Original Research Article

Comparative study for estimation of fetal weight by using two different ultrasonographical formulae in high risk pregnant patients

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Abstract

Objective: To make comparative evaluation of estimation of fetal weight in high risk pregnancies by using two different ultrasonographic formulae(E1- Gray Thurnau's equation , E2- Frank P. Hadlock *et al*) and actual birth weight. **Methods and Materials:** In the present study 92 high risk pregnant patients who had delivered within two weeks of sonography examination were studied. Fetal measurements were made by real time USG machine. **Result:** In the present study formula E1 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. **Conclusion:** Abdominal circumference and biparietal diameter are the best indicators to assess birth weight in high risk pregnancies.

Key Words: Abdominal circumference, Biparietal diameter, Ultrasonography

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INTRODUCTION

Accurate determination of birth weight is necessary for clinical management decisions, especially in imminent preterm birth to provide appropriate neonatal care. Preterm birth complications are the leading cause of death among children under 5 years of age, responsible for approximately 1 million deaths in 2015[8].Sonographic fetal weight estimation is an important component of antenatal care. Pre-natal fetal weight estimation, helps clinicians to prepare for anticipated preterm deliveries, and to settle for the optimal delivery route. 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]. Diagnostic ultrasound has been used in obstetrics for nearly 70 years. It is very important technique for examining pregnant women and can be used when clinically indicated at any time during pregnancy. 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 foetal 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. This is also beneficial for Obstetricians and Pediatricians to plan the mode of delivery and perinatal management.

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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 machine First, 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[11]. With these parameters estimated fetal birth weights were calculated by equation one (E_1) and equation two (E_2) and compared with their actual birth weights.

OBSERVATIONS

Equations for estimating foetal birth weight

- **E_1** → EFW = (BPD x AC x 9.337) – 299.076
- **E_2** → log 10 of birth weight = 1.304 + (0.05281 x AC) + (0.1938 x FL) - (0.004 x AC x FL)

Where,

EFW = Estimated foetal weight
AC = Abdominal Circumference
BPD = Biparietal diameter
FL = Femur length
ABW = Actual Birth Weight

Total numbers of cases studied were 92.

TABLE 1: 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
FETAL FL(cm)	6.18 ± 0.64

TABLE 2: MEAN AND SD OF ESTIMATED FETAL BIRTH WEIGHT BY

	MEAN ± SD
ABW(gm)	1809 ± 374
E_1(gm)	1791± 348
E_2 (gm)	1968 ± 514

TABLE 3: CORRELATION MATRIX OF SAMPLE POPULATION MEASUREMENT VARIABLES

	BPD	AC	FL	E1	E2	ABW
BPD	1					
AC	0.807	1				
FL	0.676	0.756	1			
E1	0.925	0.965	0.762	1		
E2	0.859	0.950	0.793	0.958	1	
ABW	0.810	0.911	0.744	0.925	0.915	1

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

TABLE 4: COMPARISON OF ACTUAL BIRTH WEIGHT WITH ESTIMATED FETAL BIRTH WEIGHT BY FORMULA E_1 (n= 92)

	E_1(gm)	ABW(gm)
MEAN	1791.69	1809.23
VARIANCE	121744.7	140545
t stat: 0.32		p: 0.74

Table 5 shows there was no statistically significant difference between estimated fetal birth weight and actual birth weight.

TABLE 5: COMPARISON OF ACTUAL BIRTH WEIGHT TO ESTIMATED FETAL BIRTH WEIGHT BY FORMULA E_2 (n= 92)

	E_2(gm)	ABW(gm)
MEAN	1968.35	1809.23
VARIANCE	265071	140545.5
t stat: 2.39		p : 0.017

Table 5 shows there was statistically significant difference in the means of two groups.

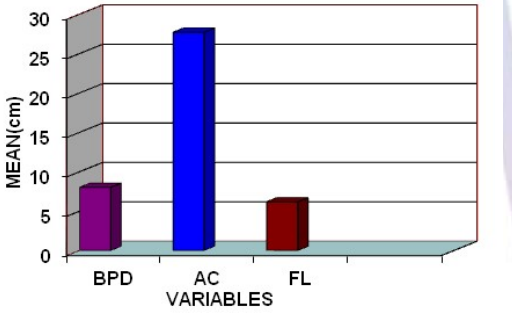

Figure 1

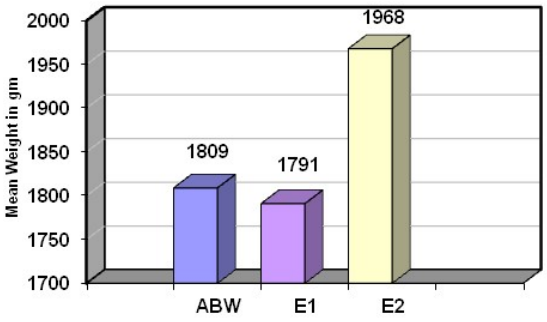

Figure 2

Figure 1: MEAN OF VARIABLES; **Figure 2:** MEAN OF ESTIMATED BIRTH WEIGHT BY E_1 AND E_2 AND ACTUAL BIRTH WEIGHT

DISCUSSION

The objective of the present study was to to make comparative evaluation of estimation of fetal weight in high risk pregnancies by using two different ultrasonographic formulae(E1- Gray Thurnau's equation , E2- Frank P. Hadlock *et al*) and actual birth weight. 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. Normal growth charts of BPD according to weeks of gestation are available. Routine single measurement of the BPD early in 2nd trimester have been shown to be an accurate method of assessing the gestational age of the fetus (Campbell4 1974) but single measurements in late pregnancy are not clinically useful in assessing birth weight (Campbell3 1973).Serial measurements have been used successfully to detect fetal growth retardation (Willocks *et al*17 1969, Campbell and Dewhurst 21971, Varma161973). But this technique can not be used to screen all obstetric patients due to the excessive work load which this would entail1. Rudy Sabbagha *et al*12 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 0.58 of SD.

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 thorax1. Campbell4, 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[1] 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*[9] 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 2.8cm of SD. Abdominal circumference is highly correlated with BPD and actual birth weight.

Femur length:

Femur sparing IUGR type is more common. And most of the published formulas specific for low birth weight infants have not considered femur length as a parameters to estimate fetal birth weight. Single femur length measurement is not used for estimating fetal birth weight in high risk pregnancy. It is always combined with other parameters. In the present study femur length has shown less degree of correlation as compared to biparietal diameter and abdominal circumference.Milo B. Sampson *et al*[13] 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. Mary J Shepard calculated birth weight by using two equations and showed that equations 2nd is better than equation one. Both these equations were based on BPD and AC parameters14.Thomas C. Key *et al*[7] did prospective study to compare two formula reported by Warsof *et al* and Shepard *et al* 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 (E1) was based on Gray Thurnau's equation (1983). Gray Thurnau *et al*[15] in 1983 did prospective study. They obtained real time ultrasound measurement of BPD and AC in 62 pregnant women within 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 E1 was highly correlated with ABW with correlation coefficient of 0.925. As well as table no. 3 shows correlation of ABW, E1 and E2 with that of BPD, AC and FL. Frank P. Hadlock *et al*6 in 1985 reported that best results of estimated fetal birth weight were obtained from the use of models based on measurement of head size, abdominal size and femur length. The estimated fetal weight showed no any statistical difference with actual birth weight. Frank Chervenak *et al*[5] in 1985 reported that obstetric gestational age and sonographically estimated fetal weight, both were important in prediction of adverse neonatal outcome. Michael T. Medchill[10] 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 E1. Present study also showed comparison of estimated fetal birth weights calculated by formula E1 and E2 with that of actual birth weights. Statistical analysis showed that by using't' test there was no statistical difference between means of estimated fetal birth weight calculated by formula E1 and actual birth weight as shown in table no.4 . It also proved that there was statistical difference means of estimated fetal birth weight calculated by formula E2 and ABW i.e. means of two group are not equal.

CONCLUSION

Fetal birth weights were estimated by two formulae E1 and E2 and compared with actual birth weight. In the present study formula E1 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 formula EFW = (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.
3. Birth weight calculated by formula E1 is more accurate than formula E2.

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