathology of spine due to multiple lifestyle factors. Most common site for herniated discs remains the L4-L5, L5-S1 intervertebral space. Majority of cases can be treated by conservative approach but few symptomatic cases need surgical intervention. Percutaneous endoscopic discectomy has superseded the traditional open discectomy approach for such cases in terms of reduced injuries to overlying paravertebral muscles intraoperatively, decreased intraoperative blood loss, less

postoperative pain leading to early discharge of patients and reduced morbidity. Regarding the choice of anesthesia for such procedures, general anesthesia was considered gold standard. General anesthesia has its own inherent set of complications related to prone position, ophthalmic injury or brachial plexus injury. But inability to assess intraoperative neurological damage and early postoperative neurological complications was a major concern for surgeons in general anesthesia. This above concern remained unsolved due to its prolonged effect of conventional lumbar spinal anesthesia as it gained popularity for spine surgeries in spite of its ability to avoid adverse effects of general

Correspondence to: Gaurav Mishra, Department of Anesthesia, Mahatma Jyotiba Phule Rohilkhand University, Uttar Pradesh, India, E-mail: dr.gauravmisra@gmail.com

Received: 02-Oct-2023, Manuscript No. JACR-23-27768; Editor assigned: 04-Oct-2023, Pre QC No. JACR-23-27768 (PQ); Reviewed: 20-Oct-2023, QC No. JACR-23-27768; Revised: 27-Oct-2023, Manuscript No. JACR-23-27768 (R); Published: 03-Nov-2023, DOI: 10.35248/ 2155-6148.23.14.1115

Citation: Chandra R, Mishra G, Vaghela PT (2023) Segmental Spinal Anesthesia for Enhancing the Safety Margin in Endoscopic Discectomy: A Feasibility Study. J Anesth Clin Res. 14:1115.

Copyright: © 2023 Chandra R, et al. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution and reproduction in any medium, provided the original author and source are credited.

anesthesia as mentioned above. With the advent of COVID- 19 pandemic affecting, the regional anesthesia techniques gained popularity for a majority of surgical procedures, earlier which were only deemed possible under general anesthesia. A long duration of pandemics also forced surgeons to do surgeries for excruciating resistant back pain even during those days. A study of spine surgery with 149 awake patients with the use of traditional lumbar spinal anesthesia was published [1]. A novel concept of segmental spinal anesthesia i.e. blockade of selective dermatomes only essential for surgery, with very low effective volume of local anesthesia drug along with an adjuvant to increase duration of analgesia made it different from conventional lumbar spinal anesthesia. This concept made the lumbar puncture at higher levels above L2 level possible with higher degrees of hemodynamic stability. Using very low dose of local anesthetics take care of surgical pain, but keeps the leg movements intact, helping surgeons to assess any possibility of nerve injury and neurological integrity intraoperatively. Myelography and Magnetic Resonance Imaging (MRI) studies have confirmed that in thoracic spine, spinal cord is more anterior with more distance between dura and posterior spinal cord, as compared to lumbar area, thus making it less prone to damage during thoracic approach [2]. In the present feasibility study, we utilized an approach of segmental spinal anesthesia for endoscopic discectomy, assessing the feasibility, utility of technique and effect on intraoperative hemodynamic stability, along with patient and surgeons satisfaction.

MATERIALS AND METHODS

This study was done at a tertiary care center after approval by the Ethical and Research committee. We enrolled 38 patients aged 20 to 70 years with American Society of Anesthesiologists (ASA) physical status I-II scheduled for endoscopic spine discectomy from April 2020 to November 2022. Written informed consent from the enrolled patients was taken. We excluded ASA III, IV and V, BMI>35, patients having contraindications of regional anesthesia e.g. local infection, coagulopathy, not giving consent for regional anesthesia, an allergy to local anesthetic drugs, abnormalities of spine e.g. kyphosis, scoliosis. During the Pre-Anesthesia Checkup (PAC) visit, patients were counselled regarding the need of surgery, proposed anesthesia plan, its merits and side effects. They were explained about thoracic spinal anesthesia in detail, all queries were met with scientific explanations and were reassured that any pain, discomfort or anxiety would be supplemented with drugs or change in anesthesia plan. They were also informed, if needed general anesthesia will be given and every measures will be taken in favor of patients. All patients had appropriate preoperative evaluation by clinical examination and laboratory investigations. All patients were investigated with Complete Blood Count (CBC), Random Blood Sugar (RBS), renal function tests, liver function tests, Chest X-ray (CXR), Electrocardiogram (ECG) and Echocardiogram (ECHO) if indicated during their preoperative hospital stay. On arrival to operative room 20G/18 G IV cannula was placed in upper limb and 500 ml of Ringer Lactate was initiated in each patient. Routine monitors e.g. ECG, Non-Invasive Blood Pressure (NIBP), SpO₂ were attached during pre-induction period. Patients were made to sit and head flexion was performed by the

assistant. We used landmarks to ascertain exact level for the block-spine of C7, spine of scapula at T3, inferior angle of scapula at T7, inferior margins of ribs corresponding to L1 vertebrae, intercristal line at L4/L5. Under aseptic precautions after local infiltration with 2 ml 2% xylocaine adrenaline solution, subarachnoid block was performed at T12-L1 Level with 27 G Quincke Babcock needle. We chose T12-L1 space, considering it in the middle of field of interest leading to equal spread of local anesthetics in both directions, along with the advantage of easy tolerance of bolsters. We used midline approach in all the patients with a 45° tilt of the needle. After piercing ligamentum flavum, we made our hand movements very slow. After every 0.5 mm inside, CSF was checked. Once free flow of CSF was ascertained, 1 ml isobaric levo-bupivacaine with 20 mcg Fentanyl was given. The patients were made supine immediately after the block and Oxygen was started with mask at 4-6 Liters Per Minute (LPM). Vital signs (HR, RR, SpO₂) were continuously monitored throughout the surgery. NBP was recorded initially every 3 minutes for first 15 minutes and then every 5 minutes till the completion of surgery. Sensory level was assessed with pin prick method. The motor block in lower limbs was assessed by Bromage score 0-free movement of legs and feet, 1-just able to flex knees with free movement of feet 2-unable to flex knees with free movement of feet 3-unable to move knees and feet [5]. Any episode of hypotension and bradycardia were noted. Hypotension was defined as systolic BP<90 mm Hg. It was treated with incremental dose of injection Mephentermine 6 mg IV bolus. Bradycardia defined as heart rate <50/minute and treated with injection Atropine 0.6 mg IV bolus. Conscious sedation with injection Midazolam 1 mg IV and injection Fentanyl 1-1.5 mcg/kg was given. Intra operative adverse effect like nausea and vomiting was duly noted and treated with injection Ondansetron 4 mg slow IV. In the post anesthesia care unit, we monitored hemodynamic parameters and any adverse effects e.g. nausea, vomiting and urinary retention. Surgical procedure was conducted using an endoscope spine system. Under C-arm level of exact lumbar vertebrae was ascertained and MRI findings of the same level was confirmed. Disc space was reached via a postero-lateral approach from the symptomatic side. Under vision a small incision was made just lateral to spinous process, trocar was inserted to the dorsolateral border of the annulus fibrosus over the k wire followed by endoscope. After separating the thoracolumbar fascia, epidural fat and dural sac was identified. Under vision herniated part of the disc was removed.

RESULTS

In this study we enrolled 40 patients initially, 2 patients were excluded from study as they opted out for regional anesthesia on the day of surgery. Therefore 38 patients (male-30, female-8) were included in study. Subarachnoid block was performed by same anesthesiologist in all the patients and was successfully achieved in all in a single attempt. However paresthesia was observed in a single patient and the needle was redirected to achieve a successful block. During the intraoperative period patients were also observed for and adverse effect and it was duly noted and dealt with appropriate measures as deemed necessary (Table 1). A single episode of hypotension was observed in two patients, which was treated with a single bolus of injection Mephentermine 0.6 mg IV. There were no observed episode of any other adverse effect during intraoperative and post-operative period.

Intraoperative complications	Number	Percentage
Hypotension	2	5.26
Bradycardia	0	0
Nausea	0	0
Vomiting	0	0
Respiratory discomfort	0	0
Paresthesia during needle insertion	1	2.63
Paresthesia during drug administration	0	0

Table 1: Intraoperative adverse effects.

At the commencement of procedure we also assessed the satisfaction level of patients and the surgeon regarding ease of positioning, intraoperative neurological assessment if required, blood loss (Table 2). All the patients were satisfied with the anesthesia technique except one patient who was anxious during procedure but was relieved with injection Midazolam 1 mg IV and reassurance.

Patient Satisfaction	Frequency	Percentage
Very satisfied	37	97.36
Average satisfaction	1	2.63
Dissatisfied	0	0

Table 2: Patient satisfaction.

There was no incidence of any post dural puncture headache or and delay in recovery of lower limb motor power. The surgeon was satisfied with the anesthesia technique and were ready to advocate the same in future surgeries (Table 3).

Variables	Number	Percentage
Surgeon satisfaction	38	100
Surgeon unsatisfied	0	0

Table 3: Surgeon satisfaction.

All surgeries were performed by the same neurosurgeon with experience of 10 years. Duration of all procedures was less than 70 minutes and patients were shifted toward after one hour of monitoring in post anesthesia care unit. All the surgeries finished within 70 minutes. All surgeries were done for back pain, leg pain and tingling of lower limb. No patient had any sensory deficit, motor weakness or cauda equina syndrome in postoperative period.

DISCUSSION

All the variety of anesthesia technique described in literature are either local anesthesia, general anesthesia, monitored anesthesia care or low dose epidural anesthesia. Local, epidural anesthesia and monitored anesthetic care were advocated as intact lower limb movements can be examined intraoperatively to safeguard against any untoward neural injuries. Despite of all the advantages these above mentioned techniques offer, the level of patient comfort and analgesia offered was not satisfactory. General anesthesia remains the gold standard for the procedure but still intraoperative neurological monitoring, if required is not possible. It was analyzed that 184 patients who underwent percutaneous endoscopic spine surgery in two outpatient ambulatory surgery centers and they found monitored anesthesia care with sedation in comparison to general balanced anesthesia with laryngeal mask airway more idealistic for the surgery [3]. General anesthesia and local anesthesia were compared for percutaneous endoscopic spine endoscopy. They found 40% patients in local anesthesia group experienced moderate pain and 5% experienced excruciating pain during procedure. In general anesthesia group 10% patients suffered nerve injury and 15% patients faced nausea, vomiting dizziness and drowsiness, which was absent in local anesthesia group. In our study there was no incidence of any such adverse effect as mentioned above [4]. General anesthesia and epidural anesthesia were compared in 86 patients undergoing percutaneous endoscopic lumbar discectomy. They clearly stated that incidence of transient motor weakness, numbness of lower limb, cauda equina is always more in general anesthesia group. It was also observed that low concentration of Ropivacaine cannot completely block the sensory nerves, thus patient can still encounter pain from surface of facet joint, posterior longitudinal ligament and annulus fibrosus. They minimized the pain by local infiltration of lignocaine in these structures [5]. In our study there was no need for any supplementation for analgesia or any local anesthetic infiltration at surgical site. 240 patients were studied for percutaneous transforaminal endoscopic discectomy under epidural anesthesia, local anesthesia and preemptive analgesia with local anesthesia. Incidence of nerve injury and transient paresis was least in local anesthesia group. Pain management was satisfactory in epidural and preemptive group, but decreased muscle strength was seen in 2 patients of EA group [6]. Incidence of nausea and vomiting postoperatively was significantly higher in preemptive group 7.5% and 3 cases has postoperative dysuria in epidural group (3.75%). Our technique is devoid of any related adverse effect including dysuria. Epidural anesthesia with the help of 20 ml-30 ml 2% lignocaine with epinephrine and 100 mcg Injection Fentanyl was used for single level micro discectomy surgery. These patients were ambulated in 24 hours and significant number of patients had urinary retention, although it was found more useful in terms of prone position mishaps under general anesthesia, less blood loss due to vasodilatation, less postoperative pain and more inhibition of stress induced

hormones [7]. Segmental approach of subarachnoid block was introduced which gave intrathecal blocks for skull, head, neck and thoracic surgeries at different level of spinal cord, as close as possible to the innervation of the operative field. It emphasized first high thoracic puncture at T1/T2 and second puncture at T12/L1 for procedures at head, neck, upper limbs, thorax and lower one for lower limb, lower abdomen surgeries. It advocated that mid dorsal punctures between T7-T8 are more difficult to perform and those dermatomal areas can be adequately covered with lower puncture sites on spinal cord [8]. It was found that higher thoracic spinal blocks need lower doses of intrathecal local anesthetics, thus avoiding major hemodynamic changes and reduced duration of sensory and motor blocks as compared to conventional high dose in lumbar area [9]. Segmental spinal anesthesia is the terminology given for that type of subarachnoid block at any spinal cord level where specific targeted dermatomal segments are blocked. In our study subarachnoid block is given at a higher level as compared to conventional approach, that so with very low dose of isobaric local anesthetics to involve up to lower lumbar and sacral roots. In our approach only sensory block is achieved but motor power of lower limbs stay intact. These surgeries are always done in prone position, so with intact motor power patient can assist in making required position for surgery in the most comfortable position in a conscious and alert state. And above all, the required condition for intraoperative neurological monitoring can be achieved. Intraoperatively there was a significant jerk was noticed when surgeon was operating near the neural field. This had a added advantage as a safety feature for the surgeons. Typically for L1 -L5 lumbar level surgery, a dermatomal sensory level of about T6-T8 needs to be achieved, as positioning also requires the patient to be placed prone over Wilson frame. In our study we performed segmental spinal anesthesia at higher level with low dose of local anesthetics, thus preserving slight movement at toes, along with comfortable positioning over the frame, good operating condition for the surgeon in addition to possibility of neurological assessment intraoperatively. In present study patients were under conscious sedation, thus making it easy to self-adjust their position to their acceptable comfortable position while being prone. Regional anaesthesia for prone position surgeries also avoided any iatrogenic eye, face and brachial plexus inuries arising from improper positioning, these complications being more prevalent under general anesthesia. In our study we used isobaric Levobupivacaine, as its motor effect is less as compared to Bupivacaine heavy, so a low dose preserves the motor power of lower extremities. Injection Fentanyl 0.2 ml was used as an adjuvant, it helped in reducing the total dose of local anesthetics along with added advantage of augmentation of block. It was illustrated that intrathecal isobaric levobupivacainefentanyl combination is a good alternative to hyperbaric bupivacaine-fentanyl combination in cesarean surgery as it is less effective in motor block, it maintains hemodynamic stability at higher sensorial block levels [10].

CONCLUSION

Segmental spinal anesthesia can prove to be a beneficial alternative to other modalities in endoscopic

discectomy surgery. This technique can provide excellent sensory and motor block at targeted dermatomal areas, while averting major complications like excruciating pain after local anesthesia, Postoperative Nausea and Vomiting (PONV), urinary retention, respiratory depression. It also has an added advantage of confirming neurological integrity intra-operatively which reduces long term morbidity and enhanced safety margin. In future many other drug combinations and that too at different level of intervertebral spaces can be tried under research domain for a wide array of spine surgeries.

LIMITATIONS

One of the major limitations of the present study is small sample size of study subjects. The results can prove to be more reliable if study is conducted on large set of population. Other group of patients with multiple co-morbidities and morbid obesity can be included to study the extended safety profile of this technique.

REFERENCES

- Khattab MF, Sykes DA, Abd-El-Barr MM, Waguia R, Montaser A, El Ghamry S, et al. Spine surgery under awake spinal anesthesia: An Egyptian experience during the COVID-19 pandemic. Neurosurg Focus. 2021;51(6):E6.
- Lee RA, van Zundert AA, Breedveld P, Wondergem JH, Peek D. The anatomy of the thoracic spinal canal investigated with magnetic resonance imaging (MRI). Acta Anaesthesiol Belg. 2007;58(3): 163-167.
- Abrão J, Dowling A, Ramirez JF, Lewandrowski KU. Anesthesia for endoscopic spine surgery in an ambulatory surgery center? Glob J Anes Pain Med. 2020;3(5).
- Kerimbayev T, Kenzhegulov Y, Tuigynov Z, Aleinikov V, Urunbayev Y, Makhambetov Y, et al. Transforaminal endoscopic discectomy under general and local anesthesia: A single-center study. Front Surg. 2022;9:873954.
- Ren Z, He S, Li J, Wang Y, Lai J, Sun Z, et al. Comparison of the safety and effectiveness of percutaneous endoscopic lumbar discectomy for treating lumbar disc herniation under epidural anesthesia and general anesthesia. Neurospine. 2020;17(1):254-259.
- 6. Zhu Y, Zhao Y, Fan G, Sun S, Zhou Z, Wang D, et al. Comparison of 3 anesthetic methods for percutaneous transforaminal endoscopic discectomy: A prospective study. Pain Physician. 2018;21(4):E347.
- Akakin A, Yilmaz B, Alp AK, Sahin S, Eksi MS, Konya D. Epidural anesthesia in elective lumbar microdiscectomy surgery: Is it safe and effective? Turk Neurosurg. 2015;25(1):117-120.
- 8. Jonnesco T. Remarks on general spinal analgesia. Br Med J. 1909;2(2550):1396.
- Imbelloni LE. Spinal anesthesia for laproscopic cholecystectomy under spinal anesthesia: Thoracic versus lumbar technique. Saudi J Anaesth. 2014; 8:477-483.
- 10. Goyal A, Shankaranarayan P, Ganapathi P. A randomized clinical study comparing spinal anesthesia with isobaric levobupivacaine with fentanyl and hyperbaric bupivacaine with fentanyl in elective cesarean sections. Anesth Essays Res. 2015;9(1):57.