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Original Research Article

Accuracy of Ultrasound Determination of Estimated Fetal Weight in Small for Gestational Age Pregnancies

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Abstract

Background: Approximately half of small for gestational age (SGA) cases are due to maternal or fetal pathology, and may result in significant neonatal morbidity and mortality. The estimated fetal weight (EFW) measurement is the cornerstone of ultrasonographic findings when diagnosing and managing SGA pregnancies. The objective of present study was to determine the ultrasound accuracy of EFW in SGA pregnancies and compare accuracy in appropriate for gestational age pregnancy (AGA) and SGA pregnancy.

Method: In this prospective randomized observational study, fifty pregnant women at term with appropriate for gestational age pregnancy and fifty other women at term with small for gestational age pregnancy had ultrasonic estimation of fetal weight performed within a week of delivery.

Results: A total of 100 cases (50 SGA and 50 AGA) were analyzed. The newborn birth weight range was 1500 gm to 3500 gm. The study found no significant difference between adjusted ultrasound EFW calculated using Hadlocks formula and actual birth weight of the neonate in both AGA and SGA pregnancies ($p>0.05$). The mean absolute percent error for the entire sample was 6.6096. Mean absolute error for appropriate and small for gestational age pregnancies was 6.16889 and 7.05031 respectively, ($p>0.05$). Percentage of overestimation of fetal weight was more in SGA pregnancy (65%) as compared to AGA pregnancy (54%), ($p>0.05$).

Conclusion: In clinically suspected SGA pregnancies ultrasound estimation of fetal weight by Hadlocks formula are a valid estimate of actual birth weight and the preferred mode of diagnosis. Accuracy of ultrasound estimation of fetal weight in SGA pregnancies is comparable to accuracy of estimation of fetal weight in AGA pregnancies.

Keywords: Small for gestational age, Estimated fetal weight, Ultrasonography, Appropriate for gestational age, Fetal weight, Hadlocks formula.

1. Introduction

Small for gestational age refers to a fetus that has failed to achieve a specific biometric or estimated weight threshold by a specific gestational age. Various thresholds (2.5^{th}, 3^{rd}, 5^{th}, 10^{th}, 15^{th}, and 25^{th} centiles and 1.0, 1.5 or 2.0 standard deviations below the population average) are used for various fetal measures. The commonly used threshold is the tenth centile for abdominal circumference and estimated birth weight [1]. Approximately 50-70% of fetuses with a birth weight below tenth centile for gestational age are constitutionally small [2] and the lower the centile for defining SGA, even though the SGA label implies fetal growth restriction (FGR). The proportion of constitutionally small fetuses to FGR fetuses will depend on the prevalence of such illnesses in the population [3]. FGR fetuses carry higher incidence of perinatal complications than appropriately grown counterparts. Late onset FGR is often missed and is responsible for most intrauterine deaths [4].

Therefore, accurate measurement of fetal weight is important in managing term FGR. Also accurate determination of fetal weight prior to delivery can have a significant bearing on the management decision in labour, thereby markedly improving perinatal outcome. In last few decades, the estimation of fetal birth weight has advanced from estimation by physical examination to fetal ultrasound using multiple parameters. This has increased the accuracy of the fetal weight estimation significantly [5]. Many ultrasounds estimated fetal weight formulae have been

designed and these are based on different fetal biometric parameters [6]. Ultrasonography is routinely used to estimate the fetal weight and is often used as a proxy to actual birth weight. Accuracy of ultrasound in predicting birth weight is more precise in early gestations, since at term there is significant deterioration of ultra sound resolution as the fluid to fetus ratio decreases, bony structures become increasingly calcified, and the vertex descends in the pelvis, making measurements of head circumference and biparietal diameter more difficult [7].

The aim of present study was to determine the ultrasound accuracy of estimated fetal weight in small for gestational age pregnancies and compare it with ultrasound accuracy of EFW in pregnancy not complicated by SGA i.e. appropriate for gestational age (AGA) pregnancy.

2. Materials and Methods

We conducted a prospective randomized observational study whereby all ultrasonic fetal weight estimations were carried in the Department of Obstetrics and Gynaecology, LTMMC and LTMGH, Sion Mumbai. Inclusion criteria of the study was the term gestation, non anomalous singleton pregnancy, subject reliably knows last menstrual period, had regular menstrual cycles plus an ultrasonography report done prior to 2^{nd} trimester confirming gestational age and subject willing for participation. Those subjects not willing to participate in the study, obese female (wt more than 90 kg), subject with polyhydramnis, oligohydramnos, preterm labor, multifetal pregnancy, ruptured membranes, abnormal lie or presentation, antepartum hemorrhage and subject with large for gestational age pregnancy were excluded from the study. Fifty pregnant women with full term gestation (>37 weeks) with singleton pregnancy, with cephalic presentation with appropriate for gestational age fetus and other fifty women with full term gestation (>37 weeks) with singleton pregnancy, with cephalic presentation with small for gestational age fetus had ultrasonic estimation of fetal weight performed within a week of delivery. Fetal weight was estimated by the Hadlocks formula [8]. In present study, we have defined small for gestational age neonate as one with birth weight equal to or below 10th percentile for gestational age according to normograms proposed by Alexander *et al*. This comprised the test group. Appropriate for gestational age neonate has been defined as one with birth weight above 10th percentile and below or equal to 90th percentile for gestational age according to normograms proposed by Alexander *et al*. This formed the control group.

Large for gestational age neonates weighing above 90th percentile for gestational age were excluded from the study. We compared estimated fetal weight with the birth weight after adjusting EFW by adding 25g for each day between the ultrasound measurement and delivery. The observed measurements of fetal weights were those obtained by ultrasound measurements of the biometric variables within 7 days of delivery plus any additional weight gain between the ultrasound scan and delivery. Previous research [9] has shown that between 37 and 40 weeks gestation, the average observed weight gain was 25g per day. Therefore; 25g was added to the EFW for each day between the ultrasound scan and delivery of the fetus. The true state, generally known as the reference standard, was the documented birth weight obtained at delivery by labour room electronic weighing machine

Before enrolling the patient into the study, patients were explained the type and nature of the study and valid consent was taken. On admission the maternal age, the parity, body weight, antenatal risk factor if any of the patient was taken into consideration.

3. Results and Discussion

Ultrasonography is an important tool for identification of fetal growth restriction. Fetuses with reduced growth pattern are at increased risk of neonatal morbidity and mortality. Monitoring of such fetuses with intra uterine growth restriction with Doppler study, optimum time of delivery and antepartum fetal heart monitoring can reduce mortality and morbidity in IUGR fetuses. Ultrasound is more accurate when it follows clinical diagnosis of intrauterine growth restriction. Based on the review of literature, we recommend routine ultrasound examination in the third trimester for timely diagnosis of SGA. However the prenatal identification of SGA neonates is important because it can reduce perinatal mortality, influence the location and time of delivery, and mitigate neonatal complications. We needed to determine our accuracy in predicting SGA neonates for two reasons: 1) the high likelihood of abnormal fetal growth in our population, 2) high rate of neonatal complications and still birth associated with intrauterine growth restriction.

In present study, the newborn birth weight range was 1500 gm to 3500 gm. 50 cases with gestational age less than 37 completed weeks clinically classified as small for gestational age pregnancy were followed by ultrasound examination for determination of estimated fetal weight. Similarly 50 cases beyond 37 completed weeks clinically classified as appropriate for gestational age pregnancy were followed by ultrasound for estimation of fetal weight. Co-efficient of correlation (r) = 0.6979 suggest high positive correlation between actual birth weight and estimated fetal weight by ultrasound (Table 1 and 2).

Table 1: Correlation between actual birth weight and estimated fetal weight by ultrasound in study group (SGA) at gestational age 37 to 40 weeks

S. No.	Birth Weight	EFWc	S. No.	Birth Weight	EFWc
1	2450	2250	26	1980	2200
2	2100	2000	27	1800	1950
3	2200	2340	28	2150	2400
4	2300	2460	29	1750	1600
5	2225	2100	30	2390	2500
6	2125	2300	31	2300	2400
7	2350	2400	32	1980	2200
8	2000	1900	33	1700	1550
9	2450	2600	34	1550	1400
10	1900	2050	35	2320	2500
11	1880	2000	36	2300	2430
12	2300	1950	37	2250	2500
13	2340	2500	38	1880	2000
14	2340	2500	39	2180	2300
15	2450	2200	40	1900	1800
16	2000	1810	41	1870	1700
17	2000	1750	42	2300	2450
18	2150	2300	43	2150	2200
19	2050	2300	44	2200	2300
20	2400	2600	45	1910	2000
21	2300	2500	46	2000	1900
22	2150	2200	47	2100	2300
23	2050	2050	48	2200	1900
24	2070	2100	49	2100	2150
25	2200	2150	50	2342	2250

Table 2: Correlation between actual birth weight and estimated fetal weight in control group (AGA) at gestational age 37 to 40 weeks

S. No.	Birth Weight	EFWc	S. No.	Birth Weight	EFWc
1	2560	2800	26	2800	2980
2	2800	3000	27	3500	3240
3	3050	2900	28	3070	3300
4	3200	3000	29	3180	3400
5	3100	3250	30	3200	3000
6	3500	3400	31	3300	3150
7	2900	3100	32	3340	3500
8	2880	2700	33	2990	3100
9	3200	3000	34	2788	3000
10	3400	3560	35	2590	2800
11	3450	3100	36	3400	3250
12	3100	2900	37	2660	2800
13	2900	3200	38	3220	3000
14	2880	2700	39	3400	3250
15	2600	2870	40	3356	3500
16	3100	3320	41	3200	3450
17	3150	3300	42	2970	3000
18	3428	3670	43	2880	2700
19	3456	3300	44	3040	3100
20	2890	3200	45	3450	3550
21	3450	3100	46	3200	2990
22	3440	3550	47	3260	3000
23	3200	3440	48	3468	3200
24	2890	3100	49	3148	3200
25	2730	2600	50	3100	3000

The study likes that of Blumenfeld *et al* [10] showed that ultrasound measurement of EFW in SGA pregnancies is consistent across all Gas and EFW measurements. In their study there was no statistically significant difference in the mean absolute percent error across all Gas (<32 weeks, 32-36 weeks, >36 weeks), and EFWs (<1500g, 1500-2000g, >2000g).

Larsen *et al* [11] reported routine ultrasound screening for fetal weight estimation at three weeks interval starting from 28 weeks of gestation improved the diagnosis of small for gestational age fetuses, but this was not associated with improved fetal outcome. Colman *et al* [12] collected data retrospectively for pregnant women who had undergone ultrasound estimation of fetal weight 7 days prior to a term delivery (≥37 weeks) over the period of July 1998-June 2005. The mean absolute and mean signed error (±SD) of ultrasound fetal weight estimations were 7.0±5.7 and -0.2±9.0 respectively (n=1777). The accuracy of ultrasound estimations of fetal weight performed was at least similar and sometimes better than reported in other studies. For one in four women, however the fetal weight estimation was more than 10% different from the actual birth weight if their infant. Present study, confirmed the finding of the studies of Larsen *et al* [11] and Colman *et al* [12].

The current study used the Hadlock formula for calculation of EFW. It is likely that the use of other formulae may result in differences in the accuracy of EFW. However, studies evaluating specific formulae for low-birth weight infants have not shown any formula to be more accurate in this particular population [13, 14]. Therefore we selected the formula most commonly used in clinical practice to allow a pragmatic comparison. We found no significant difference between adjusted ultrasound estimated fetal weight calculated using Hadlocks formula and actual birth weight of the neonate in both appropriate and small for gestational age pregnancies ($p>0.05$). The mean absolute percent error for the entire sample was 6.6096; this result was consistent with other studies of low-birthweight infants [15-17]. Likewise mean absolute error for appropriate and small for gestational age pregnancies was 6.16889 and 7.05031 respectively. There was no statistically significant difference in the mean absolute percent errors between the two groups ($p>0.05$). Table 3 showed the comparison between AGA and SGA. Percentage of overestimation of fetal weight was more in small for gestational age pregnancy as compared to appropriate for gestational age pregnancy (65% versus 54% respectively) but the difference was not significant ($p>0.05$).

Table 3: Comparison between AGA and SGA

	Cases	Overestimated fetal weight	Underestimated fetal weight	% Mean absolute error
AGA	50	28	22	6.16889
SGA	50	32	18	7.05031
Total	100	60	40	6.6096

4. Conclusion

In clinically suspected small for gestational age pregnancies ultrasound estimation of fetal weight by Hadlocks formula are a valid estimate of actual birth weight and the preferred mode of diagnosis. Accuracy of ultrasound estimation of fetal weight in small for gestational age pregnancies is comparable to accuracy of estimation of fetal weight in appropriate for gestational age pregnancies.

The present study suggested that the identification of factors influencing the accuracy of ultrasonographic EFW in extremely preterm infants provides knowledge to clinicians caring for women at risk of very early birth. Careful interpretation of EFW with consideration of risk factors can enhance guidance for timing and mode of delivery and for counseling parents about the expected neonatal outcome at gestational ages at the limit of viability.

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