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Original research article

The clinical effects of combined spinal epidural anaesthesia versus spinal anaesthesia in major surgeries

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Abstract

Combined Spinal Epidural Anaesthesia (CSEA) combines advantages of both component techniques while precluding their known disadvantages. Further, a low dose intrathecal Bupivacaine followed by sequential epidural doses calculated as per the unblocked number of segments may provide sufficient volume extension to precisely and adequately target the required surgical field. 66 patients scheduled for major surgeries under neuraxial anaesthesia were randomized into two groups. GROUP A (n=33) received CSEA with 1.5 ml 0.5% Hyperbaric Bupivacaine (7.5 mg) intrathecally at L3-L4 site followed by 0.75 ml (16 patients) to 1.5 ml (17 patients) 0.5% plain Bupivacaine per unblocked segments through epidural catheter. GROUP B (n=33) received only 2.5 ml 0.5% Hyperbaric Bupivacaine (12.5 mg) intrathecally at L3-L4 site. The maximun level of sensory block was T_{11} after spinal component of CSEA in group A and T_6 in group B. In group a, subsequent epidural dosing of 0.5% Bupivacaine with 1.5 ml per unblocked segments (stat/increment) in 17 patients raised the level by 6-segments. In the other subgroup of 16 patients who received 0.75 ml per segment epidural dose, there was 4-segment raise in block level. Time for 2-segment regression was 0.6±0.2 hours (Group A) compared to 2.4±0.5 hours (Group B) with $p<0.001$. The total duration of sensory block was 1.9±0.4 hours (Group A) and 4.8 ± 1 hours (Group B) with $p< 0.001$.

For CSEA in major abdominal surgeries, an intrathecal dose of 1.5 ml 0.5% Hyperbaric Bupivacaine (7.5 mg) is sufficient as initialising dose. The surgical need of analgesia for uncovered segments can be provided predictably with epidural 0.5% plain Bupivacaine as increments of 0.75 ml per required segment.

Key words: Spinal, combined spinal epidural, bupivacaine

Introduction

In major surgery, meaning surgery lasting over 60 minutes, 2 neuraxial anaesthetic techniques are most commonly employed, namely spinal and epidural. Spinal block is a simple method but it is associated with hypotension and bradycardia which may be rapid in onset and sometimes profound [1]. Also, distribution of analgesia is widespread. Lower limb paresis is invariable and prolonged, which may be detrimental to quick ambulation [2]. In epidural blocks, comparatively, very large volume of local anaesthetic is needed. But there is slower onset of hypotension / bradycardia which may give the anaesthesiologist more time to correct these haemodynamic changes [3]. The distribution of analgesia is segmental. Thus lower limb weakness is less and short allowing early mobilization [4].

A combined technique of judicious doses of spinal and epidural anaesthesia (CSEA) is perceived to combine advantages of both techniques while precluding the known disadvantages [5, 6]. CSEA was introduced by Soresi in 1937 using single needle single interspace technique. Later on, various modifications and different methods came into use, each having some advantages over the other. The CSEA block can be used for a variety of surgeries and also for relief of labour pain and post- operative pain.

CSEA is reported by several studies to produce rapid onset, good relaxation and controllability of duration by extending the epidural component [7, 8]. This study is being carried out to compare the clinical effects of czmbined spinal epidural anaesthesia versus spinal anaesthesia in patients undergoing major surgeries.

Methodology

A prospective randomized case controlled study was done to analyse the clinical effects of combined spinal epidural anaesthesia versus spinal anaesthesia in major surgical procedures in the Department of Anaesthesiology, Pain and Critical care. A total of 66 patients were enrolled for the study with the following inclusion and exclusion criteria.

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Inclusion criteria

1. Patients willing to give written informed consent.
2. American society of Anaesthesiologists (ASA) grades I and II.
3. **Age:** 18-60 years.
4. Major operations in general surgery/ orthopaedics and gynaecology.

Exclusion criteria

1. Contraindications to spinal anaesthesia.
2. Neurological disorder.
3. Coagulation disorder.
4. Hypotension / uncontrolled hypertension.
5. Emotional instability.
6. Unwillingness.
7. Any anticipated difficulty in regional anaesthesia.
8. ASA grade III and IV.

Following ethics committee approval, informed consent was obtained from the patients. Detailed pre-anaesthetic check-up was done. Patients fulfilling the required criteria were selected and 66 patients were randomly allocated to two groups (group A & group B) of 33 patients each using sealed envelope technique.

On arrival into the operating room, an 18G intravenous cannula was inserted and preloading was done with Ringer lactate solution 10 ml/kg/body weight over a period of 15 to 20 minutes. Patients were connected to standard ASA monitors.

In group a, 18 G Tuohy needle introduced into epidural space using loss of resistance technique at L2-L3 site in sitting posture. A 20 G epidural catheter was inserted, secured and patency checked. After this 25 G Quincke spinal needle was inserted at L3-L4 site. 1.5 ml of 0.5% hyperbaric Bupivacaine was injected through spinal needle. Patient was positioned recumbent, and block level was extended to desired level by Injecting 0.5% plain Bupivacaine through epidural catheter (epidural volume extension, EVE). In 17 patients of this group the epidural dose administered was 1.5 ml per unblocked segment. In the remaining 16 patients, this dose was divided into two equal increments of 0.75 ml. The second of the increments was administered only if needed.

In group B, 25 G Quincke spinal needle was introduced at L3-L4 site in sitting posture and 0.5% spinal Bupivacaine (H) 2.5 ml was given. Patients were then made recumbent for the ensuing surgery.

Following proper establishment of anaesthesia, patients were submitted to surgery.

Results

In Group A mean time of onset of sensory block was 2 minutes while in group B it was 2.9+/-0.7 minutes($p = 0.846$).

Table1: Distribution of TOSB (min)

TIME(min)	Group A		Group B		P value
	Mean	SD	Mean	SD	
TOSB	2.0	0.7	2.9	0.7	0.846

Note: P value* significantat 5% level of significance ($p<0.05$)

Highest level of sensory block is depicted among the Groups. 9 patients (group A) and 6 patients (group B) had sensory block up to T_4. 12 patients (group A) and 16 patients (group B) had sensory block upto T_6. 12 patients (group A) and 11 patients (group B) had sensory block upto T_8.

Table 2: Highest level of dermatome reached

Extent of sensory block up to	Group A		Group B	
	No. of patients	%	No. of patients	%
LevelT_4	9	27.27	6	18.18
LevelT_6	12	36.36	16	48.48
LevelT_8	12	36.36	11	33.33

Mean average level of sensory block was T_{11} after low dose intrathecal Bupivacaine. In 18 patients maximum level of sensory block was T_{12}. Mean level of sensory block was T_7 after using epidural plain Bupivacaine 0.75 ml /segment (16 patients). This was T_5 after using epidural plain Bupivacaine 1.5 ml/segment (17 patients). Extension of spinal blockade was by 4-segments with epidural dosing 0.75 ml/segment and 6-segments with 1.5 ml/segment.

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Table 3: Correlation of segmental level to spinal and epidural component of CSEA

Segmental level reached	No. of patients		
	After initialising intrathecal alone (spinal) 1.5 ml (n=33)	Epidural dose (n=33)	
		0.75 ml /segment (n=16)	1.5 ml /segment (n=17)
T_4	-	-	9
T_6	-	6	6
T_8	3	10	2
T_{10}	12	-	-
T_{12}	18	-	-
Mean level of sensory block	T 11	T_7	T_5
Extension of spinal blockade	-	4-segments	6-segments

Time for 2segment regression was 0.6+/-0.2 hours and 2.4+/-0.5 hours in group A and B respectively (p<0.001).

Table 4: Time for 2-Segment Regression (hours)

Time (hours)	Group A		Group B		P value
	Mean	SD	Mean	SD	
2-Segment Regression	0.6	0.2	2.4	0.5	<0.001*

Note: p value* significant at 5% level of significance (p<0.05)

Mean total duration of sensory block was 1.9+/-0.4 hours in groupA and was 4.8+/-1 hours in group B (p<0.001).

Table 5: Distribution of TDSB (hours)

Time	Group A		Group B		P value
	Mean	SD	Mean	SD	
TDSB	1.9	0.4	4.8	1.0	<0.001*

Note: p value* significant at 5% level of significance (p<0.05)

Mean time of onset of motor block was 3.3 +/-1minutes in group A and was 3.5+/-0.8 minutes in group B (p = 0.306).

Table 6: Distribution of TOMB (min)

Time (min)	Group A		Group B		P value
	Mean	SD	Mean	SD	
TOMB	3.3	1.0	3.5	0.8	0.306

Time taken to attain Bromage grade 3 motor block was compared in between two groups. Time to grade 3 motor block was 4.3+/-1.5 minutes in group A and it was 4.7+/-1.3 minutes in group B (p 0.329).

Table 7: Distribution of TTB3 (min)

Time (min)	Group A		Group B		P value
	Mean	SD	Mean	SD	
TTB3	4.3	1.5	4.7	1.3	0.329

Total duration of motor block was 1.7+/-0.4 hours and 5.1+/-1.1 hours in group A and B respectively (p<0.001).

Table 8: Distribution of TDMB (hours)

Time (hours)	Group A		Group B		P value
	Mean	SD	Mean	SD	
TDMB	1.7	0.4	4.2	1.1	<0.001*

Note: p-value* significant at 5% level of significance (p<0.05)

The time needed before administering rescue dose at VAS 4 was taken as duration of analgesia. The time taken for VAS score more than 4 was 0.51+/- 0.1 hours in group A, and it was 3.4+/-0.9hours in group B (p<0.001).

Table 9: Time taken for VAS 4 (hours)

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Time	Group A		Group B		P value
	Mean	SD	Mean	SD	
Time taken for VAS 4 (hrs.)	0.51	0.1	3.4	0.9	<0.001*

Note: p value* significant at 5% level of significance (p<0.05)

In Group A analgesia was excellent in 20 patients and good in 13 patients. In group B analgesia was excellent in 15 patients, good in 8 patients, adequate in 3 patients and poor in 7 patients (p = 0.008). This is statistically significant. In Group B, 2 patients required mask ventilation and 5 required injection Pentazocine 30 mg iv to complete the procedure, due to poor quality of anaesthesia.

Table 10: Quality of analgesia between Study Groups

Quality of analgesia	GROUP A		GROUP B		p value
	No. of patients	%	No. of patients	%	
Excellent	20	60.6%	15	45.5%	0.008*
Good	13	39.4%	8	24.2%	
Adequate	0	0.0%	3	9.1%	
Poor	0	0.0%	7	21.2%	
Total	33	100.0%	33	100.0%	

Note: p value* significant at 5% level of significance (p<0.05)

Discussion

We adopted a dose of 1.5 ml per unblocked segments. It was found that at this dose on the average, enhancement of 6 segments occurred in 17 patients. Hence in subsequent 16 patients the dose was redesigned to two increments of 0.75 ml per segment. In these patients the first increment itself produced enhancement of 4 segments. On the whole, we infer from our series that following spinal block (1.5 ml) the required enhancement of 4-6 segments can be achieved with an epidural dose as low as 0.75 ml to 1.5 ml per unblocked segments. Infact, in 9 patients who received 1.5 ml per segment epidural dose, average maximum height was T_4.

Priya *et al.* (2002) [9] found that sensory level was raised from T_8 to T_4 level by using 1.5 to 2 ml 0.5% plain Bupivacaine per unblocked segment through epidural catheter in CSEA group. In the series of Bhattacharya *et al.* (2006) [10] sensory level was raised from T_{10} to T_6 by using 2 ml 0.5% plain Bupivacaine per unblocked segment through epidural catheter in CSEA group. Ghosh *et al.* (2007) [11] found that sensory level was raised from T_7 - T_8 to T_4 - T_5 level by using 1.5 ml 0.5% plain Bupivacaine per unblocked segment through epidural catheter in CSEA group. Desai *et al.* (2017) [12] found that sensory level was reached up to T_{10} by using 2 ml 0.5% plain Bupivacaine per unblocked segment through epidural catheter in CSEA group.

It is reported in literature that used alone, spinal anaesthesia can ascend causing lower intercostal paresis and even affective dyspnoea and circulatory depression, Pourseidi *et al.* (2007) [13], Fan *et al.* (1994) [8]. Such problems can be prevented by careful titration of the epidural top-ups in CSEA.

In terms of epidural volume for extension of spinal block in our series, the mean volume required at 1.5 ml per segment was 8.5 ml. This volume when administered stat as single dose enhanced the prior spinal block level by 6 segments in 17 patients. As mentioned earlier, in subsequent 16 patients the dose was redesigned to 2 - increments of 0.75 ml per segment. The mean volume required for each increment was 3ml. It was found that in all the 16 patients first increment of 3 ml itself enhanced the prior spinal block level by 4 segments. The second increment was withheld.

In agreement with our findings, we have come across a number of references on epidural volume extension. The volume of saline shown to be effective for epidural volume extension is approximately 5 to 10 ml. Takiguchi *et al.* (1997) [14] using myelography in human volunteers demonstrated 40% reduction in diameter of subarachnoid space after 5 ml of epidural normal saline, and additional 25% reduction after second increment, attributable to "thecal compression". This was a time-dependant phenomenon with maximum benefit if performed early. Similarly Blumgart (1992) [15] showed that 10 ml saline caused epidural volume extension by raising sensory blockade by 4 segments following 1.6 to 1.8 ml of spinal Bupivacaine in Caesarean section.

The effect of epidural volume extension may be influenced by baricity and posture. Tyagi *et al.* (2008) [16] demonstrated that epidural volume extension was more effective with plain spinal Bupivacaine rather than hyperbaric Bupivacaine due to restricted spread of hyperbaric solution. Tyagi *et al.* also hypothesised that epidural volume extension works when conducted in lateral posture rather than sitting posture due to caudal pooling of intrathecal Bupivacaine in sitting posture. In concurrence with these findings, we have come across epidural volume extension (EVE) in all our patients who, underwent spinal in sitting posture followed by sequential epidural in recumbent posture. We have not used plain Bupivacaine in our series. Though epidural volume extension has been demonstrated in literature with normal saline, we have used epidural Bupivacaine for epidural volume extension. This may ensure 100% success better than normal saline, by providing both extension and epidural site of action. Karim *et al.*

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(2020) [17] compared EVE between saline and LA and concluded that for the same epidural volume, the latter produces faster onset, higher spread and longer duration. Saline simply provides mechanical the cal compression and acts best given early (5 - 10minutes after spinal) Mardirosoff *et al.* 1998 [18].

In our series patients administered spinal anaesthesia took longer time for 2-segment regression of sensory block compared to epidural block (144+/- 30 min versus 36 +/- 12 min). The advantage of CSEA is that, it can be made good by suitable calculated top-up of epidural doses.

Stienstra *et al.* (1989) [19] reported 2-segment regression of sensory block was 77 min with intra-thecal administration of 3 mL 0.5% plain Bupivacaine. Priya *et al.* (2002) [9] found that 2-segment regression time was lesser in CSEA group compared to epidural group. Gupta *et al.* (2002)20 found that 2-segment regression time for sensory block of 67±37 min with 2 ml 0.5% spinal hyperbaric Bupivacaine. Dua *et al.* (2002) [21] reported that 2-segment regression time for sensory block as 81.75 +/-11.09 minutes in CSEA group. Rama *et al.* (2020) [72] found 2-segment regression time for sensory block of 101.22±8.21 min with 2.5 ml 0.5% spinal hyperbaric Bupivacaine. Shrestha *et al.* (2020) [73] reported 2-segment regression time for sensory block as 84.1+/- 40.6 minutes in CSEA group with 2.5 ml hyperbaric bupivacaine followed by 2 ml plain Bupivacaine per unblocked segment through epidural catheter.

Motor block after spinal anaesthesia is invariably long. This makes patients not only comfortable but annoying. Also lack of limb mobility impacts limb circulation in patients predisposed to DVT. In our series motor block in group B lasted as long as 4.2 hours. On the other hand in CSEA group it lasted only 1 1/2 hours and could mobilise limbs in bed.

Kaur and Jayant *et al.* (2012) [24] stated that quick motor recovery can be achieved from epidural volume extension when spinal and epidural anaesthesia are combined.

In our series, sensory block outlasted motor block in spinal group and were administered 8th hourly analgesics thereafter empirically. In combined spinal epidural group, duration of analgesia (VAS 4) was reached on an average of 0.51 hours from when-onwards all patients were administered 50 mg epidural tramadol and thereafter same dose twice daily.

In our series analgesic experience was graded as excellent (60.6%) and good (39.4%) in group A patients, while it was excellent (45.5%), good (24.2%), adequate (9.1%) and poor(21.2%) in group B patients. This result was based on the assessment of anesthetist, surgeon and patient.

Priya *et al.* (2002) [9] graded quality of analgesia as excellent (85%), good (10%) and fair (5%) in CSEA group while the same figures in epidural group were 40%, 45% and 15% respectively. Bhattacharya *et al.* (2006) [25] reported 90% excellent and 10% good analgesia in CSEA group while in spinal group 80% were excellent, 15% good and 5% fair. Nagarajutalikota *et al.* (2015) [26] reported that the proportion of subjects who achieved the excellent quality of surgical analgesia was 92% in CSEA group compared to 88% in spinal group.

Conclusion

It is concluded that, adequate sensory and motor blockade as well as post- operative analgesia without adverse effects can be provided by Sequential CSEA with 1.5 ml intrathecal 0.5% Bupivacaine (H) followed by 0.75 to 1.5 ml per unblocked segments of plain 0.5% epidural Bupivacaine. This can be economically achieved by conventional Tuohy and Quincke needle in two-spaces approach.

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