

Investigating the Relationship Between Ultrasound Criteria in Determining the Age of Postdate Pregnancy

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Abstract- Postdate pregnancy is a pregnancy that lasts more than forty weeks. This can be dangerous for the mother, fetus, and newborn. By knowing the most appropriate ultrasound criteria in predicting the probability of postdate pregnancy, its complications can be reduced by taking timely measures. Therefore, the present study was conducted with the aim of determining the relationship between ultrasound criteria in determining the age of postdate fetuses. This cross-sectional study (descriptive-analytical type) was done in Kermanshah Imam Reza Hospital on 33 pregnant women that, according to LMP and first-trimester ultrasound, pregnancy age was more than 40 weeks. Gestational age was calculated by various ultrasound criteria, including head circumference measurement (HC), Abdominal Circumference (AC), Biparietal Diameter (BPD), femur length (FL), and Transcerebellar Diameter (TCD). The findings were compared with calculated age by LMP. Data were analyzed by SPSS16 software. Correlation rate of pregnancy age based on LMP with FL ($R=0.576$, $P<0.001$), AC ($R=0.208$, $P=0.245$), BPD ($R=-0.200$, $P=0.264$), HC ($R=-0.211$, $P=0.238$) and TCD were ($R=0.111$, $P=0.538$). The pregnancy age correlation rate based on LMP with ultrasound criteria in general was ($R=0.140$, $P=0.436$). There was a direct relationship between gestational age based on LMP with FL, AC, TCD and inversely related to BPD and HC. Among the sonographic criteria, only the FL criterion was significantly correlated with LMP. In general, the correlation between gestational age based on LMP and ultrasound was not statistically significant.

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Introduction

Achieving a healthy and mature baby is one of the most important goals of prenatal care. To achieve this goal, determining the gestational age is important (1). Accurate assessment of gestational age can affect all decisions made during pregnancy (2-4). Postdate pregnancy is a pregnancy that continues after the fortieth week of pregnancy. Its prevalence is about 7% of all pregnancies (5). The main cause of postdate pregnancy is unknown, but factors such as first pregnancy in the study population, previous postdate pregnancy, male fetus, obesity, hormonal factors, and genetic predisposition are

known to be involved in its development. But a clear relationship between race and gestational age is not known (6-15). In some studies, misreading of gestational age has been mentioned as the most common cause (16,17). Postdate pregnancy with anxiety due to untimely birth of baby, the presence of a large or macrosomic baby (3.3% vs. 2.6% in term pregnancy), difficult labor (9-12% vs. 2-7% in term) and traumatic pregnancy, amniotic fluid depletion and acute umbilical cord compression, meconium excretion and aspiration, placental insufficiency with fetal growth restriction, hypoxia, limb injury, acidosis and death, severe perineal rupture and doubling of cesarean section (14% vs. 7%) (18-23)

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Ultrasound criteria and age of postdate pregnancy

increases the risk of mortality in fetuses, infants (24,25) and mothers (26). Therefore, an accurate diagnosis of gestational age is very important for Postdate pregnancy management (27). Nowadays, ultrasound is accepted as the best method for calculating gestational age (3,28). Ultrasound significantly reduced the risk of preterm delivery and reduced postdate pregnancies by 50 to 70% (28). To calculate gestational age in the first trimester of pregnancy, ultrasound criteria such as gestational mean sac diameter (MSD) and crown-rump length (CRL) are used. The fetus' head, body, and organs such as head circumference (HC), abdominal circumference (AC), biparietal diameter (BPD), and femur length (FL) are also common indicators of gestational age in the second and third trimesters of pregnancy (29). The error rate in determining gestational age by ultrasound criteria was reported ± 7 days until 20 weeks of gestation, ± 14 days between 20 to 30 weeks of gestation, and ± 21 days after 30th weeks of gestation (30). The most accurate method for assessing gestational age is in the first trimester of pregnancy is by CRL measurement with a 95% prognosis and an interval of 2.7 days (31,32). As the pregnancy progresses, the absolute error of the ultrasound becomes larger (22,33). Some studies have recommended age measurements based on HC, BPD, AC, FL, or a combination of these (34). Other studies suggest that multiple parameters do not work more accurately than single parameter measurements (35). Other studies to determine the age of the fetus in women who do not know the exact date of their LMP or have been late for measuring the sonographic gestational age. Recommend measuring the diameter of the colon and the length of the soles of the feet in the second or third trimester (36,37). In addition, in other studies, TCD has been mentioned as an accurate method in determining gestational age along with other ultrasound parameters (38). The results of a study showed that assessing fetal age with first-trimester ultrasound reduces the incidence of postdate pregnancy from 13% to 5% compared to second-trimester ultrasound (39). Another study showed that postdate pregnancy was less common in women whose gestational age was determined by ultrasound before 12 weeks than in gestational age between 12 and 24 weeks (40). Due to the complications and risks of postdate pregnancies on the fetus, infant, and mother on the one hand and the difficulty of determining the accurate gestational age in postdate pregnancies because of decreasing amniotic fluid volume in the third trimester and fetal enlargement on the other hand, and the variability of the results of ultrasounds performed (according to the coefficient of pregnancy error in each trimester) in some cases with lack

of reliable LMP, we considered it necessary to conduct a study in this area. Because choosing a reliable ultrasound method that can determine the gestational age with less error can be effective in making the right decision to terminate the pregnancy and prevent the complications of pregnancy. Therefore, due to the lack of similar studies and also due to the relatively high prevalence of these types of pregnancies (on average 7%), we decided to investigate the relationship between ultrasound criteria in determining the age of postdated fetuses.

Materials and Methods

The present study is a descriptive-analytical cross-sectional study that was started after approval by the Vice-Chancellor for Research and Ethics Committee of Kermanshah University of Medical Sciences. The study population included pregnant women who had been referred to Kermanshah Imam Reza Hospital during 1397 and 1398, and according to LMP and first-trimester ultrasound, their pregnancy was more than 40 weeks of pregnancy. Inclusion criteria included accurate knowledge of LMP and fetal age assessment with ultrasound in the first trimester, and exclusion criteria included mothers with diabetes or hypertension, a history of various medications, or a diagnosis of IUGR or LGA on previous fetal ultrasounds. Based on the results of previous studies, which expressed the correlation between the criteria as 98% (with 95% confidence and 90% power), the minimum sample size of 11 cases was calculated (41). Eligible pregnant mothers entered the study by completing the informed consent form. Gestational age was determined with sonographic criteria such as BPD, FL, TCD, AC, and HC by Madison Ultrasound device (AccuvixA30 with 5 MHz Convex probe). Gestational age based on LMP and their first-trimester ultrasound results inter into a questionnaire designed based on the objectives of the study. Finally, to evaluate and compare gestational age based on LMP with ultrasound criteria, SPSS16 software was used. Quantitative data analysis was performed using paired t-test, Wilcoxon test, and Pearson and Spearman correlation coefficient. A significance level of 0.05 was considered for all tests.

Results

The present study was performed on 33 pregnant women 22 to 39-year-old (28.82 ± 4.95) who, according to LMP and first-trimester ultrasound, had been pregnant for more than 40 weeks. Of the 33 fetuses studied, 16

(48.5%) were female, and 17 (51.5%) were male. 18 (54.5%) pregnant mothers experienced the first pregnancy, 12 (36.4%) had the second pregnancy, and 3 (9.1%) had more than the second pregnancy. The minimum, maximum, and mean gestational age of the studied mothers based on LMP and various ultrasound criteria are shown in Table 1.

By using the correlation coefficient, the correlation of gestational age was measured based on LMP with BPD, FL, AC, HC, and TCD criteria (Table 2).

According to the results of the Pearson correlation coefficient test, there was a direct relationship between gestational age based on LMP with FL and AC sonographic criteria and an inverse relationship between BPD and HC. Among sonographic criteria, only the FL criterion had a significant correlation with LMP ($P < 0.001$). Based on the results of the Spearman correlation coefficient test, there was a direct relationship between gestational age based on LMP criterion and TCD sonographic criterion. However, this relationship was not statistically significant ($P > 0.05$). Based on the results of

the Pearson correlation test, the correlation between gestational age based on LMP and ultrasound was not statistically significant ($P > 0.05$). The difference between the mean gestational age was assessed based on sonographic criteria with LMP. The lowest difference in gestational age was determined based on LMP with FL sonographic criterion, and the highest difference was observed with AC (Table 3).

Based on the results of paired t-test, the difference between the mean gestational age based on LMP sonographic criteria and BPD, FL, AC, and HC sonographic criteria was statistically significant ($P < 0.001$). Of the 33 pregnancies studied, 24 had a gestational age based on LMP, 3 had a lower gestational age based on TCD, and 6 had a gestational age based on two criteria (Table 4).

According to the results of the Wilcoxon test, the difference between gestational age based on LMP and gestational age based on TCD was statistically significant ($P < 0.001$).

Table 1. Gestational age based on LMP and various ultrasound criteria

Gestational age (week)	Min	Max	Mean±SD
LMP	39.71	42.14	40.48±0.61
BPD	36.00	40.57	38.72±1.23
FL	37.50	42.00	39.48±1.16
AC	35.50	41.43	38.01±1.45
HC	36.00	41.00	38.99±1.23
TCD	38.28	41.00	39.69±0.69
Sonography	37.30	40.31	38.69±0.72

Table 2. Correlation of gestational age based on measurement by LMP and sonographic criteria

		BPD	FL	AC	TCD	HC	Sonography
LMP	Correlation	-0.200	0.576	0.208	0.111	-0.211	0.140
	P	0.264	<0.001	0.245	0.538	0.238	0.436

Table 3. Difference gestational age measurement by sonographic criteria with LMP

Sonographic criteria	Mean±SD LMP	P
BPD	1.75±1.47	<0.001
FL	1.00±0.95	<0.001
AC	2.46±1.46	<0.001
HC	1.49±1.48	<0.001

Table 4. Gestational age by LMP compare with TCD

	Frequency	Mean Rank	P
TCD<LMP	24	14.71	
TCD>LMP	3	8.33	
TCD=LMP	6	-	<0.001
Total		33	

Discussion

The use of an appropriate ultrasound criterion with the least error in determining gestational age is crucial in deciding to terminate a pregnancy in postdate pregnancies. Based on the results, the mean gestational age was from the most to the least in terms of TCD FL, HC, and BPD criteria, respectively. However, determining the gestational age in terms of TCD did not have a normal distribution, so it can not be judged from the mean. Also, based on the most important results, there was a direct relationship between gestational age based on LMP criteria with FL, AC, and TCD sonographic criteria and an inverse relationship with BPD and HC sonographic criteria. Among sonographic criteria, only FL had a significant correlation with LMP. In general, the correlation between gestational age based on LMP and ultrasound was not statistically significant. The mean gestational age based on LMP criteria was significantly different from gestational age based on FL, HC, BPD, and AC, respectively. In addition, in most studies, the gestational age based on LMP was significantly higher than the gestational age based on TCD. The results of a retrospective cohort study by Caughey *et al.*, (1992-2001) in examining the effect of first-trimester ultrasound (24 weeks or less compared to 12 weeks or less) in diagnosing and measuring complications of post-term pregnancy showed that early ultrasound leads to more accurate determination of gestational age and reduces post-term pregnancy estimates. This, in turn, may reduce unnecessary interventions and lead to better detection of post-term pregnancies and reduced complications (40). By comparing ultrasound determination of gestational age in the first trimester with the second trimester, Bennett *et al.*, (1999-2002) found that first-trimester ultrasound screening in Canadian pregnant women reduces the risk of pregnancy complications and significantly reduces post-term pregnancy (39). Based on the results of their cross-sectional and descriptive-analytical study, Behdani *et al.*, (2005) recommended performing ultrasound in the first trimester to reduce preterm pregnancies (42). The results of studies by Sahebghalam *et al.*, (2006-2007) showed that in the second trimester of pregnancy, the length of the fetal foot is slightly more accurate than the length of the femur and the TCD but the difference was very small. In the third trimester of pregnancy, the measurement of fetal plantar length and femur length was slightly more accurate than the measurement of fetal TCD, but in general, there was no significant difference. Therefore, they stated that

measuring the sole length of the fetus in estimating the gestational age in the second and third trimesters has a diagnostic accuracy approximately equal to measuring the TCD and the length of the femur (36). Sahebghalam *et al.*, in a cross-section study, showed that there is a good linear relationship between fetal colon diameter and gestational age, and it can be used as an independent biometer to determine gestational age. Therefore, due to the strong correlation between colonic diameter and gestational age and easy access to this index and its measurement in the second half of pregnancy can be used as a new criterion in determining gestational age (37). In a large prospective multicenter study in eight different cities by examining the sonographic indices of HC, BPD, OFD (occipitofrontal diameter), AC, and FL from week 14 until delivery, Papageorghiou *et al.*, (2009-2014) concluded that in women who delayed fetal age the combination of HC and FL ultrasound criteria in the second trimester could be useful in accurately diagnosing gestational age (41). According to the most important results of the present study, there was a direct relationship between gestational age based on LMP with FL, AC, and TCD and an inverse relationship with BPD and HC. That means, with increasing gestational age, LMP has more correlation with FL, AC, and TCD and less with BPD and HC. Therefore, the higher the fetal age is measured at older ages, the less reliable the BPD and HC sonographic criteria are. The highest correlation was seen between LMP and FL, and among the sonographic criteria, only the FL criterion was significantly correlated with LMP. But in general, the correlation between gestational age based on LMP and ultrasound criteria was not statistically significant. Finally, it is suggested to use FL sonographic criterion to determine the gestational age of women suspected of post-term pregnancy.

According to the results of the present study, there was a direct relationship between gestational age based on LMP with FL, AC, and TCD and an inverse relationship between BPD and HC. That means, with increasing fetal age, LMP is more associated with FL, AC, and TCD and less with BPD and HC. The highest correlation was seen between LMP and FL, and among the sonographic criteria, only the FL criterion was significantly correlated with LMP. But in general, the correlation between gestational age based on LMP and ultrasound criteria was not statistically significant.

The limitations of this study were the lack of similar studies as well as a small sample size.

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Ultrasound criteria and age of postdate pregnancy

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