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Ultrasonogrphic Estimation of Birth Weight by Measuring Biparietal Diameter and Abdominal Circumference in High Risk Pregnancies

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Abstract

Background: When delivery of a preterm infant is anticipated accurate antenatal assessment of the fetal weight can be a useful adjuvant for establishing a plan of management .That will minimize perinatal morbidity and mortality rate. *Objective*: To estimate fetal birth weight by measuring fetal abdominal circumference and biparietal diameter in 3rd trimester high risk pregnancies by Ultrasonography. To devise a simple and accurate equation for estimating birth weights of preterm and low birth weight fetuses. *Methods and material*: The study population was made up of 92 high risk 3rd trimester pregnant patients. Fetal measurements were made by real time USG machine. *Result*: In the present study estimated fetal birth weight calculated by Gray Thurnau's equation formula was highly correlated with actual birth weight with correlation coefficient of 0.925. *Conclusion*: Abdominal circumference and biparietal diameter are the best indicators to assess birth weight in high risk pregnancies.

Keywords: Fetal Birth Weight; Ultrasonography; Abdominal Circumference and Biparietal Diameter.

Introduction

'There is no indicator in human biology which tells us so much about the past events and future trajectory of life, as the weight of the infant at birth. - V. Ramlingaswami.

Birth weight is the single most important marker of adverse prenatal, neonatal and infantile outcome. Over 80% of all neonatal deaths in both developed and developing countries occur among low birth weight babies.

About 25-35% of babies in India are low birth weight. Out of these 10-12% babies are born preterm as compared to 5-7% incidence in West [6].

A simple and accurate method of estimating fetal birth weight, which would be applied to all pregnancies, would be an important means of reducing perinatal mortality and morbidity [1].

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Ultrasound being a painless, non- invasive inexpensive and apparently harmless technique has the potential to be used to screen all obstetric patients. So important is its role, that many countries have adopted to perform at least three scans per pregnancy for an individual (i.e. one scan in each trimester) [5].

Serial measurements have been used successfully to detect fetal growth retardation. But this technique would not be feasible for our Indian population at large especially in the rural areas. Hence a single early scan measuring Crown- Rump length or Biparietal diameter would tell us the accurate menstrual age and a late scan in 3rd trimester would help in assessing the expected fetal birth weight by taking abdominal circumference into consideration. It has been found that fetal abdominal circumference is a reliable, quick and simple method for estimating fetal weight on a large scale.

Accurate estimation of fetal weight is important for the reduction of perinatal morbidity and mortality.

Materials and Methods

The study population was made up of 92 high risk 3rd trimester pregnant patients with history of

1. Pre-eclampsia

2. Ante partum hemorrhage
3. Multiple pregnancy
4. Polyhydramnios
5. Oligohydramnios
6. Bad obstetric history
7. Medical disorders
8. Previous preterm delivery
9. Low socio economic and nutritional status
10. Addictions: Alcohol consumption, smoking

After the permission from the institutional ethics committee, the study data was obtained from high risk pregnant patients who have delivered within two weeks of ultrasonographic examination. The proforma was made. Informed consent was obtained from the women to use examination data in study.

Fetal measurements were made by real time USG machineFirst, the position, lie and presentation of fetus were seen.

The axial section was recognized when shape of the fetal skull was ovoid and the midline echo from the falx cerebri was interrupted by cavum septi pellucidi and the thalami. When this plane was found, the gain on the ultrasound unit was reduced to avoid the artifactual thickening of skull tables. Measurement was made from the outer table of the proximal surface of the skull to the inner table of the distal surface of the skull. The soft tissues over the skull were not included. This is called as leading edge to leading edge technique. The biparietal diameter was measured with an electronic caliper.

The biparietal diameter measurement was followed by displacing and moving the transducer on the maternal abdomen so as to find the fetal craniovertebral junction and the vertebral column of fetus was traced to its termination. A projection was found that showed a transverse section of one of the long bones. Then the scan was turned by 90 degrees to that to obtain a longitudinal section. The fetal body was then followed till the heart was reached and moving along the fetal body until the fetal urinary bladder was imaged. This was followed by the image of iliac crests; they appeared as two short bright echoes along the bladder. A short distance further, a bright echo appeared close to iliac crest, which was the femur. On rotation, the femoral echo increased in length. The full length was demonstrated when the femur cast an acoustic shadow, which was sufficient to conceal the posteriorly lying structures. Measurement was made from one end of the bone to other end. In case of any doubt the other limb can also be measured.

Abdominal circumference was measured at the level of fetal liver, which is very sensitive to deficient nutrition. The measurement was made as a true transaxial plane, where the umbilical portion of the left portal vein enters the liver [9].

With these parameters estimated fetal birth weights were calculated by Gray Thurnau's equation one (E_1) and compared with their actual birth weights.

Observations

Equations for estimating fetal birth weight

ª% E_1 ® EFW = (BPD x AC x 9.337) – 299.076

Where,

EFW = Estimated foetal weight

AC = Abdominal Circumference

BPD = Biparietal diameter

ABW = Actual Birth Weight

Table 1: Mean and sd of patients age (yr) and gestational age (wk)

Sex of Neonate	No of Cases	%
Male	43	47
Female	49	53
Total	92	100

Table 2: Sex distribution

Variable	Mean ± sd
Fetal bpd(cm)	8.02 ± 0.58
Fetal ac(cm)	27.7 ± 2.8

Table 3: Mean and sd of sample population measurement variables (n=92)

Variable	Mean ± SD
Fetal bpd(cm)	8.02 ± 0.58
Fetal ac(cm)	27.7 ± 2.8

Table 4: Mean and sd of estimated fetal birth weight and actual birth weight (n = 92)

	Mean ± SD
ABW(gm)	1809 ± 374
E_1(gm)	1791 ± 348

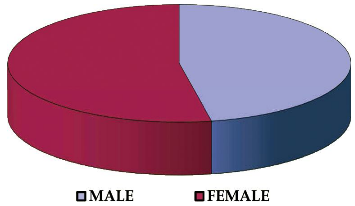
Table 5: comparison of estimated fetal birth weight, actual birth weight and sex of neonate

Sex	EFW(gm) E_1	ABW(gm)
Male	1826	1834
Female	1761	1786
P value	> 0.005	> 0.005

Thus the sex of the infant at delivery was not a statistically significant factor for difference between estimated and actual birth weight.

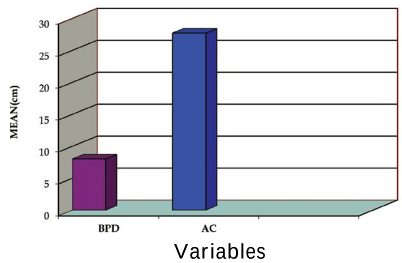
Table 6: Correlation matrix of sample population measurement variables

	BPD	AC	E1	ABW
BPD	1			
AC	0.807	1		
E1	0.925	0.965	1	
ABW	0.810	0.911	0.925	1

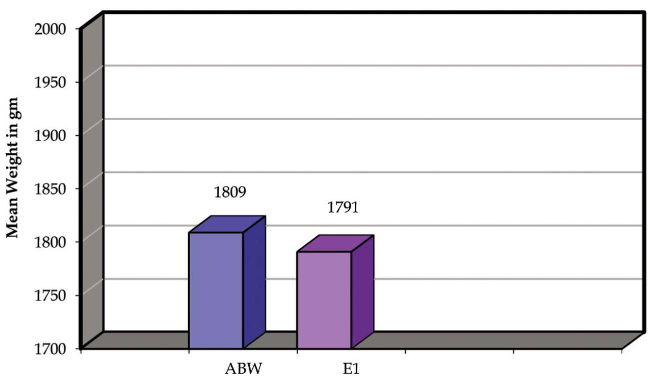


Sex Distribution

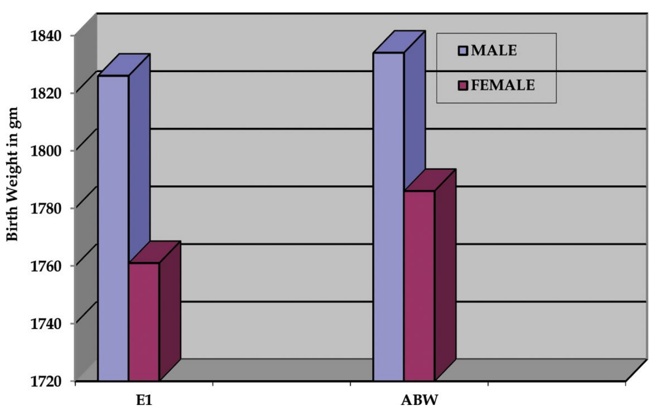
Mean of Variables



Mean of Estimated Birth Weight By E_1 and Actual Birth Weight



Mean of Estimated Birth Weight and Actual Birth Weight in Male and Female Infants



Neonatal actual birth weight was highly correlated with each of the other two measurement variables with the highest value being that for ABW and AC. ($p<0.001$)

Discussion

The objective of the present study was to develop a mathematical equation that is simple accurate and easy to use when applied to preterm and low birth weight fetuses. In this study real time ultrasound measurement of fetal biparietal diameter, abdominal circumference and femur length were obtained in 92 pregnant women within two weeks of delivery. The parameters used in this study are discussed one by one

Biparietal Diameter

The fetal BPD was the first sonographic parameters used to determine gestational age and assess fetal growth.

Routine single measurement of the BPD early in 2nd trimester have been shown to be an accurate method of assessing the menstrual age of the fetus (Campbell [3] 1974) but single measurements in late pregnancy are not clinically useful in assessing birth weight (Campbell[4]1973). Serial measurements have been used successfully to detect fetal growth retardation (Willockset al [14] 1969, Campbell and Dewhurst [2]1971, Varma [13] 1973).

But this technique can not be used to screen all obstetric patients due to the excessive work load which this would entail [5].

Rudy Sabbaghaet al [10] in 1976 obtained serial BPD readings and categorized them into three percentile rankings. And for the first time they reported that under normal condition fetuses initially placed in any of these three cephalic levels will continue to grow within the confines of the same percentile range.

In the present study the mean biparietal diameter was 8.02 cm with SD 0.58.

Abdominal Circumference

Abdominal circumference is the most sensitive predictor of fetal weight and this is to be expected because it reflects the glycogen store of the liver. It is also an easier measurement to obtain compared to those of the head whose size, shape and accessibility will be altered according to where it is positioned. Abdominal circumference increases approximately by 20 mm in 2 wks in the average fetus. Several workers have achieved greater success in predicting birth weight from single examination by linear (Thompson and Makowski 1971) or circumference (Levi 1972, Hansmenn et al 1973) measurement of fetal thora [1].

Campbell [7], 1974 have found that the greatest accuracy in prediction is achieved by taking circumference measurements of fetal abdomen at the level of umbilical vein. In 1975 Campbell [5] did prospective study and showed that the accuracy of predictions varied with the size of the fetus at a predicted weight of 1kg, 95% of birth weight fall within 160gm, while at 2 kg, 3kg and 4kg the corresponding values are 290 gm, 450gm and 590gm respectively.

W.D. McCallum et al [7] in 1979 reported multiple regression analysis of birth weight and the natural logarithm of birth weight against several measured variables. The formula giving best correlation was a polynomial regression of the natural logarithm of birth weight versus trunk circumference and a long axis measurement. The best correlation was 0.944 giving predicted birth weight error of ± 103 gm of SD.

In the present study the mean abdominal circumference was 27.7 cm with SD 2.8cm. Abdominal circumference is highly correlated with BPD and actual birth weight.

Milo B. Sampson et al [11] in 1982 compared five different equations and concluded that actual birth weight correlated best with the predicted weight when Warsof's equations was used to calculate predicted weight from AC and BPD.

Thomas C. Key et al [5] did prospective study to compare two formula reported by Warsof et al and Shepard et al and they concluded that with Warsof's formula there was a high degree of correlation between estimated fetal birth weight and the actual birth weight (r-0.9 82, P<0.001).

In the Present Study Equation one (E_1) was Based on Gray Thurnau's Equation (1983)

Gray Thurnau et al (12) in 1983 did prospective study. They obtained real time ultrasound measurement of BPD and AC in 62 pregnant women prior to one week of delivery. When predicted estimated fetal weight was compared with actual birth weight multiple regression analysis demonstrated a correlation coefficient of 0.957. They also proved that AC was highly correlated with actual birth weight. AC, BPD were also highly correlated with each other.

In the Present Study Estimated Fetal Birth Weight Calculated by Formula E_1 was Highly Correlated with ABW with Correlation Coefficient of 0.925

Michael T. Medchill [8] in 1991 compared the actual birth weight of low birth weight infants with the estimated fetal weight derived from 20 published formulas. They concluded that Rose's formula was better and showed the smallest SD and better correlation (69gm and 0.780 respectively).

Using this formula 46 of 63 (73%) of the estimated fetal weight were within 10% of the actual birth weight and 56 of 83 (89%) were within 100gm of birth weight.

In the present study 72 of 92 (78%) of estimated fetal weight were within 10% of actual birth weight by using equation E_1.

Statistical analysis showed that by using 't' test there was no statistical difference between means of estimated fetal birth weight calculated by formula E_1 and actual birth weight.

Conclusion

In the present study formula E_1 is more accurate predictor of birth weight in high risk pregnancies when the Pearson's coefficient, standard deviation, percent error and 't' test were used for comparison.

The conclusions of the present study are:

1. Abdominal circumference and biparietal diameter are the best indicators to assess birth weight in high risk pregnancies.
2. Fetal birth weight calculated by formulaEFW = (BPD × AC × 9.337) – 299.076 is accurate for high risk pregnancies. This simple equation appears to be clinically reliable and easy to use when estimating weights of preterm or low birth weight fetuses.

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