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Original Article

Correlation Between Ultrasonographically Estimated Fetal Weight and Actual Birth Weight in Females Presenting in a Tertiary Care Hospital

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ABSTRACT

Objective: To determine the correlation between ultrasono-graphically estimated fetal weight and actual birth weight in females presenting in a tertiary care hospital.

Study Design: Comparative cross-sectional study.

Place and Duration of Study: Department of Radiology Peripheral Nervous System, PNS Shifa Hospital Karachi Pakistan, from Sep 2018 to Jan 2019.

Methodology: Fifty pregnant females were enrolled after meeting the inclusion criteria. A consultant radiologist calculated fetal weight by measuring biparietal diameter (BPD), head circumference (HC), femur length (FL) and abdominal circumference (AC) with the help of an ultrasound (USG) machine having a Hadlock 3 weight estimation algorithm. A paediatrician noted actual birth weight with a weighing scale after delivery.

Results: The mean fetal weight on ultrasound was 2.52±0.34kg. The mean actual birth weight of the babies was 2.66±0.42 kg. A strong positive correlation (r=0.575, p<0.05) was found between ultrasonographic fetal weight estimation and actual birth weight.

Conclusion: Ultrasonography is an accurate, safe, cost-effective and easy available imaging modality for fetal weight estimation.

Keywords: Correlation, Fetal Birth Weight, Hadlock formula, Ultrasonography.

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INTRODUCTION

Fetal weight assessment is a universal and essential part of antenatal care, which is useful in growth monitoring and the timely identification of high-risk pregnancies and decision regarding the mode of delivery. One of the most important determinants of newborn survival is the birth weight of the fetus.[1,2] Neonatal complications such as respiratory distress syndrome and neonatal infections are more often associated with low birth weight, while fetal macrosomia leads to maternal complications and labour abnormalities such as emergency cesarean section, post-partum haemorrhage and perineal trauma. Therefore, in order to limit potential complications associated with the birth of low birth weight and large fetuses, an accurate estimation of fetal weight is of great importance in deciding the correct mode of delivery and appropriate management.[3,4]

Caregivers of pregnant women try to determine the fetal weight clinically with different formulae. However, fetal weight estimation with clinical formulae is not very accurate, especially in low birth weight babies.[5] USG has been used for decades to estimate fetal weight in which various measurements of the fetus are taken in linear and planar dimensions, which provide sufficient information for the algorithmic reconstruction of the three-dimensional fetal volume. Therefore sonographic fetal weight estimation is an important component of antenatal care.[5,6]

Fetal weight assessment is done via ultrasound on almost every pregnant female in our department. Various formulae have been used to estimate fetal weight sonographically.[1] USG machine in our department estimates fetal weight using the Hadlock formula, which is pre-programmed. Hadlock formula utilises fetal bi-parietal diameter, the fetal abdominal circumference and the fetal femoral length to calculate the fetal weight. Various studies have shown the Hadlock formula to be the most predictive.[5,7]

Ultrasound machines used for fetal weight estimation in Pakistan are imported from developed countries like Japan, the USA and Europe. The weight estimation models used in these machines are based on data derived from those populations. Few studies have also been carried out in Pakistan to estimate the

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accuracy of ultrasound in fetal weight estimation, but such a study has not been done previously in our setup. Literature shows controversial data regarding the accuracy of USG in fetal weight assessment.[8,9] Rationale of this study was to find out the correlation between ultrasonographic fetal weight estimation and the actual birth weight of babies in our setup in our population. Through this study, we also wanted to confirm the evidence of previous literature. This will help us improve our practice and attain local magnitude for sonographic fetal weight estimation. It will update local guidelines for predicting fetal weight, effective pregnancy management and its favourable outcome accordingly. This study will also help improve the technical skills and confidence level of the radiologists using USG in fetal weight estimation in our department.

METHODOLOGY

This was a comparative cross-sectional study conducted at the Department of Radiology, PNS Shifa Hospital, Karachi Pakistan from September 2018 to January 2019. Approval from the Hospital Ethical Committee was obtained (Reference number: ERC/2020/RADIO/25). A minimum sample size of 13 patients was calculated using an online calculator provided by the University of California San Francisco,[8] assuming an expected correlation coefficient of 0.71, alpha of 0.05, and beta of 0.20.9 We selected fifty pregnant females by using non probability consecutive technique from the department of gynaecology PNS Shifa. The gestational age of all selected cases was more than 32 weeks on LMP.

Inclusion Criteria: Pregnant females of age 18 to 40 years, already booked for antenatal care and delivery at PNS Shifa were included in the study.

Exclusion Criteria: Females with maternal obesity, malnutrition, premature rupture of membranes, antepartum haemorrhage, congenital anomalies, eclampsia, renal insufficiency, and liver abnormality were excluded based on history and ultrasound findings.

Informed consent was obtained from all females included in the study. Demographic details were noted. The maximum interval between ultrasound scan and delivery was less than one week.

All sonographic examinations were carried out with Toshiba Applio 500 USG machine. This machine uses the Hadlock formula for fetal weight estimation. A consultant radiologist did ultrasound scans of all patients with more than one year of experience performing antenatal scans on the machine. BPD was measured on the axial image of the skull at the level of the thalami. BPD was measured from the outer aspect of skull bones echoes close to the transducer to the inner aspect of far side skull echoes. The HC was measured on the axial image used for BPD measurement.

AC was measured on the axial image of the abdomen showing the stomach, umbilical vein and fetal liver. FL was measured from one end of the femur to its other end. Fetal weight was measured by using Hadlock's 3 formula: log (10) birth weight=1.335-0.0034 (abdominal circumference) (femur length)± 0.0316 (bi-parietal diameter)±0.0457 (abdominal circumference)±0.1623 (Femur Length).

Fetal weight was noted. All selected females were delivered at the Department of Obstetrics and Gynaecology PNS Shifa. After delivery, birth weight was noted by a paediatrician in terms of kilog-rams on the weighing machine within one hour of delivery. Birth weight was then recorded from the medical record of the female within 24 hours of deli-very. All this information was recorded on proforma. Statistical Package for Social Sciences (SPSS) version 20.0 was used for the data analysis. The quanti-tative variables, i.e., age, gestational age, body mass index, ultrasound estimated fetal weights and actual birth weights, were presented as Mean±SD. The quali-tative variable, i.e., the gender of the neonate, were presented as frequency and percentage. Parity was presented as frequency. Pearson's correlation coeffi-cient was calculated to measure the correlation bet-ween ultrasound estimated fetal weights and actual birth weights. The *p*-value of ≤0.05 was taken as significant.

RESULTS

The total number of pregnant females selected was fifty. The mean age of the females was 26.12±5.65 years. The mean BMI of the patients was 26.17±4.19 kg/m^2. The mean gestational age of the females was 36.20±2.41 weeks. In this study, 12(24%) females were primigravida. In this study, 19(38%) babies were males, whereas 31(62%) babies were females. Therefore, the male-to-female ratio of the babies was 1:1.6.

The estimated mean fetal weight on ultrasound was 2.52±0.34 kg. The mean actual birth weight of the babies was 2.66±0.42 kg. Results showed a positive correlation between the fetal weight estimation on USG and the actual birth weight of the babies, i.e. r=0.575 (p<0.05), as given in Figure.

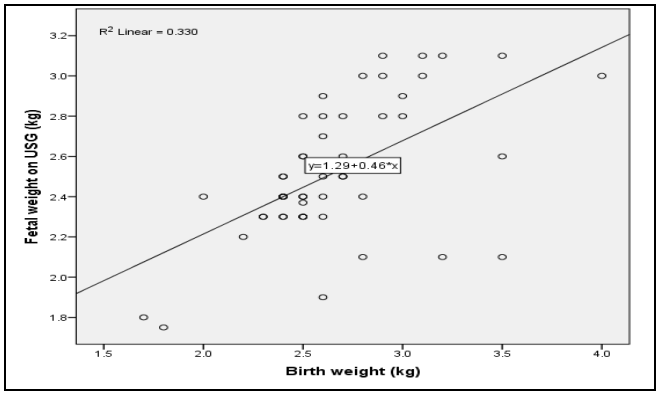

Figure: Correlation Between Fetal Weight Estimation on Ultrasound With Actual Birth Weight (r=0.575; *p*-value=0.001)

DISCUSSION

Prenatal fetal weight estimation is an important component of antenatal care which not only helps reduce maternal risks associated with pregnancy, such as postpartum bleeding, prolonged labour and perineal injuries, and also reduces fetal complications such as birth asphyxia and shoulder dystocia. USG is an established imaging modality for prenatal estimation of fetal weight. It is a widely available and relatively cost-effective imaging modality.[2,7,10]

This cross-sectional study was conducted to determine the correlation between ultrasonographic fetal weight estimation and actual birth weight in females in a tertiary care hospital. In this study, a strong positive correlation was found between the estimated fetal weight on USG and the actual birth weight of the babies, i.e., r=0.575 (p<0.05). Therefore, according to this study, USG is a reliable method for estimating fetal weight during pregnancy which is of great help in identifying high-risk pregnancies and deciding the appropriate mode of delivery. In addition, it was also found that the Hadlock weight estimation formula is more predictive than other formulae used in USG machines.

Estimating fetal weight on USG does not have a steep learning curve and can be easily mastered. Our department has observed that there is acceptable variation in fetal weight estimated by residents and consultants whenever patients are reviewed. Simms Stewart *et al*. studied the impact of the level of resident's training in the ultrasonographic estimation of fetal weight and found a good correlation between resident's results and actual birth weight after delivery. They found that due to significant development in computer technology, there is no significant difference in the weight estimated by senior and junior residents sonographically.[6]

Eze *et al*. conducted a study in Lagos, Nigeria, to find the correlation between fetal weight estimated on USG using Hadlock formula and actual birth weight at delivery. Their results were similar to our study. They found that sonographically estimated fetal weight correlated positively with the actual birth weight Nigerian population. Most of the macrosomic fetuses in their study were delivered through caesarean section.[7]

Rashid did a study in Bangladesh and showed that the correlation between ultrasonographic fetal weight estimation and actual birth weight was r=0.961, p<0.001. This relationship was strong enough to prove that USG can be used as a reliable tool for estimation of fetal weight and exploring the cases of intrauterine growth retardation as well as macrosomia.[11]

Bajracharya *et al*. did a retrospective observational study in Kathmandu, Nepal, to determine the accuracy of USG in fetal weight estimation using the Hadlock formula. However, their results showed significant errors in fetal weight estimation by USG.[1] The results contradict our study, which showed a positive correlation. This difference may be due to the observational nature of their study. Accuracy in fetal weight estimation is also highly dependent on the competency of the operator performing the ultrasound, which becomes difficult to control in retrospective observational studies. Another study by Parvathavarthini *et al*. showed that fetal weight determined clinically using abdominal girth x symphysis fundal height (AGXSFH) formula is equally good. This study compared various clinical and USG formulae for fetal weight estimation. They also concluded that the Hadlock formula used in USG had the least standard deviation in fetal weight estimation, per our study.[12]

A study by Tawe *et al*. concluded that fetal weight estimated on USG correlated strongly with actual birth weight, especially in normal birth weight babies. They also found that fetal weight estimated on USG should be correlated clinically in babies with low or more birth weight to avoid unnecessary interventions and complications at the delivery time.[13]

El Helali *et al*. did a study to compare sonographic and clinical methods for assessment of fetal weight regarding sensitivity, specificity and accuracy and concluded that USG assessment of fetal weight is a safe, reliable and sensitive method for fetal weight estimation.[14]

Lanowski *et al*. did a study and concluded that sonographic evaluation of fetal weight displayed superiority over the clinical approach as regards absolute errors and error percentages. The sonographic examination revealed better statistical sensitivity and specificity in detecting fetal weight >3500 gm. Moreover, it showed less bias on Bland–the Altman plot analysis.[15]

Ugwa *et al.* recommended the clinical method of fetal weight estimation as a screening tool for normal weight and macrosomic foetuses. They found that fetal weight estimation by USG was more accurate in cases of low birth weight babies.[16]

Taha *et al*. concluded that ultrasound could not detect fetal weight accurately. However, they found that USG estimates fetal weight with a statistically acceptable variation.[17] In this study, we also found that the variation is in an acceptable range.

Different studies found significantly lower mean error, absolute error and error percentages in the ultrasonic weight assessment versus clinical fetal weight assessment as contrasted to the actual weight of the studied babies.[18, 19,20]

LIMITATIONS OF STUDY

There was a few days gap between the delivery and USG scan, which could not be adjusted. Ideally, the scan should be done just before delivery to reduce error, which was not possible in every case.

CONCLUSION

This study showed a strong positive correlation between the fetal weight estimated on USG with actual birth weight at delivery in a tertiary care hospital. Therefore, according to this study, USG is accurate in estimating fetal birth weight and is an accurate tool in predicting low birth weight and macrosomic babies.

Conflict of Intrest: None.

Author's Contribution

Following authors have made substantial contributions to the manuscript as under:

AR: Study design, data analysis, critical review, drafting the manuscript, critical review, approval of the final version to be published., HRI & UAK: Conception, study design, drafting the manu-script, approval of the final version to be published., SS & RA: Data analysis, data interpretation, critical review, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investi-gated and resolved.

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