ORIGINAL ARTICLE

Comparison of Different Volumes of Normal Saline for Epidural Volume Extension in Combined Spinal Epidural Anesthesia for Lower Abdominal Surgeries

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Abstract

Context: Block augmentation by epidural volume extension has been adequately documented but there have been not enough studies comparing different volumes of normal saline used in this technique to augment the level of block achieved. The study compares different volumes of normal saline(5,10 and 20 ml) for epidural volume extension in combined spinal epidural anaesthesia for lower abdominal surgeries. 120 women, aged between 20-60 years belonging to ASA grade I-II undergoing elective lower abdominal surgeries were included in this study. The patients were randomly allocated into 3 groups and each group comprised of 40 patients. GROUP 1(EVE 5) received 10 mg 0.5% bupivacaine heavy (H) intrathecally with 5 ml normal saline through the epidural catheter as a part of Epidural volume extension. GROUP 2 (EVE10) and GROUP 3 (EVE20) received 10 ml and 20 ml of normal saline as a part of Epidural volume extension respectively in addition to the intrathecal drug. The patients were assessed for sensory block level to loss of pain from pin prick and for motor block using Bromage scale. Peak sensory block height, highest Bromage score, time taken to achieve maximum sensory and motor block and the time to their recovery were recorded.Statstical Analysis. was done using statistical software SSPS version 16.0 and Epi- info version 6.0 .Outcome measures were presented as % for qualitative variables and mean±SD for quantitative variables.Demographic data and duration of surgery were similar in all the groups.Sensory block augmentation was found to be significantly higher in the EVE10 and EVE 20 groups. There was no difference in the peak motor block score between the groups during the study. Time to achieve the blocks were significantly shorter for the 20 ml group than the 10 and 5 ml groups; the latter two being comparable. This was associated with a significantly faster motor recovery to Bromage 0 in groups EVE10 and EVE 20.

Key Words

Combined Spinal Epidural, Epidural Volume Extension, Sensory Block Augmentation

Introduction

During the evolution of modern day anesthesia efforts were made to make it more and more safe for the patient. These included reducing the area exposed to the anesthetic as in regional anesthesia, using ultrasound for placement of the drug at the specific places and using techniques to reduce the dose of the drug required as in the epidural volume extension.

Epidural volume extension (EVE) is a technical modification of the combined spinal epidural block which involves epidural injection of normal saline or a small volume of local anesthetic or colloid (1,2) after an intrathecal injection, aiming to augment the post-spinal sensory level. The consequent sensory block augmentation has been adequately documented.

The mechanism described in the literature to explain the enhancement of a spinal block by an epidural top-up of saline is the "volume effect" (3) in which the theca is compressed by epidural saline, resulting in the "squeezing" of cerebrospinal fluid and more extensive spread of

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subarachnoid local anesthetic. This claim has been confirmed in a myelographic study (4), which showed that 10 mL of saline given as an epidural top-up reduced the volume of the subarachnoid space by 25%.

EVE with saline is distinct from the block enhancement after an epidural top-up of local anaesthetic in that saline extends the block height by a mechanical "volume effect" and does not prolong the block duration.The volume effect appears to be time dependent as beyond 30 minutes or after two-segment regression has begun, any epidural top-up of saline would have no effect on block extension and may even accelerate spinal block regression.The advantage of this EVE technique is that a small-dose spinal block may provide an adequate level of anaesthesia while allowing faster motor recovery of the lower limbs. As much as 45% reduction in dose requirement (5) of bupivacaine for elective caesarean section has been reported.

Aims and objectives Using different volumes of normal saline in epidural space and 10 mg of intrathecal bupivicaine 0.5% (H), aims were to determine the level of sensory block and the time taken to achieve it,to evaluate the motor block with respect to the Bromage Score and timetaken to achieve complete motor block and to determine the duration of block (defined as regression of block from peak level to L1 in case of sensory block and regression to Bromage score 0 for motor block).

Material and Methods

After approval by the Institutional Ethical Committee (IEC) and obtaining written informed consent,120 women aged between 20-60 years, belonging to ASA grade I-II with height between 150 to 175 cms undergoing elective lower abdominal surgeries were included in this study.The patients were randomly allocated into 3 groups and each group comprised of 40 patients.

GROUP 1: 10 mg 0.5% bupivacaine heavy (H) + E pidural volume extension with 5 ml normal saline (EVE 5)

GROUP 2: 10 mg 0.5% bupivacaine (H) + Epidural volume extension with 10 ml normal saline (EVE 10)

GROUP 3: 10 mg 0.5% bupivacaine - (H) +Epidural volume extension with 20 ml normal saline (EVE 20)

Exclusion criteria included patient refusal, ASA III or more, coagulopathies, hypersensitivity to the study drug and any contraindication to regional anaesthesia.

All patients were premedicated with Tab alprazolam 0.25 mg at bed time, the night before surgery. In the operation theatre, peripheral iv line with 18 G cannula was established and infusion with Ringer Lactate started; premedication was given with inj ondansteron 4 mg iv and inj pantoprazole 40 mg iv.

Following application of routine monitors i.e NIBP, SpO2 and ECG, the baseline parameters were noted.

The combined spinal epidural block was performed in the lateral position using the needle through needle technique with a CSE kit (Portex® combined spinal/ epidural mini packwith lock pencil point Spinal needle) containing a 18 G Touhy's needle and a 27G pencil point Whitacre needle.UAAP the epidural space was identified using the loss of resistance technique. After inserting the spinal needle through the touhy needle, 10 mg 0.5% heavy bupivacaine was injected through the spinal needle.The epidural catheter was then inserted and secured in place leaving 4cm in the epidural space and the patient was turned supine with no tilt of the table. The epidural catheter was checked by the aspiration test to rule out its inadvertent intravascular (appearance of blood in the catheter) or intrathecal (appearance of CSF) placement. Through the epidural catheter the patients were now given normal saline according to the group allocation @ 1ml/sec. Sensory block (determined as complete loss of sensation to pin prick) was assessed every minute until there was no change in the level in three consecutive readings. Peak sensory level,maximum motor block i.e Bromage score and the time to achieve them was noted Maximum time limit for checking the sensory and motor block was 20 minutes.If the patient complained of pain any time intraoperatively, top up dose of injection bupivicaine 0.5% in 10 ml incremental doses was given

Bromage Scoreing

Grade	Criteria	Degree of Block
0	Free movement of leg and feet.	Nil
1	Just able to flex knee with free movement of feet.	Partial (33%)
2	Unable to flex knees but with free movement of feet.	Almost complete (66%)
3	Unable to move legs or feet.	Complete (100%)

and number of top up doses required were noted. In case of failure, anesthetic technique was changed to GA. All such patients were excluded from the study. Vitals were recorded every 3 minutes for first 20 minutes and then every 10 minutes.Any untoward incident like hypotension, bradycardia, nausea, vomiting or shivering during and after the procedure was recorded and suitably treated. Hypotension(20% fall from baseline or SBP <100 mmHg) was treated with mephentermine 6 mg iv boluses and bradycardia (HR<60 /min) with atropine 0.4 mg iv bolus. Nausea and vomiting was treated with inj. Ondansteron 4 mg iv and shivering with inj Tramadol 0.5 mg /kg iv.

Recovery was recorded by assessing the regression of sensory and motor block every 15 min after attaining the maximum block. Recovery was assessed until sensory block regressed to L1 &Bromage score reached zero. The catheter was left in place for post operative analgesia and removed after 24 hours.

Block characteristics like time to attain maximum sensory level, maximum motor block and regression times were calculated from the time of intrathecal drug administration.

Statistical Analysis

Analysis was done using statistical software SSPS version 16.0 and Epi- info version 6.0 .Outcome measures were presented as % for qualitative variables and mean±SD for quantitative variables. Base line comparability was ensured and its significance evaluated by chi square /Fisher/ANOVA. The difference in the outcome was assessed by one way ANOVA followed by assessment of intergroup difference by post hoc Bonferroni's t-test. A p value of < 0.05 was considered as significant. All p values were two tailed.

Results

The demographic parameters of age, weight and height of patients in all the three groups were statistically comparable .The duration of surgery and baseline haemodynamic parameters were also comparable. (*Table1*)

For the purpose of statistical analysis the maximum block heights achieved were clubbed as less than T5 or higher . On initial analysis the difference between the groups was found to be statistically significant. Further intergroup analysis showed that the maximum block height was significantly higher for EVE10 and EVE20 in comparison to EVE5. The higher volume groups were found to be comparable (p=0.061)as depicted in (*Table2*)

The mean time in minutes to reach highest level of sensory blockade was 9.76±0.902 in group EVE5, 9.13±1.76 in group EVE10 and 6.58 ±1.01 in group EVE 20.

On post hoc analysis by Bonferroni's t test EVE10 and EVE20 were found to be comparable.

Mean time in minutes to reach Bromage 3 was 8.91±1.10 in group EVE5, 8.28 ± 1.34 in group EVE10 and 6.08 ±0.86 in group EVE 20. The results were statistically significant. On post hoc analysis the

Table 1. Demographic Profile And Duration of Surgery

MEAN±SD	GROUP EVE-5	GROUPEVE-10	GROUPEVE-20	P Value
AGE (YEARS)	41.72±9.13	41.225±8.23	42.87±9.14	.366
HEIGHT(CENTIMETERS	157.73±2.810	157.95±2.943	157.23±2.750	.685
WEIGHT(KILOGRAMS	64.05±4.771	65.60±5.574	65.90±5.266	1.450
DURATION (MINUTES	69.00±8.412	68.38±8.871	68.75±9.456	.951

Table 2 : Heighest Level of Sensory Block in Three Groups

HEIGHEST LEVEL OF SENSORY BLOCK	GROUP EVE5	GROUP EVE10	GROUP EVE20	STATISTICAL INFERENCE
T10*	**3**	**0**	**0**	Chi square 2 = 86.60P<0.001Highly significant
T9	0	0	0	
T8*	4	0	0	
T7	4	0	0	
T6	27	3	1	
T5	2	20	12	
T4	0	15	20	
T3	**0**	**2**	**7**	

*7 cases were excluded from the study and were not included in calculations

Table 3 Time to Achieve Blocks and their Regression Times

TIME IN MINUTES	GROUP EVE-5	GROUP EVE-10	GROUP EVE-20	STATISTICAL INFERENCE	
				F	P
TIME TO REACH HEIGHEST LEVEL OF SENSORY BLOCKADE	9.76±0.902	9.13±1.76	6.58±1.01	63.522	0.000
TIME TO REACH HEIGHEST LEVEL OF MOTOR BLOCKADE	8.91±1.10	8.28±1.34	6.08±0.86	66.833	0.000
TIME FOR SENSORY REGRESSION TO LI SEGMENT	154.09±11.42	147.00±10.30	145.12±14.16	5.372	.006
TIME FOR MOTOR REGRESSION TO BROMAGE 0	137.27±10.01	130.12±12.43	128.25±12.22	5.836	.004

	BONFERRONI'S 't' TEST			
	TIME TO REACH HEIGHEST LEVEL OF SENSORY BLOCKADE	TIME TO REACH HEIGHEST LEVEL OF MOTOR BLOCKADE	TIME FOR SENSORY REGRESSION TO LI	TIME FOR MOTOR REGRESSION TO BROMAGE 0
EVE5-EVE10	0.123	0.053	0.043	0.032
EVE 5 -EVE20	0.000	0.000	0.006	0.004
EVE10-EVE20	0.000	0.000	1.000	1.000

significance was found to be statistically significant between EVE 20 and the other two groups.

The mean time in minutes of sensory block regression to L1 was 154.09±11.42 in group EVE5, 147.00±10.30 in group EVE10 and 145.12±14.16 in group EVE20.The results were statistically significant. On post hoc analysis by Bonferroni's t test the EVE10 andEVE20 were found to be comparable.

The mean time in minutes to regression to Bromage 0 was 137.27± 10.007 in group EVE5, 130.12±12.43 in group EVE10 and 128.25± 12.22 in group EVE20.The results were statistically significant. Post hoc analysis by Bonferroni's t test found the difference to be statistically significant between EVE5 and the other groups.EVE10 andEVE20 were found to be comparable (*Tables 3, 4*)

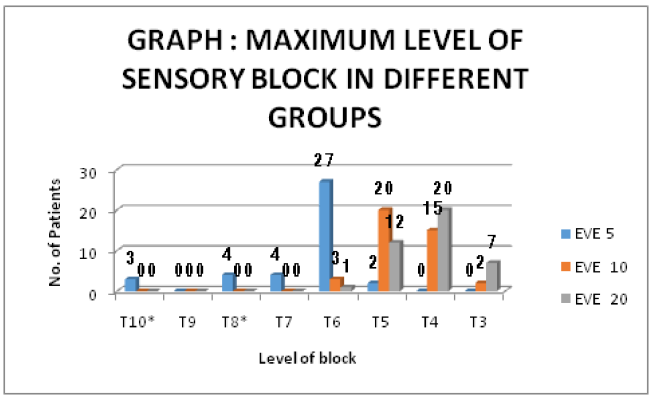
Discussion

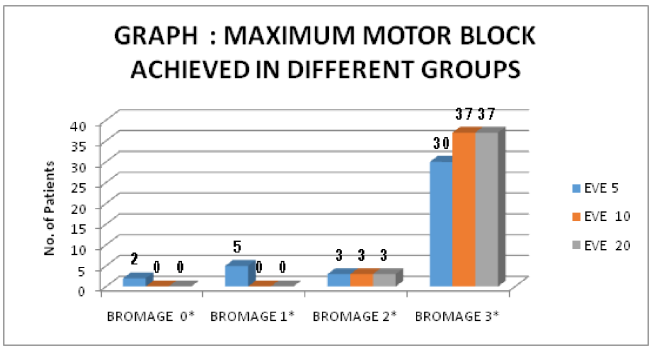
The present study was done to compare different volumes of normal saline for epidural volume extension in combined spinal epidural anaesthesia to find the optimal volume of saline to be injected in epidural space that is most efficacious.

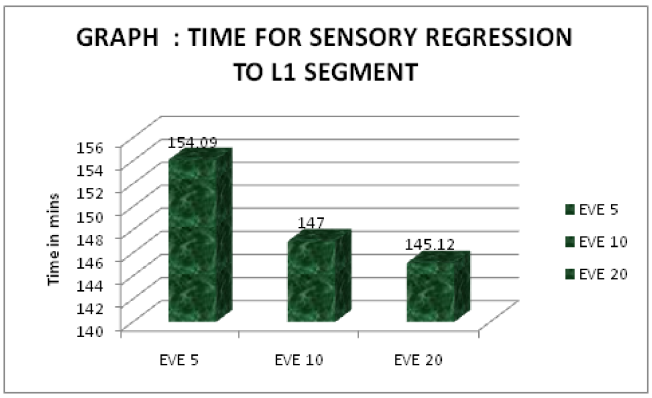
Our results show that although the block height increases from 5ml to 10 ml, yet further increasing the volume of saline injected epidurally does not prove to be advantageous in increasing the level of block.

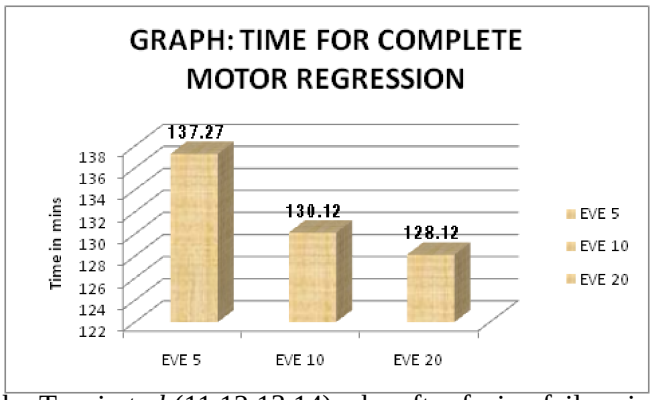
Our results are in partial harmony with the myelographic study (4) that showed that the upper level of the contrast medium in the subarachinoid space increased with every 5-mL epidural injection of saline thereby showing progressive compression of the intrathecal space with increasing volume of saline. This has also been documented by Hideyuki Higuchi (6) in their magnetic resonance imaging study.

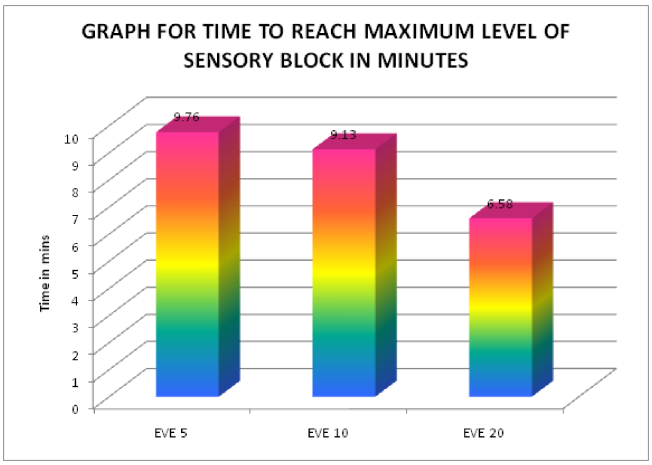
Steinstra *et al* (7) showed block augmentation with EVE but did not give any relevance to the volume injected. A similar study by Doganci *et al* (8) comparing multiple volumes of normal saline (0, 5 ml,10 ml,15 ml, 20 ml)for epidural volume extension also found the level of analgesia to be higher with administration of 5 ml of saline with no further change by increasing the saline dose. However, they used plain bupivacaine 0.5% in their study. Thus these studies are in contrast to our study which has shown











higher block levels with higher volumes of saline. Beale N *et al* (9), Loubert *et al* (10) in their respective studies failed to increase the level of sensory block with 7, 15 and 20 ml respectively. The possible explanation is that the blocks were performed in sitting position.Gravity might have counteracted the rostral spread of hyperbaric bupivacaine, thus affecting the EVE induced elevation of sensory block height in these studies . This was proved by Tyagi *et al* (11,12,13,14) who after facing failure in demonstrating the EVE effect in sitting position in 2009 designed their next study to investigate the effect of position on EVE. In 2011 they published their study wherein they declared that the CSE block should be performed in lateral position rather than in the sitting position for effective EVE. In our study all the blocks were performed in the lateral position.

In our study, 7 patients in group EVE5 did not have adequate sensory block and epidural top up had to be given . Whereas three patients attained adequate level after the top up, the other four had to be given general anaesthesia as they did not respond to the top-up. This may be the result of catheter malposition . However we consider this unlikely because in these patients for postoperative analgesia the epidural catheter functioned properly.

Mean time to reach maximum sensory level and maximum motor block was found to be statistically significant betweenEVE20 and the groups with lower volumes. The possible explanation for our findings is the different volumes of the saline injected.

The increase in height of the sensory blockade due to epidural injection of normal saline is not in proportion to

the time to regress to L1 segment, i.e higher the blockade achieved, shorter is the time taken to regress. The possible explanation to this fact is that since bupivacaine is not actually metabolised in the CSF, the action is only offset by reabsorption and circulation of CSF. In other words if the CSF mobilization becomes faster, the likely effect will last shorter (15).The injected volume in the epidural space raises the CSF pressure and enhances its reabsorption and thus the action offsets faster.

Doganci *et al* (8) revolutionarized the concept of epidural volume extension by introducing the term Ceiling effect. In this study time to regression to LI was significantly longer in patients receiving 15 ml. The difference between 10 ml and 15 ml groups was not statistically significant. Also, in case of the 20 ml group the difference in time to regression to LI was statistically significant with 0ml group only in addition to the 15 ml group. This study thus demonstrated the ceiling effect at 15 ml. In our study also the difference between EVE10 and EVE20 is not statistically significant. As already stated both these groups had significant differences with EVE5.

Whereas of the two studies comparing different volumes of normal saline in EVE Doganci *et al* (8) noted similar motor block duration among the treatment groups, the Steinstra *et al* (9) did not comment upon the motor block regression. Our study also showed faster motor recovery with higher saline groups.

The results of our study are consistent with the randomized controlled trial done by Lew *et al* (5) which is often quoted to support less motor block with EVE. Loubert *et al* (10) also observed less motor block with EVE. They attributed the failure of EVE applied to block performed in the sitting position to the entrapment of the hyperbaric bupivacaine into the sacral segments. As sacral roots do not contribute significantly to the motor function of the lower limb, the motor block was compromised. Bhandari *et al* (16) also reported significant faster motor recovery in their study. Gokce *et al* (17), however reported no change in time in motor block regression to Bromage 0 with EVE.

Despite the lower dose of bupivacaine used in our study hypotension was more common in EVE 20 . The higher levels of the block achieved may have attributed to these. Important to mention here is the high incidence of epigastric discomfort that the patients in the EVE5 group faced.

No procedure related complication was seen in our study.

Conclusion

In our study while EVE 10 and EVE20 groups were more or less equally efficacious, EVE 10 was better between the two, the reasons being the extreme rapidity of block progression in the latter group which may prove detrimental in severe cardiac cases. More side effects like hypotension in the 20 ml group EVE5 had 7 failures in our study. So weighing the pros and cons, we regard epidural volume extension with 10 ml of saline as the best choice

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