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Original Research Article

Hemodynamic Stability and Clinical Outcomes: A Comparative Study of Sequential Combined Spinal-Epidural versus Spinal Anesthesia in Lower Limb Surgery

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Abstract:

Background and Objectives: A common anesthetic method for lower limb procedures is spinal anesthesia. When haemodynamic changes do occur, they can be abrupt and harmful, especially in older people. Furthermore, spinal anesthesia has a finite duration. As a result, sequential combined spinal epidural (SCSE) anesthesia is becoming a safer method. The method combines the advantages of the two. To assess how the use of spinal anesthesia and SCSE block affects hemodynamic parameters during lower limb procedures.

Methods: The study was conducted on 60 patients in the department of anesthesia from June 2022 to June 2023. A computer-generated number was used to randomly assign the patients to two groups of thirty each; the observations were made by an anesthetist who was not associated with the research. The study included ASA Grade I and II patients (male or female, 18–60 years old) who had posted for lower limb surgery with a maximum 2-hour surgical length.

Results: 1 in group I, the number of patients who achieved T6 were 53% and in group II it was 20%, ($p<0.05$) was statistically significant. In group I the number of patients which achieved T8 were 27% and in group II it was 30%, ($p>0.05$). In group I, five patients had vomiting as against one patient in group II had vomiting $p>0.05$. The incidence of bradycardia and hypotension in either group was comparable.

Conclusion: Sequential combined spinal epidural block maintains hemodynamic stability with minimal complications as compared to spinal anaesthesia.

Keywords: pre-anaesthetic examination, Sequential spinal epidural, Spinal, Haemodynamics, Side effects.

Introduction

The majority of orthopaedic patients are older adults who may have comorbid conditions. Given its unique benefits, regional anesthesia can be deemed safe and advantageous in this situation. Hypotension, headaches from postdural puncture, and a short period of anesthesia are among the drawbacks of spinal. [1,2] With the help of an epidural catheter, epidural anesthesia allows for longer postoperative analgesia and block flexibility without significantly altering hemodynamic parameters. The combined spinal epidural approach was initially described by "Soresi." [3]

Painfully painting the barrier from both sides is what combined spinal epidural anesthesia is like. A comparatively tiny dose of the spinal local anesthetic and the epidural medication cause the block in SCSE. [4]

In SCSE, a low dosage of spinal medication—meant to be insufficient for surgery—is administered to try to lower hypotension. The block is then purposefully prolonged cephalad using an epidural medication. Patients with impaired cardiopulmonary reserve and older high-risk patients are finding great success with this method. [5]

Epidural volume extension (EVE) can be accomplished by injecting saline or a local anesthetic drug into the epidural region. It has been demonstrated that EVE increases the upward distribution of the block because of the "volume effect." [6]

In order to examine the hemodynamic changes resulting from lower limb procedures, this study will compare the sequential combined spinal epidural method with spinal anesthesia.

Materials and Methods

The study was conducted on 60 patients in the department of anesthesia from June 2022 to June

2023. A computer-generated number was used to randomly assign the patients to two groups of thirty each; the observations were made by an anesthetist who was not associated with the research. The study included ASA Grade I and II patients (male or female, 18–60 years old) who had posted for lower limb surgery with a maximum 2-hour surgical length.

Group I: Patients were given 15 mg (3 ml) of 0.5% hyperbaric bupivacaine to induce spinal anesthesia at the L3–4 intervertebral region.

Group II: Patients underwent SCSE anesthesia with 6 cc of 0.5% bupivacaine administered via an epidural catheter and 7.5 mg of 0.5% hyperbaric bupivacaine administered in the subarachnoid space.

Methodology: One day prior to surgery, a thorough pre-anaesthetic examination was performed. Every patient had routine blood work and radiological examinations completed. All patients gave their written, informed consent to be part of the study and to have general anesthesia.

All patients were given tablets containing 150 mg of ranitidine and 25 mg of alprazolam the night before surgery, and again the day of the procedure. Following the patient's admission to the operating room, the preoperative oxygen saturation (SpO2), blood pressure (BP), and pulse rate (PR) were recorded using a multipara monitor. The anesthesia workstation, along with all required medications and supplies, were always prepared. An 18 G cannula was used to get an intravenous (IV) access. The patient was preloaded with an IV ringer lactate infusion (10 ml/kg body weight) 20 minutes prior to operation. Patients were assigned at random, using a computer-generated number, to one of the groups.

Group I: The L3–4 intervertebral space was treated with a subarachnoid block under all aseptic conditions. Following verification of unobstructed cerebrospinal fluid (CSF) flow, 3 milliliters of 0.5% hyperbaric bupivacaine were administered.

Group II: Using every aseptic technique in the sitting position, SCSE anesthesia was administered at the L3–4 intervertebral spaces. Immediately following the supine position, patients got 1.5 ml of 0.5% hyperbaric bupivacaine via spinal channel and 6 ml of 0.5% bupivacaine by epidural catheter.

Vital signs, the degree of sensory blocking, any problems, and any adverse effects were noted. We monitored and recorded HR, SBP, DBP, mean blood pressure, and SpO2.

Problems during surgery like falling blood pressure, heart rate, nausea, vomiting, respiratory depression, high spinal block, chest pain, sedation, and dry mouth were all noted and addressed.

Statistical Analysis: The data was presented using percentages and numbers. The mean and SD were used to generate quantitative data. Chi square test and data analysis were performed using SPSS version 24 (statistical software for social science). The results were subjected to a qualitative T test, and a p-value of less than 0.05 was deemed statistically significant between the two groups.

Results

Table 1: Distribution according to Maximum sensory levels achieved

Maximum Sensory Level achieved	Group I		Group-II		Total	p-value
T_6	15	53%	7	20%	22	0.01
T_8	9	27%	8	30%	17	0.74
T_{10}	6	20%	15	50%	21	0.01

As per table 1 in group I, the number of patients who achieved T6 were 53% and in group II it was 20%, ($p<0.05$) was statistically significant. In group I the number of patients which achieved T8 were 27% and in group II it was 30%, ($p>0.05$). In group I the number of patients with T10 was 20% and 50% in group II and it was statistically significant ($p<0.05$).

Table 2: Distribution as per pulse rate changes

Pulse rate	Group I		Group II		p-value
	Mean	± SD	Mean	± SD	
Pulse_0 min	82.50	5.60	82.13	4.27	0.72
Pulse_2min	84.10	5.74	80.40	4.01	0.01
Pulse_4min	85.77	6.12	81.17	3.74	0.01
Pulse_6min	85.97	5.84	82.33	3.75	0.01
Pulse_8 min	87.60	5.83	84.10	2.84	0.01
Pulse_10 min	87.70	7.34	83.33	2.70	0.01
Pulse_15 min	86.77	7.71	83.00	2.75	0.01
Pulse_20 min	86.23	6.71	83.67	2.02	0.05
Pulse_25 min	85.97	9.13	84.83	2.38	0.51

Pulse_30 min	83.80	5.67	85.23	3.04	0.22
Pulse_45 min	85.90	6.62	85.20	3.02	0.60
Pulse_60 min	85.13	6.21	84.77	2.67	0.76
Pulse_75 min	86.17	9.22	85.23	1.59	0.58
Pulse_90 min	87.23	7.25	85.40	2.19	0.19
Pulse_105 min	87.17	7.65	84.90	2.62	0.13
Pulse_120 min	87.67	6.70	85.13	2.11	0.05

As per table 2 the baseline mean pulse in group I was 82.50±5.60 beats / min (bpm) and in group II was 82.13±4.27 bpm.($p>0.05$) During intraoperative period in group I it was from 83.80±5.67 to 87.70±7.3 (bpm) and in group II it was from 80.40±4.01 bpm to 85.40±2.19 bpm. From 2 minutes to 20 minutes, there was rise in pulse rate in group I. ($p<0.05$).

Table 3: Distribution of Mean Blood Pressure in both groups

MBP	Group I		Group II		p-value
	Mean	SD	Mean	SD	
MBP_0 min	92.50	4.89	95.11	5.57	0.06
MBP_2 min	78.39	2.61	85.22	3.81	0.0
MBP_4 min	77.70	2.33	85.59	3.37	0.0
MBP_6 min	78.32	2.36	86.84	3.38	0.0
MBP_8 min	78.51	2.10	88.16	3.47	0.0
MBP_10 min	79.86	2.89	90.68	3.70	0.0
MBP_15 min	80.97	2.43	91.98	3.86	0.0
MBP_20 min	84.74	4.82	93.33	3.92	0.0
MBP_25 min	88.29	5.44	94.32	4.75	0.0
MBP_30 min	91.67	4.68	96.52	3.31	0.0
MBP_45 min	94.17	4.60	98.41	3.42	0.0
MBP_60 min	96.54	4.73	99.97	3.30	0.02
MBP_75 min	98.12	3.89	98.64	3.33	0.57
MBP_90 min	99.28	3.51	100.06	3.30	0.38
MBP_105 min	99.42	3.75	100.69	2.31	0.12
MBP_120min	99.69	4.56	100.72	2.47	0.26

As shown in table 3, the baseline mean blood pressure was 92.50±4.89 mmHg in group I and 95.11±5.57 mmHg for group II. Intraoperatively it was between 77.70±2.33mmHg and 99.69±4.56mm Hg in group I and in group II it was 85.22±3.81mmHg and 100.72±2.47mmHg. From 2 min to 60 min there was decrease in MBP in group I in comparison to group II.
($p<0.05$) After 60 min both the groups were comparable.

Table 4: Post-Operative Complications

Complications	Group-I		Group-II		Total	p-value
Nausea	0	0.0%	0	0.0%	0	-
Vomiting	5	13.3%	1	3.3%	6	0.17
Bradycardia	1	6.7%	1	3.3%	2	0.55
Hypotension	1	3.3%	1	3.3%	2	0.21
Headache	1	3.3%	1	3.3%	2	0.31

As per table 4, in group I and II, none of the patients had nausea. In group I, five patients had vomiting as against one patient in group II had vomiting $p>0.05$. The incidence of bradycardia and hypotension in either group was comparable. In group I and group II, one patient (3.3%) had headache $p>0.05$(not significant).

Discussion

The sequential mixed spinal epidural procedure is a recently developed concept that is currently in style. In this procedure, the intrathecal area is injected with a modest dose of local anesthetic agent to minimize the risk of hypotension and induce an early onset of anesthesia. The block is then purposefully extended cephalad with the epidural drug. The method is becoming more and more common in contemporary obstetrics due to a number of stated advantages, the primary one being stable hemodynamic status. With good results, the sequential CSEA is already being employed for orthopaedic surgery in older high-risk patients. [7] The SCSE technique extends the length of spinal cord stimulation by combining the unique advantages of both

continuous epidural block flexibility and fast, dense, and dependable spinal block.

The number of patients who attained the T6 and T10 levels in our study was statistically significant. ($p<0.05$) Patients in both groups who attained T8 were similar. Bhattacharya et al.'s study (2010) [7] contrasted the spinal anesthesia approach with SCEA. According to his observations, the highest level of sensory block in this study was T10 in the SCSE group and T6 in the spinal group, with a range in the SCEA group from T6 to S5, and in the spinal group from T4 to S5. This observation aligned with the current research.

The highest height attained in CSE with EVE in Okasha's study [8] was T1 in 20% of cases and below T2 in 80% of cases, whereas it was below T2 in all patients in the CSE without EVE group (p value <0.02). This observation conflicts with the findings of our investigation. The mechanism for this may be related to the higher volume of saline injected into the epidural space, which causes the intrathecal medication to be pushed cephalad by the quick increase in epidural pressure caused by thecal compression. There was a significant difference (p value<0.05) between groups I and II in the decline of systolic blood pressure from 2 to 60 minutes. After an hour, both groups were similar. Group II's hemodynamic stability was thus better preserved. According to a research by Rajan S. et al [3], 10% of SCSE patients experienced hypotension, compared to 80% of spinal patients. Hemodynamic parameters are thus preserved in SCSE. The observation made sense in light of our research.

The research that Vengamamba Tummala [9] carried out with 30 people in each group, the incidence of hypotension was 20/30 in the spinal and 2/30 in the CSE. The observation made sense in light of our research. At 0 minutes, both groups were similar to what we saw. Between the ages of 2 and 60 minutes, group I's mean blood pressure decreased more than group II's ($p<0.05$).

Bhattacharya et al7 study from 2010 showed that the incidence of hypotension was three in SCSE and 24 in spinal, indicating that the hemodynamic parameters were better preserved in SCSE. The observation made sense in light of our research.

In a comparative analysis, Gupta Priya et al [10]. (2013) found that sequential spinal epidural block resulted in a lower incidence of nausea and vomiting than epidural anesthesia in orthopedic and gynecological surgery. Hemodynamic parameters are maintained in CSE because, according to Mutahar et al, [11] the incidence of hypotension was three in SCSE and 24 in spinal. The observation matched the findings of our investigation.

Conclusion

Modest amount of blocking is provided by the SCSE block. In lower extremity procedures, the lower amount of block may be helpful to prevent hemodynamic instability from sympathetic blockade, especially in patients who are already impaired. There aren't many problems with the technique. SCSE is a method that is both safe and efficient. SCSE combines the flexibility of an epidural block with the quickness, density, and dependability of a subarachnoid block. Regional anesthesia seems to have a bright future for SCSE.

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