RESEARCH ARTICLE

Estimation of Fetal Weight at Term by Clinical Method Using Symphysio Fundal Height and Abdominal Girth and Ultrasound Using Hadlock Formula and Its Correlation with Actual Birth Weight

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Abstract

In prenatal care, labor management and preparation, particularly when deciding on the mode of delivery, the accuracy of fetal weight predictions is crucial. At both extremes of birth weight, perinatal complications are higher, so it is also necessary to develop conceptual strategies to reduce the rate of unwanted pregnancy outcomes. The purpose of this study was to estimate the fetal weight during term pregnancy using clinical and ultrasonic methods, as well as to correlate the actual birth weight with the estimated weight.

Materials and methods: A prospective observational study of all term pregnant women who came for antenatal checkup and patients admitted to the obstetric ward fulfilling the inclusion criteria. The patients were subjected to clinical evaluation and investigations, and data was collected in a predesigned *pro forma*. All the measurements were routinely documented in the antenatal visit of pregnancy, and the estimated weight was calculated by using the formula abdominal girth (AG) × symphysio fundal height (SFH) and Hadlock method and both were compared with the weight of the fetus after delivery.

Results: A total of 500 pregnant women with singleton pregnancies were studied. The average actual birth weight was 2758.19 ± 341.25. The mean weight estimated by AG × SFH was 2862.67 ± 327.37, and that by the Hadlock method was 2902.11 ± 336.35. The *p*-value of the estimated fetal weight (EFW) by AG × SFH was 0.699, whereas for the Hadlock method, it was 0.669. The average error was 104.50 gm with AG × SFH and 143.9 gm with the Hadlock method. The mean percentage error was 3.8% in AG × SFH and 5.1% by the Hadlock method. The standard deviation (SD) was found to be the smallest with AG × SFH (197.85), followed by ultrasound (USG) (219.61). Correlation analysis showed a significant positive relationship between the weight of the fetus at birth and the estimated birth weight for both methods.

Conclusion: From the present study, we conclude that the estimation of fetal weight at term by a clinical method is as accurate as the USG estimation of fetal weight. It can be routinely used at term gestation. It is of more practical use at peripheries where USG machines or trained personnel for doing USG are not available.

Keywords: Abdominal girth, Actual birth weight, Fetal weight estimation, Hadlock formula, Symphysio fundal height.

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Introduction

Predicting the risk of mortality and morbidity in the 1st year of life largely depends on the weight of the fetus *in utero*. As fetal weight at birth is one of the prime factors that affect neonatal survival *ex utero*, an accurate estimate of the weight of the fetus may assist obstetricians and neonatologists in the management of the neonate after birth. It is a routine practice to calculate the weight of the fetus *in utero* clinically using Johnson's formula, but it is not done after 36 week period of gestation. After the 37 week period of gestation, we depend on USG mode for *in utero* calculation of the weight of the fetus. In high-risk antenatal women with gestational diabetes mellitus, intrauterine growth restriction and planning for vaginal delivery after cesarean section and estimation of fetal weight at term plays an important role in decision-making. Estimation of fetal weight helps us to make an early decision during labor in case of prolonged labor and malposition, so obstructed labor and its complications can be prevented.

During regular antenatal visits, estimation of fetal weight helps us in the early detection of fetuses with macrosomia and growth restriction. Detection of abnormality helps in predicting the risk of complications like prolonged labor, brachial plexus injury, intrapartum asphyxia, perineal injuries, and postpartum hemorrhage in mothers with fetuses having macrosomia.[1] It helps in predicting the risk of neonatal morbidity, neonatal intensive

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Table 1: Distribution of weight estimated by AG × SFH, Hadlock method, and actual weight in gm in terms of percentage

Weight group	*AG × SFH percentage*	*Hadlock method percentage*	*Actual weight*
<2000	0	0.4	1
2000–2500	12	11.6	14.4
2500–3000	54.4	44.4	68.2
3000–3500	28.4	41.4	12.6
>3500	4	2.2	3.8

care unit admissions, and neonatal mortality in intrauterine growth restricted fetuses.[2]

Fetal weight can be estimated by clinical method and by USG at term gestation. USG estimation of fetal weight has been extensively studied, but there are not much research studies on *in utero* estimation of the weight of the fetus after 37 week period of gestation. There is a need to use the clinical method of estimation of fetal weight as USG is not available at all places, particularly in peripheral areas, USG needs expertise, and USG estimate cannot be used at each antenatal visit.

Estimates of fetal birth weight can be made by a USG scan, but this facility may not be available to all pregnant women, particularly those living in remote areas. In such cases, clinical estimation of birth weight at term can help the obstetrician identify possible risks and anticipate obstetric complications. Clinical birth weight estimation methods are easy and of low cost for the detection of low birth weight and macrosomia by obstetricians, female care workers, paramedical staff, and medical staff in clinical and local health services where ultrasonic screening facilities are not available easily and it can be done at a lower cost.

As a consequence of categorizing fetal weight into high-risk groups and dividing those into small and large based on gestational age, obstetricians or trained birth attendants can time their interventions accordingly, resulting in good outcomes. This has important implications for developing countries, which lack technically advanced USG equipment and skilled USG care workers,[3] hence there is a need for the present study.

Materials and Methods

This is a prospective observational study done from 1st January 2019 to 30th June 2020, including all term pregnant women coming for antenatal checkup and patients admitted in the inpatient ward at Vydehi Institute of Medical Sciences and Research Centre, Bengaluru, Karnataka, India, complying with the inclusion criteria.

Inclusion Criteria

All consenting patients with 37 completed weeks with a live singleton pregnancy in a longitudinal lie with USG within 7 days of delivery, without any congenital anomalies in the fetus, no history of medical disorder complicating pregnancy, and who are willing to enroll for the study.

Exclusion Criteria

Pregnant women in labor with unknown last menstrual period (undetermined gestational age), with multiple gestations, polyhydramnios or oligohydramnios, and fibroids or adnexal masses. Mothers with any type of systemic disease, for example, diabetes mellitus, hyperthyroidism, renal or heart failure, with noncephalic birth presentation, presenting with prelabor rupture of membranes (PROM) or premature PROM, intrauterine fetal demise, and weight >70 kg at the first visit.

Information, such as patient's demographic profile, detailed history, a record of antenatal care, SFH measurement, AG measurement, engagement of head, fetal weight according to USG, actual birth weight, and subjective assessment of the women's general condition made, was recorded on a predesigned *pro forma*. Prior informed consent was taken before the examination. The measurements were taken after the women had urinated within half an hour prior to the procedure and were examined in a supine position with slightly flexed knees. Dextrorotation was corrected and the abdomen relaxed.

- A metric tape made of nonelastic material was used to measure SFH. The measurement was taken from the upper border of the symphysis pubis to the highest point of the fundus of the uterus without putting pressure to stretch the tape, and it was taken to the nearest 0.5 cm.
- Abdominal girth (AG) was recorded in centimeter at the level of the umbilicus around the abdomen without stretching the tape.
- Weight estimated by USG was calculated by fetal biometry using the biparietal diameter, head circumference, abdominal circumference, and femur length. Hadlock formula was used for the calculation.

Patients were carefully monitored for the progress of labor. Correlation between *in utero* estimation of the weight of the fetus using clinical and USG methods with the weight of the neonate at birth was noted.

All the information was collected and recorded in the predesigned *pro forma*, the data was documented in the Microsoft Excel sheet, and statistical calculation was done using Statistical Package for the Social Sciences version 19. The categorical variable will be presented as frequency and percentages. After ensuring the normal distribution of data, Pearson's Chi-square for proportions and unpaired *t*-test for numbers were employed for comparative statistics. Statistics were considered significant at p-value < 0.05.

Results

Present 500 pregnant women with term gestation abiding by the inclusion criteria. The mean age ± SD of the study population was 25.76 ± 3.9. The total number of a primigravida in this study group was 238 (47.6%) and multigravida 262 (52.4 %).

In our study, 54.4% of the weight estimated by AG × SFH and 44.4% of the weight estimated by Hadlock methods lies in the weight group of 2500–3000 gm. According to the actual birth weight distribution, the majority of the weight, that is 68.2%, lies in the weight group of 2500–3000 gm (Table 1).

The mean actual birth weight was 2758.19 ± 341.25 kg. The mean estimated birth weight by AG × SFH was 2862.67 ± 327.37 kg and the mean estimated weight by Hadlock method was 2902.11 ± 336.35 kg (Table 2).

In our study, the *r*-value for estimation of fetal weight by AG × SFH was 0.699, whereas for the Hadlock method, it was 0.669, showing strong correlation (Table 3).

According to Table 4, correlation analysis was done and the results showed a significant relationship between estimated birth weight and actual birth weight in both methods. The average error was 104.50 for AG × SFH and 143.9 for the Hadlock method. The mean percentage error was 3.8% for AG × SFH and 5.1% for the Hadlock method. This relationship assisted to predict the weight

Table 2: Comparison of weight by AG × SFH in gm and EFW by Hadlock method in gm in relation to actual birth weight in gm

	Birth weight in gm					
Variables	*<2500 gm*	*2500–3000 gm*	*3000–3500 gm*	*>3500 gm*	*Total*	*p-value*
AG × SFH in gm	2468.61 ± 197.61	2873.20 ± 237.76	3095.44 ± 326.73	3478.70 ± 310.96	2862.67 ± 327.37	<0.001**
EFW by Hadlock method in gm	2477.96 ± 279.29	2930.38 ± 245.11	3134.77 ± 323.23	3331.95 ± 366.42	2902.12 ± 336.36	<0.001**
Actual birth weight in gm	2261.88 ± 190.18	2743.43 ± 134.09	3147.09 ± 150.14	3715.00 ± 245.63	2758.19 ± 341.26	<0.001**
	% mean difference with respect to actual birth weight					
AG × SFH in gm	9.14	4.73	1.64	6.36	3.80%	–
EFW by Hadlock method in gm	9.55	6.81	0.39	10.31	5.10%	

**signifies statistically significant

Table 3: Pearson correlation

Variables	*r-value* / *p-value*	*AG × SFH in gm*	*EFW by Hadlock method in gm*	*Actual birth weight in gm*
AG × SFH in gm	*r*-value	–	0.536	0.699
	p-value	–	<0.001**	<0.001**
EFW by Hadlock method in gm	*r*-value	0.536	1.000	0.669
	p-value	<0.001**	–	<0.001**
Actual birth weight in gm	*r*-value	0.699	0.669	1.000
	p-value	<0.001**	<0.001**	–

**signifies statistically significant

Table 4: Percentage of bias (error) estimation by Bland–Altman technique

Statistics	*Actual birth weight in gm in comparison with*	
	AG × SFH	*EFW by Hadlock method*
Average error	104.50 gm	143.9 gm
Average % error	3.8%	5.1%
Overall mean	2810.43 gm	2830.15 gm
SD	197.85	219.61
Coefficient of variation	7.03%	7.76%

of the fetus at birth based on *in utero* calculation of weight of the fetus. Clinical method using AG × SFH (197.85 gm) showed least variation followed by USG calculation (219.61 gm).

Discussion

In utero calculation of weight of the fetus is an important parameter in routinue antenatal checkups. At term it helps in antenatal management and delivery recommendations. Fetal weight is estimated in the antenatal period using SFH with the help of Johnson's formula and it is used up to 36 week period of gestation. This formula cannot be used after 36 weeks as there is reduction in the fundal height because fetal head enters into maternal pelvis. In the present study, fetal weight estimation is done at term gestation using clinical methods and fetal biometry with the help of USG and later compared with the weight of the fetus at birth. Many studies have included either clinical or USG estimation and later compared with the fetal weight at birth. In our study, we have included both the methods of *in utero* calculation of the weight of the fetus, clinically and USG modality, and compared with weight of the neonate after birth.

In our study, the mean error of calculation of *in utero* weight of the fetus by using AG × SFH was the smallest 104.50 gm (3.8%), followed by the Hadlock method 143.9 gm (5.1%), consistent with Bhandari et al. study where she found that the average error in various methods of *in utero* fetal weight calculation by AG × SFH was 224.37 gm, which was the least in comparison with other methods.[4] In contrary to our study, Siddiqua et al. study showed the average error is 291.50 gm by Hadlock and by AG × SFH method, it was 310.06 gm. The difference in average error between the Hadlock formula and AG × SFH was not statistically significant.[5] Raghuvanshi et al. also found that the average error of EFW with the Hadlock method was minimal, followed by AG × SFH and Johnson's method (131, 311 and 455 gm respectively). The Hadlock method observed a more accurate value of actual birth weight (5–1026 gm) than any other method.[6]

Dare and Adernowore found a percentage error between actual and estimated weight to be 20.1% by AG × SFH method, whereas, in the present study, it was 3.8%.[7] Siddiqua et al. found the percentage error was 12.01% for the USG method, whereas it was 5.1% in our study.[5] Raghuvanshi et al. found that the average percentage error was 6% with the Hadlock method and it shows better accuracy than SFH × AG, which has a 12% error.[6] Aruna et al. in 2014 found out that the average error by AG × SFH formula was 1.9% which is the least when compared to the Hadlock formula (100.25 gm and 3.5%) and Johnson's formula (393.26 gm and 13.5%), which was similar to our study.[8]

According to our study, the mean estimated birth weight by AG × SFH and Hadlock was 2.862 and 2.9kg, respectively and the mean actual birth was 2.7 kg. Both AG × SFH and Hadlock formulae had good correlation with actual birth weight (*r*—0.699 and 0.669). Roy and Kathaley, in their study, found that the mean birth weight as predicted by Dare and Adernowore's and the Hadlock formulae, was 3.07 and 2.90 kg, respectively (*p*—0.45; nonsignificant). The mean actual birth weight was 3.01 kg. Both Dare and Adernowore's and the Hadlock formulae had good correlation with actual birth weight across all weight ranges (*r*—0.77 and 0.72).[9] Thombarapu and Agrawal found that *in utero* calculation of fetal weight using clinical estimation had overall correlation with actual birth weight $r = 0.726$ with Dare and Adernowore's formula, which showed significance statistically. The p-value < 0.001 was also found statistically significant.[10] Sharma et al. found that there was no significant difference between the mean EFW obtained from the product of SFH and AG and the mean weight of the fetuses at birth in their study participants,[11] which is similar to our study.

Conclusion

Estimating fetal weight clinically plays a major role in labor management and childbirth, as well as predicting unseen complications. Of the many clinical methods known for estimating fetal weight, our study used AG × SFH at term pregnant women. Modern methods for measuring *in utero* weight of the fetus include the fetal parameters calculated by USG using objectively assessed intrauterine fetal dimensions. USG also requires expensive equipment and specially trained personnel. Clinical estimation of fetal weight using AG × SFH will be very useful in developing countries where USG is not available in many healthcare systems. Clinical estimation of fetal weight can be routinely used at each antenatal visit and even other healthcare workers can be trained easily to use it. Our study demonstrates that clinical calculation of *in utero* weight of the fetus after 36 week period of gestation, in singleton fetuses is as accurate as USG estimation.

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