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Effect of epidural volume extension with 7.5 ml of normal saline on sensory block for caesarean section

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Abstract
Spinal anaesthesia is considered the preferred anaesthetic technique for elective caesarean section as it avoids the risks of general anaesthesia related to difficult intubation and aspiration of gastric contents. Rescue strategies like changes in tilt of table are used to raise the level of an inadequate sensory block following intrathecal injection. This prospective, randomized, controlled study was conducted in 100 parturients, ASA1 or ASAII, with gestational age 38 weeks or more undergoing elective cesarean section under CSEA. Women were randomly distributed into two equal groups: Group A (CSE with no EVE), Group B (CSE followed by EVE using 7.5ml of normal saline). Time to reach maximum sensory block was significantly shorter in group B, Higher levels of sensory block were seen in group B (60% had T3-T4 block) whereas in group A, 64% had T5-T6 block. Group B and C had significantly higher levels of peak sensory block as compared to group A (p<0.001), two or more segments higher than the group A as assessed by temperature and pinprick. Two segment regression time of sensory block was significantly shorter in group A, whereas it was significantly longer in group B.

Keywords: Epidural Volume Extension, Normal Saline, Caesarean Section

Introduction
The epidural space is a potential space located around the dural sac and within the bony cavity of spinal canal. It extends along the entire length of spinal column from base of the skull to the sacrococcygeal membrane. Mechanism ascribed to explain the rapid extension of sensory block that occurs with EVE includes a 'volume effect', 'drug effect' and augmentation of a pre-existing area of subclinical analgesia [1].

Volume effect or thecal compression: The most commonly extended explanation for EVE is theca l compression due to the volume effect on consequent epidural injection of fluid. This theca l compression causes cephalad shift of local anaesthetic within the cerebrospinal fluid, raising the level of sensory block. Imaging studies document thecal compression following EVE and several studies demonstrate an increase in post-spinal sensory block following epidural injection of normal saline.

Depends with regard to patient population and position, intrathecal drug, and timing and nature of the epidural injection. While the effect and utility of EVE appears to be influenced by the time between the intrathecal and epidural injection, the optimal time for its performance cannot be deduced from the available evidence, before the intrathecal drug is fully distributed and fixed within the neuraxial tissue [2, 3].

Levobupivacaine exerts its pharmacological action through reversible blockade of neuronal sodium channels. Myelinated nerves are blocked through exposure at the nodes of Ranvier more readily than unmyelinated nerves; and small nerves are blocked more easily than larger ones. In general, the progression of anesthesia is related to the diameter, myelination and conduction velocity of the affected nerve fibers. Specifically, the drug binds to the intracellular portion of sodium channels and blocks sodium influx into nerve cells, which prevents depolarization. It blocks nerve conduction in sensory and motor nerves mainly by interacting with voltage sensitive sodium channels on the cell membrane. It also interferes with impulse transmission and conduction in other tissues [4].

Fentanyl is primarily a mu receptor agonist with an analgesic potency greater than morphine, pethidine and alfentanil. Analgesia is produced principally through interaction with mu receptor at supraspinal sites. It also binds to a much lesser degree to kappa receptors located within spinal cord [5].

There is evidence now that, the grey matter of spinal cord also contains opioid receptors and most of them are located in substantia gelatinosa i.e, 50% kappa, 40% mu and 10% delta [5]. Fentanyl also effectively block the sympathetic stress response mediated by decrease in CNS sympathetic vasoregulatory outflow [6].

Methodology

After institutional ethical committee approval, informed written consent was taken from each patient.100 Parturients satisfying the inclusion criteria posted for elective lower segment caesarean section under subarachnoid block was selected. A detailed history, complete physical examination and investigations was done for all patients.

The study population was randomly divided into 2groups with 50 parturients (n=50) in each group by closed sealed opaque envelope method,to receive:

Group A: Intrathecal 7.5mg levo bupivacaine+fentanyl 25 µg without EVE.

Group B: Intrathecal 7.5mg levo bupivacaine+fentanyl 25 µg with EVE (7.5 ml normal saline).

Data was collected in prepared proforma meeting the objectives of the study.

All Patients with standard NPO status was premedicated with inj Pantoprazole 40mg IV, inj. Ondansetron 4mg slow IV, preloaded with Ringer lactate 500ml half an hour before anaesthesia. All patients were transported to OT in left lateral position and also placed on OT table in left lateral position.

Monitoring was done using multi- parameter monitor with electrocardiography (ECG), non-invasive blood pressure (NIBP) and pulse oximetry (SPO2).

Group A: Lumbar puncture was performed at the level of L3-L4 through a midline approach using 25 G Quincke's spinal needle and study drug wase injected after confirmation of needle tip in the subarachnoid space by clear and free flow of cerebrospinal fluid.

Group B: (CSEA-EVE with7. 5ml saline): Epidural space was identified (L3-L4) with 18G Tuohy needle and epidural catheter is inserted 3cm into the epidural space and dural puncture performed using a 25G spinal needle and study drug injected and five minutes after insertion of the epidural catheter,7.5ml normal saline is administered through it for EVE.

Subject was made to lie down in the supine posture immediately with the table kept horizontally, wedge kept under right hip and supplemental oxygen was administered.

Results

Table 1: Statistical comparison of sensory level of onset in minutes among the groups

Parameters	Group A	Group B
No. of cases	50	50
Mean	4.02	4.34
Std dev	0.811	1.319
Minimum	3	2
Maximum	6	8

Comparison of mean onset of sensory level in minutes in group A 4.02 and group B 4.34 not found to be statistical significant.

Maximum sensory level	Group A	Group B	P value
T12	1(2.0)	0 (0.0)	0.000
T10	3(6.0)	0 (0.0)	
T8	14 (28.0)	0 (0.0)	
T6	32 (64.0)	14 (28.0)	
T5	0 (0.0)	3 (6.0)	
T4	0 (0.0)	29 (58.0)	
T3	0 (0.0)	1 (2.0)	
T2	0 (0.0)	3 (6.0)	
Total	50 (100.0)	50 (100.0)	

Maximum sensory level attained among group A T6-T8 is 70%, in group B T3-T5 is 70%. The median block height of group B was clearly two segments higher than the highest sensory blockade in group A as assessed temperature and pinprick.

Parameters	Group A	Group C	F statistic	P value
No. of cases	50	50	29.806	0.000
Mean	11.6	8.72		
Std dev	1.678	1.565		
Minimum	8	6		
Maximum	15	12		

The mean time taken to attain peak sensory level in group A is 11.6 and SD$\pm$1.678 and in group B mean time 8.72 and SD$\pm$1.565.

The mean time take to attain peak sensory in group B is shorter than group A and found statistically significant (p=0.000).

Parameters	Group A	Group B	F statistic	P value
No. of cases	49	50	40.988	0.000
Mean	68.04	88.2		
Std dev	6.617	14.734		
Minimum	55	60		
Maximum	85	120		

Two segment regression time of sensory block was significantly shorter in group A mean duration time 68.04+6.617, than group B 88.2+14.734 (p=0.000).

Discussion

A prospective study was conducted involving 100 patients ASA I or ASAII PS who undergoing cesarean section. The most important finding in the present study is that administration of EVE with saline volume 7.5ml with intrathecal levobupivacaine 7.5mg+Inj fentanyl 25mcg resulted in faster onset and heighest sensory block and motor blockade attained with less. Hemodynamic compromise.

Using EVE with saline, small-dose spinal block can be extended to provide adequate anesthesia for caesarean delivery. Several mechanisms were reported to play a role in the enhancement of spinal block by EVE with saline, including the volume effect, in which the theca is compressed by epidural saline, resulting in the squeezing of cerebrospinal fluid and more extensive spread of subarachnoid local anesthetic. This effect differs from the

enhancement of block following EVE with local anesthetic, as saline extends the block height by a mechanical volume effect (that appears to be time-dependent) and does not prolong the duration of block.

Delayed administration of epidural saline beyond 10 minutes may have been the cause of frequent failure reported by Choi *et al*. [7] when administering EVE and spinal block induced with 8 mg of hyperbaric bupivacaine, the incidence of intraoperative pain exceeded 50%.

Bremerich *et al*. [8] used 7.5, 10, and 12.5 mg of hyperbaric 0.5% levobupivacaine in patients receiving spinal anesthesia for elective cesarean delivery, 40% of their patients that received 7.5 mg of levobupivacaine required additional intraoperative intravenous opioid analgesic and motor block was not complete. Celleno *et al*. [9] studied the use of CSEA for cesarean delivery and concluded that the minimum dose of local anesthetic (levobupivacaine) administered to the spinal component must be 11.10 mg, whereas Parpaglioni *et al*. [10] reported that it should be 10.58 mg. Intrathecal levobupivacaine seems to have a lower potency for motor block than bupivacaine, but the ideal dose of intrathecal levobupivacaine for cesarean delivery remains uncertain. Bouvet *et al*. [11] reported that, when combined with opioids, ED_{95} of intrathecal levobupivacaine is 12.9 mg for caesarean delivery. Gori *et al*. [12] evaluated influence of positioning on 12.5 mg plain levobupivacaine spinal anesthesia in cesarean section.

In the our study we administered 7.5 mg of levobupivacaine along with fentanyl 25mcg achieved complete analgesia and sensory block in all patients except 4 patients in group A attained sensory level below T8 and required early rescue analgesia compared to group B and group C and not adversely influence the comfort of the patient during cesarean delivery.

In study by Stienstra *et al*. [13] patients were divided into 5 groups after administration of 10 mg of bupivacaine into the subarachnoid space. The patients received 10 mL of 0.25% bupivacaine, 5 mL of 0.25% bupivacaine, 10 mL of saline, 5 mL of saline, or nothing through epidural catheters. The increase in the level of sensory block was significantly higher in the patients that received 10 mL of 0.25% bupivacaine than in the other patients, and the level of maximum sensory block increased to C_8. The researchers concluded that the increase in the level of anesthesia was not only related to the volume of the agent administered into the epidural space, but also in part to the dose effect of the local anesthetic agent.

But in our study sensory block was achieved faster, reached a higher level, and lasted longer in the patients that received EVE with saline 7.5ml(Groups B) than in those that received SSS (Group A).

Conclusion

In conclusion, sufficient and rapid motor and sensory block was achieved in all the patients in the present study. However, motor and sensory block had faster onset, achieved highest sensory blockade level in Groups B than Group A. We think that EVE with 7.5ml volumes of saline decreases the need for a spinal dose, and facilitates earlier onset of anesthesia at low dosage levobupivacaine and fentanyl, with less hemodynamic changes and also results in early ambulation.

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