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Association between Subcutaneous Tissue Thickness Measurement at Fetal Abdomen and Expected Fetal Birth Weight

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ABSTRACT
Background: In the diagnosis and treatment of macrosomia, which is related to birth pain, asphyxia, and maternal morbidity, estimating foetal weight may be critical.Fetal abdominal subcutaneous tissue thickness (FASTT) is one such ultrasound parameter that is an independent consideration in predicting big babies and can estimate foetal weight for high for gestational age babies when substantiated with other ultrasound parameters.The aim of this study was to determine the importance of using ultrasonography to measure subcutaneous tissue thickness in predicting foetal birth weight.
Patients and methods: This prospective observationl study included 276 pregnant women at term admitted to the obstetric ward and scheduled for elective Cesarean section or induction of labor or during labor. Ultrasonographic evaluation was done immediate before delivery for measurement of the thickness of the subcutaneous fat tissue at the anterior abdominal wall was done three times and the average was taken. Ultrasonic estimation of fetalweight , actual birth weight immediately after delivery by a neonatologist in the delivery room using (SECA digital medical weighing) and the thickness of the subcutaneous fat tissue were recorded.
Results:FASTTand birth weight were found to have a positive association. A responsive measure to predict large babies is the FASTT of 6.85 mm. The FASTT test is not accurate enough to estimate the birth weight of small babies weighing less than 2500 grammes.
Conclusion:Along with other established birth weight markers, FASTT may be used as a secondary predictor to forecast big for gestational age infants.
Keywords: Tissue Thickness By Ultrasonography; Actual Birth Weight; Expected Fetal Birth Weight

Introduction:

It is important to accurately estimate foetal weight at birth in order to assess the risk of morbidity and mortality in the foetus and newborn. Estimating foetal weight may

be crucial in the diagnosis and treatment of macrosomia, which is linked to birth trauma, asphyxia, and maternal morbidity **(1,2,3)**.
Ultrasonographically measured foetal weight is calculated by taking samples of foetal sections and using a regression algorithm to calculate EFW **(4)**.

New sonographic criteria, such as soft tissue thickness measures, are valuable for foetal weight measurement, according to recent science studies. The measurement of foetal abdominal soft tissue thickness in the third trimester of pregnancy has a clear positive association with foetal weight estimation **(5).**
Fetal abdominal subcutaneous tissue at term is strongly correlated with birth weight in typical pregnancies. The risk of operative vaginal and caesarean delivery increases as foetal abdominal subcutaneous tissue thickness increases **(6,7,8)**.
Using a non-invasive technique like ultrasound to assess foetal subcutaneous tissue parameters may improve the diagnosis of gestational diabetes and reduce the possible morbidity associated with undiagnosed gestational diabetes. It can be beneficial for women who are unable to handle GTT or who have bad pregnancy follow-up **(9)**.
The aim of the present study to estimate the value of measuring subcutaneous tissue thickness by ultrasonography in prediction of expected fetal birth weight.

Patients and Method:
This prospective observationl study was performed at Zagazig University Maternity Hospital, It included 276 pregnant women at term admitted to the obstetric ward and scheduled for elective Cesarean section or induction of labor or during labor during the period between October 2019 and April 2020.
Informed consent was received from patients Before prospective collection of patient data and this study was carried out in conjunction with the World Medical Association (Declaration of Helsinki) for trials involving humans.

Inclusion criteria were pregnant women aged from 19 to 39 years old with full term (37- 41 weeks) healthy living singleton pregnancy likely to give birth within 48h. Patients were selected consecutively from among those admitted for elective cesarean section or induction of labor or initial spontaneous labor.

Fetal age was primarily based on the first day of the last regular menstrual period that was confirmed by dating scan. Ultrasonographic evaluation was done immediate before delivery using (General Electric, Voluson 730 pro) ultrasound machine equipped with a 2.0 - 7.0 MHz convex transducer (abdominal probe), it included the following:

i. Assessment of fetal anatomy to exclude congenital fetal malformation(CFMF).
ii. Assessment of fetal biometry.
iii. Sonographic estimation of gestation age : when patient was seen for first time without adequate data for age estimation.
iv. Estimated fetal body weight : by using (Hadlock Formula) including the 4 fetal biometric measurements ; BPD , HC , FL , AC.

Measurement of the thickness of the subcutaneous fat tissue at the anterior abdominal wall was done three times and the average was taken. The transverse

section of the fetal trunk at the level of the abdominal circumference was obtained with specific characteristics as:
(1) Fetal abdomen free from contact with arms or legs, with amniotic fluid between the fetal trunk and the uterine wall .
(2) Circular outline .
(3) Cross section of fetal spine .
(4) Appearance of short length of umbilical vein and stomach bubble .
(5) absence of fetal breathing movement and fetal heart or kidney.
Once this section was acquired, a magnification of the anterior abdominal wall was obtained and freezing of the image. Subcutaneous fetal fat tissue was recognized as an external hyperechoic surface. The thickness of this layer was measured by placing one caliper exactly between the amniotic fluid and the fetal skin and the other caliper exactly between the subcutaneous fat layer and the anterior side of the liver in contact with the anterior abdominal wall.
Ultrasonic estimation of fetalweight , actual birth weight immediately after delivery by a neonatologist in the delivery room using (SECA digital medical weighing)and the thickness of the subcutaneous fat tissue were recorded.

Statistical Analysis:

Results were tabulated and statistically analysedusing IBM SPSS software package version 20.0(Armonk, NY: IBM Corp).Correlationcoefficient was used to study thecorrelation betweenfetal abdominal subcutaneous fat thickness (FAST) and Birth weight. Paired T-test was used to compare the fetal abdominal fat thickness of average for gestational age (AGA) large for gestational age (LGA) and small for gestational age (SGA) babies. ROC curve was used to obtain a cut-off of fetal abdominal fat thickness to predict LGA and SGA babies.

Results:

The mean of maternal age was 28.05.11 years, ranged grom 19 to 39 years; gestational age was distributed as 38.471.17, with a minimum of 37 and a maximum of 41 weeks; the majority of the women were multigravida (88.0%) and PG (12%); and the majority of the women were (multipara) with 90.0 percent **(Table 1)**. There was Significant positive correlation between actual baby weight and estimated body weight by hadlock'sformula **(Fig. 1)**.

The average thickness of foetal abdominal subcutaneous tissue at term (FASTT) was 5.47 0.9 mm (range: 3.8 - 8.3 mm). There was no important relationship between foetal anterior abdominal wall fat thickness and maternal age, parity, or gestational age in any of the women studied. The thickness of the foetal anterior abdominal wall fat and birth weight had a strong positive association.Also actual baby weight was significantly positive correlated with AC, BPD **(Table 2).**

There was a significant difference between women with different birth weight categories regarding the mean value of FASTT **(Table 3)**.

Table 1: basic demographic and obstetric data distribution among studied group (N=276) .

Age / years	**Mean± SD**	28.0±5.11	
	Median (Range)	27.0 (19-39)	
GA/ weeks	**Mean± SD**	38.47±1.17	
	Median (Range)	38.0 (37-41)	
		N	%
Gravidity	**PG**	33	12.0
	Multigravida	243	88.0
Parity	**Nullipara**	27	10.0
	Multipara	249	90.0
Abortion	**No**	243	88.0
	Yes	33	12.0
Delivery	**CS**	159	57.6
	CS&VD	42	15.2
	VD	75	27.2
	Total	276	100.0

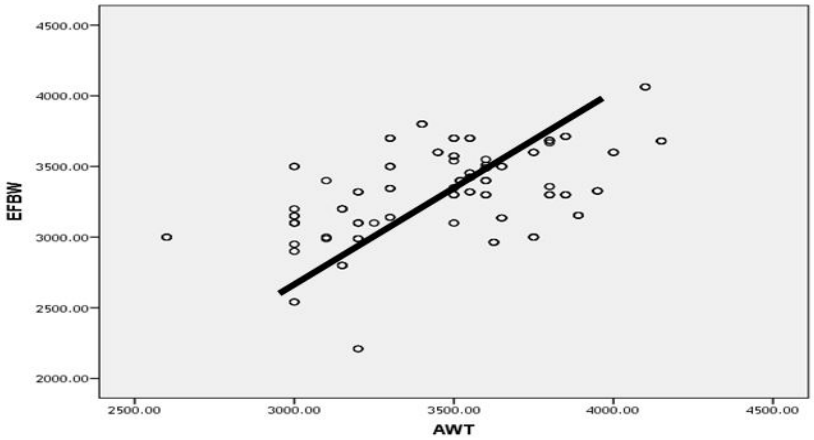

Figure 1: Correlations between actual baby weight and estimated body weight by Hadlock's formula.

Table 2: Correlations between actual baby weight and US parameters .

FL	**R**	-.034-
	P	.577
AC	**R**	.277**
	P	.000
BPD	**R**	.286**
	P	.000
FASTT	**R**	.491**
	P	.000

Table 3: Correlations between SC and EFBW by Hadlock and other US parameters .

EFBW	**R**	**.415****
	P	**.000**
FL	**R**	**.191****
	P	**.001**
AC	**R**	**.139***
	P	**.021**
BPD	**R**	**.527****
	P	**.000**

The AUC for the FASTT as predictor of Birth weight > 4000 g was larger than that for it as predictor of birth weight<2500 g, indicating that FASTT is a better predictor for Birth weight > 4000 g than for low birth weight . The best cutoff value of FASTT above which Birth weight > 4000 g is more likely was > 6.85 mm [sensitivity 94.5%, specificity 98.8%] (fig 2). The best cutoff value of FASTT below which birth weight<2500 is more likely was < 5.31 mm [sensitivity 63.3%, specificity 58.9%] **(Fig. 2)**. FASTT of 6.85 mm is a sensitive test to predict large babies .FASTT measurement for prediction of small babies with birth weight < 2500 g is not sensitive. FASTT can be used as an additional indicator to predict large for gestational age babies along with other known birth weight indicators **(Fig. 3)**.

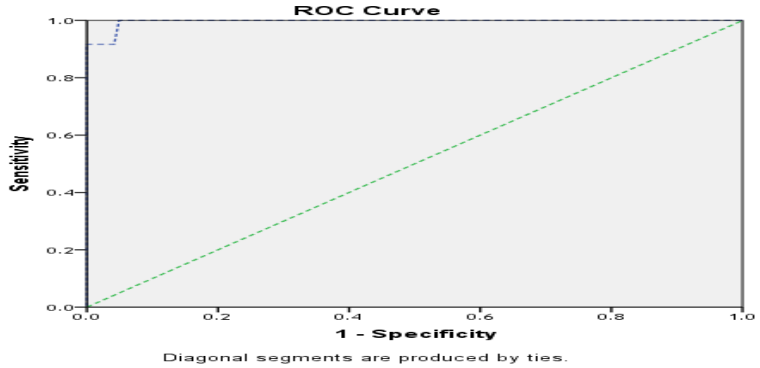

Figure (2): ROC Curve for FAST cut off regard Large Birth Weight (> 4000 g).

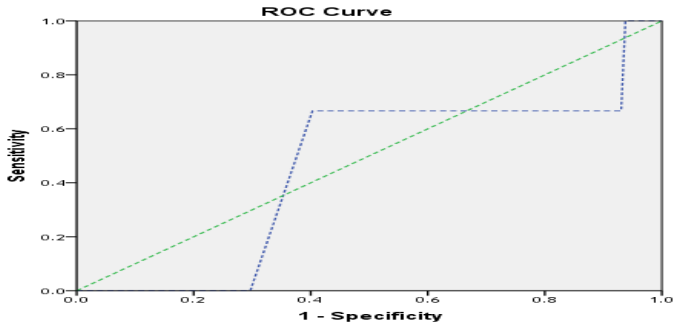

Figure (3): ROC Curve for FAST cut off regard Small Birth Weight (<2500 g).

Discussion:

The early detection of foetal macrosomia is critical for labour and delivery control as well as the avoidance of foetal and maternal abuse during childbirth **(10)**.

Modern sonographic standards, such as soft tissue thickness values, seem to be useful for foetal weight estimation, according to research. It is possible to take measurements of different parts of the foetal body. Subcutaneous tissue thickness can be measured in the knee, upper arm, abdomen, or subscapular area.

Forouzumer et al. discovered a strong connection between foetal abdominal soft tissue thickness (FASTT) and foetal weight in the third trimester of pregnancy **(11).**

In the present study, there was significant positive correlation between actual birth weight and BW by FASTT in normal birth weight,(r=0.572 , p<0.000). But not in low birth weight. Also, there was significant positive correlation between actual birth weight and BW by FASTT in normal birth weight, (r=0.316, p < 0.006). and in large birth weight .A cut-off value of FASTT for large birth weight was > 6.85 mm. (Sensitivity was 94.5% and specificity was 98.8%) . Also, cut-off value of FASTT for low birth weight was < 5.31 mm. (Sensitivity was 63.3% and specificity was 58.9%).The AUC for the FASTT as predictor of Birth weight > 4000 g was larger than that for it as predictor of birth weight < 2500 g, indicating that FASTT is a better predictor for Birth weight > 4000 g than for low birth weight.

This result was in the same line with **Ebomaya et al., (12)** showed Significant association between FASTT and a wide variety of fetal weights was apparent. Immediate birth weight compared with the FASTT estimated within 11 days of delivery following conception. Complete 300 mothers have been chosen for phrase. The total birth weight of 300 newborns was 2875±564 g; of which 6 (2%) newborns weighed over 4000 gms and 17 babies (5.7%) weighed less than 2000 gms. The FASTT mean differentiated significantly between normal and macrosomic fetuses (6.6 mm vs 12 mm respectively; p<0.001**).**

It has been shown that the assessment of Anterior Abdominal Wall (AAW) in macrosomic fetuses has improved dramatically relative to those with < 90th percentile birthweight. This research reveals that a basic additional calculation, AAW, taken at the time of normal Abdominal Circumference (AC), is substantially associated with birth weight. They reported that they assessed a fetal AAW of > 5.6 mm at term or an AC >90th percentile for gestation should alert the obstetrician to the possibility of fetal macrosomia with agood sensitivity for gestation <36 weeks and the sensitivity increases to almost 100% for 37-38 weeks gestation **(13)**.

Parretti et al., (**14**) who examined AAW thickness directly in pregnant fetuses with reduced glucose resistance, and found that AAW thickness increased dramatically from 26 weeks relative to usual levels.

Our results were comparable to results obtained by **Kongsing et al.,** (**15**). One hundred and ten births of alleged IUGR have been analysed in this review. The research group's prevalence of IUGR was 22.72 percent. The strongest cut-off value of the subcutaneous fat thickness for IUGR estimation was 4.5 mm, offering 76.0

percent, 75.3 percent, 47.5 percent and 91.4 percent, respectively, the sensitivity, accuracy, positive predictive value and negative predictive value.

Also, a study by **Aleksandra et al., (16)** who demonstrated that adipose tissue assessment of the extremities has a strong predictive effect of low birth weight prediction. It recorded 74 percent and 94 percent respectively of its sensitivity and specificity.

In contrast, some studies by **Han et al.,** (**17**) who indicated that subcutaneous tissue thickness cannot be used to differentiate fetal growth anomalies, especially in Cases of growth retardation.

Conclusion

In addition to evidence from previous researchs, our results show that foetal abdominal subcutaneous tissue thickness, as an example of foetal fat controls, may be used to estimate foetal weight. Along with other birth weight markers, FASTT may be used as an external predictor to estimate big for gestational age infants.Since it is a straightforward measurement achieved using 2D ultrasound in a regular plane, it has a wide range of applications. It could be used in conjunction with weight estimation formulas to improve precision, especially at birth weight extremities.

No Conflict of Interest.

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