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STUDY OF EFFECT OF INTERMITTENT EPIDURAL INJECTION OF NORMAL SALINE ON DURATION OF MOTOR AND SENSORY BLOCKADE AFTER COMBINED SPINAL EPIDURAL (CSE) ANAESTHESIA. A PROSPECTIVE, RCT

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ABSTRACT

BACKGROUND: Prolonged motor and sensory block following Central Neuraxial Blockade (CNB) is associated with extended postoperative immobilization and its complications. Speedy recovery from motor blockade would improve the patients' acceptance of neuraxial anesthesia.

Previous studies in patients undergoing epidural anaesthesia, demonstrated rapid motor recovery after administration of epidural crystalloids.

We studied the effect of intermittent bolus injection of Normal saline (NS) on the duration of sensory and motor recovery after Combined spinal epidural anaesthesia (CSEA).

METHODS:60 patients (ASA I-III) scheduled for surgeries under CSEA lasting for 1½ to 2 hrs were divided equally by systematic random sampling at the end of surgery.

Control group - No bolus of NS flush was given through the epidural catheter.

Intervention group -15 ml of NS flush through epidural catheter was given thrice.

Sensory level, Motor blockade and vitals were noted at 5 min interval for 2 hours from end of surgery.

RESULTS:

1. Sensory levels in two groups were significantly different (p-value < 0.001) at the end of two hours. In intervention group, T8 level was predominant, while in control group L1 level was predominant.

2. Difference in motor block in two groups was significant as (p-value < 0.001). In intervention group, 86.67% had Bromage score 0, while in control group 80% had score 1 at the end of 2 hrs.

Conclusion: Postoperative epidural flush with 45 ml Normal saline hastened the motor recovery following CSEA without shortening of the duration of sensory blockade.

KEYWORDS : Epidural Flush, Motor And Sensory Recovery, Csea

INTRODUCTION:

Subarachnoid route of CNB alone has quick onset, but it has a finite duration of action. Epidural route alone has potential of increasing the extent or prolonging the duration of block, also it provides postoperative analgesia [1] but it has disadvantages of longer onset time, missed segments and inadequate muscle relaxation. In Combined Spinal Epidural Anaesthesia (CSEA) the advantage of both spinal & epidural anaesthesia are summated[2].

However, if motor and sensory block is prolonged following CSEA, it is associated with patient's anxiety, extended postoperative care unit stays, increased hospital costs, patient dissatisfaction, and following Cesarean sections delayed time to maternal and child bonding [3]. Early ambulation promotes the maximal level of functional independence before discharge [4].

Studies have demonstrated a more rapid motor recovery following the administration of epidural crystalloids in patients who have received Bupivacaine, Lidocaine [5] and Prilocaine epidural anaesthesia [6]. On literature review, we did not find any study on whether such a bolus would hasten the return of motor function following subarachnoid block or CSEA.

Our aim was to study the effect of epidural flush of normal saline on postoperative sensory and motor block in patients undergoing CSEA.

OBJECTIVE:

Primary:-

1) To observe recovery of motor block with and without epidural flush with normal saline.
2) To observe regression of sensory block with and without epidural flush with normal saline.

Secondary:-

1) To study effect of epidural saline flush on vital signs (Blood pressure, Pulse rate, Respiratory rate and Oxygen saturation).
2) To study incidence of side effects like backache, nausea,headache, vomiting and giddiness if any.

MATERIAL AND METHODS:

The study was conducted in the Department of Anesthesiology at our institute after the Institutional Ethics Committee's approval over a period of 2 yrs. This was hospital based, prospective, randomized controlled trial.

The data published by Johnson MD et al. (1990) was referred for sample size estimation. 26 patients per group would provide enough power in the study.4 patients were added to each group and final sample size taken was 60; 30 in each group.

Inclusion criteria were ASA I-III patients undergoing elective surgical procedures expected to last for 1½ to 2 hrs under CSEA, and having no history of backache, vertigo and migraine. The patients anaesthetized with drug other than Bupivacaine, patients showing any motor recovery at the end of surgery were excluded from study.

Preoperative assessment with necessary investigations was done. Patients were explained about CSEA and written informed consent was taken.

Patients were kept nil oral for 6 hours before surgical procedure. Preoperative blood pressure, pulse rate, SpO2, respiratory rate was noted.

Ranitidine 50 mg IV and Ondensetron 4 mg IV given as premedication . Level of insertion of epidural catheter and the dose of 0.5% hyperbaric Bupivacaine for SAB was as per choice of the anesthesiologist on the case. Buprenorphine 90 mcg was added to spinal Bupivacaine as additive. 0.25% Bupivacaine was used in increments of 4 cc in patients who required intraopearative epidural top ups for maintenance of surgical anaesthesia.

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At the end of surgery 60 patients who still had a complete motor block were randomly divided into two groups by systematic randomization method.

Control group (30) - No saline flush was given postoperatively through the epidural catheter.

Intervention group (30) - Patients received 15 ml of Normal Saline (NS) flush through epidural catheter thrice; each dose being injected over 1 minute.

1st dose at the end of surgery i.e, at 0 minutes and patient shifted to PACU after 5 mins. 2 nd dose was given after 15 minutes and 3 rd after 30 minutes from end of surgery. These were given in the PACU.

In PACU patients were observed for motor recovery by modified Bromage score and for sensory level by pinprick method using blunt 22 G hypodermic needle.

Modified Bromage score[7]

0: No motor block
1: Inability to raise extended leg; able to move knees and feet
2: Inability to raise extended leg and move knee; able to move feet
3: Complete block of motor limb

Blood pressure, pulse rate, respiratory rate, SpO2 and occurrence of nausea, vomiting, vertigo, headache or backache if any were noted. All observations were made up to 2 hrs at every 5 min interval. Patients were also questioned for headache, nausea, vomiting, vertigo or backache 6 hrs after shifting to ward.

Statistical methods used for analysis were, Chi-square test for sensory and motor block and t-test for BP, Pulse rate, Spo2 and respiratory rate. All the computations were performed using SPSS ver 20.0 (IBM Corp) software and the statistical significance was tested at 5% level.

RESULTS:

Table 1: Descriptive statistics of patients in two groups

Characteristics	Control	Intervention	P-value*
	(n=30)	(n=30)	
Age (in years) [Mean± SD]	46.83±10.29	44.80±9.11	0.421(NS)
Gender [No. (%)] Male Female	 2 (6.67) 28 (93.33)	 1 (3.33) 29 (96.67)	
			0.999(NS)
BMI [Mean ± SD] kg/m2	21.29±4.60	20.18±3.74	0.311(NS)

*Obtained using independent t-test and Chi-square test; NS: Not Significant

As seen in Table 1, the patients in the two groups were comparable.

Table 2: Distribution of patients according to sensory levels at the end of 2 hrs .

Sensory level by dermatome	Control	Intervention	P-value*
	(n=30)	(n=30)	
T_6	0	1 (3.33)	**< 0.001(S)**
T_8	0	16 (53.33)	
T_{10}	5 (16.67)	4 (13.33)	
T_{12}	3 (10.00)	3 (10.00)	
L_1	19 (63.33)	3 (10.00)	
L_2	1 (3.33)	2 (6.67)	
L_4	2 (6.67)	0	
Total	30	30	

Table 2 : The distribution according to sensory level in two study groups at the end of 2 hrs.

As seen in table 2, sensory levels in two groups were significantly different at the end of the study period as indicated by p-value < 0.001.

Table 3 : Sensory levels of patients showing increased level after epidural flush.

Patient	Level before intervention	Level at the end of 2 hours	Time of increase in mins
1	T_8	T_6	65
2	T_{12}	T_{10}	65
3	T_8	T_6	55
4	T_8	T_6	45
5	T_8	T_6	30
6	T_8	T_6	40

Table 4 : Distribution of patients according to modified Bromage at the end of 2 hrs.

Modified Bromage score	Control	Intervention	P-value*
	(n=30)	(n=30)	
0	0	26 (86.67)	**< 0.001 (S)**
1	24 (80.00)	2 (6.67)	
2	6 (20.00)	2 (6.67)	

*Obtained using Chi-square test; S: Significant

Table 4: The patients' distribution according to modified Bromage score in two groups.

The motor recovery of the patients in the study is seen in table 4. In intervention group, 26 (86.67%) patients had complete motor recovery. In Control group no patient had a score of 0, 24 (80%) patients had score 1 and 6 patients had a score of 2. Pearson's chi-square test resulted into a p-value < 0.001, indicating statistically significant distribution in two groups.

Table 5: Mean time taken for improvement in Bromage score

Bromage score	Time from 0 min Control	Time from 0 min Intervention
3	35 min	35 min
2	60 min	40 min
1	110 min	80 min

Table 6: Modified Bromage score in patients who received intraoperative top-up

	Control group (n=30)		P-value*	Intervention group (n=30)		P-value*
Epidural top ups→	Yes (n=8)	No (n=22)		Yes (n=12)	No (n=18)	
Modified Bromage score↓						
0	0	0	0.999 (NS)	12 (100.0)	14 (77.8)	0.215(NS)
1	6 (75.0)	18 (81.8)		0	2 (11.1)	
2	2 (25.0)	4 (18.2)		0	2 (11.1)	

*Obtained using Chi-square test; NS: Not Significant

Table 6 provides the distribution of patients with reference to intraoperative epidural top-ups and modified Bromage score at the end of 2 hrs in these patients. In treatment groups, 12 patients required epidural topups, of them 100% had modified Bromage score of 0. In control group, 8 patients required intraoperative epidural topup, out of which 6 (75%) had score of 1 at the end of 2 hrs.

DISCUSSION:

Persistence of motor blockade after CSEA can be a source of dissatisfaction to both patient and recovery room staff [8]. Also delay in motor function increases expenses as it increases PACU stay. In certain situations like traumatic needle placement at the time of initiation of block or in a patient who is on aspirin where resolution of neuraxial blockade is anxiously awaited, facilitation of its early resolution would be an advantage.

Gissen A.J, et al[9], shown that local anesthetic-induced neuroblockade can be reversed rapidly by washing isolated nerve preparations with crystalloid solutions. Also **Corke BC, et al** [10], demonstrated that washing rat sciatic nerve preparations with Krebs-Ringer solution

reverses bupivacaine induced neural blockade in approximately 25 min.

Johnson MD, Burger GA, et al [11] first studied the effect of washing the spinal nerve roots in the epidural space with crystalloids and concluded that postoperative injections of a crystalloid solution (RL or NS) via epidural catheter markedly shortened the duration of motor blockade resulting from epidural anesthesia with bupivacaine (0.75%) used for cesarean delivery. Although these injections attenuated motor blockade, they did not significantly shorten duration of sensory anaesthesia or postoperative analgesia. Further on there have been studies which demonstrated early resolution of motor blockade when epidural flushing was done with crystalloids after epidural anaesthesia[3],[4],[5],[7],[8],[10],[13],[14],[15]. Against these studies, **J.RodríguezV. Rodríguez,A.et al** [12] **and Couture D,Osborne l, et al** [13] did not find any clinically significant benefit of epidural flush on resolution of epidural blockade. All the above studies were in cases done under epidural anaesthesia.

In previous studies [3],[4],[5],[7],[8],[13],[10],[14],[15] dose of crystalloids chosen for epidural flush after epidural anesthesia was between 20 to 45 ml. **Sitzman BT, DiFazio CA, et al** [5] studied the effect of one or two boluses of 15ml NS in their study groups and no saline in the control group after epidural anaesthesia. They concluded that a more rapid recovery of motor and sensory block can be achieved with use of 30 ml NS epidural washout. **Chan VW, Nazarnia S et al** [14] in their study used 1ml, 20ml and 40 ml saline for epidural flush after 30 min of induction of epidural with 2 % lidocaine in 8 volunteers. Their data suggested that administration of a 40 ml bolus of sterile saline epidurally can facilitate regression of both sensory and motor block, but a 20 ml bolus does not.

In our study, **Table 2** shows comparison of sensory levels between the two study groups at the end of 120 min of the first dose of epidural saline flush. The predominant level of sensory block (T_8) was higher in the intervention group in control group (L_1).

Overall, in control group there was persistent regression of sensory level from the end of surgery. Sensory block in 19 patients out of 30 regressed to L1 from the end of surgery (i.e. from 'o' min to 120 min). The regression of sensory level in control group is significantly early (p-value<0.001) than intervention group in our study. Predominance of T_8 level in treatment group vs L_1 in control group mainly contributed to the difference. In the intervention group 6 patients out of 30 (20%) had an actual increase in sensory level after normal saline wash from the level at 0 min **Table 3**.

This finding is in agreement with the study conducted by **Johnson M.D, Burger GA, et al** [11], in their study, sensory dermatome levels were significantly higher in the NS group compared with the control group.In our study, the epidural flush (total 45 ml) hastened the motor recovery in the treatment group as compared to control group**.** This can be seen on comparison of time taken for improvement in Bromage score in the two groups **Table 5**. In fact at the discharge from PACU at 120 min only 2 patients in the intervention group versus 6 patients in control had modified Bromage score 2.

The probable mechanisms for enhanced recovery of neuraxial blockade after epidural flush with crystalloids could be varied, as discussed below.

The epidural space is filled with loose adipose tissue, lymphatics and venous plexuses. If the epidural space serves as a reservoir of local anaesthetic agent, which subsequently diffuses across the meninges to reach its ultimate site of action, then an epidural administered bolus would result in a dilution of remaining local anaesthetic reservoir. Additionally, rostral and caudal spread of dilute local anaesthetic solution within the epidural space could result in exposure of local anaesthetic to a larger venous and lymphatic surface area and hence greater vascular uptake[4,15].

Resolution of block starts when the neural tissue concentration of local anesthetic falls below the minimum blocking concentration (Cm) [16]. Thus the rate at which a given dose of local anesthetic is removed from the neural tissues and CSF within the subarachnoid space determines the duration of spinal anesthesia. Elimination does not involve metabolism of local anesthetics within the subarachnoid space, but occurs completely by vascular absorption within the subarachnoid and epidural space. The blood supply (and surface area for absorption) in the subarachnoid space is significantly smaller compared to the epidural space. Therefore, as local anesthetics diffuse along a concentration gradient from the nerve roots and spinal cord into the CSF, they similarly diffuse along a concentration gradient across the spinal meninges from the CSF into the epidural space with subsequent rapid vascular absorption. Elimination of local anesthetics by diffusion from the neural tissues to the CSF and then to the epidural space occurs simultaneously, with vascular absorption within both the subarachnoid space and epidural space [16].

Local anesthetic in the epidural space maintains nerve conduction blockade as a result of the net drug concentration effect on the spinal nerve roots and spinal cord. Redistribution of local anesthetic away from neural tissues that are already blocked determines the resolution of epidural anesthesia. Redistribution can be enhanced, directly, by decreasing the concentration of residual local anesthetic in the epidural compartment, or indirectly by increasing the extent of local anesthetic absorption into the epidural vasculature. 20–45 ml of saline can speed resolution of anesthesia by 40%-50 **%** [14].

Washout effect of saline may dilute residual unbound local anesthetic in the epidural space, thereby quickly decreasing local anesthetic concentration and reversing the concentration gradient required to penetrate the neural tissues. Alternatively, saline flush might reduce the epidural concentration by displacing local anesthetic through the intervertebral foramina into the paravertebral space [14]. Also, saline injection into the epidural space appears to augment both secretion and clearance of CSF, and may therefore enhance elimination of local anesthetic from the subarachnoid space [14].

The dilute solutions of local anaesthetic give more persistent sensory block rather than the motor block [4]. This explains the higher sensory blockade in the intervention group as compared to the control group even though the motor recovery after intervention was faster.

As seen in **Table 6**, the administration of epidural top-ups does not seem to affect the motor recovery. The difference in the Bromage score between the patients who received intraoperative epidural top-ups in either the control or the intervention group was statistically not significant.

There was no significant difference of blood pressure, and pulse rate, Spo2 and respiratory rate of patients at different time points in two study groups. This finding is agreement with the study conducted by **Attia J, Mohamed A** et al [4].

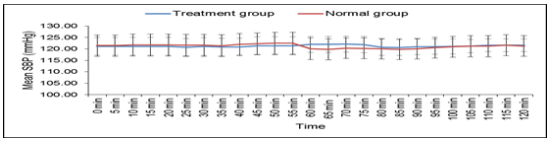

Figure 1: Line diagram showing mean systolic blood pressure according to time points in two treatment groups

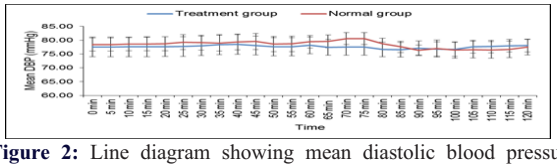

Figure 2: Line diagram showing mean diastolic blood pressure according to time points in two treatment groups

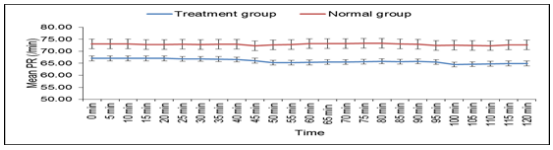

Figure 3: Line diagram showing mean pulse rate according to time points in two treatment groups

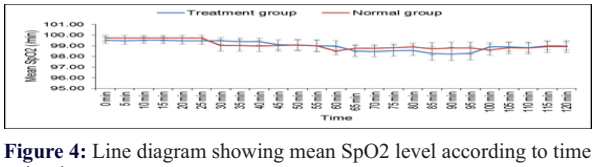

Figure 4: Line diagram showing mean SpO2 level according to time points in two treatment groups

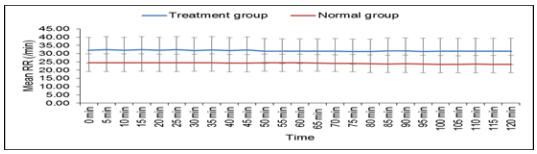

Figure 5: Line diagram showing mean respiratory rate according to time points in two treatment groups

In the present study, nausea was observed in 1 patient from treatment group who received epidural NS flush. She reported nausea from 25th minute and it lasted till 45th minute. We injected the normal saline in every dose manually over one minute. No mechanized device was used, so there is a possibility that in this particular patient the saline was given at a higher speed leading to increased pressure in the CSF. As observed by Higuchi et al [17], dural compression was observed immediately after epidural saline injection and persisted for at least 30 minutes. By this logic, in our patient increased pressure if it had occurred, should have lasted for 30 minutes after the third dose, i.e., till 60 minutes. But the patient stopped having nausea at 45 minutes without any pharmacological intervention. So we speculate that the nausea reported by the patient could have been due to other patient factors like propensity to have nausea, the Buprenorphine used etc. No patient had vomiting, headache, vertigo, and backache.

Rodriguez et al [12] found one patient in their study, which showed signs of raised intracranial pressure and hence did not recommend epidural washouts because of unwanted side effects. This patient belonged to the group which received epidural flush with normal saline 4 times the volume of mepivacaine used for epidural anaesthesia. The mean volume of saline injected in this group is 90±6.8ml. The other group in which epidural flush was given in this study received NS twice the volume of epidural mepivacaine, i.e., a mean volume of 44.9±4.4 ml. No patient in this group is reported to have shown signs of raised intracranial tension. The high volume of 90±6.8ml saline in the epidural flush may be a responsible factor for the signs of raised intracranial tension observed in the one patient mentioned. The volume of normal saline that we used in the epidural flush is very close to the 2 times group in the above study.

Increased epidural pressure can manifest as signs and symptoms of acute low back pain, par spinal muscle spasm, lower extremity radicular pain, nuchal pain, and headache [13]. No patient in our study reported any of these complaints even at 6 hours time point when the patient was visited in the ward to see whether they had any complaints.

Park, E. Y., Kil, H. K., et al [18] in their studies added fentanyl and **Attia J, Mohamed A et al** [4] added nalbuphine in epidural anaesthesia and then studied effect of postoperative epidural wash. Both authors have reported that the epidural washout did not shorten the postoperative analgesia. All our patients received 90 µg Buprenorphine intrathecally when subarachnoid block was induced as a part of CSEA. However, we did not study the postopearative analgesic requirement in our patients and so cannot comment on the epidural wash had any effect on the duration of postoperative analgesia conferred by intrathecal Buprenorphine, this is also a limitation of our study. Another limitation is that our study ended at 120 min (2hrs) after the end of surgery. Hence at this time 24 and 6 patients in the control group had a modified Bromage score of 1 and 2 respectively .In the treatment group 2 patients had a modified Bromage score of 1 and 2 each. We are unable to comment on the exact time taken by these patients to reach Bromage score of 0, though the regression of motor blockade has been shown to be statistically significantly earlier in the treatment group.

CONCLUSION:

Postoperative epidural flush with 45 ml Normal saline hastened the motor recovery following CSEA with 0.5 % bupivacaine and 90 µg Buprenorphine without shortening of the duration of sensory blockade.

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