Original Article

Comparison of median and paramedian technique of thoracic epidural anaesthesia in patients undergoing laparotomy under combined general and epidural anaesthesia – A prospective observational study

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ABSTRACT

Background and Aims: Most studies have found that lumbar epidural catheterisation is technically easier with a paramedian than median approach. There is scant literature comparing the two approaches to the epidural space in the mid-thoracic spine. This study aims to compare the median versus paramedian approaches in the location of epidural space in the T7–9 region in patients undergoing laparotomy under combined general and epidural anaesthesia. **Methods:** A prospective observational study was conducted after ethical approval and written informed consent on 70 patients undergoing major abdominal surgery. The patients received epidural analgesia either through a median or paramedian approach (Group M, $n = 35$ and Group P, $n = 35$). The primary objective was the incidence of successful epidural catheter placement in the first attempt. The secondary objectives were the overall success rate, the requirement of change of intervertebral space, approach or operator and complications associated with the procedure. **Results:** Sixty-seven patients were analysed. Epidural catheter was placed successfully in the first attempt in 40% of patients in Group M and 78.1% in Group P ($P = 0.003$). The overall success rate was 74.3% in Group M and 87.5% in Group P ($P = 0.223$). The number of attempts in Group M was more (one attempt 14, two 6, three 5 and four 1) as compared to Group P (one 25, two 2, three 1 and four 0) ($P = 0.014$). The incidence of complications was comparable between the groups. **Conclusion:** Epidural catheter insertion was technically easier in paramedian as compared to the median approach in T7–9 thoracic region with no difference in complications.

Key words: Analgesia, epidural, median approach, paramedian approach, thoracic vertebrae

INTRODUCTION

Thoracic epidural anaesthesia (TEA) along with general anaesthesia is used commonly in abdominal surgeries and is the gold standard for postoperative analgesia.[1] TEA improves postoperative gut function and reduces protein catabolism and is protective against postoperative pulmonary complications.[2] However, TEA, especially between T5 and T9, is technically more challenging than lumbar epidural due to acute angulation of the spine and narrow intervertebral spaces. There are two main approaches to epidural space – median and paramedian. A literature search revealed that most studies comparing the two approaches were done primarily in the lumbar region. In the lumbar region, the location of epidural space and insertion of the epidural catheter was easier in the paramedian approach. The incidence of catheter malposition and accidental dural puncture was also lower with the paramedian approach.[3,4] Even with

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ultrasound, imaging and access to the epidural space are better in the paramedian approach when compared to midline.[5,6] Information regarding the technique and complications of epidural catheterisation in the thoracic spine is limited, so the present study was performed. This study aimed to determine which of the paramedian/median approaches to the mid-thoracic epidural space is technically easier and associated with fewer complications. The primary objective of the study was to find the incidence of successful placement of the epidural catheter in the first attempt. The secondary objectives were to find the overall success rate, the requirement of change of either intervertebral space, approach or operator and any complications associated with the procedure such as paraesthesia, intravascular catheterisation, accidental dural puncture and patient discomfort.

METHODS

This prospective observational study was conducted from October 2018 to April 2019 in a tertiary care centre. The study was approved by the institutional ethics committee (no. EC/NIMS/2181/2018) and was carried out in accordance with the principles of the Declaration of Helsinki, 2013. A written informed consent was obtained for participation in the study and use of the patient data for research and educational purposes. Patients aged 18–60 years presenting to the department of surgical gastroenterology and oncology posted for major abdominal surgery with midline incision were included in the study. The choice of whether a midline or paramedian approach is to be used was done by simple randomisation. The procedure was initially performed by the same final-year anaesthesia resident. In case of failure, a senior consultant anaesthesiologist was called in for completion of the procedure. Patients were randomised into two groups: Group M had the median approach (*n*: 35) and Group P (*n*: 35) had the paramedian approach. A detailed history of present and past medical illness, anaesthesia exposure, past history of central neuraxial blockade (CNB) and experience of any complications along with concomitant history of drugs taken in the preoperative period were also recorded. Patients aged >60 years, patients with spinal deformities such as kyphoscoliosis on examination, patient with difficult CNB in the past, deranged coagulation profile and children and pregnant patients were excluded. The primary objective of the study was to find the incidence of successful placement of epidural catheter in the first attempt. The secondary objectives were to find the overall success rate, requirement of change of either intervertebral space, approach, operator or any complications associated with the procedure such as paraesthesia, intravascular catheterisation and patient discomfort.

After thorough pre-anaesthetic check-up, patients were pre-medicated with oral ranitidine 150 mg and alprazolam 0.25 mg the previous night at 10 pm and at 6 am on the day of operation. After shifting the patient to the operation theatre and establishing intravenous (IV) access, American Society of Anesthesiologists standard monitors were connected to the patient. Epidural anaesthesia was administrated with either a median or paramedian approach at the level of T7–T8 or T8–T9 intervertebral spaces. The procedure was performed in a sitting position. After strict aseptic precautions and skin infiltration of 2% lignocaine in the chosen epidural space (T7–8 or T8–9), the epidural space was located by either approach using loss of resistance to air technique. After identification of the epidural space with 18-G Tuohy needle, a 20-G catheter was passed and fixed at a level which leaves around 4–5 cm within the space (i.e., distance at which the space was located +4 cm). After the placement of catheter, a test dose of 3 ml of 1.5% lignocaine with 5 μg/ml of epinephrine was administered. The patient was asked to rate the discomfort associated with the procedure on the visual analogue scale with 0 as no pain and 10 as worst pain.

Data collected included incidence of success at the first attempt, overall success rate, number of attempts, change of intervertebral space, change from median to the paramedian and vice versa. Change of operator, length of the needle, incidence of paraesthesia, intravascular catheterisation, ease of passing catheter and patient discomfort during the procedure were also recorded. Haemodynamic parameters like heart rate, systolic blood pressure and diastolic blood pressure at 0, 5 and 15 min during the epidural placement were recorded. The patient was pre-medicated with fentanyl 2 μg/kg IV. General anaesthesia (GA) was induced with IV thiopentone sodium 5 mg/kg, and sevoflurane 2% and intubation of the trachea was done 3 min after administration of 0.5 mg/kg atracurium IV. Anaesthesia was maintained with isoflurane 1–2% and oxygen (50%), air, intermittent boluses of atracurium and fentanyl. An epidural infusion of 5 ml/h of 0.25% bupivacaine with fentanyl 2 μg/ml was started. After reversal of neuromuscular blockade with IV neostigmine 0.05 mg/kg and glycopyrrolate 10 μg/kg, the trachea was extubated and the patient was assessed

for pain relief with visual analogue score (VAS). VAS score of 4 or less at 2 h after extubation was considered as good pain relief. The study was discontinued after the assessment of adequacy of postoperative pain relief 2 h after extubation.

Sample size calculation was performed using power and sample size software by the NCSS-LLC Inc., (Number Cruncher Statistical System) assuming the incidence of successful epidural catheterisation on the first attempt as 60% in the median group and 90% in the paramedian group based on a pilot study done earlier by us on 10 patients in each group. Twenty-nine patients were required in each group to achieve a power of 80% with a significance of 0.05 using a two-sided *t*-test. Thirty-five patients in each group were enrolled (to account for the loss of accrual from the inability to complete the protocol or due to technical difficulty). Statistical analysis was performed with Statistical Package for Social Sciences by International Business Machines Corporation (IBM), New York, for Windows, version 20. Age and distance at which epidural space was located were given as mean and standard deviation. Success rate at first attempt and overall success rate was given as percentage incidence. The incidence of paraesthesia, blood in the catheter, dural puncture, ease of catheter insertion and patient discomfort were given as categorical data and analysed with Chi-square test. A *P* value <0.05 was considered statistically significant.

RESULTS

The total number of cases included in our study was 70 which were divided into two groups (Group M: 35, Group P: 35). Due to incomplete data, three cases in Group P were excluded. In the final analysis, 35 patients in Group M and 32 patients in Group P were included [Figure 1]. Both the groups were comparable with regard to the demographic data and the level of intervertebral space chosen [Table 1]. The epidural catheterisation was successful with the initial attempt in paramedian (78%) as compared to the midline approach (40%) (*P*: 0.003) [Table 2]. The requirement for change in the intervertebral space, change to alternate approach and change of anaesthesiologist was more in the midline approach though the statistical significance was not reached. The number of attempts in Group M was more (one attempt 14, two 6, three 5 and four 1) as compared to Group P (one 25, two 2, three 1 and four 0) ($P = 0.014$). After the change in approach in cases of the unsuccessful location of epidural space with the initial approach, of the 67 patients, 30 received epidural catheter via the midline approach and 37 via the paramedian approach. There was no difference in the incidence of paraesthesias, intravascular placement, accidental dural puncture and difficulty in negotiating the catheter between the approaches [Table 3]. Throughout the procedure, the haemodynamic parameters were stable in both groups [Table 4]. The patients tolerated the procedure with minimal discomfort (VAS <4) and had good postoperative pain relief with both midline and paramedian approaches.

DISCUSSION

The present study comparing median and paramedian approaches to thoracic epidural space observed that thoracic epidural catheterisation is technically easier in the paramedian approach. The epidural space in the T7–9 intervertebral spaces could be accessed with

Table 1: Comparison of the demographic data between Group M and Group P

Variables	Group M (*n*=35)	Group P (*n*=32)	*P*
Age in years (mean±SD)	45.50±12.857	47.50±12.517	0.544
Height (mean±SD)	159.37±9.583	157.37±9.156	0.412
Weight (mean±SD)	55.00±9.972	54.37±12.992	0.833
BMI (mean±SD)	21.73±4.201	21.90±4.656	0.885
Gender (male/female)	19/16	20/12	0.500
ASA status I/II/III	20/14/1	20/11/1	0.242
IVS			
T7-T8 (*n*)	15	12	0.422
T8-T9 (*n*)	20	20	

M: Median, P: paramedian, SD: standard deviation, ASA: American Society of Anesthesiologists. IVS: intervertebral space, T: thoracic, *n*: number of patients

Table 2: Details regarding the epidural placement in Group M and Group P

Variables	Group M (*n*=35)	Group P (*n*=32)	*P*
Success rate at first attempt *n*			
Yes	14	25	0.003
No	21	7	
Change of operator *n*			
Yes	11	6	0.182
No	24	26	
Change of IVS *n*			
Yes	11	5	0.109
No	24	27	
Change of approach *n*			
Yes	9	4	0.145
No	26	28	
Length of needle (cm) Mean±SD	4.47±0.860	4.33±1.269	0.636

M: Median, P: paramedian, *n*: number of patients, IVS: intervertebral space, SD: standard deviation

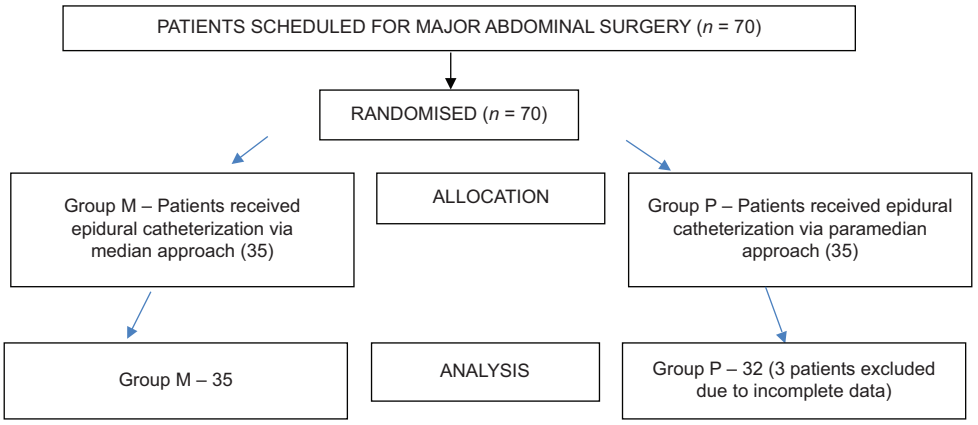

Figure 1: Consort flow chart

Table 3: The incidence of complications in Group M and Group P

Complication, *n*	Group M (*n*=30)	Group P (*n*=37)	*P*
Paraesthesia			
Yes	5	2	
No	25	35	0.134
Dural puncture			
Yes	0	0	
No	30	37	–
Blood in catheter			
Yes	2	0	
No	28	37	0.111
Difficulty in passing catheter			
Yes	30	36	
No	0	1	0.364

M: Median, P: paramedian, *n*: number of patients

Table 4: Comparison of the haemodynamic parameters between Group M and Group P

Variables	Minutes	Group M (*n*=30)	Group P (*n*=37)	*P*
HR mean±SD	0	88.4±19.60	85.2±14.44	0.479
	5	83.60±19.35	87.4±13.54	0.382
	15	82.33±16.18	89.63±15.04	0.076
SBP mean±SD	0	128.70±21.69	126.20±15.78	0.612
	5	126.07±24.74	128.07±15.67	0.809
	15	124.07±19.76	125.67±15.73	0.730
DBP mean±SD	0	76.53±10.51	73.97±10.80	0.355
	5	78.03±12.69	77.10±11.40	0.766
	15	76.00±11.38	77.17±12.09	0.702

M: Median, P: paramedian, *n*: number of patients, HR: heart rate, SBP: systolic blood pressure, DBP: diastolic blood pressure, SD: standard deviation

greater success on the first attempt and required fewer attempts in the paramedian approach.

A review article reported by GA McLeod expressed the opinion that in the mid-and high-thoracic regions, the paramedian approach is to be preferred. This is because the thoracic spine is more acutely angulated and the insertion of Tuohy needle through a small space makes the technique more difficult in the midline. This was an expert opinion and did not have any literature supporting the same.[7]

Several studies performed in the lumbar region found that the paramedian approach was superior to the median approach in the localisation of epidural space and catheter insertion.[8-10] The epidural space identification on the first attempt was easier and required fewer attempts in the paramedian approach.[8,9] A comparative study of both approaches by Leeda *et al*.[10] found that catheter insertion was faster in the paramedian technique. Podder *et al*.[11] in their study compared lumbar epidural catheter insertion patients with the spine flexed in the sitting position against patients with the unflexed spine. They found that even in the unflexed spine, the catheter insertion was less difficult in the paramedian approach. The ease of catheter insertion seems to be dependent on the angle of epidural needle puncture with success more assured when a needle is inserted at an angle of 50°–60° than when an angle of 90° is used in both thoracic and lumbar epidurals.[12] The epidural space was reached at more depth in the midline approach in our study, though not statistically significant. This may be due to the anatomy of the vertebrae in the mid-thoracic area. As the spinous process is more acutely angled, the needle needs to be inserted at an acute angle and traverse more distance to reach the epidural space in the midline in the thoracic when compared to the lumbar region. In contrast, the spinous process, the supraspinous and interspinous ligaments are circumvented leading to a more direct path in the paramedian approach.

There is evidence that the incidence of paraesthesia is more in the midline than the paramedian approach.[10,11] Leeda *et al*.[10] in the multivariate analysis of their data identified midline approach along with female gender

as risk factors for the development of paraesthesias. Paraesthesias may be reduced by injection of 10 ml of air before introduction of the catheter.[13] The incidence of paraesthesia is reported differently with the type of catheter used (44% in Portex catheter and 24% in Vas-cath catheter).[14] Paraesthesias rarely translate into permanent neurological injury (0.02–0.07%) but transient injuries are more common (0.01–0.8%).[15]Literature suggests that incidence of intravascular placement of catheter is higher in median approach.[8,11] In the present study too, the incidence of blood in the catheter was more in midline approach. Injection of 5–10 ml of saline before catheter insertion or removing the needle and performing a new placement are some measures to prevent intravascular placement.[16]

CONCLUSION

The success of locating epidural space on the first attempt was significantly more in the paramedian approach to thoracic epidural space in intervertebral spaces (T7–9) than the median approach. When comparing overall success in catheter placement, the number of attempts was significantly more in median approach. There was no difference in complications with good pain relief in the immediate postoperative period in both groups.

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Conflicts of interest
There are no conflicts of interest.

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