COMPARISON OF TWO EQUATIONS FOR FETAL WEIGHT PREDICTION BY ULTRASOUND

By

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SUMMARY

In a prospective study by realtime ultrasonography with linear array transducer, we measured the BPD, AC and FML of 60 fetuses in the third trimester. Fetal weight prediction was done by Shepard's equation using BPD and AC and by Hill's equation using Biparietal Diameter, Abdominal circumference and Femoral length for the same sample population. Results of both equations were compared with actual fetal weight, percentage error and standard deviation were calculated. With Shepard's equation the predicted weight was within 100 grams in 36.7% cases, within 200 grams in 78.3% cases, within 300 grams in 90% cases and within 400 grams in 96.7% cases. With the Hill's equation the predicted weight was within 100 grams of the actual fetal weight in 45% cases, within 200 grams in 70% cases and within 300 grams in 98.3% cases. Addition of femoral length for fetal weight prediction by ultrasound definitely improved results. Also it reduced gross errors as those associated with cases of microcephaly using Shepard's equation only. Further it was noticed that male fetuses were consistently heavier than the female fetuses after 33 weeks of gestation. This sex difference, however didn't affect the prediction of fetal weight by ultrasound.

Introduction

Many Obstetrical decisions are influenced by the weight of the fetus in utero, of the current available methods, diagnostic ultrasound due to its simplicity, noninvasiveness, safety and accuracy is the best available tool for obtaining certain fetal dimensions that corelate with fetal weight. This estimation is based on the promise that volume can be derived from measurements of the fetus and fetal volume is related to fetal weight. This relationship is justified as volume is equal to the product of mass and density, and the overall fetal density is close to unity throughout gestation. (Morrison and McLennan, 1976).

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Material, Method and Results

Realtime ultrasonography with 3.5 megahertz linear array transducer was done in the late third trimester in 60 pregnancies within 72 hours before delivery. The biparietal diameter was obtained at

the level of thalami and cavum septum pellucidum, measurements were made from outer edge of the anterior skull table to the inner edge of the posterior skull table. Abdominal girth was measured directly by electronic planimeter on the transverse section of the fetal abdomen at the level of umbilical vein when the latter was at the junction of the anterior one-third and posterior two third of the spinoumbilical line. The femoral length was measured excluding the distal epiphysis and the head of femur. All ultrasonography work was done by only one person well qualified in this field, minimizing personal errors.

In the same sample population, Shepard's and Hill *et al* equations were used for fetal weight prediction and the results were compared. The Shepard's equation viz. log 10 wt. = —1.7492 + 0.166 (BPD) + 0.046 (AC) (BPD), utilized only BPD and AC, whereas the Hill's equation was—Birth weight = exp (—4.7208 + 1.1933 (BPD) —0.0613 (FL-BPD) + 5.9509 (FL/BPD) + 0.3339 (AC/BPD) incorporated femoral length also.

Within 15 minutes after delivery, the newborn were weighed on a metric scale to provide the actual fetal weight for comparison with the predicted weight by ultrasonography. The difference between the two was recorded as error in grams. The percentage error was calculated as follows:—

$$\text{Percentage error} = 100 \times \frac{\text{actual weight-predicted weight}}{\text{Actual weight}}$$

Out of 60 cases, 84% were of less than 25 years age and the rest above 25 years. There were 45% primigravidae, 52% multigravida and 3% ground multipara. Further 85% cases had more than 37 weeks gestation and the rest were between 33-36 weeks of gestation. Ultrasonography was done within 24 hours before delivery in 77% cases and in the rest within 72 hours before delivery. There were 55% male child was remaining females..

The predicted weight using Shepard's equation was within ± 100 grams of actual fetal weight in 36.7% cases, within ± 200 grams in 78.3% cases, within ±300 grams in 90% cases and within ± 400 grams in 96.7% cases. Shepard *et al* 1982 had reported within 224 grams of actual fetal weight in 50% cases and within 608 grams in 90% cases. The standard deviation in our study was 192 grams. Warsof *et al* 1977 had reported a standard deviation of 106 grams/Kg. In 61.6% cases there was an underestimation of on an average 6.24% of the actual weight. The percentage error was 5.43% of actual weight. With Hill's equation which incorporates femoral length also, the predicted fetal weight was within 100 grams of actual fetal weight in 45% cases, within 200 grams in 70% cases and within 300 grams in 98.3% cases. Hill *et al* had reported the expected fetal weight within 168 grams of the actual fetal weight in 50% cases and within 408 grams in 90% cases. In 65% cases there was an overestimation of on an average 5.75% of actual weight. The standard deviation in our study was 152 grams and the percentage error was 5.11% of actual weight. The standard error of difference of means between the two equation was 3.50, a difference which is significant (>1.96) and was in favor of Hill's equation. One of the fetus evaluated provides useful example of why all three parameters are important in fetal weight estimation. Fetus had microcephaly and Shepard's equation predicted 675 grams less than the actual fetal weight, whereas Hill's equation es imated only 86 grams more than the actual weight. Further the male fetuses were consistently

heavier than the female fetus in the entire sample by on an average 225 grams. This is unlike Thomson *et al* 1968 who had found that male fetuses weight heavier than female fetuses after 38 weeks of gestation only. Interestingly this sex difference, however, did not affect the prediction of weight by ultrasound.

Comment

The most accurate estimates of fetal weight in utero are those based on at least three fetal measurements, the BPD as an index of head size, AC as an index of body girth and FML as an index of crown-heel length.

Jordaan 1983 found that birth weight increased with crown-heel length when abdominal circumference was held constant. Hence the weight of very short fetuses was overestimated and of very long fetuses was underestimated. Hadlock *et al* 1986 found a strong linear relationship between femoral length and crown-heel length and hence incorporated the former measurement into their estimation of fetal weight. Hill *et al* 1985 and our results using Hill's equation confirms this finding. However, although a formula may be accurate for the population from which it was derived, it may not be generally applicable because of interpopulation differences. Therefore, each Obstetric department should evaluate its own population, obtain appropriate data and a new equation must be derived for what institution.

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