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Value of fetal abdominal subcutaneous tissue thickness via ultrasound in prediction of birth weight

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Abstract

Background: Multiple interactions between maternal, foetal, and placental effects impact the development of the foetus. Numerous aspects of perinatology need that the foetal development rate correspond with its age. Abnormal foetal development can lead to prenatal and postnatal complications and is associated with an increase in infant morbidity and mortality, given that foetal weight is one of the most influential factors influencing newborn survival. The goal of this study was to evaluate the accuracy of fetal abdominal subcutaneous tissue thickness (FASTT) measured by ultrasonography at term and correlate it with the actual birth weight (BW) recorded at the time of delivery.

Methods: This study prospective observational study was carried out on 60 singleton pregnant ladies and normal viable ongoing pregnancies at 37-39th week. Women underwent the following procedures: history taking, abdominal examination, abdominal ultrasonographic examinations (at 37-39 weeks), and follow-up after delivery for the recording of the post-natal fetal weight.

Results: The mean resistive index was 0.61±0.01 among the participants while the mean FASTT was 6.8± 1.8 mm. Cut-off value of FASTT for large babies obtained by using ROC curve was 4.55 mm. Sensitivity for FASTT >4.5 mm for gestational age babies is 91.7% and specificity is 65.4%. There was statistically significant positive correlation between FASTT and weight at birth in grams. There were 44% had vaginal delivery and 56% had caesarean delivery. There were 14% had preterm labor. The mean weight at birth was 3227±642.7 g among the participants.

Conclusions: The relationship between FASTT and BW is favourable. 4.55 mm was the FASTT cutoff threshold for large newborns. The sensitivity and specificity for FASTT >4.5 mm in newborns of gestational age are 91.7% and 65.4%, respectively. In addition to other well-established birth weight indicators, FASTT can be used to predict newborns who are big for their gestational age.

Keywords: Fetal abdominal subcutaneous tissue thickness, ultrasound, prediction, birth weight

Introduction

Fetal development is governed by several interactions between maternal, foetal, and placental factors [1].

Numerous aspects of perinatology require that the growth rate of a foetus be proportional to its age. Abnormal foetal growth may lead to prenatal and postnatal complications and is associated with an increase in infant morbidity and mortality, given that foetal weight is clearly one of the most influential determinants affecting newborn survival [2].

The proper estimation of foetal weight (EFW) during labour may have a significant influence on the provision of appropriate obstetric care, particularly when macrosomia or low birth weight is suspected. Fetuses with a low birth weight are more susceptible to perinatal disease and death. Macrosomal foetuses may result in birth problems for both mother and child. Therefore, a precise assessment of birth weight may assist in avoiding some of these issues [3]. Ultrasound is the most used technique for monitoring foetal growth and determining foetal weight using morphometric formulae. The bulk of these equations use core biometric measurements, such as biparietal diameter (BPD), abdominal circumference (AC), head circumference (HC), and femur length (FL) [4].

However, all commonly used weight estimation techniques display varying degrees of inaccuracy, intra- and inter-observer variability, especially at term, when these measurements are technically more difficult to gather [3].

Hadlock and Shepard techniques are the most common, with a sensitivity of 62% and a specificity of 93% for predicting foetal macrosomia for the Hadlock method, and a sensitivity of 21% and a specificity of 99.9% for the Shepard technique [5].

Therefore, the accuracy of the conventional ultrasonographic foetal weight measuring techniques must be increased [6].

Since fat content correlates with the source of energy, fat mass is often used to assess nutritional status. 12 to 14% of the birth weight (BW) is constituted of fat, which accounts for 46% of the range in infant weight. Numerous studies conducted in the past have examined the relationship between ultrasonographic fat mass and infant BW. These ultrasonographic measurements of foetal body fat revealed considerable correlations with BW and predicted EFW [7].

It has been shown that large for gestational age (LGA) foetuses have more subcutaneous tissue. Ultrasound measurement of subcutaneous foetal fat has the ability to predict prenatal growth problems. It may be beneficial for calculating the weight of the foetus. Reduced subcutaneous fat in growth-restricted foetuses. Children with sacrococcygeal teratoma (SCT) measuring less than 5 mm at 38 weeks were five times more likely to have birth weight in the 10th percentile and significant neonatal morbidity than children with SCT measuring 5 mm or more. The limitation of 5 millimetres is not supported by the writers [8].

In light of the above, it is essential to assess the function of sonography in detecting the thickness of subcutaneous fat in the foetal belly and its link with actual foetal weight. The main objective of this study was to evaluate the accuracy of fetal abdominal subcutaneous tissue thickness measured by ultrasound at term and correlate it with the actual BW measured immediately after delivery.

Patients and Methods

This study prospective observational study was carried out on 60 pregnant ladies. They were recruited from Obstetrics and Gynecology clinics at Tanta University Hospital during the period of research from November 2020 to October 2021. The study was done after being approved from the institutional ethical committee, Tanta University. Signed consent was obtained from all patients included.

Inclusion criteria: Were singleton pregnancy and normal viable ongoing pregnancies at 37-39th week.

Exclusion criteria: Were pregnant females who delivered after more than 1 week from the last fetal biometry, preterm delivery, multiple pregnancies, fetal congenital anomalies, fetal hydrops and oligohydramnios.

Methods

Patients were subjected to the following: (1) complete history taking

Including personal history, obstetrics history, past history of medication and surgeries, menstrual history, surgical history, and history of the current pregnancy.

(2) Abdominal examination. **(3) Abdominal ultrasonographic examinations (at 37-39 weeks)** Performed by one investigator using a 3.5- 5-mhz trans abdominal probe or assessment of: fetal well-being, fetal presentation, amniotic fluid index, fetal biometry, fetal biometric measures (BPD, AC, FL, and HC). Fetal weight estimation was done by using Hadlock IV formula (1985) that incorporates fetal biometric measures into the following equation [1]. At the same level as the abdominal circumference, in the anterior third of the abdomen, it was measured in millimetres by positioning the cursor at the outside and inner boundaries of the echogenic subcutaneous fat line. (4) After calibrating the scales, the patient was examined in supine posture using a digital scale to record the post-natal foetal weight.

Possible benefits

It is essential to guarantee that the pace of foetal development corresponds to the age of the foetus. It is possible for abnormal foetal development to increase neonatal morbidity and death. To varied degrees, all regularly used formulae for estimating weight are erroneous. Thus, novel methods such as evaluating the thickness of a foetus' abdominal subcutaneous tissue may be advantageous.

Possible risks

There are few or no possible risks related with ultrasonography patient evaluation. Participants and the ethics committee were quickly informed of any unforeseen risks that could occur throughout the course of the trial.

Statistical analysis

The acquired data were imported into a computer and statistically analysed using SPSS version 26. (Statistical Package for Social Science). Examining the normal distribution of the data using the Shapiro Walk test. The presentation of qualitative data as percentages and frequencies. The mean and standard deviation were used to communicate quantitative data. Using the Pearson correlation coefficient, the link between quantitative variables may be determined. The investigation of the ROC of the IOD for predicting the location of the placenta in the third trimester. Level of P-value < 0.05 indicates significant.

Results

The mean age was 27.7±5.7 and 27.9±5.1 years among the participants. The mean BMI was 24.5±1.8 among the participants. There were 12% had chronic hypertension among the participants. The mean gravidity was 3.9±2.2 among the participants. The mean parity was 1.8±1.6 among the participants. There were 38% had previous history of abortion among the participants. There were 48% had previous history of caesarean among the participants. The mean of systolic blood pressure was 116±7.6 among the participants. The mean of diastolic blood pressure was 66.8±6.9 the participants. The mean of pulse was 84.6±4.6 among the participants. The mean of temperature was 37.5±0.2 among the participants. Table 1

Table 1: Basic maternal characteristics, obstetric history and vital signs among the studied group N = 100

Age	27.7±5.7
BMI	24.5±1.8
HTN	12 (12)
Gravidity	3.9±2.2
Parity	1.8±1.6
Previous abortion	38 (38)
Previous caesarean	48 (48)
Systolic blood pressure	116±7.6
Diastolic blood pressure	66.8±6.9
Pulse	84.6±4.6
Temperature	37.5±0.2

Data were presented as mean ± SD (Standard deviation), number (percentage).

The mean gestational age was 38.1±0.8 among the participants. The fetal movements had seen among 88% of the participants had movement. There were 4% had gross anatomical defect. The mean fetal heart rate was 146.3±7.9 bpm. The mean BPD was 84.5±6.9 among the participants. The mean femur length was 68.2±7.6 among the participants. The mean abdominal circumference was 299.0±45.2 among the participants. The mean head circumference was 281±39.9 among the participants. The mean estimated fetal weight was 3560.1-±271.6 g. The mean resistive index was 0.61±0.01 among the participants while the mean FASTT was 6.8±1.8 mm. Table 2

Table 2: Trans abdominal ultrasonography and resistive index and FASTT among the participants

	N = 100
Gestational age	38.1±0.8
Fetal movement seen	88 (88)
Fetal heart rate	146.3±7.9
Biparietal diameter mm	84.5±6.9
Femur length mm	68.2±7.6
Abd. Circumference mm	299.0±45.2
Head circumference mm	281±39.9
EFW	3560.1±271.6
Resistive index (0.61)	0.01
FASTT mm (6.8)	1.8

Data were presented as mean ± SD (Standard deviation), number (percentage), FAST: fetal abdominal subcutaneous tissue thickness.

Cut-off value of FASTT for large babies was 4.55 mm. FASTT sensitivity >4.5 mm for gestational age babies is 91.7% and 65.4% specificity. Figure 1

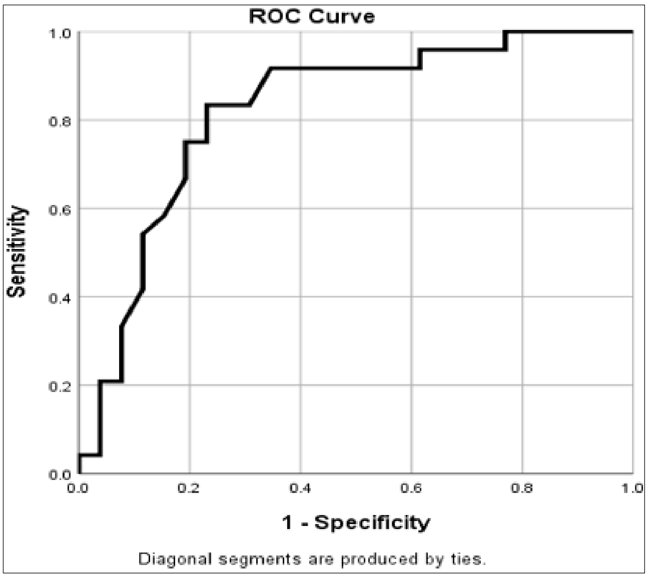

Fig 1: ROC curve analysis of FASTT in predicting weight at birth

There was statistically significant positive correlation between FASTT and weight at birth in grams. Figure 2

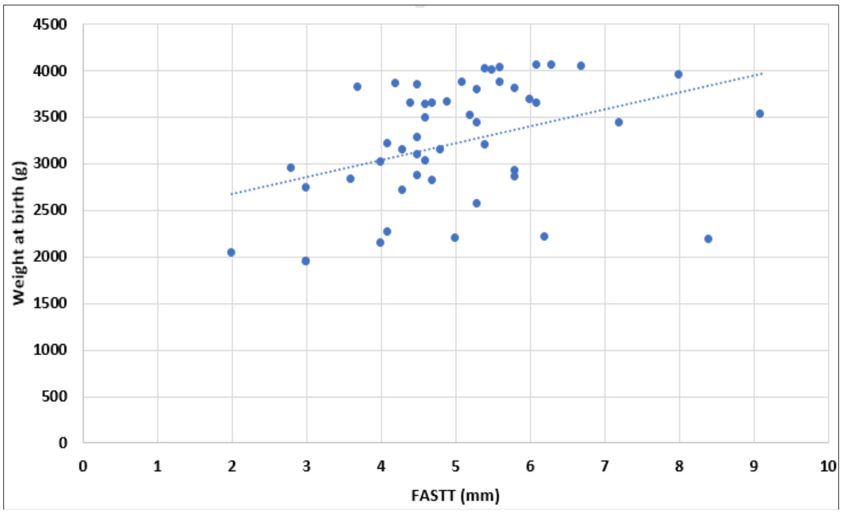

Fig 2: Scatter plot between FASTT and weight at birth

There were 44% had vaginal delivery and 56% had caesarean delivery. There were 14% had preterm labor. The mean weight at birth was 3227±642.7 g among the participants. Table 3

Table 3: Natal data among the participants

	N = 100
Mode of delivery Vaginal	44 (44)
Caesarean section	56 (56)
Preterm labor	14 (14)
Weight at birth (g)	3227± 642.7

Data were presented as mean ± SD (Standard deviation), number (percentage).

There were 72% had anterior placenta and 28% had posterior placenta among the participants. There were 32% and 68% had placenta grade I and grade II respectively. The mean AFI was 130.8±7.4 among the participants. Table 4

Table 4: Comparing trans abdominal ultrasound among the participants

	N = 46
Placental side	
Anterior	72 (72)
Posterior	28 (28)
Placental grade	
Grade I	32 (32)
Grade II	68 (68)
AFI (mm)	130.8±7.4

Data were presented as mean ± SD (Standard deviation), number (percentage).

There were 58% had cephalic presentation, 32% had breech presentation, and 10% had other presentations. There were 10% among the participants had fetal growth restrictions. Table 5

Table 5: Fetal presentation and fetal growth restriction among the participants N = 100

Fetal presentation	
Cephalic	58 (58)
Breech	32 (32)
Other	10 (10)
Fetal growth restriction	10 (10)

Data were presented as number (percentage).

Discussion

The birth weight of the newborn is the single most important predictor of neonatal survival. Both low and high birth weights are connected with an increased risk of labour and postpartum problems in newborns. In order to limit the possible problems connected with the birth of both very little and extremely big newborns, a precise calculation of the foetal weight must precede the delivery decision [9].

According to Khalifa *et al.* [1], their study of 100 pregnant women validated our findings. 86 percent of the pregnant women were multigravida, while 14 percent were first-time mothers.

However, in the study of O'Connor *et al.* [10], 43% of their studied group was nulliparous.

Forouzmehr *et al.* [11] reported that the average gestational age was 37.71.9 weeks, and the average delivery age was 39.41.9 weeks, which validates our findings. 11 days was the median (range) time from evaluation to delivery (0-31 days). The average birth weight was 2875564 grammes (range: 1600-4500 gm.). Six babies (2%) weighed more than 4000 grammes, while seventeen infants (5.7%) weighed less than 2000 grammes.

In the study by Khalifa *et al.* [1], gestational age ranged from 37 to 41.6 weeks. In addition to FASTT and EFW, biometric data were computed for the foetus. FASTT ranged between 3.6 and 13 mm, and EFW between 2275 and 4470 grammes.

According to Bhat *et al.* [2], the mean FASTT was 6 mm 0.94, with a range of 3.4 mm to 10 mm, which corresponds to our observations. When birth weight and FASTT were compared, a positive correlation was seen (scatter plot). Using a Pearson correlation value (r) of 0.418, the significance of the link between FASTT and birth weight was determined. The p-value for the link between FASTT and birth weight is 0.0001 (the test is significant at the 0.01 level), indicating a positive association between FASTT and birth weight. The average FASTT for small newborns (2500 g) was 5.44 mm (SD = 0.98), but it was 5.9 mm (SD = 0.86) for AGA infants and 6.89 mm (SD = 0.86) for large infants (>3500 g) (SD 0.94). The average FASTT rose as birth weight increased and vice versa; the average FASTT increased as birth weight grew. We examined the average FASTT scores of SGA, AGA, and LGA newborns. The difference between the mean FASTT of SGA and AGA infants was statistically significant (p-value 0.032). Similarly, there was a statistically significant difference between the mean FASTT scores of newborns who were LGA and those who were AGA (p-value 0.000). Size had a greater impact on pregnancy.

Multiple research have investigated the correlation between subcutaneous tissue thickness and birth weight. Foromouzmehr *et al.* [11]. There was a correlation between the birth weight immediately after delivery and the FASTT measured 11 days after birth. 300 term moms were recruited in total. The average birth weight of 300 babies was 2875564 grammes, with six (2 percent) being more than 4000 grammes and seventeen (5.7%) weighing less than 2000 grammes. Mean FASTT was considerably different between normal and macrosomic foetuses (6, 6 mm vs. 12 mm, p 0.001) Petrikovsky *et al.* [12] evaluated the thickness of abdominal subcutaneous tissue in 133 term pregnancies of non-diabetic women in order to predict macrosomia (birth weight >4000 g). After FASTT testing, the birth weight of infants born within 72 hours was determined. In this research, there was a statistically significant difference in abdominal wall thickness between foetuses with a normal birth weight and those with a macrosomic birth weight (7 mm vs. 12.4 mm, p = 0.0001).

In the research by Kuttan *et al.* [13], the p-value for the relationship between ASTT measurement and birth weight was less than 0.001.

Using the ROC curve, Bhat *et al.* [2] determined the FASTT cutoff value for big babies to be 6.25 mm. FASTT >6,25 mm has a sensitivity of 79%, specificity of 70%, PPV of 24.4%, and NPV of 96.4% for detecting neonates who are disproportionately large for their gestational age. Strong Negative Predictive Value shows that a baby is less likely to be disproportionately big for gestational age if the FASTT is smaller than the cutoff value (6.25 mm in their research) (LGA).

Whereas Oun *et al.* [14] demonstrated that a ROC curve was constructed for FAST as a predictor of Birth weight > 4000 g., as indicated by the significantly large area under the curve (AUC) [AUC = 0.820, 95% confidence interval (0.741 to 0.802), p 4000 g is more likely was 7.2 mm [sensitivity 91%, specificity 80%, PPV 64.3%, NPV 9 8

Higgins *et al.* [15] revealed that the Anterior Abdominal Wall (AAW) measurement in foetuses with a macrosomic birth weight was significantly higher than in those with a birth weight in the 90th percentile. This study reveals that a simple additional measurement, abdominal adiposity width (AAW), taken during a standard abdominal circumference (AC) evaluation correlate highly with birth weight. A foetal AAW more than 5.6 mm at term or an AC greater than the 90th percentile should alert the obstetrician to the possibility of macrosomia. And the sensitivity to this possibility holds true for 36-week pregnancies, approaching 100 percent at 37 and 38 weeks.

In a second research, Bethune *et al.* [16] found that foetal fat layer or subcutaneous tissue thickness >5mm was a better predictor of macrosomia than abdominal circumference in 90 pregnancies with gestational diabetes, despite only one measurement being taken between 28 and 34 weeks. Parretti *et al.* [17] investigated AAW thickness especially in foetuses of pregnant women with impaired glucose tolerance and found that starting at 26 weeks, AAW thickness rose considerably relative to normal levels.

According to Singh *et al.* [8], neonates whose birth weight fell between the 10th and 90th percentiles had an average subcutaneous tissue thickness of 5.40 millimetres. The result was 4.4 mm below the 10th percentile and > 5.9 mm above the 90th percentile.

Wu *et al.* [6] discovered that foetuses with a FASTT of 4 mm were more likely to have a low birth weight, with a sensitivity of 90% (95 percent CI = 86.8–93.3) and a specificity of 53.5%.

Conclusions

The connection between FASTT and BW is positive. The FASTT cutoff value for big infants was 4.55 mm. The sensitivity for FASTT >4.5mm in infants of gestational age is 91.7% and the specificity is 65.4%. FASTT can be used in conjunction with other established BW markers to predict large-for-gestational-age infants.

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None to be declared

Conflict of Interest

None to be declared

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