

**Original Article**

Paramedian Epidural with Midline Spinal in the Same Intervertebral Space: An Alternative Technique for Combined Spinal and Epidural Anaesthesia

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Abstract

Background & Aim: *The combined spinal epidural technique (CSE) involves subarachnoid blockade and epidural catheter placement in procedure. Aim was to compare two different approaches of CSE, paramedian epidural with midline Subarachnoid block, that is Single space dual needle technique (SDT) with the Single space technique (SST).*

Materials and Methods: *The study was randomised, comparative & prospective. A total of 80 patients were divided in Group I SST & Group II SDT. Inclusion criteria: ASA grade I/II, undergoing Hysterectomy etc. Exclusion criteria: Patient refusal, allergy, coagulopathy, IHD, local infection etc. Group I- Needle through needle technique. Group II-Epidural in paramedian position with midline spinal. Parameters observed were technique performance time, time to surgical readiness, in Epidural block: attempts for space localisation, accidental dural puncture. For epidural catheter: attempts for insertion, presence of blood / CSF, paraesthesia, inability to push test dose. While Subarachnoid block; attempts, appreciation of dural puncture, reflux of CSF < 5 seconds.*

Results: *Both were comparable in technique performance time & time to surgical readiness. Parameters relating to epidural block were comparable. The appreciation of dura in SAB in group I was 26 and group II was 39 (p 0.0002) which was statistically significant. The incidence of reflux of CSF within 5 seconds in the group I was 33 and group II was 40 which was statistically significant (p 0.0056).*

Conclusion: *Paramedian epidural with midline spinal at the same space is an acceptable alternative to the Single Space technique.*

Keywords: *Paramedian, Epidural, Spinal, Midline.*

Introduction

Neuraxial anaesthesia is the term for central blocks involving the spinal, epidural, and caudal spaces. Corning published studies documenting success with neuraxial blocks in 1885¹. Most operations

below the neck can be performed under neuraxial anaesthesia. Neuraxial blocks reduces incidence of venous thrombosis, pulmonary embolism; minimizing transfusion requirements and respiratory compromise following thoracic and upper abdominal surgery. A decreased stress response

have positive cardiac benefits, reducing perioperative and postoperative ischemia.

The combined spinal–epidural technique (CSE) involves subarachnoid blockade and epidural catheter placement during the same procedure. The combination of two different routes of anaesthesia administration improves effectiveness and reduces side effects (Stevens and Edwards, 1999)². Subarachnoid block (SAB) provides fast and reliable segmental anaesthesia with minimal risk for toxicity, while epidural anaesthesia provides perioperative anaesthesia, followed by excellent analgesia in the postoperative period.^{3,4} CSE anaesthesia reduces the problems, such as unpredictable level of blockade after SAB, and problems of missed segments, incomplete motor block, that can occur with epidural anaesthesia³.

Ability to perform CSE through single inter-vertebral space has made SST (Single space technique) a popular technique. Despite this advantage SST suffers from complications, technical problems and there is the cost factor. Migration of epidural catheter in subarachnoid space have been reported⁵ leading to extensive block⁶. Delayed respiratory depression due to drug entering into subarachnoid space through migrated catheter has also been claimed⁷. Metallic flecks getting deposited in the epidural space while using needle through needle technique have raised concern⁸. Meningitis⁹, knotting of catheter⁵, inadvertent dural puncture with the wide bore Tuohy¹⁰ needle are additional problems with Needle through needle technique.

There is risk of damage to the epidural catheter or spinal needle if SAB is carried out after epidural catheterization⁴. Introducing a spinal needle with an epidural catheter in place could allow the spinal needle to strike the epidural catheter leading to spinal needle damage¹¹ or catheter fracture¹². In an attempt to find out the best CSE technique, we conducted this study, wherein epidural was performed by paramedian approach and SAB in midline, both at the same inter-vertebral space that is Single space dual needle technique (SDT) and

this was compared with the Single space (Needle through needle NTN) technique (SST).

Materials & Methods

The study was randomised, comparative & prospective. It was time bound & hospital based.

Sample size calculation

$$N = \frac{2 * SD^2 * (1.96 + 0.84)^2}{(M1 - M2)^2}$$

Where 1.96 = Z value for 95% significance level, 0.84 = conventional multiplier for power 80%, SD^2 = squared pooled deviation = 23.75, M1 = 16.4 min, M2 = 19.5 min; N = 40 in each group.

All data so obtained was meticulously documented and statistically analysed. Quantitative data was analysed using Percentage, Mean, Standard deviation, unpaired t test. Qualitative data was analysed by chi square test.

Approval from institutional ethical committee was taken. Procedure was explained to patients and informed written consent was taken. Patients were allocated in either groups using computer generated random numbers.

Group I: Single space (needle through needle NTN) technique (SST) n=40.

Group II: Single space dual needle (Paramedian epidural with midline spinal) technique (SDT) n=40.

Inclusion criteria: ASA grade I/II, Female patients between 40 to 65 years, height 145-165 cms, Weight 45-70 kgs, patients undergoing elective Hysterectomy.

Exclusion criteria: Patient refusal, Patient with known allergy to local Anaesthetics, coagulopathy, platelet count <75,000/mm³, IHD, valvular heart disease, local infection, spinal deformity, raised intracranial tension, neurological disease.

Pre-anaesthetic check-up was done. On day of surgery, intravenous access was established using a wide bore IV cannula and preloading done with Ringer's lactate (10 ml /kg). All blocks were performed by the same Anaesthesiologist with a minimum experience of at least 50 procedures in both the techniques.

Group I: SST

In Group I, CSE kit was used. In sitting position, after painting and draping, L2-L3/ L3-L4 vertebral inter-space was locally infiltrated with inj. Xylocaine 2% 2ml. Epidural space was located in midline using 16 G Tuohy's needle. The spinal needle (26 G, pencil point, 117mm) was introduced through epidural needle and dural puncture was appreciated. After free flow of CSF, 2.5 ml of 0.5% hyperbaric Bupivacaine was injected intrathecally. Thereafter, epidural catheter 20 G was introduced and catheter was fixed leaving 9cm inside the epidural space in the cephalad direction.

Group II: SDT

In Group II, Epidural set and spinal needle (26 G, pencil point, 95mm) was used. At L2-L3/ L3-L4 inter-space point of entry for epidural needle was at 1.5cm lateral to the caudal part of spinous process of corresponding vertebra. After local infiltration, the touhy needle 16 G pointing in cephalad direction was directed towards midline. After confirming space, needle was left in the space. Spinal needle was introduced in the midline in the same space and dural puncture was appreciated. After free flow of CSF, 2.5 ml 0.5% hyperbaric Bupivacaine was injected intrathecally. Thereafter, epidural catheter 20 G was introduced through the epidural needle and catheter was fixed leaving 9cm inside epidural space in the cephalad direction.

Surgery was allowed initially under Sub arachnoid block. Test dose of inj. Xylocaine with adrenaline 2%, 3ml was given in epidural. If any blood or CSF was aspirated in the catheter or positive response to test dose observed, then no top up was given and surgery was carried under SAB only.

When Spinal anaesthesia level started weaning off, (regression of two segment sensory level, tested by pin prick) Epidural top up was given intraoperatively, using increments of 4 ml of 0.5% Bupivacaine otherwise 8 ml of 0.25% Bupivacaine with 25µg fentanyl in the postoperative period. A maximum of three attempts was tried for each procedure.

Inj. Atropine 0.6mg was given if heart rate was < 50/min. Any relevant fall in blood pressure i.e more

than 20% fall from the baseline treated with intravenous fluids followed by vasopressors. Inj. Mephenteramine 6mg with repeated doses was given if MAP was < 65mmHg.

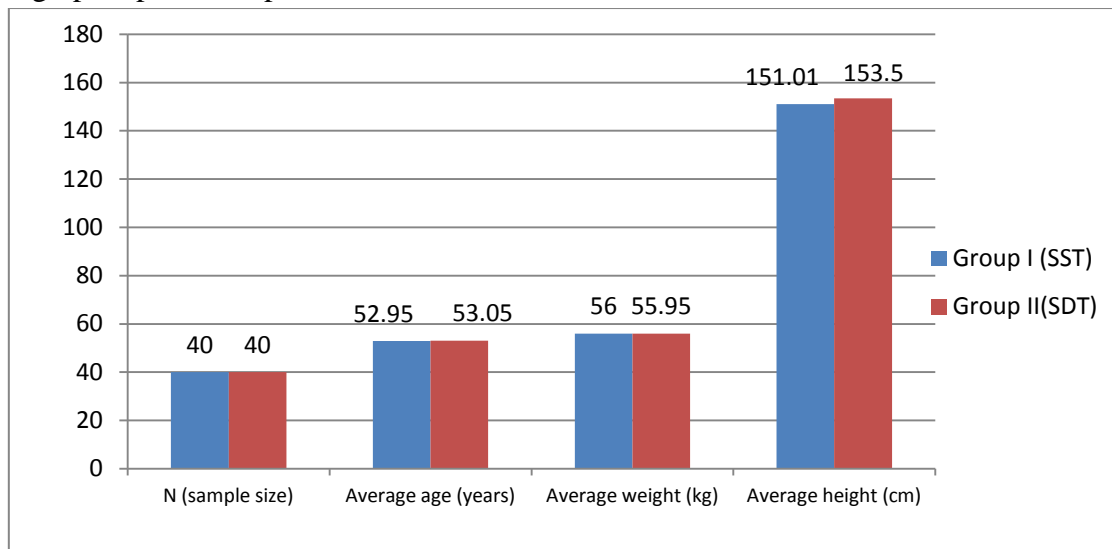
Parameters observed were

1. Technique performance time (T1): Time taken after painting and draping to the time when the patient was made supine was noted as T1.
2. Time to surgical readiness (T2): Time taken after painting and draping to the achievement of sensory level of T₆ was noted as T2.
3. While performing the epidural block following was recorded:
 - a) Number of attempts for space localisation
 - b) Accidental Dural puncture.
4. While passing epidural catheter parameters seen were:
 - a) Number of attempts for insertion of catheter
 - b) Presence of blood or CSF in the catheter
 - c) Paraesthesia during the catheter insertion
 - d) Inability to push test dose (due to kinking, blockade, malposition and coiling)
 - e) Failure to extend analgesia after epidural top-up.
5. While performing Subarachnoid block; a record of the following was made:
 - a) Number of attempts taken for SAB,
 - b) Appreciation of puncture of dura,
 - c) Reflux of CSF < 5 seconds

After 24 h, the last analgesic epidural top up was given and the epidural catheter was removed. Patients were evaluated for headache, backache, nausea, and vomiting postoperative

Results

Figure 1: Demographic profile of patients



The observed demographic data signifies that the patients in both groups were comparable and of similar profile.

Table 1: Technique performance time (T1) and time to surgical readiness (T2)

| Time | Group I (SST) [± SD] | Group II (SDT) [± SD] | P value |
|--------------|----------------------|-----------------------|---------|
| T1 (minutes) | 05:09 ± 01:02 | 05:40 ± 01:09 | 0.568 |
| T2 (minutes) | 11:36 ± 01:43 | 12:05 ± 01:29 | 0.177 |

The time taken is comparable in both the groups with no significant difference.

Table 2: Characteristics of Epidural Block

| Characteristic of Epidural Block | Group I (SST) | Group II (SDT) | P Value |
|---|---------------|----------------|---------|
| Average number of attempts at epidural space localisation[± SD] | 1.175 ± 0.501 | 1.375 ± 0.628 | 0.119 |
| Accidental puncture of Dura [%] | 2 [5%] | 1 [2.5%] | 0.556 |

The average number of attempts required at epidural space localisation in group I was 1.175 ± 0.501 and for group II it was 1.375 ± 0.628 which is slightly more in group II but the difference is statistically insignificant with p-value 0.119.

The incidence of accidental puncture of Dura in group I is 2 out of 40 [5%] and in group II is 1 out of 40 [2.5%] with p-value 0.556 indicating no significant difference.

Table 3: Parameters of Epidural catheter insertion

| Parameters of Epidural catheter insertion | Group I (SST) [n= 38] | Group II (SDT) [n=39] | P value |
|--|-----------------------|-----------------------|---------|
| Average number of attempts required [± SD] | 1.158 ± 0.37 | 1.077 ± 0.27 | 0.277 |
| Presence of Blood/CSF in the Epidural catheter [%] | 2 [5.26%] | 0 [0.0%] | 0.147 |
| Incidence of Paraesthesia [%] | 7 [18.42%] | 5 [12.82%] | 0.498 |
| Inability to push test dose [%] | 2 [5.26%] | 1 [2.56%] | 0.54 |
| Failure to extend level after top-up [%] | 3 [7.89%] | 1 [2.56%] | 0.292 |

The following parameters were statistically insignificant and comparable in both the groups.

Figure 2: Comparison of various complications in Epidural catheter insertion

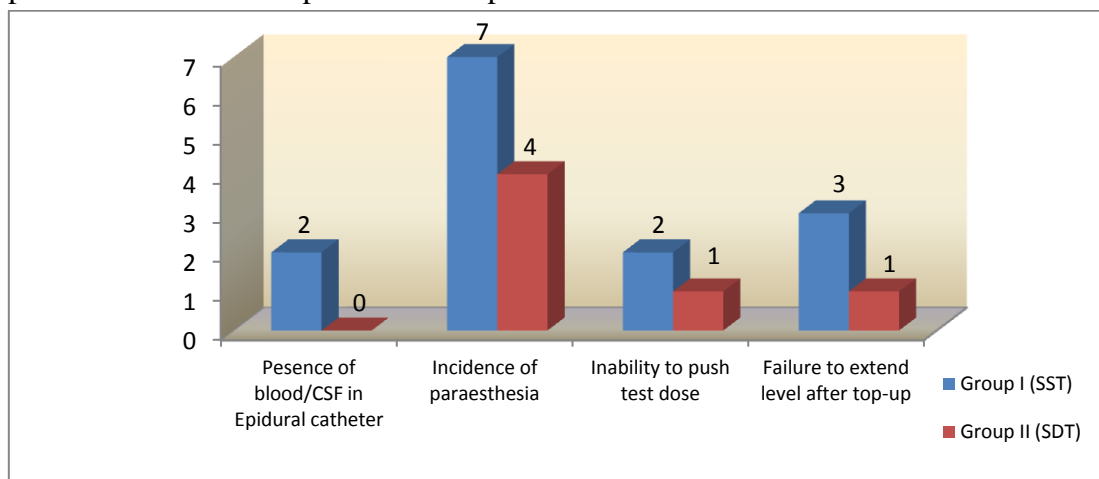


Table 4: Characteristics of SAB

| Characteristic of SAB | Group I (SST) | Group II (SDT) | P value |
|---|-------------------|-------------------|---------|
| Average number of attempts required for SAB [\pm SD] | 1.025 \pm 0.158 | 1.125 \pm 0.404 | 0.151 |
| Appreciation of Dural puncture [%] | 26 [65%] | 39 [97.5%] | 0.0002 |
| Reflux of CSF within 5 sec [%] | 33[82.5%] | 40 [100%] | 0.0056 |

The average number of attempts required for subarachnoid block is statistically insignificant in both the groups. Incidence of appreciation of dura is statistically significant (p 0.0002). The incidence of reflux of CSF from spinal needle within 5 seconds is statistically significant (p 0.0056).

Discussion

Though Single space technique is most widely used, it carries drawbacks like metallic particle toxicity,³ interpretation of test dose, warning paraesthesia, epidural catheter placement in subarachnoid space, catheter coiling, kinking, knotting⁵, delayed respiratory depression due to epidural drug passing into subarachnoid space⁷ etc. Also longer spinal needles are required which delays CSF reflux due to resistance of longer needle. Special CSE kits are needed which is costly and not easily available. Studies conducted have shown that in paramedian epidural, the angulation of the epidural needle causes less accidental dural puncture^{13,14}, less paraesthesia, lesser bloody tap and also more cephalad direction of the epidural catheter due to lesser kinking, coiling and knotting⁵. It does not require any CSE kit and is cost effective.

The demographic profile was comparable in both the groups as shown in Figure 1. The time taken for anaesthetic technique performance (T1) in group I was 05:09 \pm 01:02 minutes as compared to 05:40 \pm 01:09minutes for group II. The time for surgical readiness (T2), for achievement of analgesia up to T6 spinal level, in group I was 11:36 \pm 01:43 minutes and 12:05 \pm 01:29 minutes for group II. Both the differences were statistically insignificant as shown in Table 1. Deepti Saigal et al¹⁵ in 2013, compared three groups SST, SDT and DST (double segment technique- epidural one space above spinal in the midline). Time for performance of anaesthetic technique (T1) was 12.18 \pm 6.092 min, 13.41 \pm 2.848 min, 11.63 \pm 3.243 min in SST, SDT, DST respectively (P=0.268) and time to surgical readiness (T2) was 17.64 \pm 5.877 min, 18.28 \pm 3.624 min, 16.87 \pm 3.137 min respectively (P=0.462). In their study comparative time was higher than our study probably because we had excluded time taken for painting and draping in our study.

The average number of attempts required at epidural space localisation in group I was 1.175 \pm 0.501 and for group II, it was 1.375 \pm 0.628 which is slightly more in group II but the difference is statistically

insignificant (p-value 0.119). The incidence of accidental puncture of dura in group I was two out of 40 [5%] and in group II is 1 out of 40 [2.5%] with p-value 0.556 indicating no significant difference in both groups as shown in Table 2. In such cases epidural block was abandoned. In a cadaveric study by Blomberg, RG¹³ in 1988, found that there is presumably lower risk of accidental dural puncture using paramedian approach.

The average number of attempts required for epidural catheter insertion in group I was 1.158 ± 0.37 and for group II was 1.077 ± 0.27 with p-value of 0.277 which is statistically insignificant as shown in Table 3. However there is slight increase in average number of attempts for epidural catheter insertion in SST group indicating towards difficulty in inserting the epidural catheter in that group. In a study by Takahashi et al epidural catheterization was not possible in two cases of SST (n=169)¹⁶. There was no case with difficulty in advancement of the epidural catheter in SDT group. The influence of the dorsomedian connective tissue band can explain the difficulty in traversing of the midline epidural catheters¹³. In a study Blomberg¹³ and colleagues found less resistance to catheter insertion due to steeper angle of entry of paramedian epidural needle into epidural space, facilitating catheter insertion. In an epiduroscopic cadaver study, it was demonstrated that when catheter is advanced in the midline there is considerable dural tenting and course of the catheter is unpredictable due to strands of connective tissue restricting movement of dura mater¹³. Leeda M et al¹⁷ in 2005, studied epidural catheter insertion via midline and paramedian approach and found that catheter insertion was faster using the paramedian approach. Incidence of blood or CSF in the epidural catheter in group I was 2 out of 38 [5.26%] as compared to 0 in case of group II. The difference in incidence was found to be insignificant with p-value of 0.147 as shown in figure 2. Use of midline approach to epidural catheterization in SST is more likely to encounter the epidural venous plexus. Deepti Saigal et al¹⁵, found lower incidence of blood in the epidural catheter in Paramedian epidural with midline spinal

group. The incidence of paraesthesia while advancement of epidural catheter were comparable with p-value of 0.498 which is insignificant. Deepti Saigal et al¹⁵, found lower incidence of paraesthesia in paramedian epidural with midline spinal group. Leeda M et al¹⁷ in 2005, found a higher incidence of paraesthesias in the midline group (33% vs. 6.7%) compared to paramedian epidural. Blomberg and colleagues¹³ reported an incidence of 36% with the midline approach as opposed to 4% with the paramedian approach.

The risk of epidural catheter penetrating the duramater through the hole made by spinal needle is a major concern. However, there was no such case in our as well as other studies¹⁸. Epiduroscopy studies have concluded that it is impossible to force epidural catheter through the hole made in dura by a fine spinal needle.⁶

Lack of appreciation of dural puncture was significant (35%, P value 0.0002) in group I and was 2.5% in SDT group. Paech and Evans could not feel the dural puncture in 6-12% cases while performing CSE by NTN technique¹⁹. Lack of dural puncture appreciation may lead to failure of SAB in Needle through needle technique³.

Reflux of CSF <5 seconds was seen in 33 patients in group I and all 40 cases in group II as shown in Table 4. There was a significantly lower incidence of cases with instant reflux of CSF in SST group (82.5%) as compared with 100% incidence in SDT group (P value 0.0056). The speed of reflux of CSF primarily depends on the gauge of spinal needle used. However, the spinal needle used in SST was longer (117 mm) than the ones used in SDT (95 mm). The delay in reflux of CSF in SST can probably be attributed to the length of spinal needle, which increases the resistance and hence diminishing the speed of flow of CSF²⁰.

Hence, the single space dual needle technique (SDT) was comparable to Single space (needle through needle) technique, (SST). It was comparable in terms of time taken for technique performance and time to surgical readiness. Both the groups were statistically insignificant and comparable on various parameters but statistically

significant result was found in Group II in terms of appreciation of dural puncture and reflux of CSF within 5 seconds while performing subarachnoid block.

Conclusion

Based on the results of this study, we conclude that Paramedian epidural with midline spinal at the same space (SDT) is an acceptable alternative to the Single Space (Needle through Needle) technique (SST). The paramedian epidural with midline spinal is a lesser used technique and needs to be popularised in developing countries like ours where CSE kits may not be readily available and also not affordable at large.

References

1. Corning, JL. Spinal anaesthesia and local medication of the cord. N Y Med J. 1885; Vol. 42: 483.
2. Stevens DS, and W. T. Edwards. Management of pain in intensive care settings. Surgical Clinics of North America. 1999; v. 79, no. 2, p. 371-386.
3. Cook, T. M. Combined spinal-epidural techniques. Anaesthesia. 2000; 55(1): 42-64.
4. Rawal, N., B. Holmstrom, J. A. Crowhurst, and Z. A. Van. The combined spinalepidural technique. Anesthesiol. Clin. North America. 2000; 18(2): 267-295.
5. Norris M, Grieco W et al. Complications of labour analgesia: Epidural versus combined spinal epidural techniques. Anesthesia Analgesia. 1994; 79: 529-37.
6. Holmstrom B, Rawal N, et al. Risk of catheter migration during combined spinal epidural block: Percutaneous epiduroscopy study. AnaesthAnalg. 1995; 80: 747-753.
7. Eldor J, Guedj P, Levine S. Delayed respiratory arrest in combined spinal-epidural anesthesia: Case report. RegAnesth. 1994 Nov-Dec; 19(6): 418-22.
8. Editor J. Metallic fragments and the combined spinal epidural technique. Br J Anesth. 1992; 69: 663.
9. Cascio M, Heath G. Meningitis following a combined spinal epidural technique in a labouring term parturient. Can J Anaesth. 1996 Apr; 43(4): 399-402.
10. Morgan BM, Kadim MY. Mobile regional analgesia in labour. British Journal of Obstetrics and Gynaecology. 1994; 101: 839-841.
11. Levin A, Segal S, Datta S. Does combined spinal-epidural analgesia alter the incidence of paraesthesia during epidural catheter insertion? Anesthesia and Analgesia. 1998; 86: 445-51.
12. Kestin IG. Spinal anaesthesia in obstetrics. British Journal of Anaesthesia. 1991; 67: 663.
13. Blomberg RG. Technical advantages of the paramedian approach for lumbar epidural puncture and catheter introduction: A study using epiduroscopy in autopsy patients. Anaesthesia. 1988; 43: 837-43.
14. Satoki Inoue, Masahiko Kawaguchi, Hitoshi Furuya. Cephalad Angulation of Epidural Needle Insertion May Be an Important Factor for Safe Epidural Space Approach: a Mathematical Model. Rev Bras Anesthesiol. Clinical information. 2011; 61: 6: 764-769.
15. D. and Wason R. Paramedian epidural with midline spinal in the same intervertebral space: An alternative technique for combined spinal and epidural anaesthesia Indian Journal of Anaesthesiology. 2013; 57(4): 364-370.
16. Takahashi R, Yamada K, Yoshiyama T, Nitta S, Hamatani K. Comparison of double-segment technique with single-space technique for cesarean section using combined spinal epidural anesthesia. Masui. 1999; 48: 57-61.
17. Leeda M, Stienstra R, Arbous MS, Dahan A, Th Veering B, Burm AG, et al. Lumbar epidural catheter insertion: The midline vs. the paramedian approach. Eur J Anaesthesiol. 2005; 22: 839-42.

18. Casati A, D'Ambrosio A, Negri PE, Fanelli G, Tagariello V, Tarantino F. A clinical comparison between needle-through-needle and double segment-techniques for combined spinal and epidural anaesthesia. *RegAnesth Pain Med.* 1998; Jul-Aug; 23(4): 390-4.
19. Paech MJ, Evans SF. Prospective clinical evaluation of two combined spinal-epidural kits. *Anaesth Intensive Care.* 1995; 23: 600-4.
20. Waldman SA, Liguori GA. Comparison of the flow rates of 27-gauge Whitacre and Sprotte needles for combined spinal and epidural anesthesia. *RegAnesth.* 1996; 21: 378-9.