Accuracy of Ultrasound Examination at Term Pregnancy in Estimation of Fetal Weight

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Abstract

Objective: To determine the diagnostic accuracy of ultrasound estimation of fetal weight in low birth weight fetuses in term pregnancies keeping actual birth weight as gold standard.

Materials and Methods: This cross sectional study conducted in department of Radiology, KRL hospital, Islamabad from 29-02-2012 to 31-08-2012. Two fifty five cases using non-probability Convenience sampling were taken. Pregnant patients at term presenting in the radiology department of KRL Hospital for ultrasound examination were included in the study. Informed written consent was taken from the patient. Ultrasound examination and fetal weight estimation through measurements all parameters of fetus was carried out by consultant radiologist using GE Logic P/6 three Dimensional machine. An addition of 25 g per day was done to correct the time elapsed between the ultrasound and delivery. After birth the weight of new born was recorded within 2 hours of birth.

Results: A total of 255 patients who presented in radiology department for antenatal ultrasound at term pregnancy were recruited for study. The mean age of all patients was 29.73±4.065 SD (Range 20-38 years). The estimated fetal birth weight (g) through ultrasound was shown as low in 169 (62.27%) whereas actual birth weight was low in 184 (72.16%). Thus, the sensitivity, specificity, positive predictive value and negative predictive value of ultrasound to determine low birth weight fetuses was 80.04%,90.14%, 95.88% and74.45% respectively. The diagnostic accuracy of ultrasound in correctly estimating low birth weight was 88.63%.

Conclusion: In our study, the mean estimated weights through ultrasound were similar to mean actual weight. Hence, despite of controversies in literature, our results indicate the diagnostic accuracy of ultrasound in estimation of low birth weight to be considerably significant.

Keywords: Fetal weight, Diagnostic accuracy Ultrasonography.

Introduction

Both low birth weight and excessive fetal weight at delivery are associated with an increased risk of newborn and maternal complications during labor and the puerperium.¹² The perinatal complications associated with low birth weight are most often attributable to fetal prematurity. For macrosomic fetuses potential complications associated with delivery include shoulder dystocia, brachial plexus injuries, bony injuries, and intrapartum asphyxia, as well as maternal risks that include birth canal injuries, pelvic floor injuries damage, and postpartum hemorrhage.³

The correct determination of fetal weight prior to delivery accurately is of utmost important and greatly influences the clinical management, the outcome of pregnancy, delivery and survival of newborn especially in cases of fetal growth restriction. Fetal weight estimation is a good predictor of fetal growth and this may affect the timing and route of delivery.⁴

In low birth weight babies, the option for suppression of labor can be given to the women while Option for labor induction can be considered in women carrying oversized fetuses. Various methods are used to estimate fetal weight at birth.⁵️ These include Predicting fetal weight through clinical examination, using algorithms derived from parental and pregnancy-specific characteristics, maternal self-estimation and
through ultrasound examination.\textsuperscript{7,8} Obstetric sonographic assessment for the purpose of obtaining fetal biometric measurements to predict fetal weight has been presumed to be more accurate than clinical methods for estimating fetal weight through fetal biometric measurements. One study showed that sensitivity, specificity, positive predictive value and negative predictive value for ultrasonic detection of low fetal weight in non-diabetic women were 61%, 96%, 69% and 94% respectively.\textsuperscript{9}

The incidence of low birth weight is around 37%.\textsuperscript{10} Although sonographic assessment of fetal weight is more accurate than the clinical examination, there is a quite variation in the reported diagnostic accuracy in previous studies. The aim of this study was to determine the diagnostic accuracy of ultrasound estimation of fetal weight in low birth weight fetuses in term pregnancies keeping actual birth weight as gold standard.

**Material and Methods**

Pregnant patients at term, both primigravida and multigravida presenting in the radiology department of KRL Hospital for ultrasound examination were included in the study. Stillbirths, multiple pregnancies, patients with elapse time of >3 weeks between ultrasound estimation and delivery and patients with diabetes mellitus and hypertension were excluded from the study. Informed written consent was taken from the patient. The data was collected on the Performa attached. Ultrasound examination and fetal weight estimation through measurements all parameters of was carried out by consultant radiologist using GE Logic P/6 three Dimensional machine. The Fetal weight in grams was recorded on the Performa. An addition of 25 g per day was done to correct the time elapsed between the ultrasound and delivery. After birth the weight of new born was recorded within 2 hours of birth.

The Statistical Package for social sciences Version 13 (SPSS 13) was used for data analysis. Continuous variables such as age were expressed in as mean ± Standard Deviation. Frequency and percentage was calculated for qualitative variable true positives. The accuracy of EFW through ultrasound was calculated using formula for accuracy (True positive, True negative, False positive, False negative)

**Results**

A total of 255 patients who presented in radiology department for antenatal ultrasound at term pregnancy were recruited for study. The mean age of all patients was 29.73±4.065 with minimum of 20 and maximum of 38 years. Out of total 255 patients, 96 (37.65%) were primipara parity and 159 (62.35%) showed multiparity. Average ultrasound estimated fetal weight (g) was 2449.31±257.454 (g) with minimum of 1965g and maximum of 3021g. The variability in observed data in form of range was observed as 1065g. Mean actual birth weight was calculated to be 2406.08±279.926g with minimum actual weight observed as 1900g and maximum actual weight observed as 3200g. (Table 1)

<table>
<thead>
<tr>
<th>Age</th>
<th>Fetal weight by USG</th>
<th>Actual birth weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>29.73</td>
<td>2449.31</td>
</tr>
<tr>
<td>Std. Deviation</td>
<td>4.065</td>
<td>257.454</td>
</tr>
<tr>
<td>Minimum</td>
<td>20</td>
<td>1956</td>
</tr>
<tr>
<td>Maximum</td>
<td>38</td>
<td>3021</td>
</tr>
</tbody>
</table>

The estimated fetal birth weight (g) through Ultrasound was shown as low in 169 (62.27%) whereas actual birth weight was low in 184 (72.16%). Thus, the sensitivity of ultrasound (ability to correctly identify fetus having low birth weight) was 80.04% whereas specificity of ultrasound (ability to correctly identify fetus not having low birth weight) was 90.14%. The positive predictive value (probability of having low birth weight babies on ultrasound when it is actually present) was observed as 95.88% and negative predictive value (probability of having low birth weight babies on ultrasound when it is actually not present) was 74.45%. The diagnostic accuracy of ultrasound in correctly estimating low birth weight was 88.63%. (Table 2)

<table>
<thead>
<tr>
<th>Low fetal weight (US)</th>
<th>Actual low birth weight</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Low fetal weight (US)</td>
<td>Yes</td>
<td>162</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>22</td>
</tr>
<tr>
<td>Total</td>
<td>184</td>
<td>71</td>
</tr>
</tbody>
</table>
Discussion

Low birth weight is the most crucial element that not only causes neonatal mortality but also plays a significant role in post neonatal infant mortality as well as of infant morbidity.\textsuperscript{11} WHO, in 1979, presented the most comprehensive results of LBW that was updated later in 1982. Out of total 127 million babies who were born in 1982, about 20 million that constitutes 16\% had been estimated for having LBW. Astonishing fact in this study was that the lowest birth weights were found to be in Asia having average values from approx. 2700 - 2800g in Indian sub-continent to 3200-3300g in China and Japan and analogous Low Birth Weight rate of 30 – 40 \% and 5 – 6 \% respectively. Whilst in the West Africa the average birth weight was found to be 2800 - 3000 g with rate of Low Birth Weight to be 10 – 20 \% whilst in the North Africa mean range of weight was 3200-3300 g and LBW was 5 – 15 \%.\textsuperscript{12}

Particularly, significant focus has been posed on the causes for determining birth weight, specially determining low birth weight of infants. So that, any intervention could be made for modifying these risk factors.\textsuperscript{13} Ultrasound is a technique basically used to estimate fetal weight in order to ascertain the growth, timing and route of delivery as well as to detect any abnormality as fetal growth abnormality or genital problems.\textsuperscript{14} For estimation of low birth weight ultrasound is considered to be more precise, whilst for normal clinical examination and above 4000g range, both clinical examination and ultrasound give somewhat similar level of accuracy.\textsuperscript{15}

One prospective study concluded that the Hadlock2 method predicts birth weight more precisely compared to others. Also, the average deviation from actual birth weight (226gms) and the percentile value of absolute error for difference were minimum with above mentioned method, and it predicts maximum numbers of the cases in 10 \% of the actual birth weights (85\%). A significant difference had been observed between predicted and the actual birth weight in rest of the methods (p<0.01). Hence the conclusion was that Hedlock2 method is comparatively better predictor for birth weights compared to the other six and also, it is method of choice for estimation of the birth weights in term pregnancy where measurements of the foetal head were frequently seen to be imprecise that may either be due to engagement or molding because it integrates FL and AC only that is not affected via such alterations.\textsuperscript{16}

The Basic underlying assumption for Sonographic measurements is that the multiple linear as well as planar dimensions of fetus give enough parametric information for allowing the precise algorithmic reconstruction of 3 dimensional fetal volumes for varying tissue density.\textsuperscript{17} Hence we conducted this study to assess the diagnostic accuracy of ultrasound estimation of fetal weight in low birth weight fetuses in term pregnancies keeping actual birth weight as gold standard.

Total 255 patients who presented in radiology department for antenatal ultrasound at term pregnancy were recruited in our study. The mean age of all patients was 29.73±4.065 with minimum of 20 and maximum of 38 years. Other factors as lack of education, poverty and poor socio-economic status also contribute in early pregnancies and associated complications.\textsuperscript{18}

Among total 255 patients, 37.65\% patient were primipara and 62.35\% showed multipara parity. In one study in United States Population, it was found that primipara-multipara curves had significant impact on low birth weight of infants.\textsuperscript{19} Average ultrasound estimated fetal weight (g) was 2449.31±257.454 (g) with variability in observed data was observed as 1065g. Mean actual birth weight was calculated within 2hours after birth to be 2406.08±279.926g. The difference in estimated and actual birth weights was not much different in our study.

In our study, further, the estimated fetal birth weight(g) through Ultrasound was shown as low in 169 (62.27\%) whereas actual birth weight was low in 184 (72.16\%). Thus, the sensitivity of ultrasound (ability to correctly identify fetus having low birth weight) was 80.04\% whereas specificity of ultrasound (ability to correctly identify fetus not having low birth weight) was 90.14\%. The diagnostic accuracy of ultrasound in correctly estimating low birth weight was 88.63\%. The above mentioned study focusing on the diagnostic accuracy of ultrasound in determination of fetal weight showed that the sensitivity, specificity, positive predictive value, and negative predictive value for ultrasonic detection of fetal weight ≥4000 g among the non-diabetic women were 61\%, 96\%, 69\%, and 94\%, respectively whereas in detection of fetal weight ≥4500, the figures were 50\%, 98\%, 47\%, and 98\%, respectively.\textsuperscript{20}
Additionally, another study focused on determining the accuracy of ultrasound in estimation of the fetal weight among 246 parous women having singleton, term pregnancies who had been admitted for caesarean section. In this study, sensitivity and specificity of estimating birth weight through ultrasound measures was 12.6 % and 92.1 %. Also, the estimates by clinicians for birth weight in the term pregnancy were as much precise as the routine ultrasound in a week before the delivery. Also, the estimates for parous women for birth weight were even more precise compared to ultrasound estimation.  

One study demonstrated the sensitivity, specificity, positive predictive value and negative predictive value for ultrasonic detection of low fetal weight in non-diabetic women were 61%, 96%, 69% and 94% respectively. On one side are studies similar to that by Colman A et al showing sensitivity and specificity as 50% and 98% for ultrasound estimation of fetal weight while on the other side are studies similar to that by Ashrafanjooei T et al showing sensitivity and specificity as 82% and 62%. It is therefore evident through our results which are similar to many other studies that ultrasound technique, despite of the ongoing debates and controversies, plays a significant role in estimation of low birth weight and still is a reliable source for diagnosis of fetal weight.

**Conclusion**

In our study, the mean estimated weights through ultrasound were similar to mean actual weight. Hence, despite of controversies in literature, our results indicate the diagnostic accuracy of ultrasound in estimation of low birth weight to be considerably significant.

**Conflict of Interest**

This study has no conflict of interest as declared by any author.

**References**

17. Aldous MB, Edmonson MB. Maternal age at first childbirth and risk of low birth weight and preterm