Comparison of Fetal Cerebellar Measurements by Two Different Techniques

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We examined 53 fetuses between 15 and 40 weeks of gestation with transverse and coronal sections of the head in order to evaluate the accuracy and reproducibility of the coronal cerebellar diameter. Intraobserver coefficient of variation was ≤2.2% and the mean interobserver difference was 2.2% (range, 0 to 6%). A positive linear correlation exists between transverse and coronal measurements (coronal diameter = 1.02 × transverse diameter − 0.48; $R^2 = 0.99$; $P < 0.0001$). We conclude that the coronal cerebellar diameter is reproducible and accurate and when indicated clinically can be used instead of the transverse cerebellar diameter when the latter is not obtainable because of fetal position. KEY WORDS: Cerebellar biometry; Coronal diameter; Transverse diameter.

Cerebellar measurements during fetal life are readily obtainable with modern high-resolution ultrasound equipment. Transverse cerebellar diameter correlates well with gestational age in fetuses with normal growth and is minimally if at all affected by intrauterine growth retardation.[1,2] In addition, cerebellar biometry has been proposed as a dating parameter in fetuses with altered growth, although some controversy still exists. Obtaining a transverse cerebellar diameter is sometimes impossible because of fetal head position and presentation. Instead, a coronal view can be obtained in such cases. The purpose of this study was to compare the transverse and coronal cerebellar diameters and evaluate the reproducibility, accuracy, and clinical applicability of the coronal cerebellar diameter.

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MATERIALS AND METHODS

Transverse cerebellar measurements of the fetus are routinely obtained on all pregnant patients in our institution. The study sample consisted of patients who were referred to the Maternal-Fetal Medicine department of York Hospital for sonographic evaluation and were found to have normal pregnancies at the time of the study. The two main indications for referral were fetal anatomic evaluation and growth evaluation. A Toshiba 270 A-sonolayer system (Toshiba of America, Yonkers, NY) was employed for the ultrasonic measurements, using a 3.75 MHz curved linear or sector transducer. Cerebellar diameters were obtained from transverse and coronal sections of the posterior fossa. We obtained the transverse cerebellar diameter from the outer-to-outer margins of the cerebellum in a view obtained from the biparietal plane with mild posterior rotation of the transducer[1] (Fig. 1). We obtained the coronal cerebellar diameter also from the outer-to-outer margins of the cerebellum in a coronal view of the posterior fossa (Fig. 2).

A total of 53 patients took part in the study. One transverse and one coronal view of the cerebellum were obtained from each patient in the study group by

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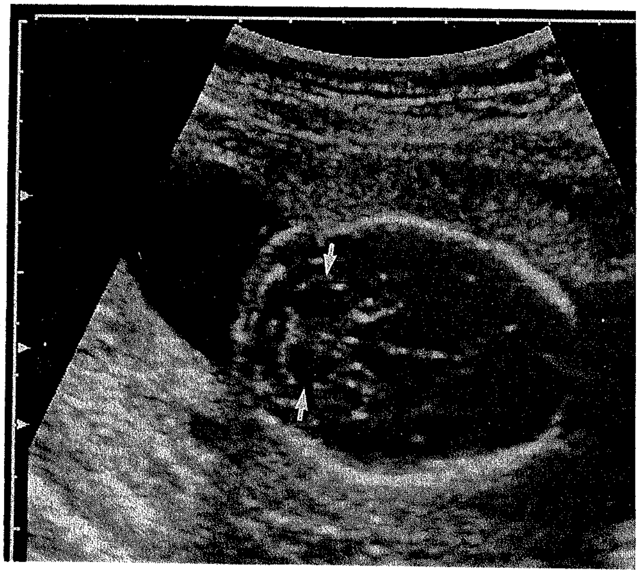
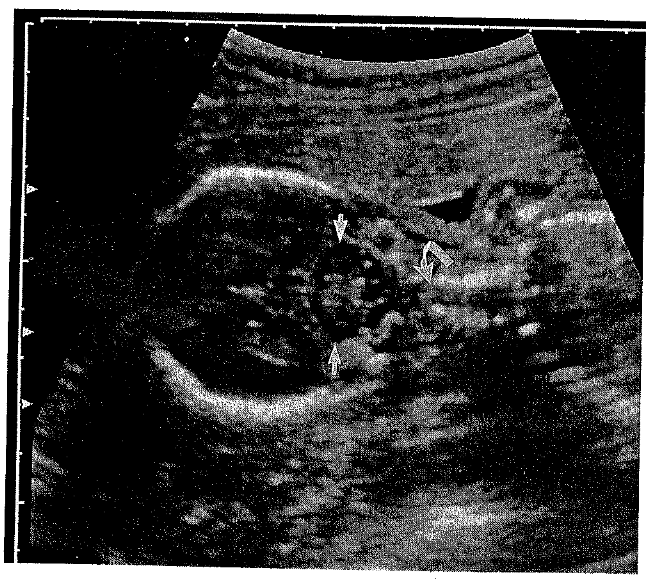


Figure 1 Sonographic view of transverse cerebellar diameter. Arrows indicate the points of measurement.

one of two examiners (AK, KK). Intraobserver variability for coronal cerebellar diameter was evaluated by the coefficient of variation calculated from 20 measurements obtained by each examiner from the same patient. Each one of the examiners obtained 20 consecutive coronal cerebellar views. The cerebellar diameter was measured by means of electronic calibers on the frozen image and stored on a videotape for later retrieval.

Figure 2 Sonographic view of coronal cerebellar diameter. The points of measurement (*straight arrows*) and nuchal spine (*curved arrow*) are indicated. This view is easily and accurately reproducible.



Interobserver variability was determined by comparison of the means of 20 measurements obtained by each examiner from the same patient (total number of examinations = 40). In addition, the absolute difference of the individual paired measurements (20 pairs) was expressed as percentage difference by the following formula:

$$\frac{\text{(measurement by AK)} - \text{(measurement by KK)}}{\text{mean of 20 measurements by AK}} \times 100$$

The mean difference (from the 20 pairs) represents an additional measure of interobserver variability.

The relationship of the coronal and transverse cerebellar diameter was evaluated by simple linear regression. The coefficient of determination (R^2), the curve slope, and the intercept were all taken into consideration in the evaluation of the relationship between transverse and coronal diameters. The paired t-test was used for the comparison of the means of the 20 measurements used in the evaluation of intraobserver variability. A P value of <0.01 was considered statistically significant.

RESULTS

Gestational ages of the sample ranged from 15 to 40 weeks. The intraobserver coefficient of variation for the coronal cerebellar diameter was 1.9% for examiner AK and 2.2% for examiner KK. Comparison of the means of 20 measurements obtained from the same patient by each examiner revealed no difference (30.7 versus 30.4, paired t-test, $t = -1.4$, $P = 0.2$). The mean percentage difference between the 20 paired measurements obtained by the two examiners was 2.2% ± 1.6% (mean ± SD) and the range was 0 to 6%. This is a small difference and does not affect the clinical usefulness of this parameter. The mean difference between coronal and transverse cerebellar diameter was 0.8 ± 0.8 mm (mean ± SD; 0 to 3 mm). The mean percentage difference was 2.7 ± 2.5 (range, 0 to 7%). These are acceptable and clinically insignificant differences. The mean coronal cerebellar diameter was not different from the mean transverse diameter (27.87 ± 11.80 versus 27.82 ± 11.50; $t = 0.313$; $P = 0.75$, $n = 53$). Simple linear regression analysis revealed an excellent correlation between transverse and coronal cerebellar diameters (Fig. 3). The relationship between the two diameters is expressed by the following equation: coronal = 1.02 × transverse − 0.48; $R^2 = 0.99$, $P < 0.0001$. The slope of the regression line is almost 1 and the intercept close to zero, enhancing further the relationship.

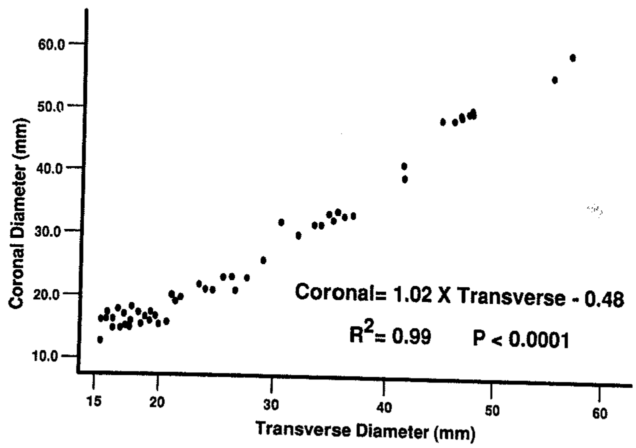


Figure 3 Simple linear regression analysis of cerebellar measurements obtained by the two different techniques.

DISCUSSION

Cerebellar biometry has been proposed as a means to evaluate fetuses with altered growth. Reece and coworkers[2] suggested that fetal cerebellar size is not affected in fetuses with intrauterine growth retardation (IUGR) and cerebellar transverse diameter can be used in the evaluation of fetuses with suspected IUGR, although others have disputed this notion.[3] Hill and coworkers[4] studied fetuses with diabetic macrosomia and found that the cerebellar transverse diameter remains normal. On the basis of this finding, it was proposed that transverse cerebellar diameter be used for dating of fetuses with diabetic macrosomia.

Cerebellar nomograms have been produced for the transverse cerebellar diameter obtained with minimal posterior rotation of the transducer from the biparietal diameter plane. This method produces a transverse view of the posterior fossa. In some cases, the position of the fetal head precludes transverse views and only coronal views can be obtained. Our data indicated no difference between the transverse and coronal diameters. Coronal cerebellar diameter is reproducible with minimal intraobserver and interobserver variability. Coronal and transverse cerebellar diameters are strongly correlated. We conclude that when cerebellar biometry is clinically indicated, the coronal diameter can be safely utilized if the transverse diameter is not obtainable.

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