RESEARCH

PARAMEDIAN EPIDURAL WITH MIDLINE SPINAL IN THE SAME INTERVERTEBRAL SPACE: AN ALTERNATIVE TECHNIQUE FOR COMBINED SPINAL & EPIDURAL ANAESTHESIA

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Abstract

Background: Combined spinal epidural anesthesia has a wide range of application in surgery, obstetrics, acute and postoperative pain management. It can reduce cardiovascular and pulmonary morbidity and mortality in high-risk patients. An attempt to resolve the controversy regarding the best CSE technique this study was undertaken where epidural catheterisation was performed by paramedian approach and subarachnoid block in midline, both at the same intervertebral space and was compared with the standard double segment technique (DST) and needle through needle technique. **Materials and Methods:** 90 patients scheduled for elective lower limb orthopedic surgery were randomly divided into three groups of 30 each. In Group I (SST), spinal and epidural anesthesia was given in midline by needle through needle technique, in Group II (SDT) standard epidural needle was used for epidural block by the paramedian route and spinal needle was used for SAB through the midline route at the same intervertebral space, in Group III (DST), epidural anesthesia was administered in the midline followed by the subarachnoid block done in the midline at the lower intervertebral space. Appreciation of dural puncture, delay in reflux of CSF and dry tap were observed while performing spinal block and while performing the epidural block, presence of fluid (blood/cerebrospinal fluid) at the tip of Tuohy's needle or epidural catheter, difficulty or failure in advancement of epidural catheter, malposition of catheter, paraesthesias during the catheter insertion were recorded. Time taken from part preparation to epidural catheter fixation was noted as t1 (technique performance time) and time taken from part preparation to achievement of analgesic level of T10 was noted as t2 (time to surgical readiness). **Result:** SDT was comparable with SST and DST in time for technique performance (12.27±1.76 min, 11.06±3.43 min, 11.48±1.86 min respectively; p=0.164), time to surgical readiness (19.05±1.78 min, 17.81±4.16 min, 17.56±2.64 min respectively; p=0.129) and incidence of technically perfect block (70%, 66.7%, 70%; respectively p=0.949). Use of the paramedian route for epidural catheterization in the SDT group decreased complications and facilitated catheter insertion. There was a significant number of cases with lack of dural puncture appreciation (SST=9, none in SDT, DST=1; p=0.001) and delayed cerebrospinal fluid reflux (SST=five, none in SDT and DST; p=0.032) while performing subarachnoid block in SST group. **Conclusion:** SDT (paramedian epidural with midline spinal at the same space) is comparable with SST and DST in time for technique performance, time to surgical readiness and incidence of technically perfect block. SDT is an acceptable alternative to the SST (NTN) and DST.

INTRODUCTION

Neuraxial blockade has a wide range of clinical applications for general surgery, obstetrics, acute postoperative pain management, and chronic pain relief. Continuous catheter-based epidural infusions of dilute local anesthetics and opioids are used for

postoperative pain relief after major surgery (e.g., thoracic, abdominal, lower limb) and obstetric labor analgesia. Evidence demonstrating epidural analgesia can reduce cardiovascular and pulmonary morbidity and mortality in high-risk patients undergoing major thoracic and abdominal surgery. Combined spinal epidural technique maintains analgesia with epidural infusion when the analgesic effect of the intrathecal dose dissipates. There is an increased risk of failure of the spinal component in combined spinal epidural anesthesia, whereas compared to epidural anesthesia, combined spinal epidural increases the risk of postdural puncture headaches so also makes the epidural test doses impractical. Combined spinal epidural produces a multi compartment block such that behaviour of the spinal block may be modified by subsequent epidural injections and epidural drugs may transfer into the CSF.[1,2,3,4,5] In needle through needle CSE techniques where subarachnoid block is performed before epidural catheterization; problems exist with interpretation of the test dose, failure of subarachnoid block, risk of metallic particle toxicity.

Various techniques and instruments have been designed and improvised upon, but controversy about the ideal combined spinal epidural still remains unresolved. The paramedian epidural catheterization has a small risk of accidental dural puncture due to no tenting of dura by the epidural catheter and promotes a straight course cephalad in the near midline due to the differential angle of the needle to the dura mater and the restricted mobility of the dura mater by the dorso-median connective tissue band.The combined influence of these two factors are greatest for the midline needle placement and catheterization.[6,7] An attempt to resolve the controversy regarding the best CSE technique, we conducted this study, wherein epidural catheterisation was performed by paramedian approach and SAB in midline, both at the same intervertebral space and was compared with the standard double segment technique(DST) and needle through needle (NTN) technique.[8]

MATERIALS AND METHODS

After getting institutional ethical committee approval and written informed consent, 90 patients of either sex and age between 15 to 65 years, of ASA grade I/II scheduled for elective lower limb orthopedic surgery were included in the study. Patients refused to take regional anesthesia, local infection, spinal deformity, raised intracranial tension, heart disease, coagulopathy, platelet count less than 50,000/ cu mm and neurological disease were excluded from the study. They were randomly divided into three groups of 30 each.

Group I –Single Segment Technique needle through needle technique) SST

Group II - Single Space Dual Needle Technique (SDT)

Group III –Double Segment Technique (DST)

All patients were preloaded with Ringer's lactate (10 ml/kg). Combined spinal epidural anesthesia was given in the sitting position in L2-3/ L3-4inter vertebral space. In Group I (SST), the spinal needle 26 G, length 117 mm was introduced through epidural needle 18 G and 2.5 ml of 0.5% hyperbaric bupivacaine was injected intrathecally in the midline. Thereafter, epidural catheter was introduced through the epidural needle. In Group II (SDT) the subarachnoid puncture was done through 26 G pencil point spinal needle, 89 mm in the midline approach and 2.5 ml of 0.5% hyperbaric bupivacaine was injected. The epidural space was located by standard epidural needle 18Gat the same intervertebral space by the paramedian route and epidural catheter was inserted. In Group III (DST), the subarachnoid block was done using 26 G pencil point spinal needle in midline and 2.5 ml of 0.5% hyperbaric bupivacaine was injected. The epidural space was identified in midline using 18 G Tuohy's needle at a higher intervertebral space followed by epidural catheterization. In all the patients, epidural catheter was inserted 4cm into the epidural space with hub of the needle pointing towards cephalad direction.

While performing SAB appreciation of dural puncture, delay in reflux of CSF (reflux after 5 sec of dural puncture) or dry tap were observed. While performing the epidural block, presence of fluid (blood/cerebrospinal fluid) at the tip of Tuohy's needle or epidural catheter, difficulty or failure in advancement of epidural catheter, malposition of catheter, paraesthesias during the catheter insertion were recorded. Time taken from part preparation to epidural catheter fixation was noted as t1 (technique performance time).Time taken from part preparation to achieve analgesia level to T10 was noted as t2(time to surgical readiness).Number of technically perfect block was calculated in each group i.e. localization of epidural space in first attempt, subarachnoid tap in first attempt and uneventful catheter insertion in the first attempt. Surgery was allowed to start after achieving T10 sensory block. Hemodynamic and respiratory parameters, level of analgesia to pin prick were monitored every 5 min for the first 20 min followed by every 10 min thereafter. Fall in blood pressure more than 20% from baseline value or systolic blood pressure less than 90 mm of Hg was treated with intravenous fluids and vasopressors. On wearing of motor blockade epidural test dose was given with 3 ml of 2% lignocaine with adrenaline (1:200000) after negative aspiration. Epidural top ups were given using increments of 4 ml of 0.5% bupivacaine during intraoperative period and 4 ml of 0.25% bupivacaine with 10 µgm/ml of buprenorphine in the post-operative period. Failure to achieve T10 analgesic level after spinal anesthesia was defined as failure of spinal component of CSE. When analgesia

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could not be extended after spinal anesthesia by epidural top up it was defined as failure of epidural component. Heart rate, systolic BP, diastolic BP, MAP, respiratory rate and post operatively headache, backache, nausea, vomiting were recorded.

RESULTS

The mean age, sex distribution, mean height and weight were comparable in all the three groups. [Table 1]

The technique performance time, mean t1 in three groups are comparable (p value = 0.164) and the time to surgical readiness, mean t2 in three groups are comparable (p value= 0.129) as per one way annova test.[Table 2]

Appreciation of dural puncture was present in 70% patients in group I, 100% in group II and 96.7% in group III which was statistically significant (p value = 0.001). Reflux of CSF within 5 seconds was present in 83.3% in group I, 30% in group II and 30% in group III which was statistically significant (p value = 0.032). The number of attempts for spinal among three groups were statistically insignificant (p value = 0.949).[Table 3]

The mean heart rate was stable throughout the intra operative period in all the three groups and the difference in heart rate was not statistically significant. [Table 5]

The mean MAP was stable throughout the intra operative period in all the three groups and was not statistically significant.[Table 6]

The respiratory rate was stable throughout the intra operative period and difference in respiratory rate between the three groups were not statistically significant.[Table 7]

Table 1: Demographic data

Parameters	Group I	Group II	Group III	P value
Age (Years)	36.80±15.95	38.17±15.40	37.47±12.89	0.937
Sex (Male)	19 (63.3%)	20 (66.7%)	19 63.3%)	0.953
Female	11 (36.7%)	10 (33.7%)	11 (36.7%)	
Height (cm)	160.40±9.12	161.60±11.32	164.23±7.73	0.284
Weight (Kg)	61.40±11.12	64.63±9.33	64.00±9.17	0.412

Table 2: Mean t1 and t2 distribution among the groups

Time	Group I	Group II	Group III	P Value
t1mins(mean±SD)	11.06±3.43	12.27±1.76	11.48±1.86	0.164
t2mins(mean±SD)	17.81±4.16	19.05±1.78	17.56±2.64	0.129

Table 3: Comparison of the spinal component among the groups

Spinal Component		Group I	Group II	Group III	P Value
Appreciation of Dural puncture	Present	21 (70%)	30 (100%)	29 (96.7%)	0.001
	Absent	9 (30%)	0	1 (3.3%)	
Reflux of CSF within 5 seconds	Present	25(83.3%)	30 (100%)	30 (100%)	0.032
	Absent	5 (16.7%)	0	0	
No of attempts for Spinal	Single attempt	20 (66.7%)	21 (70%)	21 (70%)	0.949
	Multiple attempt	10 (33.3%)	9 (30%)	9 (30%)	

Table 4: Technical aspects of Epidural Block

Technical aspect	Group I (n=30)	Group II (n=30)	Group III (n=30)
Blood present at tip of tuohy's needle	1 (3.33%)	0	1 (3.33%)
Dural tap by epidural Needle	1 (3.33%)	1 (3.33%)	0
Fluid present at tip of tuohy's needle before epidural catheter Placement	1 (3.33%)	0	0
Difficulty in advancing Catheter	3 (10%)	0	1 (3.33%)
Paresthesia while advancing catheter	5 (16.7%)	3 (10%)	4 (13.3%)
Presence of blood at tip of epidural catheter	9 (30%)	3 (10%)	4 (13.3%)
Need for resisting of Catheter	0	0	0

Table 5: Change in Heart Rate among the Groups

Heart Rate									
Group	**Baseline**	**5 min**	**10 min**	**15 min**	**20 min**	**30 min**	**60 min**	**90 min**	**120 min**
Group I	75.7± 5.2	65.2± 5.8	69.2±7.3	71.6±5.5	72.9±5.6	75.7±5.2	75.5±9.1	81.4±6.1	80.2±5.4
Group II	74.0± 10.0	65.7± 8.7	69.2± 9.3	70.8± 9.9	72.2±9.9	74.0±10.0	75.9±9.7	78.2± 10.2	79.9± 9.0
Group III	74.8± 5.1	63.6± 5.4	66.9± 5.2	69.6± 5.4	72.2± 5.4	74.8±5.1	77.6±4.9	79.2±4.6	80.1±5.7
P Value	0.645	0.461	0.398	0.580	0.908	0.645	0.593	0.249	0.987

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Table 6: Change in MAP among the Groups

Mean Arterial Pressure									
Group	**Baseline**	**5 min**	**10 min**	**15 min**	**20 min**	**30 mins**	**60 min**	**90 min**	**120 min**
Group I	95.1±2.7	77.3±2.8	80.1±2.2	85.0±2.1	88.4±2.4	95.1±2.7	99.1±4.5	103.4±3.1	104.1±2.5
Group II	93.4±3.6	77.2±3.5	79.3±3.6	84.7±3.5	87.6±3.5	93.4±3.5	98.0±2.9	102.3±2.3	103.6±2.8
Group III	93.3±2.8	77.7±3.0	79.7±2.3	84.3±2.7	86.9±2.6	93.3±2.7	96.3±4.2	101.5±3.9	101.9±3.3
P Value	0.051	0.857	0.517	0.633	0.124	0.051	0.063	0.075	0.062

Table 7: Change in Respiratory rate

Respiratory Rate									
Group	**Baseline**	**5 min**	**10 min**	**15 min**	**20 min**	**30 min**	**60 min**	**90 min**	**120 min**
Group I	13.8±1.5	13.5±2.0	14.4±2.4	14.1±1.6	13.2±1.5	13.8±1.5	13.1±2.1	12.9±2.0	13.5±2.5
Group II	13.6±1.8	13.3±1.5	13.5±1.9	14.2±1.5	13.5±1.4	13.6±1.8	12.8±1.4	12.9±2.0	13.6±2.2
Group III	13.5±1.1	13.8±2.1	14.9±2.9	14.3±1.8	13.1±1.5	13.5±1.1	13.0±2.2	12.7±1.7	13.3±1.3
P Value	0.744	0.606	0.101	0.942	0.649	0.744	0.790	0.823	0.611

DISCUSSION

Paramedian route for epidural catheterization is known to facilitate cephalad catheter placement and decrease dural puncture, bloody tap and paraesthesias.[6,7] The three groups were comparable for age, sex, height and weight of the patients. Time for performance of anaesthetic technique (t1) was 11.06±3.43 min, 12.27±1.76 min, 11.48±1.86 min in SST, SDT, DST respectively (p=0.164) and time to surgical readiness (t2) was 17.81±4.16 min, 19.05±1.78 min, 17.56±2.64 min respectively (p=0.129). A significantly lower anaesthetic technique performance time was reported by Lyon et al,[9] and Casati et al,[10] in SST, but time to surgical readiness were comparable between SST and DST. The incidence of a technically perfect CSE was comparable (p value 0.949) in the three groups (SST: 66.7%, SDT: 70%, DST: 70%). While attempting to localize the epidural space; dural tap occurred in one case each (3.3%) in SST, SDT. Accidental dural puncture was not done in any of the cases in DST group. Blood or fluid was noticed at the tip of the Tuohy's needle in none of the cases in SDT group. Blood was present at the tip of Tuohy's needle in one case each (3.3%) in SST and DST. Midline approach for catheter placement has more chance of injuring the epidural venous plexus in SST and DST group. Casati et al,[10] found no significant difference in the presence of blood at the tip of Tuohy's needle between SST and DST. Difficulty in epidural catheter advancement was encountered in 10% cases of SST group and 3.3% of DST group. In a study by Takahashi et al epidural catheter could not be placed in two cases of SST (n=169).[11,12]

In SDT group there was no difficulty in advancement of the epidural catheter. The difficulty in placement of the midline epidural catheter is due to the presence of the dorsomedian connective tissue band.[6] The incidence of paraesthesia while advancement of epidural catheter was 16.67% in SST, 13.33% in DST and 10% in SDT. A higher incidence of paraesthesia with SST versus DST was also quoted by Ahn et al,[13] (46.66% vs. 26.66%), but not by Casati et al,[10] (10%, vs. 11.6%). Blood was seen at the tip of the epidural catheter in 30% cases in SST, 16.7% cases in DST and 10% cases in SDT. This lower incidence in SDT can be explained by the midline presence of the epidural venous plexus, thus lowering the chances of it being encountered if the paramedian approach is used. There is a risk of epidural catheter penetrating the dural hole with the NTN technique. However, there was no such case in our study as well as other studies.[10,14] Epiduroscopy studies have concluded that it is impossible to force epidural catheter through the hole made in dura by a fine spinal needle.[15] Spinal needle of CSE set used by us for SST has a protrusion length of 12 mm, which is sufficient to reach the dura as epidural-dural distance is 3-17 mm. However it is difficult to handle a spinal needle when the length and fineness of the spinal needle is increased. Moving away from the midline will increase the dural-epidural distance making failure of the puncture of the subarachnoid space by the spinal needle. Incidence of unsuccessful dural puncture in NTN is reported as 5-29% by various authors.[14,16] Lack of appreciation of dural puncture was a significantly common finding (30%, p value 0.001) in SST group. Unable to appreciate dural puncture might have lead to failure of SAB in NTN.[1]

There was a significantly lower incidence of cases with instant reflux of CSF in SST group (83.33%) as compared with 100% incidence in both DST group and SST group (p value 0.032). The rate of reflux of CSF depends primarily on the calibre and length of the spinal needle used for dural tap. In our study; a 26 G spinal needle was used in all three groups. However, the spinal needle used in SST was longer (117 mm) than the ones used in DST, SDT (89 mm). The delay in reflux of CSF in SST is probably due to the longer length of the spinal needle which increased the resistance thus delaying the speed of flow of CSF.[17] In all cases with successful dural puncture, a sensory block till at least T10 level was achieved. Lyons et al. had reported failure of SAB in 16% cases in SST and 5% cases in DST.[18]

There was no post-operative migration of the epidural catheter in any group in our study, similar to previous studies.[14] No significant difference in post-operative epidural catheter migration between SST and DST was noted by Casati et al. and Lyon et

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al.[10,18] There was no significant hemodynamic variation in any group during the surgery. This was similar with the study conducted by Saigal D et al.[8] The incidence of post- operative headache (SST=0%, SDT=3.3%, DST=3.3%, p value 0.938) and backache (3.3% in SST and SDT and 0% in DST, p value 0.938) was comparable between the groups, in accordance with most of the previous studies.[10,18] Post-operative nausea and vomiting was also comparable between the groups.

Hence the technique performance time, time to surgical readiness and achievement of a technically perfect block in the single space dual needle technique(SDT) is comparable with previously established technique like SST or DST. Further SDT offers paramedian epidural catheterization where there is lower incidence of presence of blood at the tip of the Touhy's needle or epidural catheter, easier epidural catheter insertion, lesser parasthesias. The adequate epidural analgesia in the SDT group suggests correct placement of the epidural catheter however the final position was not verified.

CONCLUSION

SDT is comparable with SST and DST in time for technique performance (12.27±1.76 min, 11.06±3.43 min, 11.48±1.86 min respectively; *p*=0.164), time to surgical readiness (19.05±1.78 min, 17.81±4.16 min, 17.56±2.64 min respectively; *p*=0.129) and incidence of technically perfect block (70%, 66.7%, 70%; respectively *p*=0.949). Use of paramedian route for epidural catheterization in SDT group decreases complications and facilitates catheter insertion. There was a significant number of cases with lack of dural puncture appreciation (SST=9, none in SDT, DST=1; *p*=0.001) and delayed cerebrospinal fluid reflux (SST=five, none in SDT and DST; *p*=0.032) while performance of SAB in SST group. The incidence of nausea, vomiting, post-operative backache and headache was comparable between the three groups. To conclude, the SDT (paramedian epidural with midline spinal at the same space) is an acceptable alternative to the SST (NTN) and DST.

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