Journal of Cardiovascular Disease Research

ISSN:0975 -3583,0976-2833 VOL 15, ISSUE 02, 2024

Original research article

Combined spinal epidural anaesthesia versus spinal anaesthesia in major surgeries: Hemodynamic changes

[1]Dr. Kalesh PS, [2]Dr. Lakshmi C, [3]Dr. Haridadeeswaran TK, [4]Dr. Geethashree B

[1, 2, 3, 4] Senior Resident, Department of Anaesthesiology, ESIC Medical College and PGIMSR, Bangalore, Karnataka, India

Corresponding Author:
Dr. Geethashree B

Abstract

The cardiovascular effects of neuraxial blocks are similar in some ways to the combined use of intravenous α1- and β-adrenergic blockers: decreased heart rate and arterial blood pressure. The sympathectomy that accompanies the techniques depends on the height of the block, with the sympathectomy typically described as extending for two to six dermatomes above the sensory level with spinal anaesthesia and at the same level with epidural anaesthesia. 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. The mean basal systolic blood pressure was comparable between the two groups (p=0.846). The Mean systolic pressure was lower in group B throughout the surgery compared to group A ($p<0.001$). It was less than 100 mmHg in group B between 15-40 minutes.

Keywords: Epidural anesthesia, spinal anesthesia, hemodynamic changes

Introduction

Epidural space is the potential space between the spinal duramater and the periosteum and ligaments lining the vertebral canal. The duramater is made of two layers, the endosteal and the meningeal layer. The two layers are closely fused within the cranium. Below the foramen magnum, these two layers are separate. The outer layer forms the periosteum lining the spinal canal. The inner layer forms the spinal dura mater. Between these two layers is the epidural or the peridural space. The epidural space is widest in the midline posteriorly with an average of 5mm between ligamentum flavum and the posterior surface of the spinal dura. The depth is slightly more proximal to the inferior border of the lamina due to the obliquity of the vertebral lamina [1].

In single space technique (SST), the Tuohy needle may function as a more suitable introducer than a normal introducer, as the tip of spinal needle can be directed more accurately. Dural identification may be complicated. One cannot be sure of dural penetration after a successful localization of the epidural space, as any deviation of the Touhy needle from the sagittal plane may cause the spinal needle to enter the epidural space and pass the dural sac laterally. There is 16% failure of spinal anaesthesia in single space technique compared to only 4% when using double space technique (DST) [2].

The cardiovascular effects of neuraxial blocks are similar in some ways to the combined use of intravenous α1- and β-adrenergic blockers: decreased heart rate and arterial blood pressure. The sympathectomy that accompanies the techniques depends on the height of the block, with the sympathectomy typically described as extending for two to six dermatomes above the sensory level with spinal anaesthesia and at the same level with epidural anaesthesia. This sympathectomy causes venous and arterial vasodilation, but because of the large amount of blood in the venous system (approximately 75% of the total volume of blood), the venodilation effect predominates as a result of the limited amount of smooth muscle in venules. After neuraxial block induced sympathectomy, if normal cardiac output is maintained, total peripheral resistance should decrease only 15% to 18% in normovolemic healthy patients, even with nearly total sympathectomy. In elderly patients with cardiac disease, systemic vascular resistance may decrease almost 25% after spinal anaesthesia. Whereas cardiac output decreases only 10%. The heart rate during a high neuraxial block typically decreases as a result of blockade of the cardio accelerator fibers arising from T_1 to T_4. The heart rate may decrease because of a fall in right atrial filling, which decreases outflow from intrinsic chronotropic stretch receptors located in the right atrium and great veins. It appears that total-body oxygen consumption in patients undergoing spinal anaesthesia correlates with the extent of spinal anaesthesia, thus providing a margin of safety for organ perfusion unavailable with non-neuraxial techniques [3, 4].

Prevention of decreases in mean arterial pressure of greater than 30% has some basis, but it is important to remember that these data were derived from severely hypertensive, presumably untreated patients. For

ISSN:0975 -3583,0976-2833 VOL 15, ISSUE 02, 2024

normotensive and treated hypertensive patients, a wider undocumented margin of safety probably exists.
Reduction of cardiac output (CO) and systemic vascular resistance (SVR) are the main causes of significant hypotension. Preload is an important determinant of CO. In elderly patients, SVR decreases by 23-26%, central venous pressure by 2-3 mm Hg and left ventricular end diastolic volume decreases by 20%. Therefore, the haemodynamic effects are considerably notable and might be especially harmful to elderly patients with limited cardiac reserve compared with younger patients [5].
Sympathectomy reduces the venous return to the heart, paradoxically, the vagal tone increases leading to marked bradycardia and asystole. The significant decrease in preload may initiate the following three reflexes which cause cardiovascular collapse and syncope. The first reflex involves direct stretching of the pacemaker cells in the sinoatrial node. The decrease in venous return statement causes less stretching and can lead to a drop of heart rate due to decreased outflow from intrinsic chronotropic stretch receptors. The second reflex includes baroreceptors located in the right atrium and the vena-cava-atrial junction. The third reflex, called the Bezold-Jarisch reflex, is mediated by cardiac baroreceptors located in the inferoposterior wall of the left ventricle. Initially, it is triggered by decrease of central blood volume, followed by ventricular volume decrease and ventricular contractility increase. The vasomotor centre is stimulated via afferents of the vagus nerve and increased vagal efferent activity leads to bradycardia [6].
Cardiovascular depression occur with epidural blockade and is related to the level of sympathetic blockade. Although it has been claimed that epidural block results in lesser degree of sympathetic block and much greater cardiovascular stability than suharachnoid block there are no controlled data to support this. Apart from sympathetic block the vascular absorption of local anaesthetics may result in significant hemodynamic changes.

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.

Inclusion criteria

1. Patients willing to give written informed consent.
2. American society of Anaesthesiologists (ASA) grade 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.

Results

The mean basal heart rate (HR) was comparable between the two groups (p=0.113). Intraoperatively mean HR was lower in group B compared to group A (*p*<0.001) throughout the procedure and was statistically significant (*p*<0.001). HR was less than 60 bpm in Group B between 15 to 30th minute.

Table 1: Mean Heart Rate (bpm)

HR (bpm)	Group A		Group B		p value
	Mean	SD	Mean	SD	
Basal	78.8	7.9	75.8	7.5	0.113
5 min	83.8	9.1	73.5	14.0	0.001*
10 min	84.9	9.1	69.4	11.1	<0.001*
15 min	84.9	11.1	65.8	11.8	<0.001*
20 min	85.3	12.7	57.8	11.7	<0.001*
25 min	81.2	9.7	59.9	9.4	<0.001*
30 min	81.1	11.1	62.5	8.8	<0.001*
35 min	81.5	11.7	65.8	7.5	<0.001*
40 min	82.5	10.5	67.8	8.4	<0.001*
45 min	81.4	8.5	68.9	8.1	<0.001*
50 min	82.1	10.5	70.6	6.8	<0.001*
55 min	84.7	12.4	73.1	5.7	<0.001*
60 min	83.8	11.6	74.9	7.3	<0.001*

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

The mean of the maximum fall from the basal HR was15.9 bpm in group B, but in group A no fall was noted. p value was <0.001 and was statistically significant.

Table 2: Maximum fall in Heart Rate

Time (min)	Group A	Group B	P value
Max fall in Mean HR (bpm)	-2.3	15.9	<0.001*
Time required (min) in maximum fall	0-25	0-20	

The mean basal systolic blood pressure was comparable between the two groups (p=0.846). The Mean systolic pressure was lower in group B throughout the surgery compared to group A (*p*<0.001). It was less than 100 mmHg in group B between 15 - 40 minutes.

Table 3: Systolic Blood Pressure (mmHg)

SBP (mmHg)	Group A		Group B		p value
	Mean	SD	Mean	SD	
Basal	121.8	13.6	121.2	11.7	0.846
5 min	129.3	12.3	110.5	17.5	<0.001*
10 min	129.7	14.7	107.0	11.8	<0.001*
15 min	131.3	14.4	100.1	10.8	<0.001*
20 min	128.1	12.3	92.3	12.6	<0.001*
25 min	124.3	15.9	91.9	11.0	<0.001*
30 min	124.1	16.3	96.2	11.8	<0.001*
35 min	126.7	17.0	97.8	10.0	<0.001*
40 min	127.3	18.6	100.1	10.1	<0.001*
45 min	129.2	17.0	102.0	9.0	<0.001*
50 min	128.7	17.5	105.8	9.8	<0.001*
55 min	129.0	14.9	108.5	10.7	<0.001*
60 min	129.4	16.9	111.2	9.3	<0.001*

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

The mean of the maximum fall from the basal SBP was 25 mmHg in group B, but in group A no fall was noted. P value was <0.001 and was statistically significant.

ISSN:0975 -3583,0976-2833 VOL 15, ISSUE 02, 2024

Table 4: Maximum fall in Systolic BP

Time (min)	Group A	Group B	P value
Max fall in Mean SBP (mmHg)	-2.3	25.0	<0.001*
Time required (min) in max fall	0-25	0-25	

The mean basal diastolic blood pressure was comparable between the two groups (p=0.238). Mean diastolic pressure was lower in group B compared to group A (*p*<0.001) throughout the procedure. It was less than 65 mmHg in group B between 15-40 minutes.

Table 5: Diastolic Blood Pressure (mmHg)

DBP	Group A		Group B		p value
	Mean	SD	Mean	SD	
Basal	75.5	7.9	73.3	6.5	0.238
5 min	80.6	9.5	67.9	9.6	<0.001*
10 min	78.7	10.5	67.1	9.2	<0.001*
15 min	80.5	9.5	62.6	10.8	<0.001*
20 min	78.2	7.9	57.0	11.0	<0.001*
25 min	76.8	9.8	60.2	11.2	<0.001*
30 min	77.2	10.1	61.7	8.6	<0.001*
35 min	78.8	8.8	63.8	7.8	<0.001*
40 min	79.3	10.8	65.3	8.0	<0.001*
45 min	80.3	11.7	67.5	8.8	<0.001*
50 min	80.1	11.1	68.4	9.3	<0.001*
55 min	80.4	9.2	69.0	8.6	<0.001*
60 min	79.9	7.9	70.8	9.7	<0.001*

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

The mean of the maximum fall from the basal DBP was 16.4 mmHg in group B, but in group A no fall was noted. p value was <0.001 and was statistically significant.

Table 6: Maximum fall in Diastolic BP (mmHg)

Time (min)	Group A	Group B	P value
Max fall in Mean DBP (mmhg)	-1.3	16.4	<0.001*
Time required(min) in max fall	0-20	0-15	

The basal mean arterial blood pressure was comparable between the two groups (p=0.329). MAP was lower in group B throughout surgery compared to group A (*p*<0.001). It was less than 75mmHg in group B between 20-35 minutes.

Table 7: Mean Arterial Pressure (mm Hg)

MAP (mmHg)	Group A		Group B		p value
	Mean	SD	Mean	SD	
Basal	91.4	10.0	89.3	7.3	0.329
5 min	96.8	9.7	82.2	12.2	<0.001*
10 min	95.8	11.0	80.0	9.2	<0.001*
15 min	97.5	10.2	75.5	10.6	<0.001*
20 min	95.2	8.4	68.5	11.3	<0.001*
25 min	92.9	11.0	70.8	10.3	<0.001*
30 min	93.4	12.1	73.0	8.7	<0.001*
35 min	94.8	10.7	75.1	8.0	<0.001*
40 min	95.4	12.7	76.4	6.8	<0.001*
45 min	96.5	13.0	79.0	7.7	<0.001*
50 min	96.1	12.2	80.8	8.6	<0.001*
55 min	96.5	10.4	82.4	9.0	<0.001*
60 min	96.4	10.5	84.2	9.5	<0.001*

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

The mean of the maximum fall from the basal MAP was 20.4 mmHg in group B, but in group A no fall was noted. p value was <0.001 and was statistically significant.

Table 8: Maximum fall in MAP

Time (min)	Group A	Group B	P value
Max fall in Mean MAP (mmHg)	-1.5	20.4	<0.001*
Time required (min) in max fall	0-20	0-15	

ISSN:0975 -3583,0976-2833 VOL 15, ISSUE 02, 2024

Discussion

In our series, in group B during first 30 minutes, there were many instances of hypotension (72.7%), bradycardia (75.8%), needing even vasopresssors (91.6%) and anticholinergics (72%). Patients in group A were remarkably stable with neither bradycardia nor hypotension, throughout both phases of initial spinal or subsequent epidural increments. This infact is the main plank namely, haemodynamic stability which makes sequential CSEA attractive, safe and dependable.

Bhattacharya *et al*. (2006) [7] reported incidence of 10% bradycardia, 10% hypotension after spinal component of CSEA and 3% hypotension after epidural top- up. They found that in single shot spinal group, 70% bradycardia and 80% hypotension occured which required vasopressors. Vengamamba Tummala *et al*. (2015) [8] observed 6.67% bradycardia and hypotension in CSEA group while 66.67% hypotension and 30% bradycardia in spinal group. Desai *et al*. (2017) [9] observed that in CSEA group none of the patients developed hypotension initially, but 1.34% developed hypotension after epidural drug while in single shot spinal group 56% developed hypotension and 13.4% developed bradycardia. No bradycardia was seen in CSE group.

In our series, in group B there were many cases of nausea (66.7%) and vomiting (51.5%) needing antiemetics while in group A 6.1% had vomiting.

Priya *et al*. (2002) [10] noted 5% incidence of nausea and vomiting in CSEA group and none in epidural group. Bhattacharya *et al*. (2006) [7] observed 6.67% incidence of nausea and vomiting in both spinal and CSEA group. Tyagi *et al*. (2011) [11] noted 14% to 43% incidence of nausea and vomiting in CSEA. Karim *et al*. (2020) [12] reported 20.5% incidence of nausea in CSEA group.

Conclusion

There was no fall in HR, SBP and DBP in group A. The mean of maximum fall in HR (bpm) in Group B was 15.9 +/- 10.6. The mean of the maximum fall (mm Hg) in SBP and DBP in group B was 25 +/- 15.65 and 16.4 +/- 9.73 respecively. All these values were statistically significant.

References

1. Atkinson RS. Spinal analgesia - intradural and extradural. In: Rushman GB and Lee JA, edts. Lees Synopsis of Anaesthesia, 10th ed. Bombay: K.M. Varghese Company; c1987. p. 662-720.
2. Cousine MJ. Epidural Neuraxial blockade. In: Cousins MJ, Veering BT, edts. Text book of Neural blockade in clinical anaesthesia and management of pain, 3rd ed. Philadelphia: Lippincott - Raven; c1998. p. 243-322.
3. Holmstrom B, Laugaland K, Rawal N, Hallberg S. Combined spinal epidural block versus spinal and epidural block for orthopaedic surgery. Can. J Anaesthesia.1993;40(7):601-606.
4. Felsby S. Juelsgaard P. Combined spinal and epidural anaesthesia. Anaesth Analg. 1995 Apr;80(4):821-826.
5. Collins VJ. Spinal Analgesia - Physiologic effects. In: Collins, edts. Principles of Anaesthesia - General and Regional Anaesthesia, 3rd ed. Philadelphia: Lea & Febiger; c1993. p. 1498-1520.
6. Ganong WF. Circulation through special regions. In: Barrett KE, Barman SM, Boitano S, Brooks HL edts. Review of Medical Physiology, 23rd ed. Boston: McGraw Hill; c2010. p. 569-585.
7. Ng K, Parsons J, Cyna AM, Middleton P. Spinal versus epidural anaesthesia for caesarean section. Cochrane Database Syst Rev, 2004, 2.
8. Tummala V, Rao LN, Vallury MK, Sanapala A. A comparative study-efficacy and safety of combined spinal epidural anesthesia versus spinal anesthesia in high-risk geriatric patients for surgeries around the hip joint. Anesth Essays Res. 2015 May-Aug;9(2):185-188.
9. Desai K, Patel D. The clinical effects of combined spinal-epidural anaesthesia versus spinal anaesthesia in patients undergoing major orthopaedic surgery. Ind. Journal of Applied Research June; c2017 Jun. p. 195-197.
10. Gupta P, Dua CK, Verma UC, Saxena KN, Chakraborty I. Sequential combined spinal epidural versus epidural anaesthesia in orthopaedics and gynaecological surgery: A comparative evaluation. Ind. J Anaesthesia. 2002;46(6):453-456.
11. Tyagi A, Kumar A, Girotra G, Sethi AK. Combined spinal epidural and epidural volume extension: Interaction of patient position and hyperbaric Bupivacaine. J Anaesthesiol. Clin. Pharmacol. 2011 Oct;27(4):459-464.
12. Karim YK, Hakim. Comparative study between sequential combined spinal epidural anesthesia versus epidural volume extension in lower limb surgery: Ain-Shams Journal of Anesthesiology. 2020;12:4