FETAL WEIGHT PREDICTION BY HEAD AND ABDOMINAL MEASUREMENTS BY ULTRASOUND

By

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SUMMARY

Many obstetrical decisions are influenced by the weight of the fetus, an accurate prediction of fetal weight in utero can improve prospective management of high risk pregnancies and lead to a possible reduction in perinatal mortality and morbidity. The clinical ability to determine fetal weight in utero entails a significant margin of error. In a prospective study by Real time ultrasound with linear array transducer, we measured the Biparietal diameter and abdominal circumference. These two parameters were used in Shepard's equation for fetal weight prediction in 130 pregnancies. In 49.3% cases the predicted weight was within 100 grams of actual weight, whereas in 77.6% cases the predicted weight was within 150 gms of actual weight. The percentage error calculated was on an average 3.5% of the actual weight and the standard deviation was 108 grams. Male fetuses were found to be consistently heavier than female fetuses in the late third trimester of pregnancy. This sex difference however, did not affect the prediction of in utero fetal weight by ultrasound.

Introduction

Many obstetrical decisions are influenced by the weight of the fetus, and it is not surprising then that there have been numerous attempts to determine the weight of the fetus using various parameters. It is generally accepted that a simple, accurate and universally applicable method of asssessing in utero fetal weight leads to an improved prospective management of high risk pregnancies and a possible reduction in perinatal mortality and morbidity. In one the the largest clinical series using examinations of the maternal abdomen Loeffler 1967 found that approximately 80% of birth weight estimates were within ± 454 grams of the infants actual birth weight. The clinical ability to determine fetal weight in utero entails a significant margin of error.

Clearly another more precise method for fetal weight estimation is needed. The simplicity, non-invasiveness, safety and accuracy of diagnostic ultrasound make it, at present the best available tool for obtaining certain fetal dimensions that correlate with fetal weight. This estimation is based on the premise that volume can be derived from measurements of the

From: BYL Nair Ch. Hospital, Bombay.
Accepted for publication on 5-4-88.

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).

Material, Method and Results

The study population consisted of 130 pragnancies with 134 fetuses (including 4 twins) all examined in the late third trimester. A thorough obstetric sonography was performed wihin 72 hours before delivery with Real time portable ultrasound using 3.5 Megahertz Linear array transducer (PIE DATA 400). The biparietal diameter was obtained at the level of thalami and Cavum septum pellucidum, measurements were made from the outer edge of the posterior skull table to the inner edge of the anterior skull table. Cases with a normal cephalic index (74-83%) were only included. Abdominal girth was measured directly by electronic plainmeter 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 the posterior two thirds of the spinoumbilical line. All ultrasonography work was done by only one person well qualified in this field, minimizing personal errors.

The Shephard's equation (1982) viz—

$$100 \text{ Wt.} = -1.7492 + 0.166 \text{ (BPD)} + 0.046 \text{ (AC)} - 0.002646 \text{ (AC) (BPD)}$$

was used for weight prediction in 134 fetuses (using BPD and AC measurements). Within 15 minutes after delivery, the newborn were weighed on a metric scale to provide an actual weight for comparison with the predicted weight. The difference between the two was recorded as error in grams. The percentage error was calculated as follows—

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

In our study population 80% cases were less than 25 years of age, 15% were between 26-30 years and the remaining above 31 years of age. Out of 130 cases 42% were primigravidas, 32% had one previous child, 23% had two previous children and 3% were Grand multiparas. The gestational age was more than 37 weeks in 82% of our cases including 6 postdated pregnancies, the remaining 18% were between 33-36 weeks of gestation.

In 70% of the cases ultrasound examination was done within 24 hours before delivery, in 25% within 48 hours before delivery. There were 54% males and remaining females.

The predicted weight using Shepard's equation in our study was within ± 100 grams of the actual weight in 49.3% cases and was within ± 150 grams in 77.6% cases. Shepard *et al* had in 50% cases within ± 224 grams and in 90% cases within ± 608 grams of the actual weight. The percentage error in our study was 3.5% and the standard deviation overall was 108 grams. In 40% of cases there was an over estimation on an average of 3.6% and in 60% an under estimation on an average of 3.4% of the actual weight.

The weights ranged from 1600 to 3700 gms. Thomson *et al* 1968 had found that male fetuses weighed heavier than female fetuses after 38 weeks of gestation. However in our study male fetuses were consistently heavier than female fetuses after 33 weeks of gestation by 291 gms. This sex difference, however, did not affect the prediction of weight by ultrasound.

Discussion

Campbell and Wilkin (1975) found a close relationship between the fetal abdominal circumference and the fetal weight. They studied 140 fetuses within 48 hours of delivery and found 95% confidence limit of ± 16% for weight prediction throughout the weight range of 1000-4000 gms.

Warsof *et al* (1977) using biparietal diameter and abdominal circumference in logarithmic equation had a standard deviation of 106 grams per kg. fetal weight. Interestingly he found that the abdominal circumference was shown to be superior to total intra uterine volume as an estimator of fetal weight. Further they showed that determination of fetal weight by biparietal diameter and abdominal circumference was not improved by using total intra uterine volume determination. In a similar fashion use of head circumference did not improve fetal weight prediction according Hill *et al* 1985 and Hadlock *et al.* (1986).

Deter *et al* (1981) have compared the results of Campbell and Wilkin, original Warsef and the Shepard's modification in 125 patients and found that Campbell and Wilkin overestimated the weight by 5.3%, original Warsof overestimated by 1.6% while Shepard's modification gave systematic underestimates of about 5.2% for the latter, Deter *et al* (1981) found that the predicted weight is approximately 5 to 6% under the actual weight in all weight classes tested.

Thus several authors have tested the reliability of Biparietal diameter and abdominal circumference measurement for fetal weight estimation and have found it quite satisfactory across all weight ranges tested. In our study of 134 fetuses with the same parameters using Shepard's equation for the fetal weight prediction, results are encouraging. This is currently the best method regardless of whether or not the baby is of average, large or small weight for gestational age.

Acknowledgement

Out thanks to Dr. Mrs. P. M. Pai, the Dean of BYL Nair Ch. Hospital, Bombay for allowing us to do research in ultrasound and utilize hospital data.

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