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## Estimation of Birth Weight Using Sonographically Measured Fetal Abdominal Subcutaneous Tissue Thickness

**Background/Objectives:** Growth retardation and macrosomia are associated with increased fetal morbidity and mortality. We assessed the usefulness of sonographic measurement of abdominal subcutaneous tissue thickness in estimating birth weight.

**Materials and Methods:** Abdominal subcutaneous tissue thickness was measured sonographically in 300 fetuses between 37 and 42 weeks of gestation. The median time between sonographic examination and delivery was 11 days. The weight of newborns was measured immediately after delivery.

**Results:** The mean soft tissue thickness was significantly higher in macrosomic than normal fetuses ( $12.0 \pm 1.4$  mm versus  $6.6 \pm 1.6$  mm, respectively;  $P < 0.001$ ). There was a significant positive correlation between the abdominal subcutaneous tissue thickness and birth weight ( $r = 0.86$ ,  $P < 0.001$ ).

**Conclusion:** Sonographic examination of the fetal abdominal subcutaneous tissue thickness is useful for estimating birth weight.

**Keywords:** abdominal subcutaneous tissue thickness, sonography, birth weight

### Introduction

Macrosomic and growth-retarded fetuses both are at increased risk of perinatal morbidity and mortality.<sup>1,2</sup> Estimation of fetal weight for detecting disturbances in fetal growth is among the most difficult challenges facing the radiologist.<sup>1</sup> An accurate estimation of fetal weight helps in making decision on the route of delivery to avoid prolonged labor,<sup>3</sup> traumatic delivery, and fetal neurologic injury.<sup>4</sup>

A variety of weight estimation formulas have been developed based on sonographic measurements of biparietal diameter (BPD), abdominal circumference (AC) and limb measurements, with a wide range of accuracy.<sup>5,6</sup> New sonographic methods are now focused on soft tissue measurements but controversies are already present.<sup>7-12</sup>

The purpose of this study was to evaluate the relationship between fetal abdominal subcutaneous tissue thickness (FASTT) and birth weight in order to predict fetal macrosomia or growth retardation more accurately.

### Materials and Methods

The study included 300 consecutive fetuses between 32 and 47 weeks gestational age who underwent ultrasound examination between October 2002 and December 2003. Each woman had an accurate determination of gestational age based on recollection of regular menstrual periods, and a sonographic examination by 20 weeks. Subjects were not referred for any particular indications. Cases of multiple gestations and known anomalies were excluded.

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Sonographic examinations were performed with Siemens and LG LOGIC 200 ultrasound units using a 3.5 MHz transducer. The fetal abdominal subcutaneous tissue thickness was measured at the anterior third of the abdominal circumference by placing the cursor at the outer and inner edges of the echogenic subcutaneous fat line. (Figure 1) Each neonate was weighed on a metric scale immediately after delivery.

The Pearson correlation coefficient ( $r$ ) was used to assess the correlation between abdominal subcutaneous tissue thickness and birth weight. The student  $t$  test was used to compare the FASTT values in normal and macrosomic ( $> 4000$  gm) fetuses.

To assess intraobserver reliability, each investigator remeasured the abdominal fat line for 25 patients. The paired  $t$ -test was used to determine whether there was a difference between the first and second measurements. Interobserver variation in measurements on the same fetus by two independent examiners was assessed by two-sample  $t$  test in 25 patients. Pearson correlation analysis was used to evaluate the relationship between intraobserver and also interobserver sonographic examination values.

## Results

The mean maternal age ( $\pm$ SD) of our subjects was  $29.4 \pm 7.2$  years. Thirty six percent were nulliparus. At recruitment, the mean gestational age was  $37.7 \pm 1.9$  weeks, and at delivery,  $39.4 \pm 1.8$  weeks. The median (range) time for assessment to delivery was 11 days (0-31 days). The mean birth weight of newborns was  $2875 \pm 564$  gm (range: 1600-4500 gm). Six newborns (2%) weighed more than 4000 gm and 17 cases (5.7%) less than 2000 gm.

The fetal abdominal subcutaneous tissue thickness ranged between 3 and 14 mm in all fetuses, with a mean ( $\pm$ SD) measurement of  $6.7 \pm 1.8$  mm. The mean soft tissue thickness differed significantly between normal and macrosomic fetuses ( $6.6 \pm 1.6$  mm versus  $12.0 \pm 1.4$  mm, respectively;  $P < 0.001$ ). There was a significant positive correlation between the abdominal subcutaneous tissue thickness and the birth weight ( $r = 0.86$ ,  $P < 0.001$ ).

In the assessment of intraobserver reliability of measurements, the mean of FASTT in the first sonographic examination was  $6.6 \pm 2.1$  and in reexamination was  $6.6 \pm 1.9$  ( $p_{t \text{ test}} > 0.05$ ;  $r = 0.97$ ,  $P < 0.05$ ). These values were  $6.5 \pm 2.1$  and  $6.6 \pm 2.0$  for the second observer ( $p_{t \text{ test}} > 0.05$ ;  $r = 0.96$ ,  $P < 0.05$ ). In the assessment of interobserver reliability of measurements, the mean FASTT values in two series of measurements on the same cases by different examiners was not significantly different (mean:  $6.6 \pm 2.3$  vs.  $6.6 \pm 2.4$ ,  $P > 0.05$ ), and showed close linear correlation ( $r = 0.94$ ,  $P < 0.05$ ).



Figure 1: The figure demonstrates how to measure the fetal subcutaneous tissue thickness

## Discussion

Fetal and maternal morbidity increases in cases of macrosomia.<sup>13,14</sup> In addition, low birth weight is associated with increased morbidity and mortality of newborns.<sup>2</sup> Ultrasound is a common method in estimating fetal weight. Rosati et al<sup>15</sup> after studying 732 fetuses proposed a formula that includes BPD, abdominal diameter, femur diaphysis length and humerus diaphysis length. This formula showed a close correlation with the weight of newborns. Fetal length also demonstrated an acceptable correlation with the presence of macrosomia, but the other single ultrasound parameters and ponderal indices were less indicative of macrosomia.

Recently, some researchers respected the sonographically measured soft tissue thickness in order to estimate fetal weight.<sup>7-12</sup> One study showed that measurement of the adipose tissue of the extremities has a positive predictive value of 4% in the prediction of low birth weight.<sup>10</sup> Its sensitivity and specificity were reported 74% and 94%, respectively. In contrast, some studies have proposed that subcutaneous tissue thickness cannot be used to distinguish abnormalities of fetal growth, especially in cases of growth retardation.<sup>9,16</sup> Another study demonstrated that fetal thigh soft tissue thickness has a high degree of correlation with birth weight ( $r = 0.86$ ); its sensitivity and specificity to predict macrosomia were 91% and 94%, respectively.<sup>11</sup>

To our knowledge, reports on the measurement of abdominal subcutaneous tissue thickness as a predictor of birth weight are rare. Petrikovsky et al<sup>8</sup> measured abdominal subcutaneous tissue thickness in 133 term fetuses and found a positive correlation between this index and birth weight ( $r=0.67$ ). They also estimated the diagnostic accuracy of this index for a range of cut-off points between 8 and 13 mm in diagnosing macrosomia. The negative predictive value varied between 84.3% and 100% (for preva-

lence rates of macrosomia of 5-25%) but positive predictive value was less than 50% for cut-off values less than 11 mm.

Our findings show even a higher degree of correlation between abdominal subcutaneous tissue thickness and body weight. An important point to be considered is that this correlation was found in a wide range of fetal weights, and also that our cases were not at increased risk for macrosomia or growth retardation. Thus, the prevalence of macrosomia and growth-retarded fetuses in our subjects were lower than needed for calculating indices of diagnostic accuracy with an acceptable power. In conclusion, our findings, in addition to data from previous studies, suggest that fetal abdominal subcutaneous tissue thickness can serve as a useful single parameter for estimating fetal weight. Also we suggest comparing the abdominal subcutaneous tissue thickness with the other parameters of estimating fetal weight, such as FL, AC and BPD in more studies, for possibility of using this parameter not only in the macrosomia but also in the normal and growth retarded fetuses.

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