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Original Research Article

Assessment of Skin to Epidural Distance in Children

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Abstract: Performing lumbar epidural anaesthesia in children to provide analgesia in peri-operative period requires meticulous technique and have increased success rate if we can predict the distance from skin to posterior epidural space. The main purpose of this observational study is to measure skin to epidural distance (SED) in lumbar region in Indian children and to determine whether there is any correlation with age, weight, height of the children. Epidural space is identified by using loss of resistance (LOR) to air. The distance from the tip of the needle to the point where we encountered LOR is measured. We have analysed 52 children who received lumbar epidural anaesthesia for various surgeries. Strong correlation was noted between age, weight, height and SED and of all the variables weight has the strong prediction. We derived predicted equation based on the correlation between variables.
Keywords: epidural anaesthesia, skin to epidural distance, correlation, predictor equation.

INTRODUCTION

Provision of adequate analgesia for children in post-operative period is a challenging task. Of various options available, [1] epidural analgesia takes the highest preference in view of its safety profile [2] and efficacy. Often epidural space in children is approached through caudal route, and catheter is threaded to provide continuous analgesia. But this method has its own disadvantages, in form of catheter tip dislocation, [3] infection etc. with availability of smaller gauge needles, there is an increasing trend of approaching posterior epidural space from thoracic and lumbar regions to avoid the problems. The knowledge of skin to epidural distance is helpful in improving the success of the block.

Although various formulae have been derived to estimate the approximate depth of epidural space from skin, most of them were from western population, which we cannot imply to Indian population due to obvious reasons. Hence we undertook a study to assess the skin to epidural distance in children in our hospital.

METHODS

After obtaining institutional ethical committee approval, all children who received epidural anaesthesia concomitant with general anaesthesia were included in the study, all of them underwent a thorough pre anaesthetic check-up. Children with history of coagulation abnormalities, spine deformities, and with parental refusal were excluded from the study. On the day of surgery, children were wheeled in to the operating room after giving premedication with inj midazolam 0.03mg/kg intravenously. All children received general anaesthesia, and airway secured with appropriate sized endotracheal tube before the procedure. Children were turned to lateral decubitus position, land marks identified and draped. Epidural space was identified by using loss of resistance to air technique through midline approach. 19 G tuhoy needle with 22 G catheter was used in children less than 10 kg and 18 G needle with 20 G catheter was used in above 10 kg children. The needle was advanced with left index finger and thumb and continuous pressure was exerted on syringe with right thumb. Once loss of resistance is encountered, the needle is fixed firmly and distance from the skin is marked. After identification of the space catheter was inserted and needle gently pulled out. The distance from the tip of needle to the marking is measured using standard scale and documented. Intra operatively 0.25% bupivacaine was given at the rate of 0.3ml/kg and half of the dose was repeated after every 90 minutes. Post operatively children were shifted to paediatric intensive care unit and received continuous infusion of 0.0625% bupivacaine along with fentanyl 1 microgram/ml to provide analgesia.

RESULTS

A total of 52 children were included in the study, of which 7 were female and remaining were male. The lowest age of the children who received epidural in the study is 4days and highest age is 11 years. The age, weight, height, of the children are documented along with skin to epidural distance. Raw data was entered into Microsoft excel sheet and is analysed by using windostat version 9.2®. The relationship between the variables and SED was evaluated by using linear regression analysis. We derived the formula to predict the skin to epidural distance in paediatric patients. The correlation between individual variables are tabulated under (table1).

Table 1: correlation matrix of the variables with skin to epidural distance in children

	AGE IN YEARS	HEIGHT IN CMS	WEIGHT IN KGS	ACTUAL SED IN CMS
AGE IN YEARS	1.00000	0.95118***	0.91840***	0.82190***
HEIGHT IN CMS		1.00000	0.93218***	0.82858***
WEIGHT IN KGS			1.00000	0.89220***
ACTUAL SED IN CMS				1.00000
Significance levels	0.05	0.01	0.005	0.001
If correlation r=>	0.27324	0.35413	0.38358	0.44318

*** Strong correlation

The mean age of the children in the study group is 3.1540 years and mean skin to epidural distance is 1.532 cmsR value = 0.8219. It is inferred from the study that skin to epidural distance depends on age of the children and as R value is greater than 0.5 hence it is strong correlation. The correlation between age of the children to SED represented under (Fig-1).

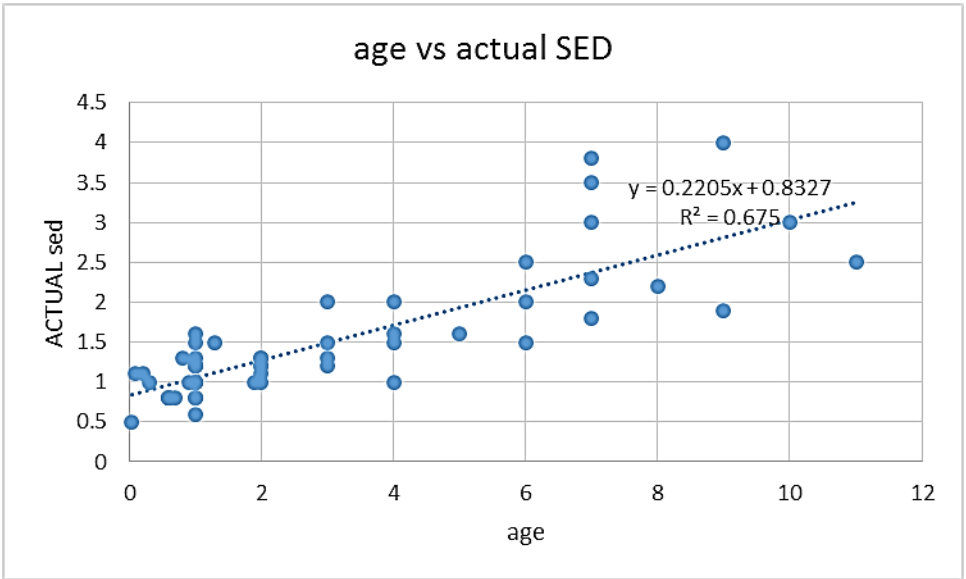

Fig-1: correlation between age of the children and SED

The mean body weight of children in the group is 12.661 kgs and mean SED is 1.532cms R = 0.8922 It is inferred from the study that weight of the children has also strong correlation for the skin to epidural distance. The correlation between body weight and SED represented under (Fig-2).

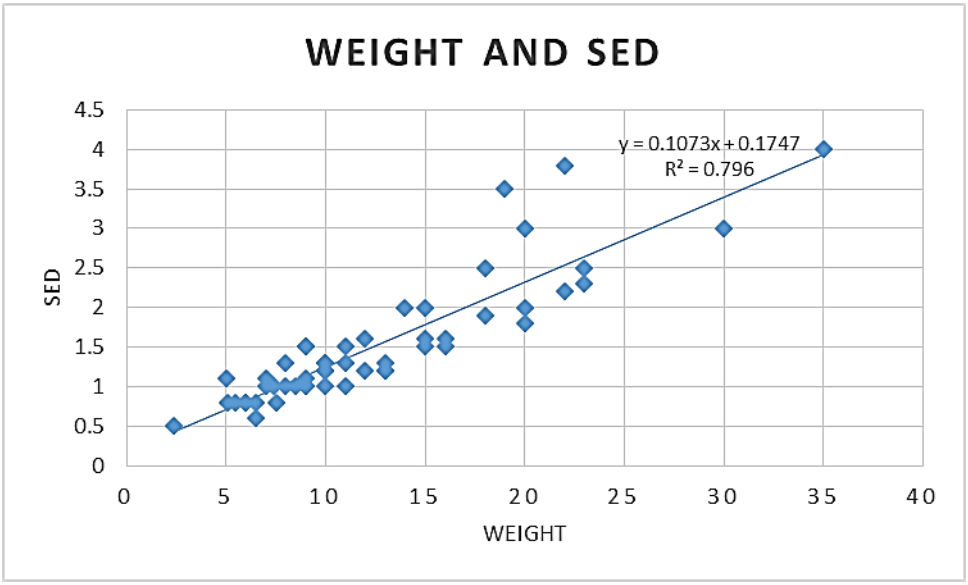

Fig-2: correlation between weight of the children and SED

The mean height of children in the group is 88.769 cms and mean SED is 1.532cms R =0.8286 it is inferred from the study that height has also has strong correlation with for skin to epidural distance. The correlation between height and SED represented under (Fig-3).

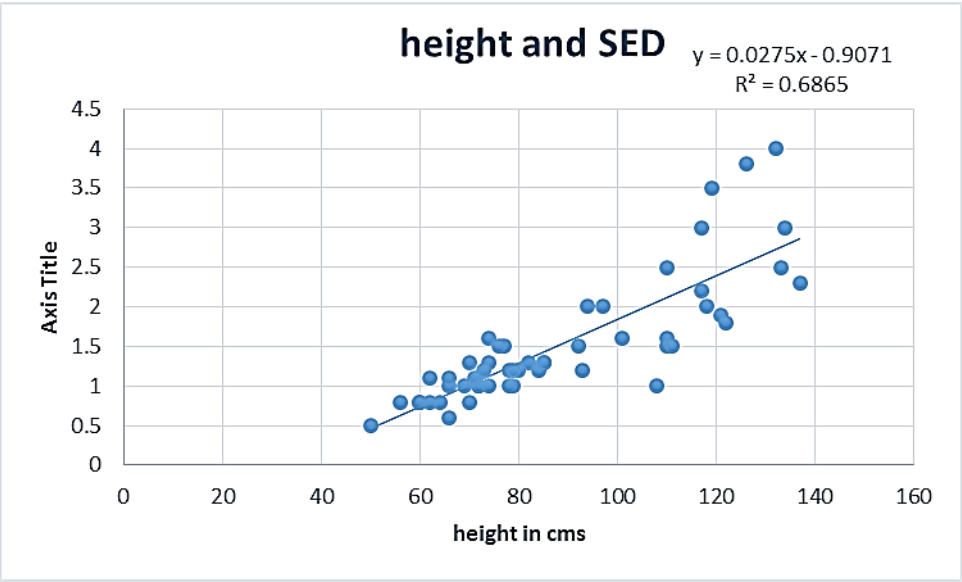

Fig-3: correlation between height of the children and SED

The following prediction equation can be derived from the study data
Individual Regressors
Actual SED in cms = 0.8406 +0.21943 x age in years (t value =10.2024)
Actual SED in cms= -0.9071 +0.02748 x ht.in cms (t value =10.4646)
Actual SED in cms = 0.1747 +0.10725 x wt.in kgs (t value =13.9685)

DISCUSSION

Even though not a new procedure, [4] paediatric epidurals remain as an underutilized modality for pain relief [5]. Precise placement of epidural needle with catheter ensures that dermatome that is involved in noxious stimulus is blocked with lower doses of local anaesthetic. The best strategy for improving success of the epidural is to have skilled and experienced anaesthesiologist who is aware of predictability of the depth of epidural space in children.

Of 52 surgeries done in the children, 35 were urological procedures, 2 were thoracic surgeries, 4 upper gastro intestinal surgeries, and 11 were lower abdominal surgeries. In all cases we have inserted epidural catheter in the lumbar region (L1-L5 level), in cases of, upper abdominal surgeries and thoracic surgeries epidural catheter was inserted at L1-L2 level and after identification of the space 4-5 cms of catheter was left insitu. In cases of urological and lower abdominal surgeries lower level (L3-L4 or L4-L5) was chosen and 3- 4 cms of catheter was threaded into the space.

Several formulae have been described to predict the depth of epidural space in children, a well-known formulae that was described by Bosenberg *et al* [6], they have measured SED in lumbar region in 274 children. Good correlation was demonstrated between age and weight of the children with SED in children's between 6months and 10 years. Our study also demonstrated strong correlation between weight and SED (R value 0.8922). Majority of the children in our study group also between the same age group and more over our study also demonstrated strong correlation between age and SED, but of all variants weight of the patient has strong correlation with SED. Hence we concur to the recommendation given by Bosenberg that weight is strong factor in predicting depth of SED.

Epidural space is identified after induction of general anaesthesia in all children. Even though there are concerns regarding safety of insertion of epidural needles while patients are under general anaesthesia [7], none of our patients had neurological deficits. Moreover it would be impossible to make child cooperative for the procedure without deeper levels of sedation.

In another study conducted by umera *et al* [8] who measured SED in 355 children, by using micro drop infusion technique to identify epidural space. They noticed significant correlation between weight and SED. Of various methods for locating epidural space we have adopted loss of resistance to air due to the familiarity of the technique by the author.

In all the cases epidural space is approached by midline approach only. Children in whom epidural space is identified through para median method were not included in the study because it will falsely increase the distance from skin to the space. Post-operative pain was assessed by physiological monitoring of vitals in neonates and infants and by wong baker scale and level of discomfort expressed by older children or their parents.

Good correlation was also observed between skin to epidural space for both age and weight of the children in a retrospective audit done by P. Dalal *et al* [9] and also in observational study by M. A. Hasanetal [10]. Which is in coherence with our study.

Jane m peutrell *et al* [11] by using MRI calculated distance between skin to anterior aspect of ligamentum flavum found that SED correlated with weight post-conceptional age and length of the child. They have calculated the perpendicular distance between skin to the epidural space, hence we recommend that whenever CT or MRI films are available in children in perioperative period, they can also provide valuable information regarding SED.

Although techniques like ultra sound [12], stimulation [13] are available for precise placement of epidural catheter, these are not routinely available and more over they can help in assisting the localisation of catheter. The most critical point in identifying the epidural space is appreciation of LOR while piercing ligamentum flavum, even though there is lot of inter individual variability in appreciation of feel of ligamentum flavumpiercation our study will be helpful in guiding precise placement of epidural catheter.

CONCLUSION

In conclusion, even though there can be lot of variability among children, weight age and height are the three important factors which have significant correlation for SED. Among these three variables bodyweight of the child is the better predictor of SED.

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