*Original Research Article*

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# A Prospective Observational Study – Epidural Catheter Insertion Site and Adequacy of Post-Operative Pain Relief in Children undergoing Thoracic and Upper Abdominal Surgeries

**Afroz Shahana M. Khan[1], Vijaya Prakash Patil[2], Azhar A. Quazi[3], Sunil Panigrahi[4]**

[1]Assistant Professor, Department of Anaesthesiology Critical Care, & Pain, [3]Senior Resident, Department of Plastic Surgery, Grant Medical College, Mumbai, Maharashtra 400008, India. [2]Professor, Department of Anaesthesiology Critical Care, & Pain, Tata Memorial Hospital, Dr E Borges Road, Parel, Mumbai, Maharashtra 400012, India. [4]Senior Resident, Department of Community and Family Medicine, All India Institute of Medical Sciences, Raipur, Chhattisgarh 492099, India.

**Abstract**

*Background and aims:* Effective postoperative pain relief from epidural analgesia has numerous benefits including earlier ambulation, rapid weaning from ventilators, lowered circulating stress hormone levels. Precise placement of epidural catheters ensures selective blockade of dermatomes affected by surgical procedure, allowing reduction of doses of local anaesthetics and additional analgesics. The aim of the study was to analyse efficacy of epidural analgesia in relation to distance between catheter placement and site of surgery. *Methods:* This was prospective observational study carried out for a year, total of 44 paediatric patients who underwent thoraco-abdominal surgery under general anaesthesia with epidural analgesia were considered and studied for general practice in our institute for epidural catheter placement, efficacy of epidural analgesia in relation to distance between catheter placement and site of surgery, complications of epidural catheter placement.Data were expressed as means (with standard deviations) and percentages (for categorical data). Unpaired t test and chi square test were used to compare continuous and categorical data respectively. *Results:* The total volume of local anaesthetic required in first 24 hrs postoperative in congruent group was 6.67±2.56ml/kg as compared to 8.60±2.938ml/kg incongruent group (p=0.025). In congruent group 16% of children required additional analgesic as compared to incongruent group where 36.84% of children required additional analgesics. *Conclusion:* Our study shows that putting the epidural catheter congruent to surgical incision required less of volume of local anaesthetic and additional analgesics and should be practiced preferably.

**Keywords**: Epidural Analgesia; Paediatric Patients; Congruent Group; Incongruent Group.

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## Introduction

Paediatric epidural analgesia [1,2], combined with general anaesthesia is an excellent technique for a balanced intra-operative anaesthesia and post-operative analgesia [3]. It decreases the requirement of intra-operative anaesthetic agents [4], enabling fast and smooth recovery. Precise placement of epidural catheters for continuous epidural anaesthesia ensures the dermatomes affected by surgical procedure to be selectively blocked, allowing for lower doses of local anaesthetics and sparing of unnecessary blockade in the regions where blockade is not desired [5,6]. Performing regional anaesthesia in children may be perceived as difficult because of risk of inadvertent cord injury as epidural catheters are inserted under anaesthesia. Also many anaesthetist believe that keeping longer length of epidural catheter inside the space will help reach the tip of the catheter near required dermatome level since there are no fibrotic bands inside epidural space in children as against in

**Corresponding Author: Vijaya P. Patil,** Professor, Department of Anaesthesiology Critical Care, & Pain, Tata Memorial Hospital, Dr E Borges Road, Parel, Mumbai, Maharashtra 400012, India.
E-mail: vijayappatil@yahoo.com

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adults. We hypothesised that congruent placement of epidural catheters will result in less amount of local anaesthetic to be given epidurally and better analgesia as against non-congruent placement of catheter.

## Methods

This was a prospective observational study. Subsequent to Institutional Research Board approval we enrolled all patients under the age of 12 yrs of American Society of Anaesthesiologist (ASA) risk I and II undergoing thoracic and upper abdominal surgeries over the period of 1yr. Patients of either sex above 12 yrs of age, those undergoing lower abdominal/ extremities surgeries, ASA grade III or IV patients, infection at site of insertion of epidural needle, coagulopathy or on anticoagulation therapy, vertebral deformities, refusal of parental consent for procedure were excluded. The demographic data obtained were age, weight, sex and primary surgery. Intra-operative data included the type of surgical procedure, anaesthetic technique and agents, attempts and difficulties encountered during epidural catheter placement. Data concerning the epidural catheter were recorded which included level of placement, amount of bolus epidural drug and infusion rate administered via the catheter, and technical problems for catheter placement, number of attempts, number of operators and experience of operator. After the conclusion of surgery all patientswere shifted to post-operative recovery room for monitoring. Postoperative data was collected by an independent observer who was blinded to the epidural insertion site. Child's back was dressed by using large sized gauze piece dressing so that assessor will not know site of catheter insertion. The parameters assessed in the recovery room included the quality of analgesia which was measured by pain score in immediate post-operative period and then every 8hrs till the epidural catheter was removed, total volume of local anaesthetic infusion, need for rescue analgesic or additional analgesia. If pain score was equal to or more than 3, rescue analgesic in form of intravenous (IV) fentanyl 1μg/kg was administered. The assessment of post-op pain was based on FLACC scale.

Data was expressed as means (with standard deviations) and percentages (for categorical data). Unpaired t test and chi square test were used to compare continuous and categorical data respectively. P value less than 0.05 is considered significant.

## Results

A total of 44 patients with ASA physical status I or II who underwent thoracic and upper abdominal surgeries were included into study. We divided patients in two groups based on difference of dermatome segment between insertion of epidural catheter and the midpoint of dermatomes involving surgical incision.Out of 44 patients 25 patients got epidural catheters which were inserted within 2 spaces (57%) from midpoint of dermatomes to be covered as against 19 patients had epidural catheter insertion site further away (43.18%). When catheter was inserted by anaesthetist experienced in paediatric epidural catheter insertion 61% times catheter insertion site was congruent as against only 50% times it was congruent when inserted by less experienced anaesthetist.

These two groups were compared with respect to minimum and maximum pain score on day 0 and day 1, volume of local anesthetic per kg required on day 1and additional analgesic required for adequate pain relief during first 48 hours. The total volume of local anaesthetic required in first 24 hrs post-operative in group where epidural catheter was inserted within 2 segments from incision was 6.67±2.56ml/kg as compared to 8.60±2.938ml/kg in group where epidural catheter was inserted at distance more than two segments from incision. This was statistically significant (p .025).

**Table 1:** FLACC Scale

| Categories | Scoring | | |
|---|---|---|---|
| | 0 | 1 | 2 |
| Face | No particular expression or smile | Occasional grimace | Frequent quivering |
| Legs | Normal position/relaxed | Uneasy restless | Kicking |
| Activity | Lying quietly | Squirming shifting back and forth | Arched , rigid |
| Cry | No cry | Moans/whimpers | Crying steadily |
| Consolability | Content, relaxed | Reassured by touching | Difficult to console |

In group where epidural catheter was inserted within 2 segments from incision significantly less number of children required additional analgesic (16%) as compared to group where epidural catheter was inserted at distance more than two segments from incision (36.84%).

**Table 2:**

| | Less than 2 segments | More than 2 segments | P value |
|---|---|---|---|
| Total volume of local anaesthetic per kg required in first 24hrs | 6.67±2.563 | 8.60±2.938 | .025 |

In the group where epidural catheter was inserted at distance more than two segments from incision, day 0 maximum and minimum pain score was 3.47±1.67 (mean±SD) and 1.58±0.67 respectively as compared to group where epidural catheter was inserted within 2 segments from incision in whom day 0 maximum and minimum pain score was 2.63±0.69 and 1.21±0.37 respectively which was statistically significant (p .045)

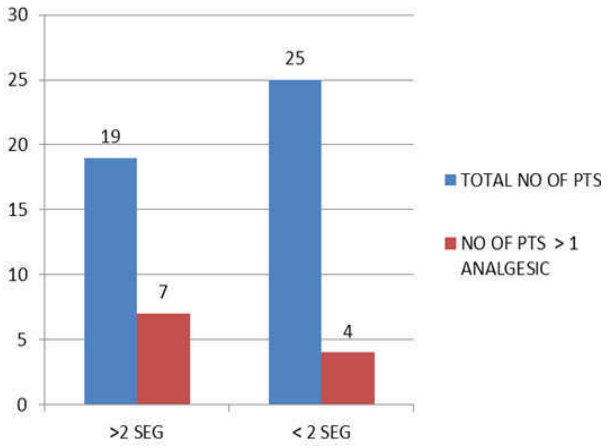


**Fig. 1:**

In the group where epidural catheter was inserted at distance more than two segments from incision, day 1 maximum and minimum pain score was 2.84±1.25 and 0.88±.72 respectively as compared to group where epidural catheter was inserted within 2 segments from incision in whom day 0 maximum and minimum pain score was 2.79±.98 and 1.00±.67 respectively which was statistically insignificant.

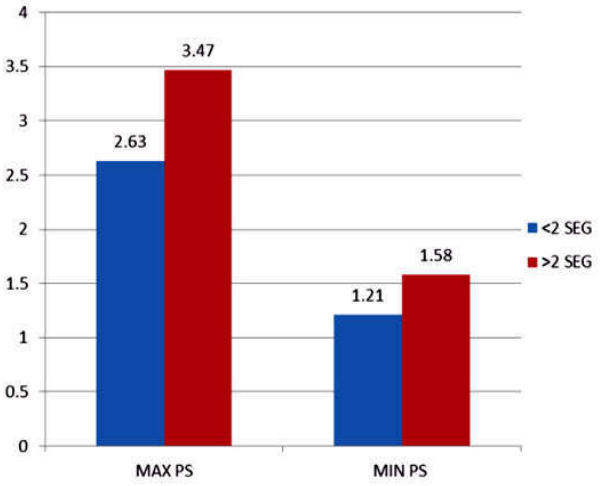


**Fig. 2:** Pain score on pod 0

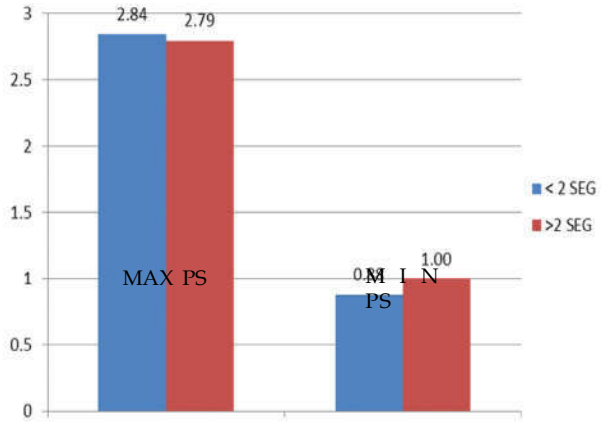


**Fig. 3:** Pain score on pod 1

## Discussion

In this prospective observational study epidural catheter insertion site and adequacy of post-operative pain relief in children undergoing thoracic and upper abdominal surgeries was assessed by the requirement of total volume of local anaesthetic infusion, need for rescue analgesic and or additional analgesia.

Several investigators have reported on the use of the caudal or lumbar approach for thoracic epidural anaesthesia. Bosenberg et al reported on the use of the caudal route [8]. Their study consisted of three parts: (1) a human cadaver study to determine feasibility of passing a catheter through the sacral hiatus to the thoracic epidural space, (2) an animal study to determine any potential trauma

to the canal, and (3) a human study on patients requiring biliary tract surgery. The results in their human phase were excellent. In 19 out of 20 cases the epidural catheter was placed within one vertebra of the desired level. However this human study was done in infants ranging from 2.7 to 6.5 kg. On 14 occasions some slight resistance to the passage of the catheter was encountered but that passage was successful with minimal flexion or extension of the infant's spine.

Gunter and Eng investigated the feasibility of placing thoracic epidural catheters through the caudal approach in children from 1 to 10 years of age [9]. In 20 patients studied, the radiographically determined catheter tip position was within two vertebrae of the target position in 17 of the 20 subjects. However, theses authors used catheter with stylets. Their study concluded that it is possible to use the caudal approach to thoracic epidural anaesthesia in children as old as 10 years.

Blanco et al reported on their series of thoracic epidural anaesthesia through the caudal space [10]. They studied 47 children up to 8 years age. They used an 18 G Tuohy needle and a catheter without a stylet. The $L_4$-$L_5$ area was reached in 46 of 47 children but only in 16 (30%) the targeted $T_{10}$-$T_{12}$ area was reached. They also found that age was a limiting factor because, in their children over 1 year of age, the level of success decreased significantly. In their study on using the lumbar approach for thoracic epidural anaesthesia in infants and children, out of 39 patients studied, the catheter tip reached $T_{10}$-$T_{12}$ in 7 patients, $L_2$ in 1, $L_3$ in 8 and $L_4$-$L_5$ in 23. Forty-eight percent of the catheters that were easily advanced remained at the $L_4$-$L_5$ level [11]. Thus concluding that easy insertion of catheter is not the reliable sign of epidural catheter having reached at desired site [11].

In our group of patients we did not use radio-opaque catheters so we could not ascertain the position of tip of catheter. Instead we used inadequacy of pain relief as seen by requirement of additional analgesic and requirement of large volume of LA to achieve desired band as surrogate marker of catheter positioning. We found that patients who had incongruent catheter insertion 37% children required 2 additional oral analgesics suggesting inadequate epidural analgesia probably due to incorrect position of catheter tip and 52% patients required very large volume of local anaesthetic drug to achieve required band of anaesthesia. These findings suggest that in around 52% patients the catheter did not reach desired site. We cannot compare our results with any other study as no study in literature has used this methodology. Since we had used lumbar route and not caudal for epidural catheter insertion we may compare our results with Blancos second study [11] that used lumbar approach for thoracic in which only around 20% catheters reached the desired site. We had better rates of adequate catheter positioning as seen clinically in that 48% patients probably had desired position and this difference in findings may be due to significant number of catheters were actually placed in lower thoracic region.

Another major issue of placing thoracic epidural catheter under anaesthesia is safety. Retrospective review of three years involving 63 patients done by D. Tobias and colleagues showed that placing direct thoracic epidural catheter is feasible and quite safe in experienced hands and technique can be easily taught [12].

We did not find any incidence of nerve injury in our study population however our patient number was very small to draw such a conclusion and all epidural catheters were placed by highly experienced anaesthetists or under direct supervision of experienced anaesthetist.

Our study shows that putting the epidural catheter congruent to surgical incision required less of volume of local anaesthetic and additional analgesics and should be practiced preferably.

## Conclusion

Placing epidural catheter congruent to surgical incision required less volume of local anaesthetic per kg in first 24hrs and needed less additional analgesic for adequate pain relief as compared to patients in which epidural catheter was not congruent.

*Prior Publication:* Nil

*Support:* Nil

*Conflicts of Interest:* Nil

*Permissions:* Nil

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