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# COMPARATIVE STUDY OF SEQUENTIAL COMBINED SPINAL EPIDURAL ANAESTHESIA VERSUS SPINAL ANAESTHESIA IN HIGH RISK GERIATRIC PATIENTS FOR MAJOR ORTHOPAEDIC SURGERY

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**Abstract**

Sequential combined spinal epidural anaesthesia (Sequential CSEA) is probably the greatest advance in central neuraxial block in this decade for high risk geriatric patients because here the advantages of both spinal and epidural anaesthesia are summated avoiding the side effects. This study is designed to compare the clinical effects of sequential combined spinal epidural anaesthesia versus spinal anaesthesia in high risk geriatric patients undergoing major orthopaedic procedure.

Sixty patients aged 65 to 80 years, ASA III were randomly allocated into two equal groups. Group A (n=30) received sequential combined spinal epidural anaesthesia with 1 ml (5 mg) of 0.5% hyperbaric bupivacaine with 20 mg fentanyl through spinal route, and the expected incompleteness of spinal block was managed with small incremental dose of 0.5% isobaric bupivacaine through epidural catheter, 1.5 to 2 ml for every unblocked segment to achieve $T_{10}$ sensory level. Group B (n=30) received spinal anaesthesia with 2 ml (10 mg) of 0.5% hyperbaric bupivacaine and 20 mg of fentanyl.

Both the groups showed rapid onset, excellent analgesia and good quality motor block.

Group A showed a significantly less incidence of hypotension ($p< 0.01$) along with the provision of prolonging analgesia as compared to group B.

So sequential combined spinal epidural anaesthesia is a safe, effective, reliable technique with stable haemodynamic along with provision of prolonging analgesia compared to spinal anaesthesia for high risk geriatric patients undergoing major orthopaedic surgery.

**Keywords:** Sequential combined spinal epidural anaesthesia, Spinal anaesthesia, Fentanyl, Geriatric

## Introduction

Spinal anaesthesia is widely Practice in orthopaedic surgery. Combined spinal epidural, single segment, needle though needle technique is gaining popularity in modern anaesthesia practice. [1,2] It offers rapid onset, efficacy and safety with minimal chances of toxic effects combined with potential for improving an inadequate block and prolonging duration of analgesia Intraoperatively and post operatively.[3] This technique reduces or eliminates some of the disadvantages of spinal anaesthesia while preserving their advantages.[3] Geriatric patients undergoing major surgery have a significantly higher incidence of morbidity and morality compared with younger age group because of their reduced cardio respiratory reserve and concomitant diseases.[4] An association can be made between American Society of Anaesthesiologist (ASA) classification and morbidity.[5] White et al noted that patients with hip fractures and ASA I and II were no more risk for mortality than age and sex adjusted controls (8% death per year).6 However those of ASA III status had mortality rates of 49% or 6.3 times that of their controls.[6]

However no correlation between the outcome for geriatric patients and various anaesthetic techniques have been found.[7,8]

A more improved method called the modified combined spinal epidural technique or the sequential combined spinal-epidural technique, in which a spinal dose intended to be inadequate for surgery is used in an attempt to reduce hypotension and the block is then deliberately extended cephalad with the epidural drug.[9,10] This technique is becoming increasingly popular in modern obstetric practice, because of various claimed benefits [9] – mainly stable haemodynamic status. The sequential CSEA is now being used in elderly high risk patients for orthopaedic surgery with encouraging results.[10]

This study was done to compare the clinical effects of sequential CSEA versus spinal anaesthesia in elderly high risk patients undergoing major orthopaedic surgery.

## Methods

After obtaining approval from the institutional ethical committee and informed written consent from the patient,

sixty patients, aged 65 to 80 years of both sexes, ASA III were randomly allocated into two equal groups.

The chosen sample size for the study was determined, based on a study conducted earlier in the same institute. Number needed for the study was calculated using the results of the pilot study about the difference between the two groups regarding clinical effects and the well accepted power of 80% and value of 0.05.

ASA I and II patients and any patients with absolute contraindication for regional anaesthesia were excluded from the study. All patients received premedication with alprazolam 0.5 mg at 9 PM before the day of operation and at 6 AM on the day of operation. All patients had standard monitoring like ECG, NIBP, pulse oximeter and invasive monitoring such as CVP if specific indication was present. Intravenous line with 18 g Jelco was secured and a preload of 500 ml Ringer's lactate was given to every patient before start of operation. The patients were supported in sitting posture on a horizontal table, by an assistant. The lumbar area was prepared aseptically and draped. The inter vertebral space at L3-4 and L2-3 was identified. The prick point was infiltrated with 2 ml of 2% lignocaine. Group A (n=30) received sequential combined spinal epidural anaesthesia with 1 ml (5 mg) of 0.5% hyperbaric bupivacaine and 20 mg fentanyl through 26G Whitacre spinal needle which was introduced through a 16G Tuohy needle (combined spinal epidural needle) (portex) in the epidural space. Identification of epidural space was done by using air, for loss of resistance technique. The dose of spinal hyperbaric bupivacaine was intentionally kept small because the aim was to produce a block restricted to T10 spinal segment. The spinal needle was withdrawn after injection of drug into CSF, 16G epidural catheter (Portex) was inserted and secured. The patient kept sitting for five minutes and then placed in supine portion. Group B (n=30) received spinal anaesthesia with 2 ml (10 mg) of 0.5% hyperbaric bupivacaine and 20 mg fentanyl through 26 G Whitacre spinal needle through a 21G introducer in sitting position. They were also kept sitting for five minutes and was then made supine for surgery. Sensory block was assessed after 10 minutes by pin prick method. In group A, 1.5-2 ml of 0.5% isobaric bupivacaine was given for every unblocked segment through epidural route to extend block to T10. In group B if after 10 to 15 minutes the block did not reach to T10 sensory level supplementation with general anaesthesia was given.

Motor block of lower limbs was assessed bilaterally using Bromage Scale (grade I inability to move feet, II able to move feet only, III just able to move knees, IV full flexion of knee and feet). The following variables were recorded

Onset and level of sensory block.

Total dose of epidural bupivacaine required to establish desired level of block and to prolong block.

Supplementation with general anaesthesia.

Degree of motor block.

Assessment of quality of block by patients.

Assessment by surgeon.

Duration of analgesia.

Haemodynamic variables such as systolic arterial blood pressure and heart rate were monitored before administering anaesthesia and throughout the intraoperative period. If systolic blood pressure was less than 90 mm of Hg small incremental dose of ephedrine hydrochloride 5 mg IV was administered. Bradycardia, which was defined as heart rate < 60 / min was treated with 0.6 to 1.2 mg atropine intravenously. Sedation was provided to all patients intraoperatively with intravenous injection of midazolam 1 to 3 mg IV in titrated dose. All patients received 3l/ minute of oxygen through a disposable face mask intraoperatively. In group A, to prolong anaesthesia, all patients received 1st epidural top up with 5 ml of 0.5% isobaric bupivacaine one and half to two hours after start of surgery Any intraoperative and postoperative side effects (in the form of nausea, vomiting, retching, rigor) during first 24 hours were recorded. Blood loss more than 15% was managed with transfusion of properly groped and cross matched blood at the end of surgery in both the groups. After operation all the patients were sent to post anaesthesia care unit (PACU). Patients in Group A received 0.125% of 8 to 10 ml bupivacaine through epidural catheter and group B received parenteral opioids on demand. Our study ends at this point. Statistical analysis was done. Students 't' test and Chi-square tests were used where applicable, $p<0.05$ was considered to be significant.

**Results**

Table I showed the demographic profile of the patients in two groups. Both the groups were comparable according to age, sex, body weight, height, type of surgery, duration of surgery and type of patients according to ASA status. Table II showed neural block assessments between the two groups. The highest level of block was T10 (median) with a range from T6 to S5 in group A where as the highest level of block in group B was T6 (median) with a range from T4 to S5, $p < 0.05$. All patients achieved maximum degree of motor block Bromage scale I in both the groups. Onset of sensory block was rapid in both the cases but duration was prolonged in group A (Sequential CSEA) by the epidural drug, whereas, this facility could not be obtained in group B (spinal) anaesthesia.

**Table 1:** Demographic data.

| | Group A n=30 Sequential CSEA | Group B n=30 spinal block |
|---|---|---|
| Age (yrs) | 70.2 ±?2.5 | 71±1.89 |
| Sex (M : F) | 15 / 15 | 16 /14 |
| Weight (kg) | 55.3 ± 2.1 | 54.2 ± ?2.5 |
| Height (cm) | 154.2 ± ?9.6 | 155 ± ?6.8 |
| Type of surgery : | | |
| 1. Dynamic hip screw for fracture shaft femur with iliac crest bone graft. | 10 | 10 |
| 2. Dynamic compression screw for fracture shaft femur with iliac crest bone graft. | 10 | 10 |
| 3. Hip arthroplasty | 10 | 10 |
| Duration of surgery (mins) | 150±10 | 150± 5.5 |
| Type of ASA III patients | | |
| 1. Patients with COPD with previous h/o hospitalization once / twice for acute episode, now symptom free with grade II exercise limitations, on bronchodilator & steroid nebulization, antibiotic and incentive spirometry. | 15 | 12 |
| 2. Patients with moderate hypertension on two antihypertensive drugs (b blocker and calcium channel blocker—with ischaemic heart disease and grade II exercise limitation,. | 10 | 10 |
| 3. Patients with insulin dependant diabetes without neuropathy with moderate hypertension and IHD | 5 | 8 |
| Mean ± SD where applicable | | |

Table 3 showed Group A had much less incidence of hypotension compared to group B, the result was highly significant, p<0.01.

Table 4 showed any intraoperative or post operative side effects in between two groups. Very few patients in group A and B suffered from post operative nausea and vomiting (PONV) and pain and were treated accordingly.

## Discussion

Several studies have shown that analgesia levels obtained after subarachnoid injection of hyperbaric local anaesthesia solution are approximately 3-4 spinal segments higher in elderly compared with young adult patients.11,12 Precipitous arterial hypotension due to high levels of sympathetic block remains a common and acute problem associated with spinal anaesthesia in geriatric patients. Despite prophylactic measures such as fluid preload and prophylactic vasopressor (ephedrine), it may be difficult to maintain a near normal blood pressure in these patients.

**Table 2:** Neural block Assessment.

| | Group A n = 30 Sequential CSEA | Group B n = 30 spinal block |
|---|---|---|
| Onset of sensory block (min) | 10.10±1.1 | 9.8±?1.0 |
| Analgesia level after 10 minutes. Median (range) | T6 – S 5 T10 | T4 – S 5 T6 |
| Total bupivacaine dose (mg) : (Mean) Initial dose<br>Top up dose(1½ — 2 hrs) after start of surgery to prolong anaesthesia | 40±5.5*<br>15 ±5.5<br>25±0.0 | 10± 0.0<br>—<br>— |
| Supplementation with general anaesthesia | — | 10%* |
| Bromage scale time to achieve Bromage I (min) | 12.9±2.1 | 11.90±1.1 |
| Assessment of analgesia by patient : Excellent<br>Good Fair Poor | 90% Excellent<br>10% good | 80 % Excellent<br>15 % Good<br>5% Fair |
| Assessment of quality of motor block by surgeon | Excellent | Excellent |
| Duration of analgesia | 260±10* | 190±10 |

* p < 0.05

**Table 3:** Incidence of hypotension and bradycardia.

| | Group A n = 30 Sequential CSEA | Group B n = 30 spinal anaesthesia |
|---|---|---|
| Number of patients developed hypotension after spinal | 3 (10%) | 24 (80%) ** |
| Number of patients developed hypotension after epidural top up | 1 (3%) | — |
| Number of patients developed bradycardia | 3 (10%) | 21 (70%) ** |
| Number of patients who required vasoconstrictor | 3 (10%) | 21 (80%) ** |
| Total dose of vasoconstrictor in mg ( mean ± SD) | 0.05 ± 0.05 | 12.5±2.0** |

* * p < 0.01

**Table 4:** Number of patients with adverse effects.

| | Group A n = 30 Sequential CSEA | Group B n = 30 spinal anaesthesia |
|---|---|---|
| Nausea | 2 | 2 |
| Vomiting | 2 | 2 |
| Shivering | 2 | 1 |

The result was not significant.

To reduce the incidence and severity of hypotension a sequential combined spinal epidural technique has been described in obstetric practice in which a spinal dose of local anaesthetic intended to be inadequate for surgery is used in an attempt to reduce hypotension. The block is then deliberately extended cephalad with the epidural drug.13 The onset of block is not delayed by this method but at the same time adequate level of sensory block is obtained.13 The sequential CSEA is particularly advantageous in high risk old orthopaedic patients where gentler onset of sympathetic block is desirable to reduce haemodynamic side effects.14

It has been a common practice now to add opioid additives to local anaesthetics to reinforce the spinal block and at the same time to reduce the dose. We have used 20 mg of fentanyl to local anaesthetic bupivacaine in both the groups with an idea that fentanyl can convert an inadequate dose of local anaesthetic to an adequate dose without prolonging recovery. These effects, well exemplified by series of studies by Ben David et al who showed that a 5 mg dose of hyperbaric spinal bupivacaine was inadequate for knee arthroplasty in 27% cases, whereas addition of 10 mg intrathecal fentanyl reduced the failure rate to zero.15 In this dose it does not produces any respiratory depression which is dose dependent and unlikely to occur in dose of 25 mg or less.16 In group B (spinal anaesthesia group) 2 ml (10 mg) of 0.5% hyperbaric bupivacaine with fentanyl produced analgesia for 2½ hrs in 90% cases but 10% required supplementation with general anaesthesia. In our study the aim of injecting hyperbaric bupivacaine in sitting position and to keep the patient in the same position for 5 minutes was to restrict the

sympathetic block (T6 to S5). In group A all patients electively received first top up one and half to two hours after start of surgery in order to prolong the duration of surgical analgesia. We found only 10% (3./30) of our patients in group A suffered hypotension and required vasopressor (ephedrine 5 mg) single dose to maintain systolic arterial blood pressure to 100 Hg, whereas in group B 80% (24/30) suffered hypotension and required vasopressor (ephedrine 5 mg) single dose, 40% of them required two incremental doses of vasopressor to maintain systolic blood pressure to desired level. Three patients in group A who developed hypotension the sensory level was T6.

As a result of advanced age the compensatory mechanisms were not as effective as in the younger age group, thus they developed hypotension even at T6 spinal level. Remaining patients were haemodynamically stable.

Both groups had complete analgesia, excellent muscle relaxation, rapid onset but provision of prolonged analgesia through epidural catheter was provided with sequential CSEA with no systemic side effects.

In our study double blinded method was not used but the difference in incidence of hypotension and bradycardia and other important variables between the groups were great (in group A the incidence of hypotension and bradycardia was 10% (each) whereas in group B it was 80% and 70% respectively, only 10% in group A required vasoconstrictor while it was 80% in group B). Therefore it was thought that the distinct differences could overcome the possible bias. The block in sequential CSEA resulted from a relatively small amount of the local anaesthetic through spinal route followed by epidural drug which help to increase the subarachnoid block to desired level which conforms to the study of Swami et al for caesarean section.17 Many considerations have been given as to how epidural top up works after a spinal anaesthesia in sequential CSEA.18

Continuing spread of initial subarachnoid block (correlated to epidural injection).

Existence of sub clinical analgesia at a higher level, which is enhanced and becomes evident by perineural transdural spread of epidural local anaesthetic.

Leakage of epidural local anaesthetic though the dural hole in subarachnoid space.

Change in epidural pressure. The pressure becomes atmospheric which may result in better spread of local anaesthetic through an effect on volume and circulation of CSF.Compression of the theca by the epidurally injected volume of local anaesthetic (or even saline) solution resulting in a 'squeezing' of CSF and more extensive spread of spinal local anaesthetic.

Combination of last two mechanisms.18

In spite of rapid extension of sequential CSEA block, very low incidence of hypotension was seen which was significantly less than spinal block Very few patients of both the groups complained of intraoperative side effects like nausea, vomiting and shivering. The result was not significant.

Continuous spinal technique may be argued to provide all advantages of CSEA. However, there is increased risk of post dural puncture headache and cauda equina syndrome.19

To conclude sequential combined spinal epidural technique is effective and safe, produces a stable haemodynamic and provision of prolonging analgesia compared to spinal anaesthesia in geriatric patients undergoing major orthopaedic surgery.

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