Section: Miscellaneous

Original Research Article

COMPARISON OF SENSORY AND MOTOR BLOCK CHARACTERISTICS FOLLOWING 7.5 MG AND 10 MG INTRATHECAL HYPERBARIC BUPIVACAINE IN SEQUENTIAL COMBINED SPINAL EPIDURAL ANAESTHESIA FOR LOWER LIMB ORTHOPAEDIC SURGERY IN ELDERLY PATIENTS

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ABSTRACT

Background: Sequential combined spinal epidural anaesthesia (SCSEA) is commonly used in elderly patients undergoing lower limb orthopaedic surgery because it combines the advantages of spinal and epidural anaesthesia. The optimal intrathecal dose of hyperbaric bupivacaine for achieving effective sensory and motor blockade remains an area of interest. **Aim:** To compare the sensory and motor block characteristics of 7.5 mg and 10 mg intrathecal hyperbaric bupivacaine administered during SCSEA in elderly patients undergoing lower limb orthopaedic surgery. **Materials and Methods:** Sixty patients aged above 60 years were divided into two groups. Group B7.5 received 7.5 mg hyperbaric bupivacaine intrathecally, while Group B10 received 10 mg. Time to achieve T10 sensory block, sensory level attained, motor blockade, epidural top-up requirement, and adequacy of surgical anaesthesia were assessed. **Results:** The mean time required to achieve T10 sensory blockade was significantly shorter in Group B10 than in Group B7.5 (4.37±1.27 min vs 8.43±2.56 min; p=0.001). The median sensory level achieved was T10 in both groups (p=0.796). Motor blockade and epidural top-up requirements were comparable between the groups. No patient required supplementary analgesia or conversion to general anaesthesia. **Conclusion:** Both 7.5 mg and 10 mg intrathecal hyperbaric bupivacaine provided effective anaesthesia during SCSEA. Although the 10 mg dose produced a faster onset of sensory blockade, both doses achieved satisfactory sensory and motor block characteristics and adequate surgical conditions.

INTRODUCTION

The growing elderly population has led to an increasing number of lower limb orthopaedic surgeries being performed in older patients. Regional anaesthesia is commonly preferred for these procedures because it provides effective pain relief, reduces the surgical stress response, and avoids many of the risks associated with general anaesthesia. However, advancing age is associated with physiological changes that increase sensitivity to local anaesthetic drugs, making careful dose selection essential.

Combined spinal epidural anaesthesia (CSEA) combines the advantages of both spinal and epidural techniques. It offers the rapid onset and reliable sensory and motor blockade of spinal anaesthesia while providing the flexibility to extend the block through an epidural catheter when required. Since its introduction by Rawal and colleagues, CSEA has gained widespread acceptance for a variety of surgical procedures because of its effectiveness and versatility.[1,2]

Sequential combined spinal epidural anaesthesia (SCSEA) is a modification of this technique in which a smaller intrathecal dose is administered initially, followed by epidural supplementation to achieve or maintain the desired level of anaesthesia. This approach allows adequate surgical anaesthesia while preserving the option of extending the block when needed. Previous studies have shown that SCSEA provides satisfactory sensory and motor blockade and is particularly useful in elderly and high-risk patients undergoing major surgery.[3,4]

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Several studies have evaluated different doses of intrathecal hyperbaric bupivacaine used during combined spinal epidural anaesthesia. Choi et al. demonstrated that low-dose combined spinal epidural anaesthesia could provide satisfactory surgical conditions with adequate sensory and motor blockade.[5] Leo et al. also reported that lower doses of hyperbaric bupivacaine were capable of producing effective anaesthesia when supported by a functional epidural catheter.[6] In addition, Chen et al. showed that the dose requirement for intrathecal bupivacaine decreases with advancing age, suggesting that lower doses may be sufficient in elderly patients.[7]

Although SCSEA is increasingly used in geriatric patients, studies directly comparing different low doses of intrathecal hyperbaric bupivacaine for lower limb orthopaedic surgery remain limited. Therefore, the present study was undertaken to compare the sensory and motor block characteristics of 7.5 mg and 10 mg intrathecal hyperbaric bupivacaine administered during sequential combined spinal epidural anaesthesia in elderly patients undergoing lower limb orthopaedic surgery.

Aim

To compare the sensory and motor block characteristics of 7.5 mg and 10 mg intrathecal hyperbaric bupivacaine administered during sequential combined spinal epidural anaesthesia in elderly patients undergoing lower limb orthopaedic surgery.

Objectives

1. To compare the time required to achieve T10 sensory blockade between the two groups.
2. To compare the sensory block characteristics and peak sensory level achieved following intrathecal administration of 7.5 mg and 10 mg hyperbaric bupivacaine.
3. To compare the degree of motor blockade using the modified Bromage scale.
4. To assess the requirement for epidural top-up supplementation in both groups.

MATERIALS AND METHODS

This prospective observational study was conducted in 60 patients aged above 60 years undergoing elective or emergency lower limb orthopaedic surgeries. Patients belonged to ASA physical status I–III and were divided into two equal groups.

Group Allocation

Group B7.5 (n=30): Received 1.5 ml of 0.5% hyperbaric bupivacaine (7.5 mg) intrathecally.

Group B10 (n=30): Received 2 ml of 0.5% hyperbaric bupivacaine (10 mg) intrathecally.

Following the spinal component, epidural top-ups with 0.5% isobaric bupivacaine were administered whenever required to maintain a T10 sensory level.

Parameters Studied

1. Time required to achieve T10 sensory block
2. Sensory block level
3. Motor blockade using modified Bromage scale
4. Epidural top-up requirements

Statistical Analysis: Data were analysed using Statistical Package for Social Sciences (SPSS) software. Continuous variables were expressed as mean ± standard deviation, whereas categorical variables were expressed as frequencies and percentages. Student's t-test was used for comparison of continuous variables and Chi-square test was used for categorical variables. A p-value <0.05 was considered statistically significant.

Ethical Considerations

The study was approved by the Institutional Ethics Committee, and written informed consent was obtained from all participants prior to enrolment in the study.

RESULTS

Demographic Characteristics

Both groups were comparable regarding age, sex distribution, height, weight and ASA grading. No statistically significant differences were observed.

Time to Achieve T10 Sensory Block

The mean time required to achieve T10 sensory blockade was significantly shorter in Group B10 (4.37±1.27 min) compared with Group B7.5 (8.43±2.56 min) (p=0.001), indicating a faster onset of sensory block with the higher intrathecal dose.

Table 1: Comparison of time required to achieve T10 sensory blockade

Group	Time to T10 (min) Mean ± SD
Group B7.5	8.43 ± 2.56
Group B10	4.37 ± 1.27
p-value	0.001*

Significant

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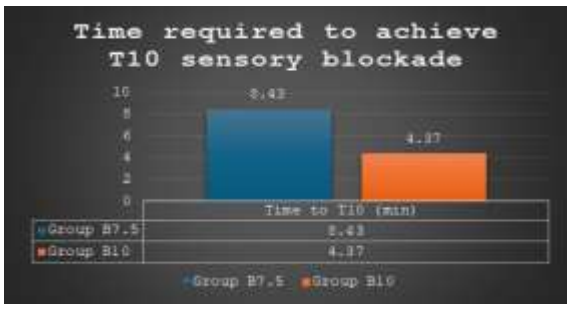

Figure 1: Time to T10 Sensory Block

Sensory Block Characteristics

The distribution of sensory levels achieved at 10 minutes after intrathecal injection is shown in Table/Fig-3. The median sensory level achieved was T10 in both groups. Adequate surgical anaesthesia (T10 level or higher) was achieved in all patients in Group B10 and in 27 of 30 patients in Group B7.5 before epidural supplementation. The difference in sensory block distribution between the groups was not statistically significant (p=0.796).

Table 2: Distribution of sensory levels achieved at 10 minutes after intrathecal injection

Sensory Level	Group B7.5 n (%)	Group B10 n (%)
T8	2 (6.7)	5 (16.7)
T9	10 (33.3)	9 (30.0)
T10	15 (50.0)	16 (53.3)
T12	3 (10.0)	0 (0.0)
Median sensory level	T10	T10
p-value		0.796 (NS)

Figure 2: Sensory levels achieved at 10 minutes after intrathecal injection

Motor Block Characteristics

Motor blockade was assessed using the modified Bromage scale. The mean Bromage score was 2.47±0.51 in Group B7.5 and 2.43±0.50 in Group B10, with no statistically significant difference between the groups (p=0.760). All patients in both groups achieved Bromage grade III motor blockade, providing satisfactory muscle relaxation for surgery.

Table 3: Comparison of mean motor block characteristics between the two groups

Group	Mean Bromage Score (Mean ± SD)
Group B7.5	2.47 ± 0.51
Group B10	2.43 ± 0.50
p-value	0.760 (NS)

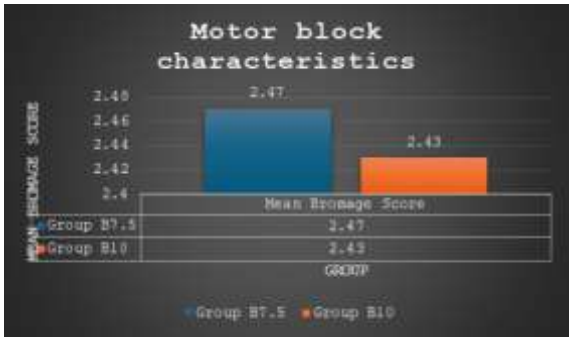

Figure 3: Mean modified Bromage scores between the study groups

Epidural Top-Up Requirement

The requirement for epidural top-up was slightly greater in Group B7.5 than in Group B10. Patients in Group B7.5 required a mean of 1.73±0.88 top-ups compared with 1.40±0.52 top-ups in Group B10; however, the difference was not statistically significant (p=0.075). Similarly, the mean total epidural bupivacaine dose administered was higher in Group B7.5 (26 mg) than in Group B10 (21 mg).

Table 4: Comparison of epidural top-up requirements between Group B7.5 and Group B10

Number of Top-ups	Group B7.5 n (%)	Group B10 n (%)
0	15 (50.0)	20 (66.7)
1	8 (26.7)	6 (20.0)
2	3 (10.0)	4 (13.3)
3	4 (13.3)	0 (0.0)
Mean number of top-ups	1.73 ± 0.88	1.40 ± 0.52
p-value		0.075 (NS)

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Table 5: Mean epidural bupivacaine consumption

Variable	Group B7.5	Group B10	p-value
Mean number of top-ups	1.73	1.40	0.124
Mean epidural bupivacaine dose (mg)	26	21	NS

Figure 4: Top-up Requirement

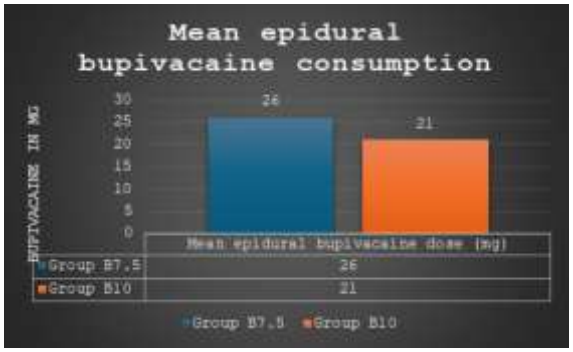

Figure 5: Bupivacaine Consumption

DISCUSSION

The present study demonstrated that both 7.5 mg and 10 mg intrathecal hyperbaric bupivacaine provided effective anaesthesia when used as part of sequential combined spinal epidural anaesthesia (SCSEA) in elderly patients undergoing lower limb orthopaedic surgery.

A major finding of the present study was the significantly faster onset of sensory blockade with 10 mg hyperbaric bupivacaine. Patients in Group B10 achieved T10 sensory blockade significantly earlier than those in Group B7.5. This finding is consistent with the pharmacological principle that larger intrathecal doses produce a more rapid spread and onset of neural blockade. Choi et al. reported that higher intrathecal doses were associated with a faster onset and denser sensory block during combined spinal epidural anaesthesia.[5] Similarly, Leo et al. observed that lower intrathecal doses required a longer time to achieve the desired sensory level compared with conventional doses, although adequate anaesthesia was eventually achieved in all patients.

Despite the slower onset in the low-dose group, both groups achieved satisfactory sensory blockade for surgery. The median sensory level achieved was T10 in both groups, and no statistically significant difference was observed. These findings suggest that reducing the intrathecal dose does not necessarily compromise the final sensory level when epidural supplementation is available. Similar observations were reported by Van de Velde et al., who demonstrated that low-dose combined spinal epidural anaesthesia could achieve adequate sensory block while maintaining satisfactory surgical conditions.[8] Teoh et al. also found that low-dose intrathecal bupivacaine, when combined with epidural supplementation, provided reliable sensory blockade comparable to that achieved with higher doses.[9]

Motor blockade was comparable between the two groups. All patients achieved Bromage grade III motor blockade, indicating that both doses provided excellent muscle relaxation for surgery. Hamdani et al. reported similar findings in elderly patients undergoing major orthopaedic procedures, where sequential combined spinal epidural anaesthesia produced satisfactory motor blockade without compromising surgical conditions.[1] Gupta et al. also demonstrated effective motor blockade with sequential combined spinal epidural anaesthesia and concluded that the technique provided adequate operating conditions for lower limb surgeries.[10]

The requirement for epidural top-up was slightly greater in the 7.5 mg group, although the difference was not statistically significant. This observation is expected because a smaller intrathecal dose may require additional epidural supplementation to maintain the desired block level during surgery. Rawal et al. described epidural supplementation as one of the principal advantages of the combined spinal epidural technique, allowing extension and maintenance of anaesthesia without the need for additional systemic analgesics or conversion to general anaesthesia.[1,2] Bhattacharya et al. similarly reported that low-dose sequential techniques may require occasional epidural supplementation while still providing effective surgical anaesthesia.[4]

An important finding of the present study was that none of the patients required supplementary analgesia or conversion to general anaesthesia. This indicates that both dosing regimens provided adequate surgical anaesthesia throughout the procedure. Comparable findings were reported by Tummala et al., who observed successful completion of orthopaedic surgeries using low-dose combined spinal epidural anaesthesia without the need for conversion to general anaesthesia.[11]

Age-related changes in neuraxial sensitivity may explain why both doses produced satisfactory sensory and motor blockade. Chen et al. demonstrated that the median effective dose of intrathecal bupivacaine decreases with advancing age, suggesting that elderly patients require lower doses to achieve adequate blockade.[7] This supports the use of reduced intrathecal doses as part of SCSEA in geriatric patients.

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Overall, the findings of the present study add to the growing body of evidence supporting the use of low-dose intrathecal bupivacaine in sequential combined spinal epidural anaesthesia. Although 10 mg hyperbaric bupivacaine produced a faster onset of sensory blockade, 7.5 mg provided comparable sensory and motor block characteristics, satisfactory surgical conditions, and minimal requirement for additional interventions. These results suggest that lower intrathecal doses can be effectively used in elderly patients undergoing lower limb orthopaedic surgery.

Limitation (S)

The present study was conducted at a single centre and included a relatively small number of patients. Long-term postoperative outcomes and patient satisfaction were not assessed. Larger multicentric studies are required to further validate these findings.

CONCLUSION

Both 7.5 mg and 10 mg intrathecal hyperbaric bupivacaine provided effective anaesthesia when used as part of sequential combined spinal epidural anaesthesia for lower limb orthopaedic surgery in elderly patients. Although the 10 mg dose produced a faster onset of sensory blockade, both doses achieved similar sensory and motor block characteristics and provided satisfactory surgical conditions. The slightly greater requirement for epidural supplementation with the lower dose did not affect the overall quality of anaesthesia. These findings suggest that 7.5 mg hyperbaric bupivacaine can be used effectively in elderly patients when combined with epidural supplementation.

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Conflict of Interest: The authors declare that there is no conflict of interest regarding the publication of this paper.

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