

HEAD CIRCUMFERENCE VERSUS BIPARIETAL DIAMETER IN ASSESSING FETAL GROWTH ULTRASONOGRAPHICALLY

Sedef KAYHAN, M.D., Sedat IŞIK, MD., Sadi GÜNDOĞDU, M.D.,
Mehmet ARAÇ, M.D., Erdoğan KÖKER, M.D.

Gazi University, Faculty of Medicine, Department of Radiology, Ankara, Turkey
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SUMMARY : *We measured the biparietal diameter and head circumference in 554 normal and singleton 16-40 weeks pregnancies between July 1988-March 1989 in Gazi University Medical Faculty, Radiology Department. Head circumference was calculated by means of the circle formula where two diameters were biparietal diameter and occipito frontal diameter. Gestational age of the fetus was calculated from mother's menstrual history and the relation between gestational age and biparietal diameter and head circumference was analysed separately. The correlation coefficient between the gestational age and biparietal diameter was 98.7 % while it was 99.7 % for head circumference. The probable reasons of this finding were discussed and it was concluded that the head circumference was a more accurate index of the gestational age and as a consequence head circumference should replace biparietal diameter in obstetric scanning.*

Key Words : *Ultrasonography, Fetal Growth, Biparietal Diameter, Head Circumference.*

INTRODUCTION

To have a healthy baby requires antenatal care. Accurate knowledge of fetal gestational age depends on clinical dating parameters such as the last menstrual period, fundal height and also most importantly, routine ultrasound screening. Ultrasound plays a major role in the assessment of normal and abnormal fetal growth (Shields et al. 1987; Smith et al. 1986).

Traditionally, gestational age has been derived from measurements of the biparietal diameter and the femur length. But recently investigators have introduced head circumference and abdominal circumference for assessing fetal growth and gestational age. However, there are still hesitation among others to measure the head and abdominal circumferences.

The purpose of this study was to determine the relation between the head circumference and menstrual age and also to disclose the measurement errors based on of the effect of head shape and to discuss the usefulness of head circumference measurements both in predicting menstrual age and detecting intrauterine growth retardation.

Discrepancies between the head circumference and biparietal diameter measurements are related to head shape variations. Especially in the last trimester it depends on the pressure exerted either by the uterus wall itself or by the way of amniotic fluid indirectly.

Such pressure, if applied along the transvers diameter of the head, would result in a decrease in biparietal diameter with a compensatory increase in the occipito - frontal diameter, resulting in dolico-

cephalic head. In such a situation, biparietal diameter would be falsely small while head circumference would remain unaltered. If on the other hand, the direction of the pressure is along the sagittal diameter of the fetal head, occipito - frontal diameter would be reduced and the biparietal diameter is increased as the head becomes brachycephalic. Here again the head circumference would remain unaltered (De Vore and Platt, 1984; Hohler, 1984).

Our study indicates that the head circumference is a more useful index for assessing fetal maturity.

MATERIALS AND METHODS

We measured biparietal diameter (BPD), occipito - frontal diameter (OFD), head circumference (HC), fetal abdominal circumference and femur length on 554 pregnant women with menstrual ages between 15 and 40 weeks, referred to the Ultrasound Division of the Radiology Department in Gazi University Faculty of Medicine.

Patients with suspected menstrual dates, multiple pregnancies, intrauterin abnormalities, intrauterin growth retardation, severe oligohydramnios and maternal diseases such as hypertension or diabetes mellitus were excluded.

If gestational ages established by menstrual history and sonographic assessment were discordant by two weeks or less the patients with reliable menstrual history were included to the study and the last menstrual period was assumed to be correct.

All examinations were performed by Toshiba SAL 55-A real - time ultrasonography equipment with 3.5 MHz linear transducer.

The mean maternal age was 24.5 and the mean frequency of observation per week of gestation was 22. Although some patients underwent multiple ultrasonic examinations during their pregnancies, only one sonographic measurement was used for each patient.

Sonographically biparietal diameter and occipito - frontal diameter were measured in the sections demonstrating that the fetal head is in occiput transvers position by visualization thalamus and cavum septum pellucidum on transvers sections. This was also the section where both hemispheres were observed symmetrically and the midline echo was best seen. For biparietal diameter, we measured the widest transvers diameter of the head perpendicular to the midline echo. Although several techniques have been used for actual measurement

that lead outer to inner, outer to outer or middle to middle distance between the parietal bones, we preferred outer to inner measurement as usually done before (Sanders and James, 1985). For occipito - frontal diameter, we measured the largest diameter between occipital and frontal bones, perpendicular to biparietal diameter (Fig 1).

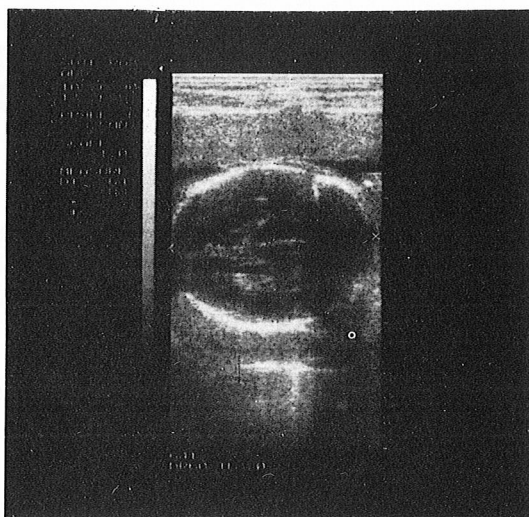


Fig. 1 : The transvers section for BPD and OFD measurements.

Head circumference was calculated using the formula of a circle. This formula for head circumference was : $HC = (BPD + OFD) / 2 \times 3.14$

RESULTS

We calculated the mean values and standard deviations for the measurements of biparietal diameter and head circumference for each gestational week (Figs 2, 3).

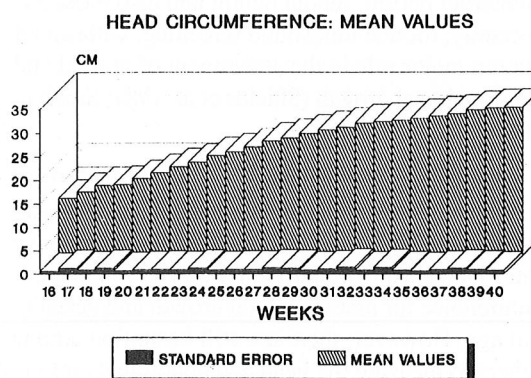


Fig. 2: Mean values and standard deviations for HC.

BPD: MEAN VALUES

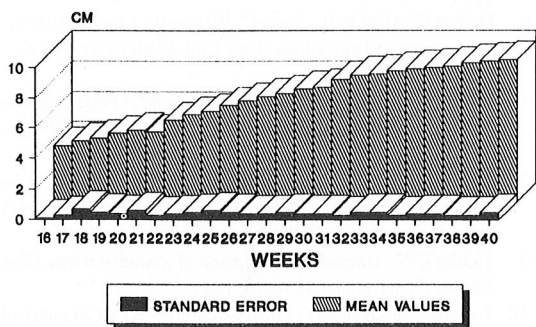


Fig. 3 : Mean values and standart deviations for BPD.

For determination of the relation between the biparietal diameter and head circumference values and the gestational age, we used statistical linear and quadratic correlation models between 16-40 weeks of gestation (Table 1).

| Linear regression model | n | %r | %R2 | Standart error |
|-------------------------|-----|------|------|----------------|
| BPD=Y=0.19+0.252 x | 554 | 98 | 96 | 1.1 |
| HC=Y=0.98+0.81 x | 554 | 98.8 | 97.4 | 0.76 |

Table - 1 : Linear regression model for BPD and HC.

Quadratic function was the optimal model for both biparietal diameter and head circumference with correlation coefficients 98.7 % and 99.7 % respectively (Table 2).

| Quadratic regression model | n | %r | %R2 | Standart error |
|---------------------------------------|-----|------|------|----------------|
| BPD=Y=13.3-0.05 x+0.3 x ² | 554 | 98.7 | 97.4 | 0.97 |
| HC=Y=18.03-0.57 x+0.04 x ² | 554 | 99.7 | 99.0 | 0.58 |

Table - 2 : Quadratic regression model for BPD and HC.

| Quadratic regression model | n | %r | %R2 | Standart error |
|-------------------------------------|-----|------|------|----------------|
| BPD=Y=5.8+2.7 X+0.06 X ² | 280 | 99.2 | 98.8 | 0.65 |
| HC=Y=6.3+0.72 X+0.06 X ² | 280 | 99.7 | 99.3 | 0.48 |

Table - 3 : Quadratic regression model for BPD and HC between 16-30 weeks of gestation.

| Quadratic regression model | n | %r | %R2 | Standart error |
|-------------------------------------|-----|------|------|----------------|
| BPD=Y=142-31.8 X+2.2 X ² | 274 | 77 | 60 | 1.93 |
| HC=Y=189+12.9 X+0.18 X ² | 274 | 99.9 | 99.7 | 0.33 |

Table - 4 : Quadratic regression model for BPD and HC between 31-40 weeks of gestation.

Then we divided the pregnancies into two subgroups of 16-30 and 31-40 weeks according to their menstrual ages. We calculated the correlation coefficient for both groups with quadratic function (Tables 3, 4).

The optimal correlation coefficient for biparietal diameter was 99.2 % between 16-30 weeks and for head circumference was 99.9 % between 31-40 weeks. In the same period correlation coefficient for biparietal diameter was 77 %.

DISCUSSION

Since the correlation coefficient shows the relation and correlation between the parameter and the gestational age : Head circumference has a higher relationship with the gestational age during the whole pregnancy.

It is clear that biparietal diameter is significantly unsuccessful after 30 weeks in assessing gestational age while head circumference is significantly successful. Biparietal diameter is a reliable parameter in the first 30 weeks of gestation in determi-

ning fetal growth but in the last trimester this reliability decreases.

The relationship between the head circumferen-

ce and the gestational age was studied by many investigators in recent years. Our study with 554 cases is one of the largest.

Several investigators differed from each other to some degree depending on the section of measurement, techniques of measurement, number of cases, weeks of gestation and the head circumference formula. But they all concluded that the head circumference was a more accurate index of the age of the fetus than biparietal diameter and we propose that the use of head circumference should, in consequence, replace that of the biparietal diameter in obstetric scanning (Deter et al. 1981; Deter et al. 1982; Deter et al. 1982; De Vore and Platt, 1984; Gomez et al. 1979; Hadlock et al. 1982; Hadlock et al. 1984; Law and MacRae, 1982; Shields et al. 1987; Smith et al. 1986; Todros et al. 1987).

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Correspondance to : Dr.Sedef KAYHAN
Gazi Üniversitesi Tıp Fakültesi
Radyoloji Anabilim Dalı
Beşevler
06510 ANKARA - TURKEY
Phone : 4 - 212 65 65 / 272

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