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THE IMPACT OF THE ACTIVE STAGE OF LABOR ON ESTIMATE FETAL WEIGHT: A PROSPECTIVE COHORT STUDY

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Abstract

Objective: In the literature, there have been few data on ultrasound measurements during the active phase of labor. In this study, it was aimed to compare the accuracy of fetal weight estimation by ultrasound in terms of active phase of labor.

Methods: This was a prospective cohort study at the obstetrics clinic of Esenler Gynecology and Children's Hospital in Istanbul. A total of 85 patients in active labor were included in the study. All pregnant women were evaluated for estimated fetal weight (EFW) by ultrasound evaluation, and cervical dilation and effacement measurements by pelvic examination, at most 24 hours before labor. Hadlock-4 formula was used for EFW. EFW and actual birth weight (ABW) and absolute errors of pregnant women in active labor were compared.

Results: The mean EFW and ABW of the patients were 3161±482 and 3150±476 g, respectively. In terms of EFW and ABW, a finding in favor of the ultrasound was found. The error and error rates between EFW and ABW were found to be 234±191 g and 7.6±6.2, respectively. No significant difference was found in terms of these parameters *(p*>0.05*)*. A significant and strong (0.80) correlation was found with estimated fetal weights and actual birth weights.

Conclusion: Ultrasound can be used as a safe method to measure estimated fetal weight in the active phase of labor.

Keywords: *Estimated fetal weight, ultrasound, active phase of labor*.

Introduction

Sonography based estimate of fetal weight is an important aspect of parameter for labor planning. Measuring fetal weight is useful for clinicians not only in the management of labor, but also in reducing perinatal morbidity and mortality associated with suspected complications with macrosomia, cephalopelvic incompatibility, and IUGR.[1,2] Macrosomic fetuses are at risk for shoulder dystocia, brachial plexus damage, clavicle fracture, and humerus fracture. For these reasons, it serves as an essential tool for assessing fetal health and complications during antenatal and labor. The two main methods of estimating fetal birth weight in current obstetrics are clinical (using abdominal palpation, fundus height and abdominal circumference) and ultrasound (Biparietal diameter (BPD), Abdominal Circumference (AC), Femur Length (FL) and Head Circumference (HC)) or as a combination of several of these fetal parameters) techniques.[3] Considering that labor, especially the active phase of labor, may affect ultrasonographic biometric measurements, it is aimed to investigate the accuracy of fetal weight estimation was performed ultrasonography during active labor.

Methods

Study Design and Participants

This prospective study included data on 85 consecutive pregnant women who had deliveries in the third trimester from September, 2020 to December 2020, at the obstetrics clinic of Esenler Gynecology and Children's Hospital in İstanbul, the largest city of Turkey. As a second care facility performing nearly 8.000 deliveries annually. Data on pregnant women were retrieved from hospital and patient records, including maternal age, parity, abortus, gestational age, APGAR score, estimated fetal weight, amniotic fluid index, maternal body mass index (BMI), birth weight, cervical dilatation, and effacement. Gestational age was calculated from the last menstrual period in combination with obstetric ultrasound examination done before 20 weeks of pregnancy. In all patients included in the study, the estimated fetal weight was determined by measuring Hadlock biparietal diameter (BPD), head circumference (HC), abdominal circumference (AC) and femur length (FL) in 2D view on ultrasonography in active labor (cervical dilatation >4 cm). (within 24 hours) were compared with the actual birth weight.

Inclusion criteria were 18-39 years of age, single pregnancy, live fetus and the third trimester of pregnancy. Women were excluded in the presence of any of the following: multi-gestation, incomplete clinical or hospital data, no head presentation, chronic diseases (hypertension, diabetes mellitus), placental diseases (preeclampsia, placenta previa, placental abruption), and congenital f**e**tal anomalies. Ultrasound examination was performed by the same experienced physician with the same ultrasound training, using a General Electric Voluson 730 (GE Healthcare, Chicago, IL, United States) ultrasound device with a 4-8 MHz transabdominal convex probe. BPD and HC measurements were used from the axial plane of the cranium at the level of the cavum septum pellicidum and thalamus, the AC measurement was from the axial plane level where the porto-umbilical vein complex in the liver was seen, and the linear distance between the greater trochanter and the distal metaphysis of the femur was used to obtain FL. The amniotic fluid index (AFI) was calculated by collecting the vertically measured amniotic fluid pockets that do not contain an umbilical cord and are divided into four quadrants by taking the linea nigra and umbilicus as reference.

The number of cases included in the study was calculated as n=32 when the first type error level was α=0.05, the second type error level was β=0.20, and the power of the test was 80% according to the study "The Effect of Oligohydramnios on Estimated Fetal Weight Measurements in Term Pregnancies'' G*power analysis.[4]

Definitions

Estimated fetal weight measurement was calculated using Hadlock-4 formula, log10 EFW=1.3596-0.00386 (AC) x (FL) + 0.0064 (HC) + 0.00061 (BPD) x (AC) + 0.0424 (AC) + 0.174 (FL). Oligohydramnios diagnosis was defined as AFI less than 50 mm without fetal anomaly, while normal AFI value was defined as AFI values equal to or greater than 50 mm and AFI values equal to or less than 250 mm. Maternal BMI was calculated from height and weight measured at admission and subdivided into <25 kg/m^2 and ≥25 kg/m^2.

Data Processing and Analysis

For data collection, a structured format was used including all relevant clinical information. Data were processed using the Statistical Package for Social Sciences (SPSS) version 21 (IBM Corp., Armonk, N.Y.; USA). Quantitative data were expressed as means, standard deviation (SD), median, minimum, and maximum, and qualitative data as frequencies and percentages. Homogeneity was checked using the Levene's test, with a p value of *>0.05* considered in favor of homogeneity. The Shapiro-Wilk normality test was used to check whether continuous variables were normally distributed. For pairwise comparisons, numerical variables were compared using the independent t-test or paired simple t-test if normally distributed. Nominal variables were analyzed with the Pearson's or Fisher's chi-squared test. Pearson correlation analysis was applied to determine correlations between cervical changed and fetal birth weight. p<0.05 value is accepted as statistically significant. All variables were expressed with 95% confidence intervals (CI).

Results

Socio-Demographic and Obstetric Characteristics

The characteristics of the participants are summarized in Table 1. The mean age was 26.4±5.61 (range 18-39). The median parity was 1 (range 1-5). The mean labor was 38.5±1.9 (range 34-41) weeks. The mean birth weight was 3150±476 gr and mean uterine cervical dilatation was 5.5±1.4 (range 4-8) cm.

Correlation Analysis

In correlation analysis, uterine cervical effacement and dilatation showed a weak and insignificant negative correlated with EFW, BPD, HC, AC, and FL ($p>0.05$) (Table 2). In addition, EFW was strong positive correlated with ABW (r:0.80 and p=0.005).

Table 1. Baseline clinical characteristics

Parameters	**Mean±SD**	
Maternal age (years)	24.4±5.1	
Maternal BMI (kg/m^2)	29±4	
Fetal biometry (weeks)		
BPD	36.6±1.9	
HC	36.7±1.7	
AC	37.0±2.4	
FL	36.4±1.8	
Gestational age at time of labor (weeks)	38.5±1.9	
Fetal weight (g)		
EFW	3161±482	
Actual birth weight	3150±476	
Absolute error	234±191	
Absolute % error	7.6±6,2	
Cervical dilation (cm)	5.5±1.4	
Cervical effacement (%)	60±12	
APGAR score		
1.minute	8.9±0.4	
5.minute	9.9±0.3	
	n	**%**
Labor method		
NVD	76	89.4
C-section	9	10.6
Amnion fluid duration		
Non-oligohydramnios	65	76.5
Oligohydramnios	20	23.5
Polyhydramnios	0	0
Ethnicity		
Turkish	39	45.9
Syrian	46	54.1
Parity duration		
Primary	42	49.5
Multiparty	43	50.5

SD: standard deviation, min: minimum, max: maximum, n:number, %:percentage, EFA: estimate fetal weight, g: gram

Table 2. Correlations of cervical dilatation and effacement with newborn clinical characteristics

Parameters		**cervical dilatation**	**cervical effacement**
BPD	r	-0.06	-0.01
	p	*0.598*	*0.387*
HC	r	-0.14	-0.20
	p	*0.194*	*0.064*
AC	r	-0.04	-0.05
	p	*0.732*	*0.649*
FL	r	-0.18	-0.19
	p	*0.102*	*0.078*
EFW (g)	r	-0.04	-0.08
	p	*0.689*	*0.496*
Absolute error (g)	r	0.04	0.09
	p	*0.706*	*0.425*
Absolute percent error	r	0.06	0.10
	p	*0.618*	*0.349*

r: Pearson correlation coefficient

Between-Group Comparisons

A comparison between oligohydramnios and non-oligohydramnios mothers showed no significant between-group differences with respect to absolute error ((g) and percent), absolute % error (>10% and >15%). In addition, BMI was similar considering the same parameters ($p>0.05$) (Table 3).

Table 3. A comparison of newborn clinical characteristics with oligohydramnios and BMI

	Non-oligohydramnios	Oligohydramnios	*p*
Absolute error mean±SD (g)	307±253	212±164	*0.051*[a]
Absolute percent error mean±SD	7±5.8	9.3±7.4	*0.159*[a]
Absolute % error > 10% % (n)	14 (21.5)	9 (45)	*0.039**[b]
Absolute % error > 15% % (n)	6 (9.2)	4 (20)	*0.191*[b]
	BMI<25	**BMI≥25**	***p***
Absolute error mean±SD (g)	221±164	236±197	*0.791*[a]
Absolute percent error mean±SD	8±6.8	7.5±6.2	*0.781*[a]
Absolute % error > 10% % (n)	4 (30.8)	19 (26.4)	*0.744*[b]
Absolute % error > 15% % (n)	2 (15.4)	8 (11.1)	*0.66*[b]
	EFW	**ABW**	***p***
Mean±SD (g)	3161±482	3150±476	*0.748*[c]

BMI: Body mass index, g: gram, SD: standard deviation, n:number, %:percentage, *p<0.05, a: independent t-test,b: chi-squared test, and c: paired simple t-test

Discussion

In this prospective cohort study, we examined the feasibility of performing EFW in the active phase of labor. The results obtained from studies on estimated fetal weight measurement may vary depending on the period from the time of fetal weight estimation to labor. Ashwal et al. and Blitz et al. performed the estimated fetal weight measurement within a week before birth in their study, while Karahanoğlu et al. shortened this period to 72 hours.[1,5,6] In our study, we included pregnant women whose ultrasound examination was performed with in 24 hours before labor in order to determine fetal weight estimation with the highest accuracy.

Another factor affecting the accuracy of the estimated fetal weight is the formula used for measurement.[7,8] For the estimated fetal weight measurement in our study; Hadlock 4 formula was used. It is our opinion that is the most appropriate for our population. It is obtained from BPD, HC, AC, and FL and therefore we prefer it in our routine practices. In addition, the EFW measurement may differ depending on the clinicians performing the measurement and their experience. In order to minimize this difference, prenatal ultrasound evaluation and estimated fetal weight measurement were performed on all pregnant women hospitalized in the labor room by the same ultrasound device and the same doctor who had received ultrasound training.

We found high correlations between the EFW method and the actual birth weight, and also, findings favoring ultrasound were found in the accuracy of fetal weight estimation in all absolute error calculations. There are limited studies of EFW with ultrasound during the active phase of labor. Consistent with the present study, Weiner et al. showed that ultrasonographic EFW performance at birth correlated with actual birth weight.[9] Barros et al. and Blann and Prien also compared ultrasound with EFW and clinical methods in pregnant women in the active period of labor and found that both methods were well correlated with actual birth weight.[10,11]

In our study, 10% error margin for EFW in which labor occurred in the oligohydramnios group was found to be significantly higher when compared to the group with normal amniotic fluid. When both groups were compared in terms of absolute error and absolute percent error, no significant difference was found. Similarly, Karahanoğlu et al. and Blitz et al. found no significant difference in absolute error rates in the oligohydramnios group in their studies.[6,5] Similar to the results of our study, no significant correlation was found between amniotic fluid volume and estimated birth weight measurement in all of these studies.

Strengths and Limitations

The strengths of our study are that it was performed by the same specialist and with the same ultrasound device, as well as presenting the prospective data obtained from a pragmatic evaluation of pregnant women who came to our department for labor. We included in the analysis all women who had consecutive births in our department, thus avoiding a selection bias. A limitation of our study is the limited number of patients and the fact that it was conducted from a single center.

Conclusions

In our study, it was found that there was no significant effect on the error difference between the fetal weight calculated in the active phase of labor and the weights of the babies born, and there was also a strong positive correlation between the fetal weight calculated in the active phase of labor and the weight of the babies born was found. Ultrasound may be recommended as a safe method in the active phase of labor.

Conflict of Interest

There is no conflict of interest.

Compliance with Ethical Statement

Approval was obtained from the Istanbul Sadi Konuk Training and Research Hospital Clinical Research Ethics Committee (2020/134). Informed consent was obtained from the patients.

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