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Research Article

Ultrasound Evaluation of the Depth of the Epidural Space at T3-T4 Level

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Abstract

Thoracic epidural anesthesia is an important and widely applied clinical procedure, but the injection depth poses a clinical challenge. The anatomical characteristics of the thoracic spinal column demand extreme caution at performing this technique. Ultrasound is a valuable method that adds to success in anesthetic blockages. However, literature registry on the ultrasound distance from skin to epidural space (epidural depth) at the thoracic level is scarce.

The objective of this study is to measure the epidural depth at the level of interspace T3-T4.

A cross-sectional study with 48 non-obese and healthy volunteers, being 20 men and 28 women was carried out. Measurements of epidural depth were accessed and correlated to anthropometric variables, gender and age of the subjects. The quality of the obtained ultrasound images was also inspected and associated to the study.

Means epidural depth values were: 3.60 + 0.5 cm and 3.54 + 0.6 cm on the transverse and right sagittal oblique planes, respectively. The obtained distances were positively correlated to weight in both men and women, to height in men and to body mass index (BMI) and age in women. Eighty three percent of the ultrasound images on transverse plan were classified as conclusive and 16.7 % inconclusive, whereas 77.1 % on right sagittal oblique plan were conclusive and 22.9 % inconclusive.

Epidural depth was 3.60 cm and 3.54 cm on transverse and right sagittal oblique planes, respectively. The index of conclusive images found in this study was higher than the ones reported in the literature.

ABBREVIATIONS

Lf-Dm complex: Complex formed by the Ligamentum Flavum and Dura-Mater; BMI: Body Mass Index; TM: Transverse (Median line); RSOP: Right Sagittal Oblique (Paramedian line); HC-UFPE: Hospital das Clinicas of the Universidade Federal de Pernambuco; ASA: American Society of Anesthesiologists; SPSS: Statistical Package for the Social Sciences); Distance A: Ultrasound Distance from Skin to the Lf-Dm Complex in the Transverse Plane; Distance B: Ultrasound Distance from Skin to the T3 Transverse Process on the Transverse Plane; Distance C: Ultrasound Distance from Skin to the Lf-Dm Complex on the Right Sagittal Oblique Plane; Distance D: Ultrasound Distance from Skin to T3 Vertebral Lamina on the Right Sagittal Oblique Plane; Conclusive Image: Ultrasound Image in which the Identification of the Hyperechogenic line that represents the Lf-Dm Complex is Visible; Inconclusive Image: Ultrasound Image in which the Identification of the Hyperechogenic line that represents the Lf-Dm Complex is not Visible; Typical Conclusive Image: Conclusive Ultrasound Image in which the Lf-Dm Complex shows like a clear and Continuous Hyperechogenic Line; Atypical Conclusive Image: Conclusive Ultrasound image in which the Lf-Dm Complex shows like an unclear and Discontinued Hyperechogenic Line; Ultrasound Distance from Skin to Epidural Space (epidural depth): Distance Measured by the Ultrasound Software existing between the Sonoanatomical Elements Representing the Skin and the Epidural Space (respectively), and seen in the obtained Ultrasound Image

INTRODUCTION

The first epidural blockage in surgery took place in France, by Sicard and Cathélien in 1901via caudal. Fidel Pagés, in

1921, described the access to epidural space via lumbar. The technique became popular after Dogliotti described in 1931 his identification method for the epidural space by means of the loss of air resistance with a pressure exerted against the piston of a syringe connected to a puncture needle [1]. The access to the epidural space allows anesthetic and analgesic interventions at the neuroaxis, depending on the volume and concentrations of the administered local anaesthetic and adjuvants (like opioids) [1]. Such interventions can occur in simple or continuous fashion by means of catheter insertions. The epidural block constitutes by itself a good anesthetic option both as a unique technique and in association to general anaesthesia. It plays an important role as well on approaches with patients bearing chronic pain syndromes or in palliative treatments [1]. There is great amount of publications that evaluate the depth of the lumbar epidural space specially in parturients [2,3]. Nevertheless, thoracic vertebrae show anatomical peculiarities that impose difficulties to both the access to the epidural space and the identification of its depth. The spinous processes from the fifth to the eighth vertebrae show inclinations that can reach over 60 degrees with relation to the skin. At the same time, the costovertebral joints and the thinner intervertebral disks reduce the flexibility of the collumn and the separation of the vertebral laminae. Finally, the posterior epidural space is the narrowest at thoracic level and the ligamentumflavum is thinner than in lumbar segment [4]. Ultrasound devices are useful tools for the blockage of neuroaxis allowing at the same time the gathering of information on the anatomy, which is totally unreachable by blind methods [5, 6]. The objective of this study was to measure the ultrasound distance from skin to epidural space at T3-T4 level, by approaching the transverse plane (median line) and the right sagittal oblique (paramedian line). We aimed to acquire and explore ultrasound-derived anatomical information on the topography of the vertebral column, still scantily studied [7] because of the well known anatomical challenges that are imposed to ultrasound studies [8].

MATERIALS AND METHODS

The study was carried out in the surgical block facility of the Hospital das Clinicas of the Universidade Federal de Pernambuco (HC-UFPE) after approval of the Ethics Committee. The cross-sectional study described the ultrasound distance between the skin and the epidural space at T3-T4 level among inpatients at HC-UFPE. The sample size was determined by considering: the objective of the interval estimation for the means ultrasound distance from skin to epidural space at T3-T4 level, the margin of error of 0.2 cm higher or lower, the confidentiality of 95% that the interval will not exceed the fixed error and the estimation of the standard deviation of 0.7 cm, according to data in the litterature [9]. Thus, we obtained a sample size of 48 volunteers. The inclusion criteria were age between 18 and 50 years, BMI < 30 kg/m², American Society of Anesthesiologists (ASA) classification between I and III and volunteers with no reports on mental morbidities. Volunteers with known pathologic alterations of the column and with history of surgery in the column were excluded. Measurements were taken from the volunteers for weight, height and BMI. They were then positioned sitting with the head bent for spinal flexion, shoulder relaxed and exposing the upper part of the back (region between the neck and scapulae). The first vertebra was identified by palpation in the cervicothoracic transition and it was considered as being C7. By use of palpation method T3-T4 interspace was identified when scanning in the craniocaudal sense from C7. Ultrasound evaluation was performed in the interspace of the transverse plane with a transducer of 5 – 2 MHz of a M-turbo Sonosite® ultrasound device. The obtained ultrasound images were classified as conclusive or inconclusive. The conclusive ones on its turn were differentiated as typical or atypical. The best ultrasound image obtained was subsequently fixed and the ultrasound distance between the skin and the Lf-Dm complex, by use of the ultrasound device's software. It was checked the distance between the skin and one of the T3 transverse processes as well. The analysis of this lastdistancewas especially useful in cases where an obtained image was classified as inconclusive, since it estimates the distance from skin to Lf-Dm complex [9]. Next step in our study was to analyze the image on right sagittal oblique plane. The transducer was positioned longitudinally in parallel to the neuroaxis 1-2 cm to the right of a skin marking of the median line. It was provoked the inclination of the transducer towards the median line of the neuroaxis, aiming to obtain the desired image. In this plane it was measured the ultrasound distance between the skin and the Lf-Dm complex and analysis of the quality of the captured ultrasound image was performed as well, similarly to the analysis of the image in transverse plane. As a replacement to the analysis of the ultrasound distance from skin to the transverse process, measurement of the distance between the skin and the vertebral lamina was performed. Although this distance measurement is less accurate than the previously obtained between the skin and the transverse process, it provides an estimate of the distance between the skin and the Lf-Dm complex [9] as well. Data were descriptively analyzed by absolute frequencies and percentage for the categorical variable. Numerical variable were statistically analyzed with mean, standard deviation and coefficient of variation. Data were inferentially analyzed for comparison between genders with: t-Student test with equal variances (with regards to numerical variables) and the Pearson's chi-squared test or the Fisher Exact test (with regards to categorical variables).

In order to evaluate the means values for the measurements intervals of confidence were obtained, and in order to evaluate the degree of relationship between the measurements and the numerical characterization variable, Pearson coefficient correlation were obtained along with the application of t Student test for the hypothesis of null correlation. We should mention that the verification of the normality hypothesis of data was performed by use of the de Shapiro-Wilk's test and the variances equality by use of Levene F test.

The margin of error used on decisions with statistic tests was of 5% and the intervals were obtained with 95% of confidentiality. Data were typed on an EXCEL spreadsheet and the statistical software used for the calculations was SPSS (Statistical Package for the Social Sciences), version 21.

RESULTS AND DISCUSSION

As per what was determined by the previously explained calculation of the sample 48 volunteers were recruited to take part on his study, being 20 men (41.7%) and 28 women (58.3%).

Results on the numerical variable for age, weight, height and BMI are shown in Table (1) for the whole group, and separated by gender.Statistically significant bias values are verified among genders ($p < 0.05$) for all variables, except for the age variable. Means of numerical variable were higher in masculine gender. The variable expressed by the coefficient of variation is shown as reduced, since this measure was no higher than 16.08% (< 30%). Measurements were taken for 4 ultrasound distances, being 2 on the transverse and 2 on the right sagittal oblique plane. A on the transverse plane refers to the ultrasound distance from skin to the transverse process of T3 thoracic vertebra. On the right sagittal oblique plane distance range C distance refers to the distance from skin to the Lf-Dm complex; yet distance range D refers to the distance from the skin to the lamina of the T3 thoracic vertebra. Table (2) shows descriptive and inferential results on the measures for whole group and gender. The means distance for masculine gender varied from 3.22 cm (distance range D) to 4.21 (distance range B). For feminine gender the means distances varied from 2.96 cm (distance range D) to 3.68 cm (distance range B). In both genders distance range D showed the lower means value and distance range B showed the highest. Measurements for masculine gender presented higher means distances than feminine gender. A statistically significant difference was seen among genders ($p < 0.05$) for values in distance ranges B and C. The variability was reduced, since the highest value was 21.96% (< 30%) in the distance range D for feminine gender. The classification of images into categories of quality was also the objective of this work. Ultrasound images were classified as Typical Conclusive (when Lf-Dm complex was visualized as a sharp and distinctive continuous line). The Atypical Conclusive class of image was the most frequently seen on Right Sagittal Oblique Plane (47.9%) as it can be observedon Table (3). No statistical significance was observed between gender and class of image quality ($p > 0.05$).

Tables (4,5) shows the correlations of each numeric variable (age, height, weight and BMI) with each one of the four measured distances performed by Pearson correlation ratio. Table (4) shows the correlations among the volunteers of masculine gender and Table (5) the correlations among the volunteers of feminine gender.

It is verified on Table (4) the statistically significant positive correlation for all distances with weight and height. The significant correlations were all positive, which means a direct relationship between the variable, and medians (varied between 0513 - 0.709 with weight and 0.553 – 0.652 with height). Table (5) shows the correlations for feminine gender. Pearson's correlations were positive and statistically significant ($p < 0.05$) between the distances and weight, BMI and age (except for the distance range C and age). Correlations were high (> 0,750) between weigth and distance range B (0.849), between BMI and distance range D (0.835), between BMI and distance range B (0.831), and between weight and the distance range D (0.771). The remaining significant correlations varied between 0.462- 0.740.

This prevalence study had as a main objective the measurement of the ultrasound distance from skin to epidural space at the level of the thoracic T3-T4 vertebra interspace. There are data in the literature that defends ultrasonography as a valid element for estimating the real distance between neuraxis anatomical

Table 1: Numerical statistic variable in the whole group and separated by gender.

Variable	Male Means ± SD (CV%)	Female Means ± SD (CV%)	Whole group Means ± SD (CV%)	p Value
Age (years)	31.90 ± 5.04 (15.80)	31.61 ± 4.38 (13.86)	31.73 ± 4.62 (14.56)	0.831[1]
Weight (kg)	77.02 ± 8.25 (10.71)	61.19 ± 7.10 (11.60)	67.79 ± 10.90 (16.08)	< 0.001[1,2]
Height (m)	1.76 ± 0.06 (3.41)	1.63 ± 0.05 (3.07)	1.68 ± 0.09 (5.36)	< 0.001[1,2]
BMI (kg/m²)	24.83 ± 1.90 (7.65)	23.09 ± 2.72 (11.78)	23.81 ± 2.54 (10.67)	0.018[1,2]

Abbreviations: ([1]): By t-Student test with equal variances; ([2]): Significant (p ≤0.05)

Table 2: Results on the measures for whole group and by gender.

Distance (cm)	Male Means ± SD (CV%) 95% CI on the means	Female Means ± SD (CV%) 95% CI on the means	Whole group Means ± SD (CV%) 95% CI on the means	p Value
TM				
Distance A	3.76 ± 0.47 (12.50) 3.50 a 4.02	3.50 ± 0.50 (14.29) 3.29 a 3.71	3.60 ± 0.50 (13.89) 3.44 a 3.76	0.112[1]
Distance B	4.21 ± 0.61 (14.49) 3.92 a 4.50	3.68 ± 0.69 (18.75) 3.41 a 3.95	3.90 ± 0.70 (17.95) 3.70 a 4.10	0.009[1,2]
RSOP				
Distance C	3.87 ± 0.56 (14.47) 3.57 a 4.17	3.28 ± 0.51 (15.55) 3.05 a 3.51	3.54 ± 0.60 (16.95) 3.34 a 3.74	0.002[1,2]
Distance D	3.22 ± 0.48 (14.91) 2.99 a 3.45	2.96 ± 0.65 (21.96) 2.71 a 3.21	3.07 ± 0.59 (19.22) 2.90 a 3.24	0.147[1]

Abbreviations: ([1]): By t Student test equal variances; ([2]): Significant (p ≤0.05);
TM: Transverse (Median line); RSOP: Right Sagittal Oblique (Paramedian line); Distance A: Ultrasound Distance from Skin to Lf-Dm Complex; Distance B: Ultrasound Distance from Skin to Transverse Process of T3 Thoracic Vertebra; Distance C: Ultrasound Distance from Skin to Lf-Dm Complex; Distance D: Ultrasound Distance from Skin to Lamina of T3 Thoracic Vertebra.

Table 3: Image classification according to gender.

Variable	Gender				Whole group		p Value
	Male		Female				
	N	%	N	%	N	%	
TOTAL	**20**	**100.0**	**28**	**100.0**	**48**	**100.0**	
TM							
Typical conclusive	4	20.0	8	28.6	12	25.0	0.509(1)
Atypical conclusive	11	55.0	17	60.7	28	58.3	
Inconclusive	5	25.0	3	10.7	8	16.7	
RSOP							
Typical conclusive	5	25.0	9	32.1	14	29.2	0.708(2)
Atypical conclusive	11	55.0	12	42.9	23	47.9	
Inconclusive	4	20.0	7	25.0	11	22.9	

Abbreviations: (1): By Fisher Exact test; (2): By Pearson's chi-squared test; TM: Transverse (Median line); RSOP: Right Sagittal Oblique (Paramedian line)

Table 4: Pearson´s Correlations between each measure with each variable: age, weight, height and BMI for masculine gender.

Measurement	Age r(p)	Weight r(p)	Height r(p)	BMI r(p)
TM				
Distance A	- 0.120 (0.671)	0.645 (0.009)*	0.580 (0.023)*	0.393 (0.147)
Distância range B	0.069 (0.771)	0.513 (0.021)*	0.312 (0.180)	0.430 (0.059)
RSOP				
Distance C	- 0.427 (0.099)	0.709 (0.002)*	0.652 (0.006)*	0.446 (0.083)
Distance D	- 0.208 (0.380)	0.633 (0.003)*	0.553 (0.011)*	0.376 (0.103)

Abbreviations: (*): Correlation statistically different than zero ($p \leq 0.05$); TM: Transverse (Median line); RSOP: Right Sagittal Oblique (Paramedian line); Distance A: Ultrasound Distance from Skin to Lf-Dm Complex; Distance B: Ultrasound Distance from Skin to Transverse Process of T3 Thoracic Vertebra; Distance C: Ultrasound Distance from Skin to Lf-Dm Complex; Distance D: Ultrasound Distance from Skin to Lamina of T3 Thoracic Vertebra.

Table 5: Pearson´s Correlations between each measurement with each variable: age, weight, height and BMI for feminine gender.

Measurement	Age r(p)	Weight r(p)	Height r(p)	BMI r(p)
TM				
Distance A	0.462 (0.020)*	0.657 (<0.001)*	0.142 (0.499)	0.587 (0.002)*
Distance B	0.550 (0.002)*	0.849 (<0.001)*	0.018 (0.927)	0.831 (<0.001)*
RSOP				
Distance C	0.430 (0.051)	0.664 (0.001)*	- 0.181(0.431)	0.740 (<0.001)*
Distance D	0.488 (0.008)*	0.771 (<0.001)*	- 0.153 (0.438)	0.835 (<0.001)*

Abbreviations: (*): Correlation statistically different than zero ($p \leq 0.05$); TM: Transverse (Median line); RSOP: Right Sagittal Oblique (Paramedian line); Distance A: Ultrasound Distance from Skin to Lf-Dm Complex; Distance B: Ultrasound Distance from Skin to Transverse Process of T3 Thoracic Vertebra; Distance C: Ultrasound Distance from Skin to Lf-Dm Complex; Distance D: Ultrasound Distance from Skin to Lamina of T3 Thoracic Vertebra.

structures. In a recent review article Chin et al. [8] evaluated the correlation between the estimated ultrasound distance and the real distance travelled by the needle from the skin to the peridural or subarachnoid space. The ultrasonographic images were obtained on transverse, sagittal and sagittal oblique planes. An excellent correlation was found in all ten studies analyzed with Pearson's correlation ratio varying from 0.8 to 0.99. In that review six articles identified small divergences between the distances measured with the needle in the puncturing process. These variations were attributed to the compression of the skin by the probe or by the puncturing needle, as well as to the difference in trajectory between the ultrasound beam and the puncturing needle. Despite of the variations, ultrasound has proven to be an important tool to estimate the depth from skin to epidural space. Our study relied on a sample of 48 volunteers, being 20 men and 28 women. With regards to the characteristics of the group related to height, weight and BMI, it was verified that men showed higher values of the variable, being the statistically significant bias values regarded to feminine gender. It was expected that in this instance que evaluated distances were higher among men when compared to women. Such expectation was achieved. Men showed higher means than women for the four analyzed ultrasound distances: 3.76 cm x 3.50 cm on distance range A; 4.21 cm x 3.68 cm on distance range B; 3.87 cm x 3.28 cm on distance range C and 3.22 cm x 2.96 cm on distance range D. The difference in means distance between genders was statistically significant for distance range B (ultrasound distance from skin to transverse process of the T3 thoracic vertebra, on transverse plane) and for distance range C (ultrasound distance from skin to the Lf-Dm complex, on right sagittal oblique plane), with $p < 0.05$. Differently from the study by Avramescu et al. [9] who evaluated the sonoanatomy of thoracic vertebral column among healthy volunteers, bias measurement values were found for distance ranges A and B in this work. Means distance range B was higher than mean distance range A both for whole group (3.90 cm x 3.60 cm) and for groups separated by gender. It was also noticeddifference between the mean distance ranges C and D (3.54 cm x 3.07 cm).

In a retrospective study, Lai et al. evaluated the depth of the thoracic epidural space by measuring the distances travelled by the puncture needles on the paramedian approach [10]. The body weight and the body mass index show direct relationship to the depth of the thoracic epidural space; on the other hand, age, height and gender do now show correlation in this study. (Table 4,5) show Pearson's correlations between the distances and each one of the evaluated numeric variable, separated by gender. In Table (4) it is seen the positive correlation and statistically significant between the measured distances taken from masculine gender and the variable: weight (with all distances) and height (with the only exception for distance range B). Differently from studies by Lai et al. [10], for height it was presented a direct correlation to the measured distances and the body mass index, although it shows positive correlation, did not show statistically significant association. Table (5), depicts Pearson's correlations between distances and the numeric variable for feminine gender and shows the positive correlation and statistically significant between the distances and variable: age (except for distance range C), weight and BMI (for all distances). Differently from the work by Lai et al. [10], it was found statistically significant correlation between age and three out of the four measured distances. Although this was not the objective in our work, we verified that by dividing the group of feminine gender into two subgroups of age (women 30 or less and women over 30), two ranges of 14 elements each is obtained. The first subgroup showed 58.2 kg as means weigh; yet the second subgroup composed by older women showed 64.13 kg as means weight. Adding to that, in our sample, older women also showed higher body mass indexes, and it was in this subgroup that it was observed a significative correlation between the age and the measured distances. In the subgroup of younger women no significative correlation was verified between the age and the distances. A Japanese study, in which the distance travelled by the needle from skin towards the epidural space using thoracic and lumbar approaches was evaluated, it was verified the positive correlation between the age and the weight of the volunteer subject with the distance travelled by the needle [11]. It is valid to highlight that the study by Adachi [11] included on its analysis the interspace T3-T4, whereas the study by Lai et al. [10] evaluated other segments of the thoracic portion of the vertebral column. Both studies were carried out with patient's position in lateral decubitus, differently from our studies, in which the volunteers were evaluated in sitting position. Chung et al. [12]evaluated the distance from skin to the thoracic epidural space in women, by median T4-T5 interspace approach, with patients sitting, and they found as value 5,59 + 1,26 cm. Like in our study, they found significative correlation between the depth of the epidural space and the weight and the BMI index. Avramescu et al. [9] found medians for all four distances evaluated in this work. They were 4.1 cm, 4.2 cm, 4.0 cm and 3.3 cm for distance ranges A, B, C and D, respectively. Avramescu et al. analyzed in their study all thoracic vertebral interspace in volunteers and found median values similar to distance ranges A and C. Nevertheless, these medians did not differ among vertebrae at the three thoracic levels (lower, medium and upper), with $p > 0.05$. In presentstudy the following means for distance ranges A, B, C and D: 3.60 cm, 3.90 cm, 3.54 cm and 3.07 cm, in this order, were found. Present study have decided to use means as statistical instrument of analysis because it is a well known measuring system, it is broadly used and it is sensitive to all elements of the measure ranges. Since the variability in the measured distances was low, the means are representative. Confidence intervals are usually obtained and are associatedto them. The present work also analyzed the quality of the obtained ultrasound images. Each one of them was classified as conclusive or inconclusive, according to the visibility or not of the Lf-Dm complex, respectively. Conclusive images were subclassified as typical and atypical, according to the fashion in which the Lf-Dm complex was depicted (continuous or discontinuous line, respectively). In the transverse plane, 16.7% of the images were classified as inconclusive. Yet in the right sagittal oblique plane 22.9% obtained this classification. This data surprised the researchers, since it was expected to find higher rates of inconclusive images from the transverse plane (when compared to the right sagittal oblique plane), due to the acoustic shadowing imposed byT3 spinous process. Grau et al. [13] in a comparative study between ultrasound and magnetic resonance for visualization of the anatomical structures of the neuroaxis (at T5 and T6 interspace), identified the acquired ultrasound images in the oblique sagittal plane as the ones with best quality. Avramescu et al. [9] on their turn, found higher indexes of conclusive images on the oblique sagittal plane, when compared to the ones on the transverse plane, along with all vertebrae interspaces they analyzed in their study. The finding of a high index of conclusive image on transverse plane can be a consequence of peculiarity of the analyzed vertebral interspace. T3 spinous process elongates towards the posterior side with not much of a caudal inclination, differently to what is observed on vertebrae of the medium segment of the thoracic vertebral column. However, by analyzing the same (T3-T4) interspace and using the same classification used in this study Avramescu et al. [9] found 38% and 98% of the images inconclusives on right sagittal oblique plane and ontransverse plane, respectively. Like in our study, the study by Avramescu et al. found means body mass index of 23.8 kg/m2 in the group of volunteers. However, the means weight and height of volunteers were higher in Avramescu's study.

It is believed that anatomical and anthropometrical differences between the analyzed populations in both studies justify the discrepancy in results for quality assessment of the ultrasound images. Another relevant factor is that we are not fully familiar with acquiring ultrasound images from right sagittal oblique plane, and this fact might have imposed a drawback in obtaining good quality images via this plane. The present study showed under certain limitation a sonoanatomical analysis of T3-T4 vertebral interspace of healty volunteers. Ultrasound is a tool that is specially useful to compose the anatomical analysis of patients with some degree of morphological alteration in the vertebral column. However, since the studies that evaluate the sonoanatomy of T3-T4 vertebral interspace are still scanty, it is believed that the evaluation with healthy volunteers performed in this work is meaninful. All ultrasound images were obtained and analysed by the researcher and his/her research supervisor in a joint effort. Thus, biases regarding to the evaluation of the images or to differences on the way they were obtained (like the strengh applied to the ultrasound transducer while positioning it over the skin) were avoided. The authors of this work hold degree in anesthesiology as main qualification with ultrasonography as an area of interest, not holding, therefore, a proper certificate in ultrasonography. The present work measured the ultrasound distance from skin to Epidural Space at T3-T4 level, on transverse and right sagittal oblique planes. Means distances of 3.60 cm and de 3.54 cm were found, respectivamente. The studied sonoanatomic components were evaluated, analysing the both the ultrasound distances from skin to them and the sharpness in which they were depicted in the captured images. The obtained distances were correlated to anthropometrical, age and gender data of the volunteers, correlation among them were assessed and they sometimes confirmed data in the litterature and sometimes brought new findings to science.

High indexes of conclusive images were found in present work, thus overcoming present data in the litterature on this regard. Valuable data are extracted from ultrasound images, bringing higher accuracy and safety for assessments to the epidural space performed at the level studied.

CONCLUSION

The present work measured the ultrasound distance from skin to epidural space at T3-T4 level, on transverse and right sagittal oblique planes. The average distances of 3.60 cm and 3.54 cm were found, respectively. The sonoanatomical components that compose the studied vertebral interspace were evaluated by analyzing both the ultrasound distances from skin to them and the sharpness in which they were depicted on captured images. The obtained distances were correlated to patient anthropometrical parameters, age and gender and correlation among values in them were assessed.

Results sometimes confirmed data in the literature, and when they didn't they brought new findings to science.

High indexes of conclusive images were found in present work, thus overcoming drawbacks in the literature on this regard. Valuable data are extracted from ultrasound images. They can improve accuracy and safety in assessments to the epidural space at the thoracic level of the spinal column.

REFERENCES

1. Delfino JVN. History and stories of epidural anesthesia in epidural anesthesia: update and outlook. Atheneu, Editor. 2000; 7.
2. Balki M, Lee Y, Halpern S, Carvalho JC. Ultrasound imaging of the lumbar spine in the transverse plane: the correlation between estimated and actual depth to the epidural space in obese parturients. Anesth Analg. 2009; 108: 1876-1881.
3. Grau T, Leipold RW, Horter J, Conradi R, Martin E, Motsch J. The lumbar epidural space in pregnancy: visualization by ultrasonography. Br J Anaesth. 2001; 86: 798-804.
4. Cangiani LM, Slullitel A, Potério GM, Pires OC, Posso IP, Nogueira CS, et al. Treaty of Anesthesiology : SAESP , Atheneu , Editor. 2011; 1465-1478.
5. Wallace DH, Currie JM, Gilstrap LC, Santos R. Indirect sonographic guidance for epidural anesthesia in obese pregnant patients. Reg Anesth. 1992; 17: 233-236.
6. Bonazzi M, Bianchi De Grazia L, Di Gennaro S, Lensi C, Migliavacca S, Marsicano M, et al. [Ultrasonography-guided identification of the lumbar epidural space]. Minerva Anestesiol. 1995; 61: 201-205.
7. Salman A, Arzola C, Tharmaratnam U, Balki M. Ultrasound imaging of the thoracic spine in paramedian sagittal oblique plane: the correlation between estimated and actual depth to the epidural space. Reg Anesth Pain Med. 2011; 36: 542-547.
8. Chin KJ, Karmakar MK, Peng P. Ultrasonography of the adult thoracic and lumbar spine for central neuraxial blockade. Anesthesiology. 2011; 114: 1459-1485.
9. Avramescu S, Arzola C, Tharmaratnam U, Chin KJ, Balki M. Sonoanatomy of the Thoracic Spine in Adult Volunteers. Reg Anesth Pain Med. 2012. 37: 349-353.
10. Lai HC, Liu TJ, Peng SK, Lee KC, Luk HN, Lee SC. Depth of the thoracic epidural space in paramedian approach. J Clin Anesth. 2005; 17: 339-343.
11. Adachi YU, Sanjo Y, Sato S. The epidural space is deeper in elderly and obese patients in the Japanese population. Acta Anaesthesiol Scand. 2007; 51: 731-735.
12. Chung MG, Kim SI, Kim SC, Ok SY. A clinical measurement of the high thoracic epidural depth in women. Korean J Anesthesiol. 2007. 53: 589-592.
13. Grau T, Leipold RW, Delorme S, Martin E, Motsch J. Ultrasound imaging of the thoracic epidural space. Reg Anesth Pain Med. 2002; 27: 200-206.

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