CASE SERIES

Efficacy of isobaric intrathecal levobupivacaine in laparoscopic procedures: Case series

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ABSTRACT

Introduction: Spinal anesthesia, particularly with isobaric levobupivacaine, offers an effective alternative with a favorable safety profile, faster recovery, and better postoperative analgesia. This study aimed to evaluate the efficacy and safety of single-shot subarachnoid block with isobaric levobupivacaine in laparoscopic procedures.

Materials and Methods: This prospective interventional case series was conducted over two months, including 20 patients aged 18-65 years undergoing laparoscopic surgeries under spinal anesthesia. The study included patients classified as ASA I and II. Patients with contraindications to spinal anesthesia, hypersensitivity to study drugs, or significant comorbidities were excluded. Spinal anesthesia was administered at the T10-T11 or T10-T11 space using 2 mL of 0.5% isobaric levobupivacaine with 25 mcg fentanyl. Sensory and motor block levels, hemodynamic parameters, and adverse effects were recorded intraoperatively and postoperatively.

Results: The mean age and weight of patients were 50.65 ± 14.26 years and 63.8 ± 3.58 kg, respectively. Sensory block to T6 level was achieved in 266 ± 21.13 seconds, with a total sensory duration of 67 ± 5.23 minutes. The mean time to rescue analgesia was four hours. Hemodynamic parameters were largely stable, with minor fluctuations. Three patients (15%) experienced shoulder pain, which was managed effectively.

Conclusion: Isobaric levobupivacaine provided effective sensory and motor blockade with stable hemodynamic responses and minimal adverse effects. The study supports its use as a reliable and safe anesthetic option for laparoscopic surgeries.

Keywords: Laparoscopy, Levobupivacaine, Motor block, Sensory block, Spinal anaesthesia.

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INTRODUCTION

General anaesthesia has traditionally been the preferred method for laparoscopic abdominal surgeries to mitigate risks such as aspiration, shoulder tip pain, respiratory complications, and hypercarbia resulting from carbon dioxide pneumoperitoneum. However, it poses several disadvantages, including systemic drug-related side effects, prolonged recovery time, lack of postoperative pain relief, safety concerns, and an extended duration of hospital stay.1

Spinal anaesthesia, first introduced in 1898 by Karl August Bier, is a regional anaesthesia technique where a local anaesthetic is administered into the cerebrospinal fluid to provide effective sensory and motor block.2,3 Spinal anesthesia is almost the most preferred anesthetic technique for laparoscopic surgeries due to its better reliability and cost-effectiveness along with good muscle relaxation, intraoperative and postoperative analgesia.4 The name segmental spinal is often widely used synonymously with thoracic spinal anaesthesia. But in real sense segmental spinal anaesthesia means “Blocking of the required dermatomes essential for the proposed surgical procedure with very low effective local anesthetic drug dose.” This often necessitates dural puncture at high lumber or thoracic levels apart from the conventional spinal below L1. Lower the dose of local anesthetic drug used more likely it is to produce a true segmental block.5

There are three main issues related to spinal at unconventional levels risk of neuronal injury , respiratory embarrassment due to extensive thoracic nerve blockade and cephalad spread of local anaesthetic drugs causing high or total block.6

Levobupivacaine, the pure S-enantiomer of bupivacaine, is considered a safer alternative because of reduced cardiac and neurotoxic effects, attributed to its faster protein binding and lower affinity for cardiac sodium channels.7-10 Additionally, it facilitates earlier motor recovery compared to racemic bupivacaine.11 Isobaric solutions, possessing a density similar to cerebrospinal fluid (CSF), and hyperbaric solutions, which are denser, exhibit distinct distribution patterns within the subarachnoid space. Isobaric solutions generally produce more consistent and uniform effects across spinal levels, whereas hyperbaric solutions, owing to their higher density, tend to create a more localized and concentrated block at specific spinal levels.12

Addition of small doses of fentanyl causes increased intensity of sensory blockade. Other advantages are - onset is gradual , haemodynamic stability even with high level of blocks, motor block time is shorter leading to early ambulation , early bladder control , improves postoperative analgesia and facilitates optimum spinal anesthesia (SAB) with a diminished dosage of the local anesthetic.13

There is limited literature available on efficacy and safety of single-shot subarachnoid block with isobaric levobupivacaine in abdominal surgeries. Therefore, this study was conducted with the objective of assessing the efficacy and safety of single-shot subarachnoid block with isobaric levobupivacaine in patients undergoing laparoscopic procedures.

MATERIALS AND METHODS

This hospital-based prospective, interventional case series was conducted over two months, from April 2024 to May 2024. All procedures adhered to ethical standards, with approval from the Institutional Ethics Committee, and written informed consent was obtained from all participants. The study included 20 consenting patients aged 18–65 years, undergoing laparoscopic surgeries lasting less than two hours under spinal anaesthesia, and fulfilled the inclusion criteria.

Inclusion and Exclusion Criteria

Patients with an American Society of Anesthesiology (ASA) classification of I or II, and consenting to participate in the study, were included in the study. Patients with hypersensitivity to study medications, infection at the site of subarachnoid block, spinal deformities, inability to participate in pain scoring systems, body mass index (BMI) above 37 kg/m², ECG abnormalities like sinus bradycardia and heart blocks, use of alpha-adrenergic blockers, and contraindications to spinal anesthesia such as bleeding diathesis or local infections, were excluded from the study.

Methodology

Patients were recruited from the institution's surgical unit. Upon arrival in the operating theatre, standard monitors were attached, including non-invasive blood pressure, pulse oximetry, and electrocardiography. Baseline vital signs were recorded, and an intravenous (IV) line was secured. Preloading was performed using Ringer's lactate solution at a rate of 10 mL/kg over approximately 15 minutes. Premedication was administered intravenously, consisting of glycopyrrolate 0.2 mg, ondansetron 4 mg, and midazolam 1 mg. Under aseptic conditions, spinal anesthesia was performed via a lumbar puncture at the T9-T10 or T10-T11 intervertebral space using either the median or paramedian approach. A 25G spinal needle was used to administer the anesthetic solution, which consisted of 2 mL of 0.5% isobaric levobupivacaine combined with 25 mcg (0.5 mL) of fentanyl as an adjuvant.

Following the spinal block, patients were monitored for sensory and motor block levels, hemodynamic stability, and any adverse effects. The surgical procedure was initiated after achieving an adequate block level. Intraoperative parameters and postoperative outcomes were recorded for subsequent analysis.

The procedure commenced with preoperative preparation, where oxygen was administered through a Hudson mask at a flow rate of 5 L/min. Vital parameters, including heart rate, blood pressure, and oxygen saturation, were monitored rigorously, with observations recorded every minute during the first 15 minutes and then every 5 minutes thereafter. A sensory block covering the T6 to L3 levels was achieved and confirmed using the pinprick test, while the onset and intensity of motor blockade were assessed and documented using the modified Bromage scale. In the intraoperative phase, surgery proceeded after ensuring an adequate sensory block and establishing pneumoperitoneum with an intra-abdominal pressure maintained at 12 mmHg. Adverse events during surgery were effectively managed. Bradycardia, defined as a heart rate below 55 beats per minute, was treated with intravenous atropine at a dose of 0.6 mg. Hypotension, indicated by a systolic blood pressure lower than 80 mmHg, was managed using 6 mg of intravenous mephentermine and rapid infusion of intravenous fluids. Patients reporting intraoperative shoulder pain with a visual analogue scale (VAS) score exceeding 3 were administered 100 mcg of intravenous fentanyl to alleviate discomfort. Postoperatively, vital parameters, sensory block, and motor block were assessed every 15 minutes until the complete regression of the block. Pain levels were measured using the VAS, and the time at which postoperative pain reached a VAS score of 3 was noted. At this point, 75 mg of diclofenac was administered via infusion to manage pain. Side effects such as shoulder pain, nausea, vomiting, urinary retention, headache, and backache were monitored and treated on postoperative

days 0, 1, and 2. Finally, the overall success of the procedure was evaluated using a robust three-point scoring system, which assessed both patient and surgeon satisfaction with the process.

Perioperative sedation was evaluated using the Ramsay Sedation Score (RSS), which categorizes sedation levels as follows:

1 – The patient is anxious, agitated, or restless, or both.

2 – The patient is cooperative, oriented, and calm.

3 – The patient responds only to commands.

4 – The patient exhibits a brisk response to a light glabellar tap or a loud auditory stimulus.

5 – The patient demonstrates a sluggish response to a light glabellar tap or a loud auditory stimulus.

6 – The patient shows no response.

Statistical Analysis

Descriptive statistics, including mean and standard deviation (SD), were used to summarize continuous variables such as age, weight, heart rate, blood pressure, and hematological parameters. Categorical data were expressed as frequencies and percentages.

RESULTS

[Table-1] The mean age of the patients was 50.65 ± 14.26 years, and the mean body weight was 63.8 ± 3.58 kg. The mean hemoglobin level was 11.78 g/dL, the mean platelet count was 187.6 × 10^9/L, and the average total leukocyte count (TLC) was 6.36 × 10^3/μL. There were 12 (60%) male patients, while the remaining 8 (40%) were female. The majority of patients, 16 (80%), had ASA grade 1, while the remaining 4 (20%) cases had ASA grade 2. Regarding the diagnosis, 16 (80%) cases were of cholelithiasis, and the remaining 4 (20%) cases were of appendicitis.

[Table-2] The mean time to achieve a sensory block at the T6 level was 266 ± 21.13 seconds, while the total sensory duration was 67 ± 5.23 minutes. The total duration of motor blockage for each patient was one hour, and the total time to rescue analgesia was four hours for all patients. More than half of the patients, 12 (60%) experienced level 1 motor blockage, while the remaining eight (40%) cases had level 2 motor blockage. Post-operatively, three (15%) patients experienced shoulder pain, whereas the remaining patients reported no adverse events.

Most of the patients, 16 (80%), were satisfied, while three (15%) were very satisfied, and one (5%) were not satisfied. Nearly two-thirds of the patients (65%, 13 out of 20) had a Modified Ramsay Sedation Score of 2, followed by a score of 3 in five patients (25%), and a score of 4 in the remaining two patients (10%).

[Table-3] The baseline heart rate was 77.2 beats per minute (bpm). At 0 minutes, there was an initial increase to 82.8 bpm. A progressive decline was observed, with the heart rate decreasing to 71.2 bpm at 30 minutes. At 45 minutes, a slight upward fluctuation was noted, with the heart rate rising to 75.5 bpm. By 60 minutes, the heart rate returned to 72 bpm, indicating a stabilization phase after the initial fluctuations.

[Figure-1] The baseline systolic blood pressure (SBP) was 129.6 mmHg. At 0 minutes, it increased to 136.8 mmHg, followed by a drop to 111.4 mmHg at 15 minutes. A slight increase was observed at 30 minutes, reaching 117.0 mmHg, followed by a further drop to 111.25 mmHg at 45 minutes. At 60 minutes, the SBP rose again to 118.0 mmHg.

[Figure-2] The baseline DBP was recorded at 79.6 mmHg, rising to 87.6 mmHg at 0 minutes. A declining trend was observed at 10 and 15 minutes. At 30 minutes, there was a slight increase to 78.8 mmHg, followed by a decrease to 73.0 mmHg at 45 minutes. At 60 minutes, the DBP showed a modest increase to 76.0 mmHg.

[Figure-3] The baseline mean arterial pressure (MAP) was 94.8 mmHg, which increased to 100.6 mmHg at 0 minutes. A drop to 85.2 mmHg was observed at 15 minutes. At 30 minutes, the MAP slightly increased to 87.0 mmHg but dropped again to 81.0 mmHg at 45 minutes. By 60 minutes, the MAP reached 76.0 mmHg, indicating a continued downward trend.

DISCUSSION

In our study, the mean onset of sensory block was observed to be 266±21.13 seconds, which is comparable to the findings of Samar P et al14, who reported a mean onset time of 6.97±1.82 minutes with levobupivacaine. Similarly, Makwana H et al1 reported a mean sensory block onset time of 2.0 ± 1.0 minutes, with a mean regression time of sensory blockade being 180 ± 8 minutes. These findings suggest that levobupivacaine provides a rapid and consistent onset of sensory blockade, aligning closely with previously published data.

Regarding the duration of motor block, our study observed a mean duration of approximately four hours, which is in agreement with the findings of Samar P et al14, who reported a prolonged motor block duration of 207.33±22.27 minutes with levobupivacaine. This consistency in results reinforces the reliability of levobupivacaine in providing effective and prolonged motor blockade, making it suitable for laparoscopic procedures requiring sustained intraoperative anesthesia.

Verma AK et al12 reported that the mean sensory block was achieved within 266±21.13 seconds, with a total sensory duration of 67±5.23 minutes, and a motor blockade duration of approximately one hour, with most patients achieving level 1 motor block on the Bromage

scale. These findings closely mirror our results, further supporting the efficacy and predictability of levobupivacaine in achieving adequate sensory and motor blockade.

The Modified Ramsay Sedation Score (RSS) revealed that 65% of patients achieved an optimal sedation level of 2, indicating they were cooperative, oriented, and calm. A sedation score of 3, reflecting a response to commands only, was observed in 25% of patients, while 10% demonstrated a higher level of sedation with a score of 4. The predominance of RSS scores of 2 and 3 indicates that patients remained comfortable and cooperative during the procedure, which is crucial for maintaining surgical efficiency and patient satisfaction. These results suggest that the combination of 0.5% isobaric levobupivacaine with fentanyl provided an adequate level of perioperative anaesthesia while maintaining patient safety and comfort.

In terms of hemodynamic stability, both our study and Samar P et al14 observed a gradual decline followed by a subsequent rise in mean pulse rate intraoperatively with levobupivacaine. This trend suggests that the drug maintains a stable hemodynamic profile with minimal fluctuations, making it a favorable choice for patients with cardiovascular comorbidities. The gradual nature of hemodynamic changes with levobupivacaine, as reported in various studies, indicates that it provides a safer anesthetic profile compared to other local anesthetics, with a lower likelihood of significant hypotension or bradycardia.

Overall, our findings, along with corroborating evidence from existing literature, highlight the efficacy, reliability, and safety of segmental spinal anesthesia for laparoscopic procedures, emphasizing its favorable sensory and motor blockade characteristics, as well as its hemodynamic stability.

The small sample size in our study limits the generalizability to a larger population, this study was conducted at a single center, which may introduce biases related to institutional practices and patient demographics. This study did not include a control group with alternative anesthetic agents for direct comparison. Future studies are warranted with larger sample size, multicenter trials, comparative studies with alternative anesthetic agents, and longer follow-up periods to assess potential late-onset adverse effects and long-term outcomes.

CONCLUSION

On the basis of findings, we concluded that isobaric levobupivacaine as spinal anesthesia provides adequate sensory and motor blockade with a predictable onset and duration, ensuring effective intraoperative anesthesia and postoperative pain relief. Hemodynamic responses were generally well-maintained, with minor fluctuations observed over time, suggesting that the technique offers stable cardiovascular performance. The procedure was well-tolerated by the majority of patients, with minimal adverse effects reported, highlighting its safety profile. In conclusion, segmental spinal anaesthesia with isobaric levobupivacaine appears to be a reliable option in laparoscopic surgeries.

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Table 1- Demographic and Hematological characteristics of patients

Variable	Mean	SD
Age (Years)	50.65	14.26
Weight (kgs)	63.8	3.58
Hb	11.78	1.23
Platelet count	187.6	14.89
Total Leukocyte Count (TLC)	6.36	1.46

Table 2- Sensory block characteristics of patients

Variable	Mean	SD
Time to achieve block at T6 (sec)	266	21.13
Total sensory duration (Minutes)	67	5.23

Table 3- Heart rate at different time intervals

Heart Rate	Mean	SD
Baseline	77.2	12.54
At 0 min	82.8	10.98
At 5 min	75.6	12.05
At 10 min	72.2	12.92
At 15 min	71.8	11.79
At 30 min	71.2	10.02
At 45 min	75.5	9.95
At at 60 min	72	-

Figure 1- Systolic Blood Pressure (SBP) at different time intervals

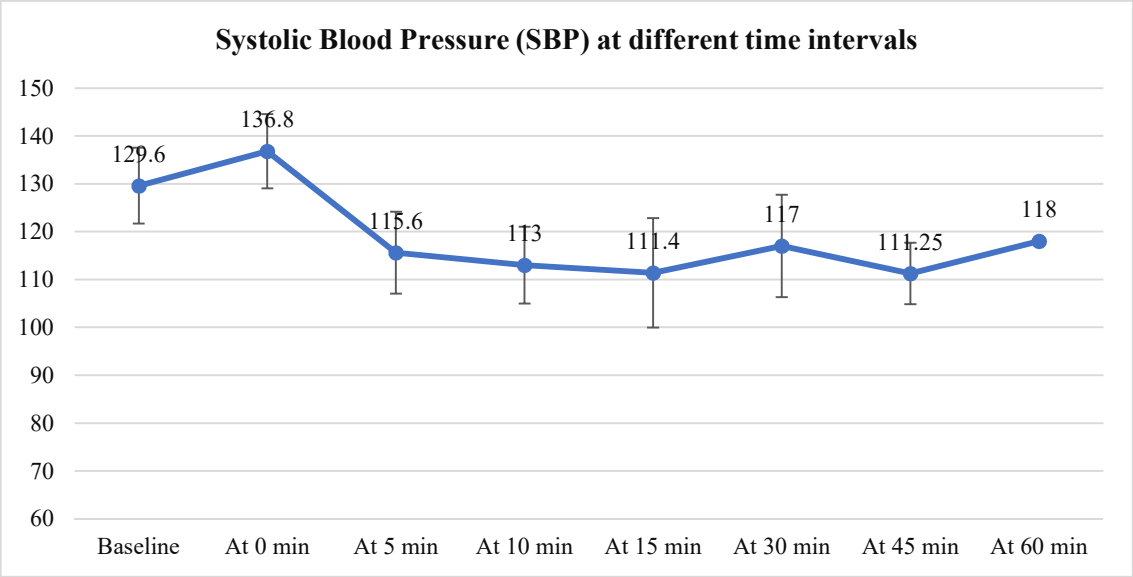

Figure 2- Diastolic Blood Pressure (DBP) at different time intervals

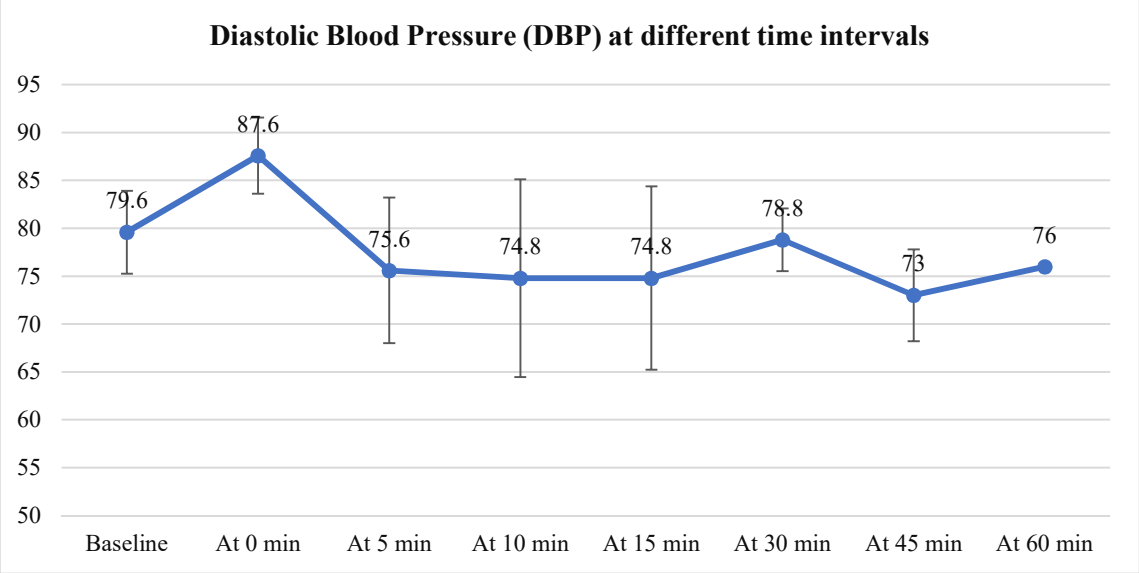

Figure 3- Mean Arterial Pressure (MAP) at different time intervals