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A Practical and Safe Parameter for Determining Gestational Age: Transverse Cerebellar Diameter

Gestasyonel Yaşın Tespitinde Pratik ve Güvenilir Bir Parametre: Transvers Serebellar Çap

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Abstract

Introduction: We aimed to investigate the role of transverse cerebellar diameter (TCD) measurement as a reliable and practical method on routine 2nd trimester transabdominal obstetric ultrasound for calculating the fetal gestational age.

Materials and Methods: The women with a pregnancy of 18-25 weeks (according to date of the last menstrual period(LMP)) who underwent a obstetric ultrasound were included in the study. The biparietal diameter (BPD) , femur length (FL) and TCD were calculated and their correlation with the gestational age were examined with statistical analysis.

Results: Our study was conducted on 114 pregnant women. The mean age was 27 (22-44) and approximately 54% of them were between 21-22 weeks. The value of TCD in millimeters in transabdominal ultrasonography showed a strong positive correlation with LMP, BPD and FL at 18-25 weeks in indicating gestational age. As the gestational age increased, TCD also increased. In addition, the value of TCD in millimeters was the same as the gestational age in approximately 80% of all patients, especially when compared with BPD.

Conclusion: Because TCD calculation on transabdominal obstetric ultrasound between 18-25 week of gestation is a safe and easy method for evaluating the general condition of fetus, it may be added to BPD, FL and LMP calculation in the routine practise.

Keywords: Cerebellum; gestational age; ultrasound.

Özet

Amaç: Bu çalışmamızda ikinci trimester transabdominal ultrasonografi tetkikinde transvers serebellar çap (TSC) ölçümünün fetal gestasyonel yaş tayininde rutinde güvenli ve pratik bir yöntem olarak kullanılabilirliğini araştırdık.

Gereç ve Yöntem: Yaklaşık bir yıllık süreçte hastanemize başvuran ve radyoloji departmanında transabdominal obstetrik ultrasonografi değerlendirmesi yapılan 18-25. hafta arasında gebeliği olan hastalar dahil edildi. Hastaların rutin ultrasonografi incelemelerinde, gestasyonel yaş tespiti yapılırken son adet tarihi (SAT) hesaplaması, biparietal çap (BPC) ve femur uzunluğu (FU) yanında transvers serebellar çap ölçümü yapıldı. TSC'nin milimetre cinsinden ölçülen değerleri SAT, BPC ve FU'nun hafta cinsinden değerleri ile istatistiksel olarak karşılaştırıldı.

Bulgular: Çalışmamıza nihayi 114 gebe dahil edildi. Yaş ortalaması 27 (22-44) yıl olup gebelerin yaklaşık %54'ü gebeliğin 21-22. haftaları arasındaydı. Transabdominal ultrasonografide TSC'nin milimetre cinsinden değeri gestasyonel yaş göstermede 18-25. haftalarda SAT, BPC ve FU ile kuvvetli pozitif korelasyon göstermekteydi. Gebelik haftası arttıkça TSC de orantılı artmaktaydı. Ayrıca TSC'nin milimetre cinsinden değeri özellikle BPC ile karşılaştırıldığında tüm hastalar arasında yaklaşık %80 oranında gestasyonel yaş ile aynı değerdedi.

Sonuç: Gebelerde özellikle 18-25. Haftalarda bakılan rutin ayrıntılı transabdominal obstetrik ultrasonografi incelemesinde fetusun genel sağlığı değerlendirilirken gestasyonel yaş tespitinde kullanılan SAT , BPC ve FU gibi parametrelerin yanında TSC ölçümünü de pratik ve güvenle kullanılabilecek ek parametrelerden biri olarak tavsiye etmekteyiz.

Anahtar Kelimeler: Serebellum; gestasyonel yaş; ultrason.

Introduction

Determining the gestational age by using fetal parameters in pregnant women and following up the pregnancy process with this information are the basic applications in obstetric ultrasonography (1). Gestational age is an important part of pregnancy management and it has been found that perinatal mortality increases when it is not known clearly. In addition, in cases when the gestational age is not known, risks such as premature birth

and low birth weight are encountered (2-5). Second trimester ultrasonography examination is one of the most important evaluation elements of pregnancy. During pregnancy, it is a commonly accepted examination that ultrasonography should be performed several times in low-risk pregnant women. Especially, it is recommended that this review be done in 18th-22nd weeks (6). Crown-rump length (CRL), femur length (FL), abdominal circumference (AC), biparietal diameter (BPD) are frequently used parameters for the determination

of gestational age in obstetric ultrasonography (7). Since the cerebellum is located between dense bone tissues in the posterior fossa, it is more resistant to external pressures and deformations. Although it is easy to evaluate with ultrasonography, it requires experience. While the central nervous system elements are evaluated in obstetric ultrasonography, the examination of the fetal cerebellum is also routinely performed. The presence of pathological findings, especially in posterior fossa structures, should be carefully examined. In addition to these sonographic evaluations, there are many articles advocating that TCD should also be measured (8-10). In our study, the compatibility and reliability of TCD with the parameters showing the gestational age in pregnant women between 18th-22nd weeks in our society were investigated.

Materials and Methods

Pregnant women who applied to our hospital between 18th-25nd weeks of pregnancy and requested obstetric ultrasonography between January 2021-August 2021 were evaluated by our radiology department. Measurements were made by radiologist with at least 5 years of experience in obstetric ultrasonography. Those with multiple pregnancy and congenital anomaly in the fetus were not included in the study. In addition, those with maternal pathologies such as hypertension, diabetes, and obesity were also excluded from the study. Ultrasonographic measurements were made with a Siemens S 3000 device using 3.5MHz convex probe with transabdominal examination. The estimated week of pregnancy according to LMP was questioned, whether there was any additional pathology and age information were recorded. BPD and FL were used for the determination of gestational age during routine obstetric ultrasonography examination. During this procedure, while evaluating fetal cranial structures, the TCD was also measured. Measurements in millimeters were made by combining the echogenic borders forming both hemispheres of the cerebellum at the level that transversely cuts the cerebellum (Image 1). In these measurements, the compatibility of the millimeter value of TCD with the gestational week was checked. In order to have a more objective evaluation during obstetric ultrasonography, TCD measurement was performed first, and then gestational age was determined by BPD and FL. TCD values which had been obtained were statistically compared with LMP, BPD and FL measurements.

Ethical approval: The study was carried out with the decision of the Kırşehir Ahi Evran University ethics committee dated 28/05/2019 with a number of 2019-10/116.

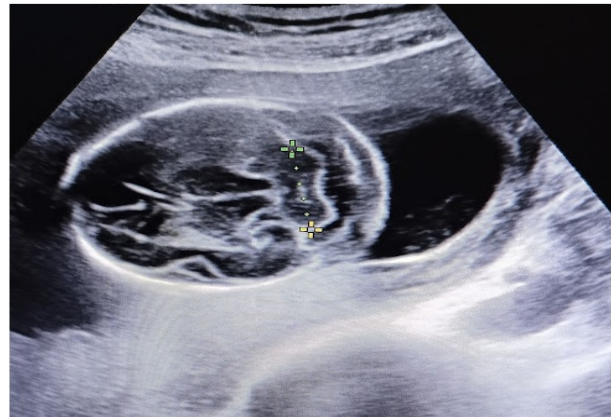


Image 1. Transverse cerebellar diameter measurement, the line connecting the echogenic borders of the cerebellum in the axial plane.

Statistical analysis: Descriptive statistics were presented as count and percent for discrete variables. Statistical analyzes of the study were performed using Statistical Package for Social Sciences Version 21.0 software for Windows (IBM SPSS Statistics for Windows, Version 21.0. Armonk, NY: IBM Corp. USA). Normality assumptions were tested with Kolmogorov-Smirnov and Shapiro-Wilk tests. Relationships between variables were examined by Spearman correlation analysis. A p<0.05 was accepted as statistically significant.

Results

Our study is prospective and was conducted on 114 pregnant women. The average age of them was 27 (22-44). Most of the pregnant women (54%) were within 21-22 weeks according to LMP. There were no additional pathologies in the pregnant women or any anomaly in the fetus. All variables were statistically compared with each other. The compatibility of TCD with other variables was especially evaluated. The results of the relationship between BPD, FL, TCD and LMP variables are given in (Table 1).

Table 1: Relationships between variables

| | FL | TCD | LMP |
|-----|---------|---------|---------|
| BPD | 0.855** | 0.939** | 0.892** |
| FL | 1 | 0.880** | 0.831** |
| TCD | | 1 | 0.916** |

*: p<0.05; **: p<0,01

When the Spearman's Rho coefficients are examined; TCD has a positive and strong relationship with LMP ($r=0.916$, $p<0.001$) (Figure 1). There is a strong positive relationship between FL and TCD ($r=0.880$, $p<0.001$) (Figure 2). A strong positive relationship was also found between BPD and TCD ($r=0.939$, $p<0.001$) (Figure 3).

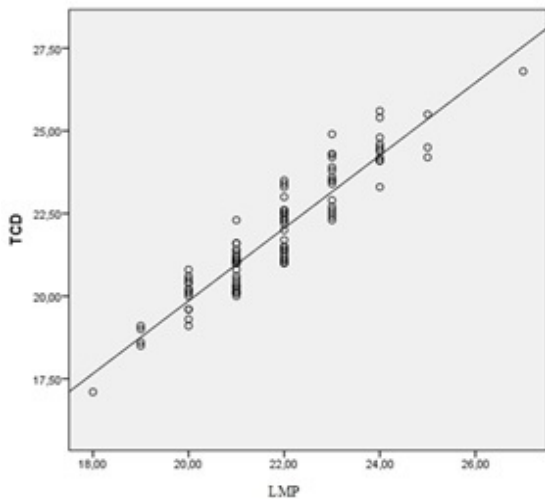


Figure 1. The relationship between LMP and TCD

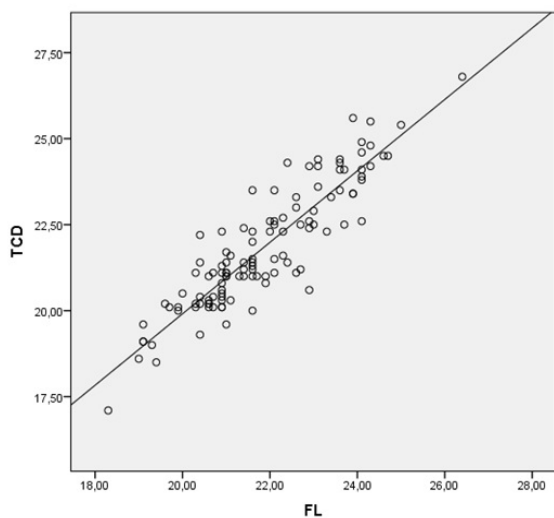


Figure 2. The relationship between FL and TCD

It was determined that there is a statistically significant relationship between BPD and FL ($r=0.855$, $p<0.001$). The relationship between BPD and LMP is also statistically significant ($p=0.892$, $p<0.001$). The relationship of FL variable with LMP is also statistically significant ($p=0.831$, $p<0.001$). TCD has a positive correlation with BPD, FL and LMP in determining gestational age.

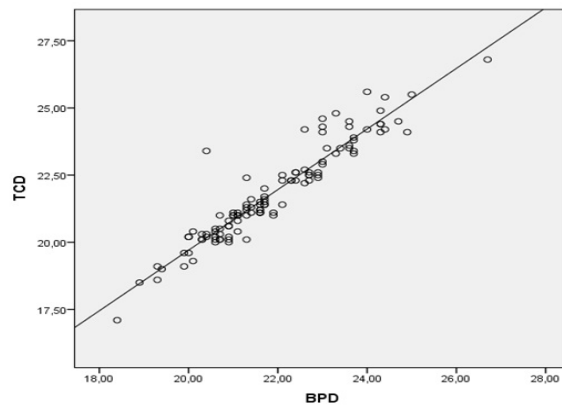


Figure 3. The relationship between TCD and BPD

Table 2. Concordance of TCD in millimeters with BPD

| BPD(week) | TCD(mm) | Number of pregnant(n) |
|-----------|---------|-----------------------|
| 18 | 18 | 2 |
| 19 | 19 | 3 |
| 20 | 20 | 22 |
| 21 | 21 | 28 |
| 22 | 22 | 16 |
| 23 | 23 | 10 |
| 24 | 24 | 8 |
| 25 | 25 | 2 |
| | | Total:91(80%) |

Number of pregnant women showing the similarity between the week of gestational age and the size of TCD according to BPD (especially at 20th-21st-22nd weeks)

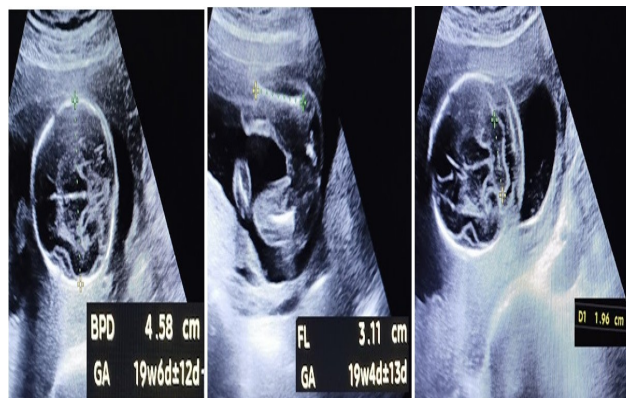


Image 2: TCD measurement of the pregnant woman whose gestational age was 19 weeks and 6 days according to BPD and 19 weeks and 4 days according to FL was measured as 19.6 mm.

In addition, the value of TCD in millimeters coincided with the gestational age shown by BPD by 80% (Table 2, Image 2).

Discussion

In the evaluation of pregnant and fetus health, the gestational age should be determined correctly. We can obtain information about the normal and abnormal development of the fetus with the parameters used in determining the gestational age. The cerebellum becomes visible sonographically in the 10th-11th weeks of pregnancy and can be seen more clearly in the following weeks (11). In addition to the parameters used in determining the gestational age in obstetric ultrasonography, it has been demonstrated in some studies that TCD can also be used. For example, when Oloyede OA et al. evaluated the TCD according to LMP, consisting of 488 pregnant women, between 18 and 23 weeks, they stated that the TCD was reliable in showing the gestational age(12). Ramireddy Harikiran et al. on the other hand, compared TCD and LMP in 100 pregnant women between 15-40 weeks and found similar results(13). When Nagesh et al. compared the gestational age determined by BPD, FL and AC in 100 pregnant women with TCD, they concluded that TCD can be used safely in determining the gestational age in fetal development(7). Again, in a large-scale study by Chavez et al. to create a nomogram for TCD on 24026 pregnant women; It is stated that it accurately determines the gestational age in the range of 0-4 days between 17-21 weeks, 0-2 days between 22-28 weeks and 0-5 days between 29-36 weeks(14). In our study, there was a strong positive correlation between the BPD, FL and LMP, which we used to determine the gestational age between 18-25 weeks, and TCD, and results were compatible with the articles studied on this subject. Another situation that should be emphasized is that BPD, FL or AC variables used in the determination of gestational age in some studies are stated to be adversely affected by pathologies such as IUGR, achondroplasia, macrosomia, hydrocephalus, maternal diabetes and obesity or conditions that affect the skull development of the fetus, and therefore there may be errors in the determination of gestational age. However, there are studies indicating that fetal cerebellum development is not or only slightly affected by all these adverse conditions. Therefore, they argued that TCD can be used safely in determining the gestational age(13,15,16). Therefore, TCD measurement gains importance in such pathological conditions and contributes positively to the evaluation of fetal and maternal health. Fetal anomalies can be detected in the second trimester obstetric ultrasonography scan. Especially central nervous system anomalies,

posterior fossa pathologies and Chiari malformations are the most important ones(17). The follow-up and treatment of related pathologies during pregnancy and postpartum are very important for the patient. Therefore, TCD can provide preliminary information in terms of contributing to the correct evaluation of the size of the cerebellum located in the posterior fossa in obstetric ultrasonography and its compatibility with gestational age. We think that it is important to monitor TCD diameters that are not compatible with the gestational week more closely. One of the remarkable results of our study, which we wanted to emphasize in addition to previous studies, was that the value of TCD in millimeters directly showed the gestational age. Studies have shown that TCD is compatible with BPD, FL, AC and LMP in determining the gestational age, and TCD increases in line with these parameters as the gestational week increases(15). In addition, the result found after measuring BPD, FL or AC on ultrasonography devices is converted to the gestational age to which it is compatible by the device. However; there is no data on the week of the TCD measurement in ultrasonography devices, because there is no specific nomogram. In our study, we reached the conclusion that the millimeter value of TCD, especially measured between 18-25 weeks, shows the gestational age accurately at the rate of 80%. For example, according to BPD, the TCD of the fetus at 19 weeks was 19mm, and the TCD of the fetus at 21 weeks was 21mm. In a large-scale study by Chavez et al. similar results were found especially at 17-19 weeks (14). We think that this practical information can be used routinely by confirming it in more fetuses. Our study is a preliminary research and can be used as a step for some future information.

Study limitations: The major limitation is this study is relative small sample size. The other limitations is that ultrasonography is dependent on the person, the area measured is anatomically small and its value is milimetric.

Conclusions

In conclusion, this study showed us that there is a strong correlation between TCD and the parameters used to determine gestational age in obstetric ultrasonography. We recommend creating nomograms with larger patient numbers and using TCD in practice.

Ethical consent: This study was approved by Kırşehir Ahi Evran University ethics committee

which we can present when it is requested.
Decision no:2019-10/116, Date:28/05/2019

Conflict of interest: There is no conflict of interest for this study.

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Author Contributions: Concept, design, data collection and/or processing analysis and/or Interpretation(MA)

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