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# Efficacy of Unilateral Spinal Anaesthesia and Sequential Combined Spinal Epidural Anaesthesia for Surgery of Lower Limb - A Prospective and Comparative Study.

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## ABSTRACT

**Background:** Orthopaedic anaesthesia plan requires customi-zation as per patient's need for safe outcome. Sequential Combined Spinal Epidural Anaesthesia (Sequential CSEA) and Unilateral Single Shot Spinal anaesthesia (Unilateral SA), both have advantages over conventional spinal anaesthesia that they provide longer lasting block with less hypotension. Aim: To compare safety and efficacy of unilateral spinal anaesthesia with sequential combined spinal epidural anaesthesia for lower limb orthopaedic surgery. **Methods:** This prospective randomized study was conducted on sixty ASA I-III patients aged 18- 65 years undergoing lower limb orthopaedic surgeries of approximately two hours duration. Sequential CSE group received spinal with 5 mg of 0.5 hyperbaric bupivacaine followed by incremental epidural top up of 2 cc of 0.5% isobaric bupivacaine to achieve and maintain T10 level. In unilateral SA group, unilateral spinal anaesthesia was given with 10 mg of 0.5% hyperbaric bupivacaine. Haemodynamic parameter, anaesthesia readiness time and block characteristics were recorded and results were analysed using unpaired Student's t-test. **Results:** There was no failure of block, surgical anaesthesia with T10 sensory level and bromage score three motor block was achieved by all patients in both groups. Anaesthesia readiness time was less in unilateral SA ($p<0.001$) Incidences of hypotension (p-0.0059) and mean ephedrine dose were significantly less in sequential CSEA. Five patients of unilateral SA required supplementation with general anaesthesia. **Conclusion:** Thus, our study concludes that unilateral SA is a cost-effective and rapidly performed anaesthetic technique. Unilateral SA with 10 mg bupivacaine and sequential CSEA with 5 mg spinal and incremental epidural top up, both provide good quality sensory and motor block for lower limb orthopaedic surgery but sequential CSEA provides significantly more stable haemodynamics with feasibility to prolong block. Thus sequential CSEA should be preferred over unilateral SA in high risk patients especially for major lower limb orthopaedic surgeries.

***Keywords:*** Epidural Anaesthesia, Orthopaedic Surgery, Spinal Anaesthesia.

## INTRODUCTION

In modern era choice of anaesthesia for orthopaedic surgeries is neuraxialanaesthesia, spinal anaesthesia is most preffered.[1] Spinal anaesthesia can be used as sole anaesthesia, it is easily administered producing dense block, given with spinal needle with small amount of drug requirement thus being a good alternative to general anaesthesia. Spinal anaesthesia produces differential blockade. Spinal anaesthesia can cause severe hypotension as a side effect,however spinal anaesthesia can be given by two way either as a single shot unilateral spinal anaesthesia or a sequential combined spinal epidural anaesthesia(CSEA) but it has been seen that single shot unilateral spinal anaesthesia can cause dense block with prolonged analgesia with fast onset of action and with lower incidence of failure and less hyptension.[2,3] Sequential combined spinal epidural anaesthesia is advancement in regional anaesthesia, with advantages of both spinal and epidural aaesthesia with better haemodynamic stability and feseability to provide better post operative analgesia.[4] CSEA is advancement of combined spinal epidural as being used as needle through needle instead of using separate needle. The sequential CSEA is being used for high risk geriatric patient posted for orthopaedic surgeries with better result and good haemodynamic stability.[5,6]

Extensive Medline search revealed limited literature evaluation of Efficacy and Safety of Unilateral Spinal Anaesthesia with Sequential Combined Spinal Epidural Anaesthesia for Lower Limb OrthopaedicSurgery. Thus, we conducted a comparative study for evaluating the above-mentioned techniques comparison on haemodynamic stability.

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## MATERIALS AND METHODS

After approval from the Institutional Ethical Committee, the study was conducted in Department of Anaesthesia at Muzzafarnagar Medical College and Research Centre. Sample size calculation was based on previous study and the pilot study considering difference of 30% in episodes of clinically significant hypotension between the two groups,[5] With α error of 0.05 and power of study 80%, sample size came to 27 per group. We decided to study 60 patients to account for possible dropouts.

The study included 60 patients of between 18-65 years of age, of both sexes, BMI 18-24 kg/m2 with American Society of Anaesthesiologists (ASA) Grade I/II and posted for unilateral lower limb orthopaedic surgery predicted to last approximately two hours. However, patients with hypersensitivity to local anaesthetic agents or any contraindication to central neuraxial blockade and patients who were not able to get in lateral position were excluded from our study.

Randomisation was performed using chit and box method. After obtaining written informed consent, 60 patients were enrolled for the study. The patients were divided into two groups of 30 patients each.

Group S: Patient in this group received unilateral spinal anaesthesia.

Group C: Patient in this group received sequential combined spinal epidural anaesthesia.

Standard monitors (Pulse Oximeter, Non-Invasive Blood Pressure, ECG, End-Tidal Carbon-dioxide) was attached in all patients and base-line haemodynamic parameters were recorded. Intravenous access was established with 20 G cannula and patients were preloaded with Ringer lactate (500ml)before start of surgery. Nature of intervention did not allow the blinding of investigator except for noninvasive haemodynamic variables which was recorded by blinded investigator who was not a part of anaesthesia team.

In Group C sequential combined spinal epidural anaesthesia was given in sitting position under strict aseptic precautions after local infiltration with 2 cc of 2% lignocaine in L2- L3 interspace. Epidural catheter was inserted after identifying epidural space with loss of resistance technique using 18 G Tuohy needle (Portex) facing cranially. The 3 cc of 1.5% lignocaine hydrochloride and adrenaline was given through epidural catheter as a test dose to rule out intravascular or subarachnoid catheter placement. Spinal anaesthesia was given with 1 cc (5 mg) of 0.5% hyperbaric bupivacaine over 30 seconds by midline approach in L3- L4 interspace using a 25 gauge Quincke point needle (Spinocan, Braun Melsungen, Germany). Patients were then placed in supine position immediately after fixing epidural catheter in position. If the desired spinal level of T10 was not achieved after 10 minutes of subarachnoid block, then incremental epidural top up dose with isobaric 0.5% bupivacaine 2 cc for every unblocked segment was given through epidural catheter till T10 level was achieved. Intraoperative if spinal level receded to T12 level, then again incremental epidural top up with isobaric 0.5% bupivacaine was given to maintain sensory block at T10 level.

In Group S patient were placed in lateral decubitus position with the limb to be operated in the dependent position. Under strict aseptic precautions subarachnoid block was given in L3- L4 space using 25 gauge Quincke point spinal needle with (Spinocan, Braun Melsungen, Germany) with midline approach. After noting free and clear flow of CSF, needle's bevel was turned towards dependent side and 2 cc (10 mg) of 0.5% hyperbaric bupivacaine was injected over two minutes without further aspiration of CSF. Patient was kept in this lateral position for 15 minutes and then made supine. Pin prick method was used to assess sensory block on operated limb side. Dermatome level tested every five minutes till thirty minutes, then every fifteen minutes until the point of regression of sensory level reached to L3 on the operated limb. At the end of 15 minutes if sensory block failed to reach T10 level or if patient had pain due to inadequate block, it was considered as failed block and general anaesthesia was given and these patient were excluded from further statistical analysis.

We recorded various variable like anaesthesia readiness time as time from the end of injection of spinal drug to the time sensory block reached T10 level and patient anaesthesia wise ready to be handed over to surgeon for surgery.

**Table 1:Modified Bromage Scale**

| | |
|---|---|
| **0** | **Free movement of limb at hip,knee and ankle joint.** |
| 1 | Free movement of limb at knee and ankle joint. |
| 2 | Free movement limb at ankle joint. |
| 3 | No movement of limb at hip, knee and ankle joint |

Duration of motor block noted as time from the onset of grade 3 motor block to complete resolution of motor block. Time to regression of sensory block to T12 noted as time from the onset of T10 sensory block to regression of sensory level to T12. If due to regression of spinal block and inability to maintain surgical anaesthesia during surgery in any group and if general anaesthesia was supplemented intraoperative then it was noted as supplementation of general anaesthesia. Initial and total dose bupivacaine required to establish and maintain block to T10 level also noted down.

Blinded observer noted down haemodynamic variables such as systolic arterial blood pressure and heart rate before administering anaesthesia and throughout intraoperative period. Clinically significant hypotension was defined as decrease in systolic arterial pressure by 30% or more from baseline values or <90 mm Hg. It was treated with IV ephedrine 5 mg incremental boluses dosages and

the total amount of ephedrine required was noted. Clinically significant bradycardia was defined as a heart rate less than 50 beats per min and it was treated with IV atropine 0.5 mg boluses. Incidences of clinically significant hypotension and bradycardia were noted as incidence of haemodynamic adverse event.

Epidural catheter was kept in situ after surgery for pain relief. Patients were monitored in post anaesthesia care unit till they were shifted to general ward after they fulfilled PACU discharge criteria. Time to demand first rescue analgesia after completion of surgery from the onset of T10 sensory level was noted as duration of analgesia. Rescue analgesia was provided by epidural 8 cc of 0.1% bupivacaine with 1mg/Kg preservative free tramadol in sequential CSEA and with IV tramadol 1-2 mg/Kg in unilateral SA.

## RESULTS

**Table 2: Demographic data of patients,duration of surgery.**

| Variables | Group S | Group C | P-value |
|---|---|---|---|
| Age (years) Mean±SD | 48.4±9.70 | 50.5±10.18 | 0.230 |
| Height (cm) Mean±SD | 165.47±4.49 | 165±3.76 | 0.660 |
| Weight (kg) Mean±SD | 66.43±4.92 | 65.57±4.01 | 0.460 |
| Gender (M/F) N {%} | 21(70%)/9(30%) | 19(66.7%)/11(36.7%) | 0.580 |
| ASA Grade I/II/III N {%} | 14/10/6 46.7%/33.3%/20% | 14/9/7 46.7%/30%/23.3% | 0.940 |
| Duration of surgery (min) Mean ± SD | 138.5±14.57 | 140±10.75 | 0.290 |

*P<0.05 is considered statistically significant.

A total of 60 patients randomly divided into two groups of 30 each, were studied. No patient in either group had failed block. Both groups were comparable with regard to age, height, gender ratio, ASA grade physical status and duration of surgery [Table-2].

Anaesthesia readiness time was significantly longer in sequential CSEA (p-value<0.001) [Table-3].

On comparing characteristics of block, all patients in both group achieved sensory level T10 and grade 3 Bromage score in operated limb. In group S only one patient achieved T5 peak sensory level while 12 patients achieved T10 level thus median was T10 with max -min range was T5 to T10 while in group C only six patients achieved T9 level rest 24 patients achieved T10 level thus median was T10 with max -min range was T9 to T10. Thus, the peak sensory level achieved was significantly higher in group S.

**Table 3: Block characteristics and total bupivacaine consumption**

| Variables | Group S | Group C | P-value |
|---|---|---|---|
| Anaesthesia readiness time (Mean±SD)min | 20.93±1.98 | 25.13 ± 2.87 | <0.001 |
| Peak sensory level Median (Max-Min) | T10 {T5 – T10} | T10 {T9 – T10} | 0.004 |
| Degree of motor block Grade 0/1/2/3 | 0/0/0/3 | 0/0/0/3 | 1.0 |
| Time to regression of sensory block to T12 (Mean±SD) min | 143.67±13.50 | 116.33±6.29 | <0.001 |
| Duration of motor block (Mean±SD) min | 165.33±17.27 | 180.83±10.59 | <0.001 |
| Supplementation with general anaesthesia N (%) | 6(16.66%) | 0(0%) | 0.02 |
| Total bupivacaine consumption (mg) | 10.00±0.00 | 42.66±6.37 | <0.001 |

*P<0.05 is considered statistically significant.

**Table 4: Incidence of hypotension and bradycardia.**

| Variables | Group S | Group C | P-value |
|---|---|---|---|
| Number of patients developed clinically significant hypotension Number (percentage) | 9(30%) | 1(3.3%) | 0.0059 |
| Number of patients developed clinically significant bradycardia Number (percentage) | 6(20%) | 1(3.3%) | 0.040 |
| Mean ephedrine requirement (Mean±SD) mg | 1.83±3.07 | 0.17±0.91 | 0.0062 |

Regression of sensory block to T12 was faster in Group C. Duration of motor block in operated limb and duration of analgesia was longer in Group C . Total bupivacaine consumption was more in Group C . On comparing haemodynamics [Table 4] nine patients (30%) in Group S and one patients 1 (3.3%) in Group C had episode of clinically significant

hypotension (p-value=0.0059). The mean dose of ephedrine required was higher in unilateral SA (1.83±3.07) as compared to sequential CSEA (0.17±0.91 mg) (p=0.0062). One patient (3.3%) in sequential CSEA and 6 (20%) patient in unilateral SA required atropine for bradycardia (p-value=0.040).

## DISCUSSION

The outcomes from this research show that consecutive Combined Spinal Epidural Anaesthesia and unilateral Spinal Anaesthesia both delivered good quality block at tenth thoracic spinal sensory level and motor block of modified Bromage score 3 for surgery of lower limb with no disappointment. Although CSEA requires extra anesthesia inclination time but had meaningfully low circulatory adverse proceedings and less dose of ephedrine required and due to its possibility to outspread block. Various researches,[4,7,8] have compared sequential CSEA and unilateral SA with conventional spinal anaesthesia. Both, sequential CSEA as well as unilateral SA have been verified to be more effective than conventional spinal anaesthesia particularly in relation to interval of block and stability of circulatory parameters. According to the literature, continuous spinal anaesthesia is a method in which there is a fixed end point for efficacious anaesthesia. But technical exertion in introduction of spinal catheters occurs, due to the likelihood of complication like Caudal Equina syndrome and Post Dural Puncture Headache (PDPH), thus limiting the technique.[9,10] We did not find any randomized studies in the literature comparing sequential CSEA with unilateral SA for lower limb orthopaedic surgery.

The aim of giving unilateral SA is to bound dispersal of spinal block only to the operated side for unilateral lower limb interventions. It is attained by giving nominal dose of intrathecal agent so that only nerve roots supplying specific area and only the modalities that require to be anaesthetized are affected. Limited degree of sympathetic block causes low rate of cardiovascular hurdles in unilateral SA as compared to bilateral.[8,11,12] It has been advocated that one-sided dissemination of spinal anaesthesia can be tried in the lateral decubitus position with trivial doses of non-isobaric spinal anaesthetic solution, small gauge directional pencil point needles, injecting the drug slowly over long time and maintaining the lateral decubitus position for 15 to 20 minutes.[2,3] A dose of 10 mg (2 ml) hyperbaric bupivacaine 0.5% is acclaimed to deliver anaesthesia of duration roughly two to three hours for surgeries above the knee.[13,14] Thus, we used 10 mg of 0.5 % hyperbaric bupivacaine for unilateral SA for the block to last approximately two hour in our study.

Sequential CSEA practice is a significant improvement in regional blockade.[4] Sequential CSEA comprises intentional subarachnoid blockade with stumpy dose of local anaesthetic permitting high sympathetic blockade and thus reducing the probabilities of hypotension. This has also expanded popularity because of the diminutive onset time, while the catheter offers flexibility to permit the blockade to be stretched when desirable.[5,6]

As disadvantages of both these techniques is still controversial in elderly as well as in ASA grade III patients, we conducted this study.[5,10] The incidence of double segment CSE method has 100% success rate compared to single segment needle-through-needle CSE technique.[10,15] Double segment CSE technique was also used to sidestep postponement in giving supine position after injecting spinal drug if there is trouble in passing epidural catheter to acquire optimal effect of low dose spinal drug.[16-18]

Dose of ephedrine needed in unilateral SA as well as sequential CSEA was small as compared to dose of ephedrine mandatory in study by Yun MJ as level of block was upper as epidural dose was not titrated as per level.[19]

Unilateral SA is cost-effective as sequential CSEA requires extra cost of epidural set and extra drug. Possible limitation of study is that we did not do this study selectively in elderly high risk patients or selectively in major orthopaedic surgeries in elderly patients.

## CONCLUSION

Unilateral SA is a economical and hastily performed anaesthetic skill. Unilateral SA and sequential CSEA technique both deliver sufficient sensory and motor block for lower limb orthopaedic surgery but sequential CSEA provides significantly more stable haemodynamics control thus eludes general anaesthesia. Thus, sequential CSEA should be preferred over unilateral SA in high risk elderly patient for major lower limb orthopaedic surgeries.

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