

Short Report

The Effect Of Normocephalic Foetal Skull On Foetal Dating Using Biparietal Diameter

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Abstract:

The study was conducted to determine the desirability or otherwise of mathematically correcting every normal foetal head shape to an ideal shape prior to dating using the biparietal diameter (BPD). Transabdominal Sonography was performed in 118 pregnant women in their second- and third- trimesters. The BPDs and fronto-occipital diameters (FODs) were measured. A study of 100 fetuses with normal head shapes was used to derive in this environment, a regression equation for an area corrected BPD (BPDa): $BPDa = - 2.853 + 0.483 (BPD + FOD)$. The BPDa of 18 fetuses with normal head shapes, were computed with this equation. Z test was performed to compare the mean BPD and Mean BPDa. Z statistic showed no significant difference ($p > 0.5$) between BPDa and BPD in this group of fetuses with normal head shapes. There is no need to mathematically correct normocephalic foetal head shapes to ideal shapes before dating using the BPDs

Key Words: Foetus, Mathematical Correction, Biparietal Diameter, Cephalic Index, Ultrasonography

Introduction:

The Obstetrical Standard recommends establishing gestational age by the biparietal diameter (BPD), head circumference (HC), or femur length (FL) measurement.¹ Other foetal parameters, for example the humeral length and cerebellar transverse diameter, can also be used for dating. However, they are often less precise. The BPD can establish gestational age² provided that there is a normal ovoid transaxial head shape. If the head is too round (brachiocephalic) or too elongated (dolichocephalic), usually a normal variant, the BPD measurement will be falsely increased or decreased and this gives a wrong foetal dating if the BPD is used for estimation of gestational age. The Obstetrical Standard² suggests avoiding this error by obtaining a second linear measurement from the BPD image called the fronto-occipital diameter (FOD). The BPD and FOD are compared in an equation called the cephalic index (CI): $CI = BPD/FOD \times 100/1$. The CI detects atypical head shapes when numbers deviate from its mean, particularly as they approach or go beyond the outer 2SD limits.² An area-corrected BPD (BPDa) can avoid this problem by mathematically correcting the head to its ideal shape. According to Doubilet et al.,³ $BPDa = (BPD \times FOD/1.265)^{1/2}$.

In the second trimester, the head measurements are preferred.⁴ The area-corrected BPD (BPDa) and the HC are the most precise, ± 1.2 weeks between 14 and 20 gestational weeks and ± 1.9 weeks from 20 to 26 gestational weeks.⁵ The practice is to mathematically correct an abnormal head shape (BPD) to an ideal shape (BPDa) before foetal dating in order to avoid errors in dating. Ugwu et al⁶ have carried out a study establishing normal values of foetal cephalic indices in an African population.

With a technically adequate BPD image, and an accurate measurement, and if pathologic causes of variation in fetal head size (e.g. microcephaly, hydrocephaly, growth retardation) are eliminated there remain two obvious reasons why women with the same last menstrual period may have foetuses with different BPD measurement: (1) genetic variations in head size in foetuses of the same conceptual age and (2) differences in time of ovulation and fertilization with respect to the first day of the last menstrual period.² We thus undertook this study to determine the desirability or otherwise of mathematically correcting every normal foetal head shape to an ideal shape prior to dating using the BPD.

Patients and Methods:

Transabdominal ultrasound was carried out in 118 pregnant patients coming for obstetric sonography in the second and third trimesters between January and December 2006 in Ebonyi State Nigeria. Criteria for inclusion included: a subjectively normal head shape and good indications of foetal viability. Ethical approval was obtained from the Human Research Ethics Committee of the Jeomedics ultrasound centre, Ebonyi State.

The Sonographic images were obtained using Siemens sonoline SL 1, version C ultrasound Machine (Siemens Medical systems, USA Inc, Ultrasound Group, Issaquah WA) with a 3.5 MHz sector transducer.

All measurements were taken by one imaging scientist (AC). Each patient was scanned in supine position. According to the obstetric standard¹ the BPD measurements were obtained from a transaxial image of the head, at the level of the thalami. The measurements were taken 'leading edge to leading edge', from the outer edge of the closer temporoparietal bone to the inner edge of the farther temporoparietal bone.⁴ The overlying soft tissues were excluded.

The FOD measurements were taken from middle of the frontal bone to the middle occipital bone.⁴ This was done to avoid indistinct lateral margins of the calvarium. FOD measurements were taken from the BPD images with the calipers crossing each other at 90°.

The first study was carried out on 100 foetuses between January and October 2006. The aim of this baseline study was to derive a correction equation for abnormal (atypical) head shapes (BPD) using the normal head shapes in this study as models. Pearson's correlation coefficient (r) between BPD and BPD + FOD was 0.989. A regression equation of BPD on BPD + FOD gave the area-correction equation in this environment thus:

$$BPDa = - 2.853 + 0.483 (BPD + FOD).$$

In November and December 2006, 18 foetuses were studied. The area-corrected BPD (BPDa) of these foetuses were computed using the equation derived from the baseline study.

Statistical analysis was done using Microsoft Excel. Mean \pm standard deviation (SD) of both measured and area-corrected (fitted) BPDs were calculated. Z test was used to compare the mean BPD and the mean BPDa. A p-value of <0.05 was considered indicative of a statistically significant difference or relationship.

Results:

The mean BPD \pm standard deviation was 66.55 ± 14.88 while the mean BPDa \pm standard deviation was 66.64 ± 14.77 .

Z statistic showed no significant difference ($p > 0.05$) between the measured BPD and the area corrected BPD among these foetuses with normal head shapes.

Discussion:

There was no significant difference ($p>0.05$) between the measured BPD and the area-corrected BPD in fetuses with normal head shapes (cephalic indices). The implication of this is that there is no need approximating every normal head shape to an ideal shape before foetal age is estimated using the BPD. Only abnormal (atypical) head shapes ought to be corrected. In this study, the foetal biometric measurements were taken by one sonographer (imaging scientist). This was to remove the problem of interobserver variability as it has not been previously demonstrated that these biometric measurements could be taken and reported equally as consistent between Sonographers.

The development of ultrasound scanning of obstetric patient includes the ability to make measurements of various foetal structures. By evaluating large groups of fetuses found to be normal at birth, it has been possible to create standard tables and curves of foetal growth. The accuracy of the Biparietal diameter is affected by the shapes of foetal head.

In this situation measurement which considered both transverse (BPD) and front to back (OFD) will be more accurate. Head circumference is calculated with the formula $(OFD + BPD)/2 \times 3.14$. Several recent obstetrical sonographic examinations have demonstrated that variations in the shape of the foetal skull (e.g dolichocephaly, brachycephaly) may adversely affect the accuracy of the biparietal diameter (BPD) measurement in estimating foetal age.

A previous study in Africa have established normal values for the foetal cephalic index (cephalic index 77.66-93.98, mean $C.I \pm SD$: 85.92 ± 4.88).⁶ Hass⁷ found a mean value of 81.7 in 52 infants each 4 weeks to 12 months. With an observed range of 73-90.4. He noted that these values might be slightly higher than actual values because the distortion by projection of breadth was greater in this series than that of length. Jordan⁸ measured the cephalic index directly in 50 neonates delivered by cesarean section; he found a mean value of 80.6% With a normal range of 76-85. Dolichocephaly is defined by a cephalic index below 75.9, while brachycephaly is said to occur when the cephalic index exceeds 81.⁹

A head that is too elongated is "dolichocephalic", a finding that is often associated with anhydramnios or breech presentation. A round head - termed "brachycephalic" - suggests the presence of a genetic abnormality. A lemon shaped head is usually a sign of spina bifida in the fetus.¹⁰

Also visible in the "BPD view" are the thalamus and the cavum septum pellucidum. In a slightly higher view the anterior horns of the lateral ventricles are seen, as is the midline falx cerebri. When the transducer is rotated slightly, bringing into view structures that are lower in the brain posteriorly, the atria and posterior horns of the lateral ven-

tricles are seen. The choroid plexus should fill the ventricle from side to side. The choroids plexus appears quite large in the early second trimester compared to its appearance at term. Unequivocal narrowing of the anterior cranium, with an apparent constriction in the approximate region of the coronal sutures, in the absence of oligohydramnios is presented as a warning sign of spina bifida in the second trimester foetus.¹⁰ This study has shown that mathematical correction of BPDs in normocephalic fetuses to ideal BPD (BPDa) before dating with BPD would not yield any significant result.

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