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Comparision of Fetal Weight Estimation at Term by Clinical Method, Ultrasound and after Delivery

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Abstract

Background and Objectives: Fetal weight is one of the greatest factors, determining the survival of the fetus. Ultrasound study presents a very important tool in modern day obstetrics. Accurate assessment of fetal weight is mandatory for obstetric management particularly at term. Present study is a prospective observational study comparing the fetal weight estimation by clinical method using Johnson's formula and ultrasound method using Hadlock's formula at term and its accuracy with the actual birth weight. Methods: Present study was a prospective observational study conducted in 300 term pregnant women. Expected fetal weight was estimated by measuring symphysio fundal height clinically using Johnson's formula and ultrasonographically using Hadlock's formula. Both the weights were compared with actual birth weight. Statistical test were done using student-t test and chi square test. Results: The mean birth weight of Hadlock's formula, 2942.57 gms, was closest to mean of actual birth weight, 2958.01 when compared to Johnson's formula mean birth weight 3046.95. The difference between mean birth weights of Hadlock's and Johnson's formula with actual birth weight being 15.433 gms and 88.947 gms respectively. The mean error and standard deviation from actual birth weight are least with Hadlock's formula compared to Johnson's formula. Conclusion: Birth weight is a key variable affecting fetal and neonatal morbidity, particularly in preterm and small for date babies. In addition, it is of value in the management of breech presentations, diabetes mellitus, trial of labour, macrosomic foetuses and multiple births. Of the two methods studied, ultrasonographic method, i.e., Hadlock's formula has better predictable results in fetal weight estimation, compared tho clinical method, i.e., Johnson's formula.

Keywords: *Ultrasound, Hadlock's formula, Johnson's Formula, Symphysio Fundal Height, Actual Birth Weight.*

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Introduction

Accurate estimation of fetal weight is of paramount importance in the management of labour and delivery. During the last decade, estimated fetal weight has been incorporated into the standard routine antepartum evaluation of high risk pregnancies and deliveries. An accurate pre-delivery assessment and estimation of fetal weight is important in many obstetric situations. Identification of the fetus at risk still represents one of the main difficulties in modern obstetrics, in spite of the availability of a wide range of clinical, biochemical and ultrasonographic techniques [1].

Various calculations and formulae based on measuring uterine fundal height above symphysis pubis have been developed. Ojwang et al used the product of symphysio-fundal height and abdominal girth measurement at various levels in centimetres above symphysis pubis in obtaining a fairly acceptable predictive value but with considerable variation from the mean [2].

Dare et al simplified and used the product of symphysio-fundal height (Mc Donald's measurement) and abdominal girth at the level of umbilicus measured in centimetres and result expressed in grams to estimate foetal weight in uterus at term, and the estimation correlated well with birth weight [3].

Weight in grams =Abdominal girth (centimetres) X symphysio-fundal height (centimetres) (AG X SFH). Abdominal girth was measured at the level of the umbilicus. Symphysio-fundal height or Mcdonald's measurement was taken, after correcting the dextrorotation, from the upper border of the symphysis pubis to the height of the fundus.

Johnson's formula- Weight in grams = Mcdonald's measurement of symphysiofundal height in centimetres – x) X 155. Mcdonald's measurement was done as mentioned above. Station of the head was noted [4].

X=13, when presenting part was not engaged.

X=12, when presenting part was at 0 station.

X=11, when presenting part was at +1 station.

Estimation of birth weight by symphysio-fundal height measurement is a useful alternative where ultrasonography is not available. However sonography superior to SFH in estimating low birth weight babies, while both methods show wide standard deviations for birth weights above 4000g. The SFH derived birth weight centiles will be found more useful in clinical situations where knowledge of the minimum, maximum and approximate fetal weight are all required for clinical decision-making [5].

Ultrasound is a basic diagnostic tool in obstetrics and its benefits extend from use in diagnosis of very early pregnancy to estimation of fetal weight at the time of delivery. Monitoring of fetal growth is a standard component of antenatal care. There are various techniques for fetal weight estimation. The two main methods for predicting birth weight are clinical and sonographic estimations. Although the clinical estimation, based on abdominal palpation and fundal height, is easy, inexpensive and more helpful in developing countries, it is subjective and has no standard technique [6].

Many formulae were derived for estimation of fetal weight through ultrasound.

1. Hadlock (AC) – (Hadlock et al [7])

   $Ln\ EFW = 2.695 + 0.253\ (AC) - 0.00275\ (AC)2$

2. Warsof (FL) (Warsof et al [8])

   $Ln\ EFW = 4.6914 + 0.151\ (FL)2 - 0.0119\ (FL)^2$

3. Shepard (BPD, AC) (Shepard et al [9])

   $Log_{10} EFW = 1.7492 + 0.166\ (BPD) + 0.046\ (AC) - 0.002546\ (AC)\ (BPD)$.

4. Warsof (BPD, AC) (Warsof et al [10])

   $Log_{10} EFW = 1.599 + 0.144\ (BPD) + 0.032\ (AC) - 0.000111\ (BPD)^2\ (AC)$.

5. Woo (AC, FL) (Woo et al [11])

   $Log_{10} EFW = 0.59 + 0.08\ (AC) + 0.28\ (FL) - 0.00716\ (AC)(FL)$.

6. Hadlock (BPD, HC, AC, FL) (Hadlock et al [12]) Log_{10} EFW = 1.3596 +0.0064 (HC) + 0.042 (AC) +0.174 (FL) +0.00061 (BPD) (AC) – 0.00386 (AC) (FL)

Aims and Objectives

1. To evaluate the accuracy of fetal weight estimation by Johnson's formula and ultrasound Hadlock's formula.
2. To compare the results obtained by Johnson's formula and ultrasound Hadlock's formula with actual birth weight.

Methodology

Source of Data

This study was carried out in the department of Obstetrics and Gynaecology at Shri Adichunchanagiri Institute of Medical Sciences, B.G. Nagara. 300 antenatal women who are at term gestational age admitted for safe confinement were taken. Expected fetal weight was obtained by clinical method using Johnson's formula, ultrasound using Hadlock's formula and the results were compared to that of actual birth weight.

Study Design	: A prospective study
Study Period	: 24 Months (November 2012 to October 2014)

Inclusion Criteria

- Primi or multigravida
- Singleton pregnancy with vertex presentation
- Cases admitted at >37 weeks of gestation with intact membranes

Exclusion Criteria

- Obese patients (weight more than 90 kg
- Patients with polyhydramnios
- Antepartum haemorrhage
- Eclampsia
- Obvious congenital abnormalities
- Oligohydramnios
- Anteriorly-inserted placenta

- Poor visualization of foetal part

Table 1: Mean age distribution

Study	Maternal mean age in years
Amritha et al [13]	27.13
Kavitha et al[14]	24.20
Chauhan et al[15]	22.87
Bajracharya et al[16]	25.51
Present study	23.83

Table 2: Parity distribution

Study	Parity distribution
Amritha et al[13]	45% primigravida
Watchre et al[17]	85.75% primigravida
Kavitha et al[14]	45% primigravida
Present study	57.3% primigravida

Table 3: Gestational age in weeks

Study	Gestational age in weeks
Watchree et al[17]	39.14 weeks
Amritha et al[13]	38.5 weeks
Ayoola et al[18]	39 weeks
Alnakash et al [19]	38.3 weeks
Present study	38.72 weeks

Table 4: Mean weight distribution

Study	Hadlock's formula	Johnson's formula	Actual birth weight
Alnakash et al[19]	3109 gms	3457 gms	3376 gms
Ashrafganjooei et al[20]	3305 gms	3321 gms	3339 gms
Watchree et al[17]	-	3318 gms	-
Ayoola et al[18]	3238 gms	-	-
Shittu et al[21]	3424 gms	-	-
Parvin et al[22]	-	3080 gms	2990 gms
Guducu et al[23]	3924 gms	-	3422 gms
Present study	2942.57 gms	3046. 95 gms	2958.01 gms

Table 5: Standard deviation distribution

Study	SD in grams with Hadlock's	SD in grams with Johnson's
Amritha et al[13]	258.48 g	309.98 g
Alnakash et al[19]	375.5 g	559.8 g
Mario et al[24]	335 g	312 g
Bajracharya et al[16]	290 g	-
Ashrafganjooei et al[20]	335 g	449 g
Chauhan et al[15]	258.48 g	309.98 g
Present study	249.6 g	334.98 g

Table 6: Mean error distribution

Study	Mean error in Hadlock's	Mean error in Johnson's
Shittu et al[21]	12.6 %	16.1 %
Mario et al[24]	9 %	11 %
Present study	14.4 %	19.3 %

Results

Discussion

Birth weight is a key factor for the outcome in the utero growth of fetus. It helps to determine the mode of delivery, predict the fetal outcome hence reducing the maternal and neonatal morbidity.

The two main methods for predicting birth weight in current obstetrics are :

a. Clinical techniques based on abdominal palpation of fetal parts and calculations based on fundal height.

b. Sonographic measures of skeletal parts which are then inserted into regression equations to derive estimated foetal weight.

The present study was conducted in Adichunchanagiri Institute of Medical Sciences, B G Nagara, in the dept of OBG from period 2012 to 2014, wherein, 300 cases of term singleton pregnant women with no other obstetric complications were taken. Fetal weight estimation using clinical method by Johnson's formula and ultrasonographic method by Hadlock's formula were used in prediction of the actual birth weight.

All the patients studied were aged between 18 to 40 yrs. Mean age in present study is comparable with Chauhan et al [15] where the mean age was 22.87 yrs, Kavitha et al [14] where the mean age was 24.20 yrs. Other studies also show almost similar age distribution. As most of the Indian population are married at around 20 yrs, most of the pregnant women fall in this age group. As such, there is no effect of age on fetal weight estimation as seen by the studies. The mean fetal weight according to all the age distribution, i.e., < 20 yrs, 21-25 yrs, 26-30 yrs, 31-35 yrs and 36-40 yrs was observed using both Johnson's and Hadlock's formula and the actual birth weight. There is no significant difference in the p values, which

shows that age has no significant effect on the fetal weight estimation.

The parity distribution in present study is almost similar to that of Amritha et al [13] and Kavitha et al [14] most of the women were primigravidae. In Watchree et a [17] almost 85% women were primigravidae.

Also the mean weight distribution according to parity by Johnson's and Hadlock's formula and actual birth weight were observed. There is no difference in mean weight distribution in all 3 groups. The mean weight using USG in primigravidae was 2964 g and multigravidae was 2913. The mean weight using clinical method in primigravidae was 3055 g and in multigravidae was 3034 g. The mean actual birth weight in primigravidae was 2966 g and in multigravidae was 2946 g. thus the present study shows that parity has no significant effect on the fetal weight estimation.

In present study 82.7% patients are having gestational age between 37-40 weeks. The mean gestational age is 38.72 weeks which is comparable to Amritha et al [13], Ayoola et al [18], Watchree et al [17], Alnakash et al [19. Also the mean fetal weight distribution according to gestational age was observed in all three groups. The mean fetal weight using ultrasound between 37-40 weeks was 2948 g and > 40 weeks was 2916 g. the mean fetal weight with Johnson's formula between 37-40 weeks was 3058 g and > 40 weeks was 2992 g. The mean actual birth weight between 37-40 weeks was 2967 g and > 40 weeks was 2913 g. Thus the present study shows that gestational age has no significant effect on the fetal weight estimation.

The mean fetal weight using Hadlock's formula in present study is comparable to Alnakash et al. [29] The difference with actual birth weight is comparable to Ashrafganjooei et al. [20] The mean fetal weight using Johnson's formula is comparable to Parvin et al [22] .The present study shows that the mean birth weight of Hadlock's formula is closest to the mean of actual birth weight, the difference being 15.433 gms whereas in Johnson's formula, difference is 88.947 gms. Thus Hadlock's formula is more accurate in predicting the actual birth weight.

Also, majority of birth weights are distributed between 2.5 to 3.5 kg which is comparable to Amritha et al [13], Shittu et al [21], Watchree et al [17]. Ultrasonography estimates of fetal weight between 2500-3500 gms are more accurate with actual weights, Johnson's formula overestimated the fetal weight <2500 gms whereas Hadlock's formula overestimated the fetal weight above 3500 gms.

The standard deviation from the mean is least with Hadlock's formula which is 249.6 gms whereas with Johnson's formula it is 334.98 gms. The results are comparable to most studies such as Amritha et al [13], Alnakash et al [19], Ashrafganjooei et al [20], and Chauhan et al [15]. Whereas Mario et al had standard deviation less with Johnson's formula than Hadlock's formula [24].

The mean percentage error of Hadlock's formula is 14.4 % which is less compared to that of Johnson's formula which is 19.3 %. The results of the study are comparable to that of Shittu et al [21] and Mario et al [24]. The overall variation from the actual birth weight is studied by finding the mean difference between the actual birth weight and expected birth weight using the two formulae. The mean error of Hadlock's formula is least because Hadlock's formula uses four parameters for estimation of fetal weight , i.e., BPD, HC, AC, FL, whereas Johnson's formula uses only one parameter for estimating the fetal weight , i.e., symphysiofundal height.

The p value of both Hadlock's and Johnson's formulae using Pearson correlation with actual birth weight is <0.01. This indicates that both the formulae are highly significant and can be used for prediction of birth weight. In this study, since the mean weight of Hadlock's is more closer to actual birth weight with least standard deviation and mean percentage error compared to actual birth weight, ultrasound might be considered superior to clinical estimation of fetal weight.

Conclusion

Clinical estimation of birth weight clearly has a role in management of labour and delivery in a term pregnancy.

Birth weight is a key variable affecting fetal and neonatal morbidity, particularly in preterm and small for date babies. In addition, it is of value in the management of breech presentations, diabetes mellitus, trial of labour, macrosomic foetuses and multiple births.

Of the two methods studied, ultrasonographic method, i.e., Hadlock's formula has better predictable results in fetal weight estimation, compared tho clinical method, i.e., Johnson's formula. But the clinical method is nearly as accurate as ultrasound method when the actual birth weight was in the range of 2500-3500 gms, whereas it overestimates the fetal weight below 2500 gms. Overall ultrasound forms the best method of fetal weight estimation at term.

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