International Journal of Medical Research Professionals
P-ISSN: 2454-6356; E-ISSN: 2454-6364
DOI: 10.21276/ijmrp

IJMRP

Original Research Article

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

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ABSTRACT

Background: 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.

Aims & Objectives: This study was done to assess the accuracy of ultrasound examination in estimation of fetal weight from 37 weeks to 40 weeks of pregnancy in appropriate for gestational age and small for gestational age.

Material & Methods: The prospective randomized observational study whereby all ultrasonic fetal weight estimations were carried by prosound i4 ALOKA. 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: The present study showed that majority of subjects of control and study group were in the age group 21 to 30 years and co-efficient of correlation (r) = 0.6981 suggest high positive correlation between actual birth weight and estimated fetal weight by ultrasound.

Conclusion: The study showed that ultrasound predicts the fetal weight in both categories with a mean absolute error of 1.092435 USG estimation of fetal weight can be used to predict the birth weight with high degree of accuracy and plan delivery and neonatal management for a better neonatal outcome.

Keywords: Ultrasound, Fetal weight, AGA, SGA, Gestational age.

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Article History:

Received: 28-05-2016, **Revised:** 06-06-2016, **Accepted:** 17-06-2016

Access this article online	
Website: www.ijmrp.com	Quick Response code
DOI: 10.21276/ijmrp.2016.2.4.014	

INTRODUCTION

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.[1]Multiple formulae have been developed for the estimation for birth weight using ultrasound measurement. At present, fetal ultrasound is extensively used to estimate the fetal weight. Fetal growth has been divided into three phases. The initial phase of hyperplasia occurs in the first 16 weeks and is characterized by a rapid increase in cell number. The second phase, which extends up to 32 weeks gestation, includes both cellular hyperplasia and hypertrophy. After 32 weeks, fetal growth is by cellular hypertrophy, and it is during this phase that most fetal fat and glycogen are accumulated. The corresponding fetal growth rates during these three phases are 5g/day at 15 weeks gestation, 15 to 20g/day at 24 weeks, and 30 to 35g/day at 34 weeks.[2]

Fetal weight can be estimated clinically by Johnson's formula as height of the uterus above the symphysis pubis in centimeters minus 12, if the vertex is at or above the level of ischial spines or minus 11, if the vertex is below the level of ischial spines-multiplied by 155 in either case gives the weight of the fetus in grams. This is however, applicable only in vertex presentation. However, the approximate size of the fetus is modified by the amount of liquor and thickness of the abdominal wall.[3] When the pregnancy cannot be dated accurately by clinical evaluation, sonography is accepted as the most useful and accurate tool for estimating gestational age and fetal weight.

SGA refers to a fetus that has failed to achieve a specific biometric or estimated weight threshold by a specific gestational age. Various thresholds (2.5th, 3rd, 5th, 10th, 15th, and 25th 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.[4] SGA fetuses are heterogeneous group comprising fetuses that have failed to achieve their growth potential (fetal growth restriction, FGR) and fetuses that are constitutionally small. Approximately 50-70% of fetuses with a birth weight below tenth centile for gestational age are constitutionally small[5] and the lower the centile for defining SGA, the higher the likelihood of FGR.

SGA fetuses are at greater risk of stillbirth,[6] birth hypoxia,[6] neonatal complications,[6] impaired neurodevelopment,[7] and possibly type 2 (non-insulin-dependent) diabetes and

hypertension in adult life.[8] The reason that studies on SGA fetuses have shown poor perinatal outcome is likely to be the high incidence of true fetal growth restriction in this group.

The etiology of IUGR is very diverse and the presentation insidious and confusing hence diagnosis can be quite difficult especially in early stages. Detailed history taking, looking out for the high risk factors and vigilant clinical monitoring, along with use of Ultrasonography, and Doppler studies, are essential for early and accurate diagnosis. Once the diagnosis of IUGR is reached the mother and foetus should be under close scrutiny, any complicating factors identified should be ameliorated (whenever possible) and all attempts should be made to take the pregnancy to viability and maturity. The delivery of these high risks, delicate fetuses should be handled with extreme care as these babies cannot withstand prolonged labour. Presence of expert neonatal support is also essential for resuscitation as well as follow-up to look for long-term complications.

Before the development of ultrasonography, delayed fetal growth was indicated by low maternal weight gain, Leopold maneuvers and fundal height measurement. Currently, IUGR is still often suspected on the basis of fundal height measurement. A significant lag in fundal height is a 4-cm or greater difference than expected for gestational age. However, even carefully performed fundal height measurements only have a 26 to 76 percent sensitivity in predicting IUGR.[9] IUGR is frequently detected in a pregnancy with a less-than-expected third-trimester weight gain (100 to 200 g per week) or as an incidental finding on ultrasound examination when fetal measurements are smaller than expected for gestational age. The main prerequisite for determining IUGR is precise dating. The most accurate dating method uses ultrasound examination at 8 to 13 weeks. Later ultrasound examinations are helpful, but the margin of error is increased. The date of the last menstrual period, early uterine sizing and detection of fetal heart tones are helpful ways to accurately date the pregnancy. Most cases of IUGR present during the third trimester, which makes them difficult to accurately diagnose. This is especially true if the patient has presented for prenatal care at a late stage. The physician must determine if the dating is incorrect and the fetal size is actually normal or if the mother truly needs further evaluation for IUGR.

Ultrasonography is normally the first study done to assess IUGR. This test loses its accuracy as the pregnancy progresses, but the sensitivity and positive predictive value can be improved if several variables are combined.[10] These variables include estimated fetal weight, head circumference and abdominal circumference. The present study to evaluate the accuracy of ultrasound in determination of estimated fetal weight in small for gestational age pregnancies and compare accuracy in AGA and SGA fetus.

MATERIAL & METHODS

The prospective randomized observational study whereby all ultrasonic fetal weight estimations were carried by prosound i4 ALOKA in the department of Obstetrics and Gynaecology, Jawahar Lal Nehru Medical College and Associated Group of Hospital, Ajmer from Dec. 2014 to Nov. 2015. 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. Fetal weight was estimated by the Hadlocks formula:

Hadlock'sformula[11] :

Log_{10} EFW = 1.3596 - 0.0038 AC x FL + 0.0064 HC + 0.00061 BPD x AC + 0.0424 AC + 0.174 FL

EFW= estimated fetal weight (g),

BPD= biparietal diameter (cm)

FL= femur length (cm),

AC= abdominal circumference (cm)

In our study we 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.

Alexander's table of percentiles of birth weight for gestational age

Weeks	10th%tile	Average	90th%tile
20	275	412	772
21	314	433	790
22	376	496	826
23	440	582	882
24	498	674	977
25	558	779	1138
26	625	899	1362
27	702	1035	1635
28	798	1196	1977
29	925	1394	2361
30	1085	1637	2710
31	1278	1918	2986
32	1495	2203	3200
33	1725	2458	3370
34	1950	2667	3502
35	2159	2831	3596
36	2354	2974	3668
37	2541	3117	3755
38	2714	3263	3867
39	2852	3400	3980
40	2929	3495	4060

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.

Between 37 and 40 week's gestation, the average observed weight gain was 25g per day.[12] 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 Smart Care Digital Baby Scale. 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 age, the parity, maternal age, body weight, antenatal risk factor if any of the patient was taken into consideration.

RESULTS

The present study showed that majority of subjects of control and study group were in the age group 21 to 30 years (table 1). Co-efficient of correlation (r) = 0.6981 suggest high positive correlation between actual birth weight and estimated fetal weight by ultrasound (table 2 &3). In our study table no. 4 showed the comparison between AGA & SGA.

DISCUSSION

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 need accuracy in predicting SGA neonates for two reasons:

(1) High likelihood of abnormal fetal growth in our population,

(2) High rate of neonatal complications and stillbirth associated with intrauterine growth restriction.

Majority of subjects of control and study group were in the age group of 21-30 years. In our study group greater number of subjects were below the poverty line with respect to control group, this fact will have a bearing on the fetal weight.

Table 1: Distribution of subjects according to the age

S.No.	Age(yrs)	No. of Control %	No. of cases %
1	15-20	14%	12%
2	21-25	48%	62%
3	26-30	38%	26%
	Total	100%	100%

Table 2: Correlation between actual birth weight and estimated fetal weight by ultrasound in study group at gestational age 37 to 40 weeks

S.No.	Birth Weight	EFW_C	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 3: Correlation between actual birth weight and estimated fetal weight in control group at gestational age 37 to 40 weeks

S.No.	Birth Weight	EFW_C	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

Table- 4: Comparison between AGA & SGA

	Cases	Overestimated fetal weight	Underestimated fetal weight	% Mean absolute error
AGA	50	28	22	0.48534
SGA	50	32	18	1.69953
Total	100	60	40	1.092435

In our observation estimated fetal weight is over estimated in 56% and under estimated 44% in AGA fetuses. In case of SGA over estimation was 64% and under estimation was 46%.

In our study the newborn birth weight range was 1500 gm to 3500 gm. 50 cases with gestational age more 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.

Similar study by Blumfeld YJ et al[13] showed that ultrasound measurement of EFW in SGA pregnancies is consistent across all gestational age and EFW measurements. In their study there was no statistically significant difference in the mean absolute percent error across all gestational age (<32 weeks, 32- 36 weeks, >36 weeks), and EFWs (<1500 g, 1500- 2000 g, >2000 g).

Larsen et al[14] 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.

Atalie Colman et al[15] 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 were small for gestational age. Our study confirmed the finding of the studies of Larsen et al[14] and Atalie Colmam et al.[15] We found that there is 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 1.092435 Mean absolute error for appropriate and small for gestational age pregnancies was 0.48534 and 1.69953 respectively. There is no statistically significant difference in the mean absolute percent errors between the two groups ($p>0.05$).

Percentage of overestimation of fetal weight is more in small for gestational age pregnancy as compared to appropriate for gestational age pregnancy (64% versus 56% respectively). But the difference is not significant ($p>0.05$).

CONCLUSION

The study showed that ultrasound predicts the fetal weight in both categories with a mean absolute error of 1.092435 USG estimation of fetal weight can be used to predict the birth weight with high degree of accuracy and plan delivery and neonatal management for a better neonatal outcome.

In clinically suspected small for gestational age pregnancies ultrasound estimation of fetal weight by Hadlocks formula is 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.

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Source of Support: Nil. **Conflict of Interest:** None Declared.

Cite this article as: Manoj Kumar Malhotra, Deepali Jain. Accuracy of Ultrasound Determination of Estimated Fetal Weight in Small for Gestational Age Pregnancies. Int J Med Res Prof. 2016; 2(4):57-61.