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Original Research Paper

Radio Diagnosis

FETAL ABDOMINAL SUBCUTANEOUS TISSUE THICKNESS FOR ESTIMATING FETAL BIRTH WEIGHT MEASURED BY ULTRASOUND – ITS RELIABILITY AND ACCURACY IN INDIAN POPULATION.

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ABSTRACT

Context: Estimated Fetal weight (EFW) influences the management and outcome of pregnancy. Commonly used ultrasound fetal weight estimation like Hadlock four parameter method(Hadlock-4) based on fetal biometry is widely used. These formulas show variable degrees of error which is more evident in fetuses with nutritional and metabolic issues; better accuracy of fetal weight estimation can be obtained by incorporation of fetal soft tissue parameters like the fetal subcutaneous tissue in the weight estimation process. **Aims:** To determine if measurement of fetal abdominal subcutaneous tissue thickness (FASTT) for Estimating Fetal birth weight by ultrasound in Indian population. **Settings and Design:** Prospective observational study, **Method and Materials:** A study was done in Department of Radio-diagnosis facility of K.V.G. Medical College and Hospital, Sullia, enrolling 100 women of third trimeter pregnancy who underwent ultrasonography and delivered within one week of scan. Abdominal subcutaneous fat tissue thickness of the fetuses was measured, from the inner to the outer aspect of the echogenic subcutaneous fat at the level of the abdominal circumference (AC). **Statistical analysis used:** Pearson coefficient. **Results:** Mean age of 100 ladies enrolled was 26 years and 4 months. FASTT was positively correlated with actual birth weight (Pearson's, $r = 0.69$, $p < 0.001$). FASTT of > 8.9 mm was sensitive to predict large for gestational age (LGA) babies. **Conclusion:** FASTT can be used as an additional indicator to predict large for gestational age babies along with other known birth weight indicators to make it more reliable in Indian context.

KEYWORDS : Actual birth weight; Estimated Fetal weight, Fetal abdominal Subcutaneous tissue thickness(FASTT).

INTRODUCTION

Estimated fetal weight (EFW), as obtained by ultrasonography, play vital role in the management of pregnancy and prognosticating post-natal outcome.[1-3] Various models proposed to assess EFW on Ultrasonography are based on fetal biometric measurements.[4-13] Hadlock formula using four measurements(Hadlock-4) of Head Circumference(HC), Biparietal diameter(BPD), Abdominal Circumference(AC) and Femur Length(FL), is considered reliable and is widely used.[14-16] Hadlock-4 model was based on American data. This method has also been found by some studies to be more accurate in Indian context.[17-18] Most of present ultrasound scanners available in India are configured with Hadlock-4 method. However, in our practice, we found significant discrepancies between EFW by this method and actual birth weight(ABW). The obstetricians often complained about these issues affecting the management of cases adversely.

Ultrasound has its limitations despite the use of more than 50 different formulae to estimate fetal weight as their performance is poor at the extremes of fetal weight. There has been emerging interest in studying fetal soft tissue measurements to improve the detection of growth abnormalities.[19]

The aim of present study to determine the reliability and accuracy of fetal abdominal subcutaneous tissue thickness (FASTT) for Estimating Fetal birth weight by ultrasound in Indian population.

METHOD AND MATERIALS

A prospective observational study was conducted in K.V.G. Medical College and Hospital for a period of two months in 2021. Institutional review committee clearance was obtained for the study. All ladies presenting to scanning room, during the study duration, in their third trimester, were enrolled for the study with an intention to include first 100 ladies who would deliver within 1 week of their last ultrasound scan. The sample size was calculated based on the delivery rates of the institute and setting 95 percent confidence limits. Ladies were considered as being in third trimester if their gestational age (GA), as assessed by their last menstrual period (LMP) or any first trimester scan available. Wherever there was discrepancy between GA by LMP and earlier ultrasound scan, GA by ultrasound was considered for inclusion. When neither LMP nor earlier scan report was available, the lady was not included in the study. After taking written informed consent, obstetric scan was performed with high-resolution real-time scanner Voluson 730 expert / Voluson S8 in 2 D mode by a curvilinear probe of frequency 2 – 6 MHz. Scanning parameters (depth, gain and Time Gain Compensation) were optimized for each participant. All fetal anomalies detected during the present or past scans were excluded from the study. BPD, HC, AC and FL of the fetus were measured on still images of the respective fetal parts using the digital calipers on the monitor. Fetal Abdominal Subcutaneous Tissue Thickness (FASTT) was measured at the anterior 1/3rd of abdominal circumference between outer and inner edges of abdominal wall by abdominal ultrasound at the level of measurement of abdominal circumference.

If the lady delivers within seven days of the scan, then the actual nude birth weight of the neonate, as entered in the parturition register of the institute was noted. All newborns were routinely weighed in the labour room, immediately at birth, using a digital weighing scale in grams. This weight was endorsed in the parturition register. Other ladies who did not deliver within 3 days of the scan were excluded from the study.

Figure: Axial B mode ultrasound scan image of the fetal abdomen depicting the measurement of Abdominal Circumference (AC). The Stomach bubble (thin white arrow), umbilical vein at portal sinus (Thick white arrow) and liver (asterisk) is seen in this plane. FASTT measured at the anterior 1/3rd of abdominal circumference.

The collected data for statistical analysis included following: Maternal age, gestational age by US, estimated fetal weight (EFW) by Hadlock formula, fetal abdominal subcutaneous tissue thickness(FASTT), fetal gender and actual nude birth weight. The data was tabulated using Microsoft Excel 2010. Pearson's correlation coefficient was calculated to study the correlation between FASTT and actual birth weight.

RESULTS

A total of 100 ladies, who presented to the scanning room for third trimester ultrasound scan were considered for inclusion in to the study. The antenatal sonographic data was collected for the purpose of the study.

The mean age of the ladies included in the study was 26 years and 4 months, with minimum of 20 years 2 months and maximum of 31 years 8 months. Majority of the ladies enrolled delivered between 36 weeks and 40 weeks. A large number of enrolled ladies delivered between day 3 and day 6 of the last ultrasound scan.

In 71 out of 100 cases, the EFW was higher than ABW. In the remaining 29 cases the ABW was higher than EFW by a mean of 3.6%. In 19 out of 100 cases, the ABW's were lesser than the defined 2 SD of the value of EFW. There were 5 cases in which the ABW was more than of the value of EFW by over 15%. Overall 21 ABW values were beyond the 2 standard deviations of EFW.

The Pearson's correlation coefficient was determined to be 0.69, which indicates a positive correlation between FASTT and ABW. P-value was 0.001, which is highly statistically significant.

Fetal biometric measures were estimated as well as FASTT and EFW. FASTT ranged from 3.5 to 13 mm and EFW ranged from 2265 to 4482 g. Included subjects in this study were classified into three categories based on the fetal birth weight. FASTT ranged from 3.5 to 4.2 mm for the SGA category, from 4.3 to 8.8 mm for the AGA (appropriate for gestational age) category, and from 8.9 to 13 mm in LGA category, while EFW of the included subjects ranged from 2265 to 2395 g in SGA category, from 2396 to 3857 g for the AGA category, and from 3858 to 4482 g in the LGA category. FASTT showed a high statistically significant correlation with EFW by Hadlock formula and ABW. Both EFW and FASTT showed higher values in LGA category than AGA and SGA categories and also showed higher values in AGA category than SGA category.

Sr. No.	EFW (grams)	Category Name	FASTT (mm)
1.	2265 – 2395	Small for gestational age(SGA)	3.5 – 4.2
2.	2396 – 3857	Appropriate for gestational age(AGA)	4.3 – 8.8
3.	3858 - 4482	Large for gestational age(LGA)	8.9 - 13

No statistical correlation between fetal gender and FASTT denoting that fat deposition in the fetus is not related to the fetal gender (r = 0.14, p value = 0.12 (NS),Spearman correlation)

DISCUSSION

In the present study, there were no significant correlation between fetal anterior abdominal wall fat thickness and each of maternal age and gestational age of the fetus was found.

EFWs, obtained in the present study, overestimated the birth weight in most cases (71%). This is similar to studies by Hiwale et al.[20] and Prajapati et al.[21] found the overestimation in approximately 60% and 62.5% of the cases respectively.

There was a significant difference between women with different birth weight categories which are LGA, AGA and SGA; regarding the mean value of FAST, in such a way that the mean FASTT was significantly higher in women with LGA when compared to women who were AGA and in women with SGA neonates.

The Pearson's correlation coefficient to find linear correlation between FASTT and ABW is least in the present study as compared to other studies. This can also be attributed to the variations among newborns in terms of composition.

In this study, EFW by Hadlock-4 model, which is currently the widely used method in this region, was compared with ABW commonly used in Indian setup. Hadlock-4 is a method, based on the four fetal biometry measurements configured in most ultrasonography machines.[14-18] It is based on data of the USA. Few studies have even proposed newer formulae to cater to other population. On literature search, there are fewer studies of such kind in Indian context, mostly by non-Radiology specialities. Hence, Radiologists undertaking such studies will help arrive at a more appropriate method of EFW assessment by Ultrasonography.

Similar to our study, Khalifa et al. (2019)[22] concluded that FASTT showed a high statistically significant correlation with EFW by Hadlock formula and BW (birth weight). Also, a high statistically significant difference between each of the birth weight categories regarding the value of EFW by Hadlock formula as well as by FASTT was noted. Both EFW and FASTT showed higher values in LGA category than AGA and SGA categories and also showed higher values in AGA category than SGA category.

Bhat et al. (2014)[23] plotted birth weight against FASTT (scatter plot graph) and it showed a positive significant correlation between FASTT and birth weight obtained by Pearson's correlation coefficient. Similarly, Grace and Josefina (2014)[24] demonstrated that FASTT may be useful in the assessment of fetal nutritional risk as they showed a significant correlation between subcutaneous tissue thickness, estimated fetal weight and ABW.

Regarding the statistically significant difference of FASTT in different birth weight categories, Odthon et al. (2015)[25] showed similar results. They studied the correlation between FASTT and birth weight. The mean FASTT differed significantly between normal and macrosomic fetuses.

Singh et al. (2014)[26] stated that average subcutaneous tissue thickness in babies having a birth weight between 10th and 90th percentile was 5.4 mm below 10th percentile was 4.4 mm and above 90th percentile was > 5.9 mm.

Additionally, the present study results were in accordance with the results recorded by Bhat et al. (2014)[23], who found that the difference in mean FASTT between SGA, AGA and LGA babies was statistically significant.

Regarding the demographic data of the included subjects, the current study showed no correlation between FASTT and maternal age.

The best cutoff value of FASTT for LGA was 8.9 mm and that of SGA was 4.2 mm. Cutoff points of FASTT for LGA and SGA varied in different studies.

CONCLUSION

FASTT can be used as an additional indicator to predict large for gestational age babies along with other known birth weight indicators to make it more reliable and accurate in Indian context.

However, a large study should be conducted on a wider scale for Indian population in attempt to generate formulas for the estimation of fetal weight based on the Indian ethnic group and be the reference of medical practice in India.

Conflicts of interest – Nil

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