THE RELATIONSHIP OF SKIN TO EPIDURAL SPACE DEPTH WITH DIFFERENT PHYSICAL PARAMETERS IN OBSTETRIC PATIENTS

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ABSTRACT

Objective: The objective of the study was to find out the correlation between the skin to epidural space depth and different physical parameters like age, height, parity, weight and Body mass index in obstetric patients.

Study Design: Prospective non-probability purposive correlational study.

Place and Duration of Study: This study was conducted in Department of Anaesthesia and Intensive care, Combined Military Hospital, Quetta, over duration of one year from may 2005 to April 2006.

Patients and Methods: This was prospective correlational study and total of 100 obstetric patients belonging to ASA-I and II class were included. All patients received epidural anaesthesia with 16/18G Tuohy's needle and an epidural catheter was passed at the level of L3-L4/L4-L5 interspace. The skin-to-epidural space depth was marked on the Tuohy's needle with a marker and was subsequently measured with a scale.

Results: This study was conducted on parturients undergoing Caesarean section having ages between 18-40 years with mean 27.27 + SD 4.90 years, weight between 44-92 kg with mean 62.73 + SD 9.37 kg, height 142-166 cm with mean 153 + SD 5 cm, parity between primigravida to gravida 9 with mean 2.43 + SD 2.24 and body mass index of 19-38 kg/m2 with mean 27 + SD 4 kg/m2. The skin-to-epidural space depth ranging between 31 mm to 78 mm with mean of 41.59 + SD 6.49 mm was noted. Pearson correlation coefficient for the relation of skin to epidural space depth with patient's age was r=0.317 (p=0.001), with weight was r=0.618 (p=0.0001), with height was r= -0.004 (p=0.966), with body mass index was r=0.623 (p=0.0001) and with patient's parity was r=0.210 (p=0.028).

Conclusion: It was concluded that the skin-to-epidural space depth had statistically significant strong correlation with weight and body mass index but statistically significant weak correlation with age and parity, and statistically insignificant correlation with height.

Keywords: Obstetric anaesthesia, epidural anaesthesia, weight, height, age, parity and body mass index

INTRODUCTION

Obstetric anaesthesia is absolutely demanding but one of the gratifying sub-specialty of anaesthesia. The American Society of Anaesthesiologists and the American College of Obstetricians and Gynecologists recommend that the anaesthetist be readily available for labor analgesia and that Caesarean section (C-section) should be started within 30 minutes of the recognition of its need [1].

The regional techniques employing the epidural or intrathecal route, alone or in combination (Combined spinal epidural) are currently the most popular (almost 80%) methods of pain relief during labor and C-section [1]. These techniques are preferred because general anaesthesia is associated with higher maternal mortality [1]. Other advantages include an awake mother at birth of her child with a decreased risk of pulmonary aspiration, less neonatal exposure to potentially depressant drugs and post-operative pain relief.

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Received: 22 Feb 2007: Accepted 13 Aug 2007

The epidural anaesthesia is preferred over spinal anaesthesia because of less or no motor blockade, less and gradual hypotension and post-operative analgesia. But the incidence of "Wet Tap" in obstetric patients is very high (about 1-4%) [1] that may lead to "Post dural puncture headache" and neurological sequelae [2]. The depth of epidural space from the skin surface varies at different levels of the spinal column in the same patient and also varies from patient to patient at the same vertebral level [3].

The hormonal effects of pregnancy on the body like weight gain, softening of tissues/ligaments, and the collection of fat and positive pressure in the epidural space make its identification a difficult procedure.

There is some inter-relationship between age, height, weight and epidural space depth in different ethnic and patient populations [4-7]. By determining more precise correlationship between physical parameters like age, weight, height, body mass index and parity, we may predict the epidural space depth and help avoid its complications [8].

Lots of work has been done abroad to measure the epidural space depth with the help of Ultrasonography [9,10]. Computed Tomography scan [11], and Magnetic Resonance Imaging techniques [12,13]. In Pakistan no/less work has been done on finding out the correlation of the skin to epidural space depth with different physical parameters in obstetric population since we lack such sophisticated techniques. More work needs to be done in our country, in this field keeping in view our resources so that our society be benefited as much as possible.

The main objective of the study was to find out the correlation of skin to epidural space depth with different physical parameters like age, parity, height, weight and Body mass index in Pakistani obstetric population.

PATIENTS AND METHODS

This prospective correlational study was conducted in department of Anaesthesia and Intensive Care, Combined Military Hospital, Quetta, over duration of one year. After approval from the ethical committee, one hundred Pakistani obstetric patients, enlisted for elective Caesarean Section and willing to participate, were selected by non-probability purposive sampling. The criteria of selection were based on the clinical condition of full term pregnancy with ASA-I and ASA-II status.

All enrolled patients were free of any neurological disorder. Patients suffering from diseases of the spinal canal, low back pain, and prior back surgery at the site of injection, coagulation defects; morbid obesity; cardiovascular diseases like severe mitral and aortic valve stenosis or any other concurrent medical illness were not enrolled in the study.

The epidural puncture was performed either by the consultant anesthetist or the anesthesia resident (under supervision). All the staff had prior experience of handling epidural, spinal and combined spinal-epidural techniques.

The procedure of epidural anaesthesia was explained to the parturients and informed written consent was taken. The name, date, hospital registration number, age, weight, height and parity of all selected parturients were noted on the study proforma. The body mass index of the patients was then calculated by the following formula and was noted on the proforma.

$$\text{Body mass index} = \frac{\text{Weight (kg)}}{\text{Height (meters)}^2}$$

An automatic non-invasive blood pressure monitor took a baseline heart rate and left brachial artery blood pressure. All parturients were passed 18G intravenous lines and were preloaded at the rate of 10 ml/kg 15 min prior to epidural injection. The patients were placed in left lateral position during infusion or supported with wedge placed under right hip.

The patients were then placed either in left lateral or sitting position considering the choice and convenience of the patient on the operation table before instituting the epidural anaesthesia. Under strict aseptic conditions,

the L_{3-4} or L_{4-5} inter-vertebral space was identified by applying the knowledge of surface anatomy. A 16/18 gauge, 8 cm long Tuohy's needle with 1 cm spaced markings and a huber bevel tip (Portex Ltd U.K), was inserted in the midline of the interspace as determined by standard landmarks, at a right angle to the skin and in a plane parallel to the surface of the surgical table. The needle was advanced to about 2 to 2.5 cm until it was fixed in the interspinous ligament.

The epidural space was identified by loss of resistance technique and the needle was judged to have entered the epidural space when initial loss of resistance to air was observed. Keeping the bevel of the needle cephalad, an 18/20 gauge polyamide closed tip catheter with three lateral openings was passed to cover at least four vertebras and the needle was removed. In some patients where urgent delivery of fetus was required, combined spinal epidural was also given.

The skin to epidural space depth was measured by applying a line with the help of a marker on the Tuohy's needle near the skin and it was measured with the help of a scale afterwards and noted down on the proforma. Afterwards the patient was placed in supine position on operation table with 15˚ wedge placed under right hip to avoid aortocaval compression. A continuous monitoring of heart rate and blood pressure as well as the level of anaesthesia was done. Injection ephedrine i.v. was given in the form of 5 mg boluses whenever hypotension was encountered. All patients were monitored in post-op period in recovery room for post-op pain and hypotension.

STATISTICAL ANALYSIS

The SPSS version 11 was used to analyze the data. The descriptive statistics were used to measure the mean, standard deviation, minimum, maximum and range of the age, height, weight, body mass index, parity and skin to epidural space depth. "The Pearson Correlation Coefficient (r)" was used to study the relationship of skin to epidural space depth with the age, height, weight, parity and Body mass index. The P value less than 0.05 considered statistically significant correlation.

RESULTS

This study was conducted on 100 full term parturients with ASA Status I & II, selected through the non-probability purposive sampling, which went through elective C-Section under lumber epidural anaesthesia. The epidural space was identified in all patients without difficulty so no adverse events or dural punctures occurred during the study. Consequently no post-dural puncture headaches, unexpected high blocks, or catheter migration into the subarachnoid space were reported. As epidural anesthesia was sufficient and successful in all patients, all data are included in the analysis. The L_{3-4} vertebral interspace was most frequently used for epidural puncture accounting for 59% of the patients and rest of the epidural punctures was done in L_{4-5} interspace.

The mean $\pm$ SD value of skin to epidural space depth was found to be 41.59 ± 6.49 mm with a minimum value of 31 mm and a maximum of 78 mm with the range of 47 mm.

The mean age of the study population, as per descriptive statistics, was estimated to be 27.27 years with SD 4.90 years. The minimum age was 18 years and the maximum was 40 years (fig. 1). The Pearson correlation coefficient (r value), for the relation between patients' age and skin to epidural space depth, was found to be r=0.317 which showed a weak positive linear correlation but found to have a statistically significant relationship (p=0.001).

The mean weight was estimated to be 62.73 kg with SD 9.37 kg (fig. 2). The minimum weight was 44 kg and a maximum was 92 kg. For the correlation between patients' weight and skin to epidural space depth, the Pearson coefficient (r value) was found to be r=0.618 which showed a strong positive linear correlation and found to have a statistically significant relationship (p=0.0001).

The mean height was found to be 153 cm with SD 5 cm .The minimum height was 142 cm, maximum was 166 cm (fig. 3). The Pearson correlation coefficient for the correlation between patients' height and skin to epidural space depth was found to be r = -0.004 which showed a very weak negative linear correlation but found to have a statistically insignificant relationship (p=0.966).

The mean body mass index was calculated to be 27 kg/m² with ± SD 4 kg/m². The minimum body mass index was 19 kg/m² and a maximum was 38 kg/m² (fig. 4). The Pearson correlation coefficient, defining the relation between patients' body mass index and skin to epidural space depth, was found to be r=0.623 which showed a strong positive linear correlation and found to have a statistically significant relationship (p=0.0001).

The Pearson correlation coefficient (r value) for the correlation between patients' parity and skin to epidural space depth was found to be r = +0.210 which showed a weak positive linear correlation but found to have a statistically significant relationship (p=0.028) (fig.5).

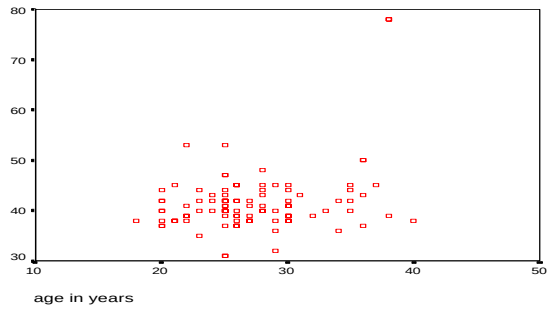

Fig. 1: The correlation of mean skin to epidural space depth with the patients age in years

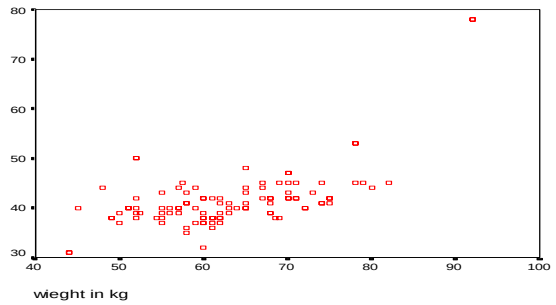

Fig. 2: The correlation of mean skin to epidural space depth with the patient's weight

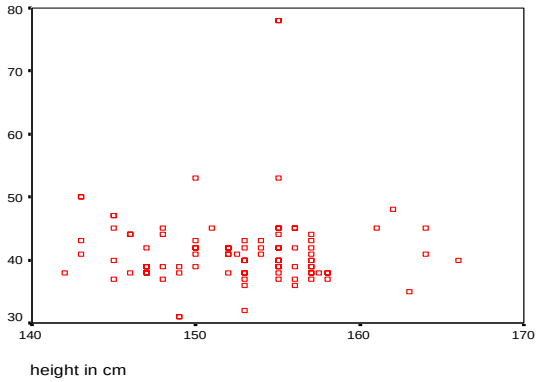

Fig. 3: The correlation of mean skin to epidural space depth with patient's height.

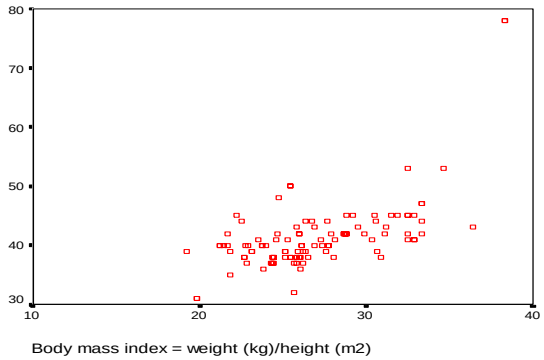

Fig. 4: The correlation of mean skin to epidural space depth with patient body mass index

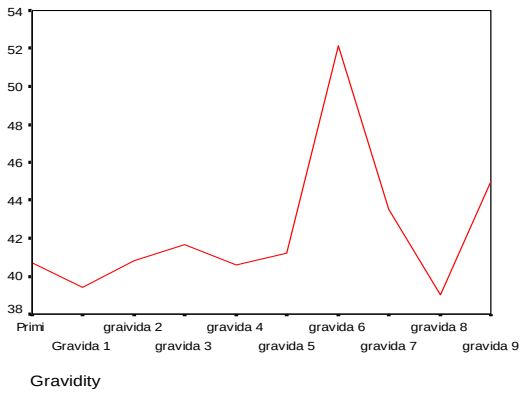

Fig. 5: The correlation of the mean skin to epidural space depth with the parity of the patient

DISCUSSION

This study was designed to determine the relationship of skin to epidural space depth with different physical parameters in Pakistani obstetric patients undergoing C-section.

The study included a total of one hundred Pakistani full term parturients, selected by non probability purposive sampling, based on the clinical condition of ASA I and II undergoing elective C-section.

The dependant variable "skin to epidural space depth" as measured by loss of resistance technique and the independent variables "age, weight, height, parity and body mass index" were all noted on the study proforma.

It was observed that the weight and body mass index had the statistically significant strong correlation with the skin to epidural space depth, the patients' age and parity had statistically significant but weak correlation, whereas height did not have any significant correlation with the skin to epidural space depth.

In our study the mean value of skin to epidural space depth is 41.59 ± SD 6.49 mm with minimum value of 31 mm and the maximum value of 78 mm. The results of our study are comparable to the results of the previous studies.

Shiroyama and colleagues examined the distance from skin to epidural space in 95 Japanese Parturients and the median value of 35 mm (range 25 to 65 mm) [4].

In another study on Chinese obstetric patients, Lau found the skin to epidural space depth between 30-70 mm which is very close to our results [5].

Harrison studied the depth of epidural space at different intervertebral interspaces in 1000 parturients and found that the median distance from the skin to epidural space was 47 mm but this median distance varied with lumber interspace at which it was measured, being greatest at L_{3-4} interspace (49.3 mm) and the least at L_{1-2} interspace (42.3 mm) [14] .

Preusser and colleagues studied 231 German women and found that the epidural space depth values fluctuated between 33 to 69 mm with a median value of 46 mm [15].

Currie studied the skin to epidural space depth by means of ultra sound scanning and direct measurement. The mean value for the skin to epidural space depth was 41.3 mm (range 29-72 mm) and 43.5 mm (range between 32- 71 mm) respectively [16].

Javed and his colleagues in their study on non-obstetric patients found the mean skin to epidural space depth of 43.8±5.63 mm (range of 3.5 – 6.5 mm) [6].

As the range in our study is 31 to 78 mm, it is proposed therefore that while using the midline approach the Tuohy's needle can be inserted safely to distance of 30 mm but thereafter a continuous and careful testing of the loss of resistance is mandatory.

The Pearson correlation coefficient in our study revealed statistically significant strong positive correlation of skin to epidural space depth with body weight (r=0.618) and significant strong positive correlation was also found with body mass index (r=0.623). The increase in skin to epidural space depth with increasing weight and body mass index is probably due to the hormonal changes of the pregnancy which bring about the redistribution of fat in the body. The increase in the water content of the body with resultant edema may be another cause of the increase in depth due to increase in body weight and body mass index. This is supported by the previous work, which also confirms the strong correlation with patient weight and body mass index.

Bevacqua and colleagues measured the skin to epidural space depth in 55 patients and found mean skin to epidural space distance of 50.9 ± 12 mm (range of 27-94 mm) and found significant correlation between patients' weight (r=0.572) and body surface area (r=0.597) [17].

Wong and colleagues in their study on 159 non-obstetric patients found significant correlation between skin to epidural space depth and patients weight (r^2=0.35) and weight – height ratio (r^2= 0.137) [3].

Bahk and colleagues studied the depth of epidural space with the help of CT scan in young male patients of 20-25 years of age at L_{3-4} interspace and found significant correlation between body mass index and the skin to epidural space depth [11].

Hoffmann and colleagues used combined spinal epidural technique in their study and found statistically significant correlation with body weight and body mass index ($P \leq 0.001$) [18].

Palmer and colleagues studied skin to epidural space depth in obstetric patients showing significant relationship between patient's weight and the depth of epidural space [19].

Kao and colleagues in their study "Prediction of the distance from skin to epidural space for low thoracic epidural catheter insertion by computed tomography" found significant correlation of both Estimated Insertion Length (EIL) and Actual Insertion Length (AIL) with weight (P≤ 0.01) and body mass index (P≤ 0.01) and body fat percentage (P≤ 0.01) [20].

Stamatakis and colleagues in their study found the best association of skin to lumber epidural space with weight of the patient (r=0.590), body surface area (r= 0.530) and body mass index (r= 0.543). The results of this study are very close to our results [21].

In our study it was found that there is a statistically significant but weak positive correlation of skin to epidural space depth with age of the patient (r=0.317) and parity (r= 0.210). This means that with the advancing age and parity of the parturient the skin to epidural space depth also increases. The average weight gain during pregnancy is 10 to 12 kg which after delivery of the baby never comes to the baseline. Due to the peculiar eating habits of Pakistani obstetric population and lack of weight reducing exercises, the weight adds up with every subsequent pregnancy. So this may cause increase in skin to epidural space depth. These findings are also comparable to the previous studies on the subject.

Stamatakis and colleagues in their study found a weak correlation with age of the patient (r=0.240) [21]. The correlation coefficient in his study is very close to our study.

Bevacqua and colleagues in their study on 55 patients found no statistically significant correlation between skin to epidural space depth and age of the patient (p > 0.05) [17]. Due to the small sample size and different geographical territory their results are different from our study results.

In our study it was also found that the skin to epidural space depth has no statistically significant correlation with the height of the patient (r = - 0.004). Previous studies on the subject also support our results that there is either a very weak or no correlation of the skin to epidural space depth with the height of the patient.

Bevacqua and colleagues found no statistically significant correlation between patients' height and skin to epidural space depth (P > 0.05) [17].

Wong and colleagues in their study on 159 non-obstetric patients found no statistically significant correlation with height alone (P > 0.05) [3].

Kao and colleagues in their study " Prediction of the distance from skin to epidural space for low thoracic epidural catheter insertion by computed tomography" found statistically insignificant correlation of both Estimated Insertion Length (EIL) and Actual Insertion Length (AIL) with height (p > 0.05) [20].

Stamatakis and colleagues in their study found a weak correlation of skin to epidural space depth with height of the patient (r=0.243). They also found a trend towards an increase in skin to lumber epidural depth in cephalad to caudal direction from L_{1-4} intervertebral space [21].

There are several limitations to our study. First of all the method used to identify the intervertebral spaces was surface anatomy & identification of the bony land marks. The previous investigators using the similar methods to locate the anatomic land marks of the lumber punctures, showed that the assumed interspaces was correctly identified in only 41 % of the cases with most epidural punctures at an interspace higher than the expected [22].

The second is the tenting and distensibility of the dural membrane by the Tuohy's needle could potentially add to the measured skin to epidural space depth.

There is likelihood that a proportion of our cannulations may have been more

laterally placed from the midline so this may add a few millimeters to the actual midline skin to epidural space depth and may result in erroneous inference.

Last but not the least is the generalization of results. Although our study population represents fairly homogenous Pakistani population in terms of ethnic and geographic composition as this study was carried out in an army hospital which looks after obstetric patients from different regions of the country. But due to the small sample size and non-probability purposive sampling technique, the results of our study cannot be generalized.

Consequently these models can provide a guide to what might be expected in patients presenting with specific characteristics. But further studies incorporating a variety of methods, like Computed tomography scans, Ultrasonography and Magnetic resonance imaging for accurate identification and prediction of skin to epidural space depth, are required in addition to standard techniques. This will be useful in increasing the success of the epidural anesthesia along with reduction in risk of dural puncture and its sequelae.

CONCLUSION

It is concluded from our study that the skin to epidural space has got statistically strong positive linear correlation with the patient's body weight and the body mass index but it has got a statistically significant weak positive linear correlation with patient's age and parity whereas no statistically significant correlation was found between the skin to epidural space depth with the height of the study population. As the skin to epidural space depth was found between 31 mm to 78 mm so one should be cautious after insertion of Tuohy's needle beyond 30 mm and continuous and careful testing of loss of resistance is essential especially in thin and lean patients.

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