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The Association Between Ultrasonic Estimated Fetal Weight and Neonatal Weight

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ABSTRACT

Predicting neonatal birth weight based on fetal parameters assessed by the ultrasonography has been suggested and thus an association between fetal weight and neonatal weight has been hypothesized. The present study aimed to determine the value of ultrasound fetal weight estimation for predicting birth weight. We also discovered an equation between fetal weight estimated by ultrasonography and birth weight. This cohort study was performed on 125 singleton pregnant women with the gestation of 39 weeks and healthy fetus that referred to our hospital due to receive prenatal cares. The Fetal biparietal diameter measurements were obtained simultaneously by gray scale and bistable ultrasonography and then the fetal weight was estimated using the hadlock formula. After birth, all neonates were weighted using a single calibrated balance. There was a strong association between ultrasonic fetal weight before delivery and neonatal birth weight (r coefficient 0.875, p < 0.001). Based on the area under the ROC curve (AUC) analysis, estimating ultrasonic fetal weight had high value for predicting LBW (AUC = 0.936, 95%CI: 0.865 – 1.008, P < 0.001). In this regard, the best cutoff point of ultrasonic fetal weight to discriminate LBW from normal weight was 2725 gr yielding a sensitivity of 92.9% and a specificity of 83.3%. Assessing the linear association between ultrasonic fetal weight and birth weight led to obtain the following equation to estimate neonatal birth weight: BW = 0.97 × UFW + 144.82. Due to strong association between ultrasonic estimated fetal weight and birth weight and thus by ultrasonic determination of fetal weight, early prediction of neonatal-related weight abnormalities such as LBW can be possible.

Key words: Birth Weight; Ultrasonography; Fetal Weight

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INTRODUCTION

The main goal of antenatal care is to prevent postnatal adverse consequences such as neonatal death or developmental defects. Birth weight is an important related to adverse outcome of pregnancy [1,2]. It has been well accepted that neonatal mortality and morbidity is notably higher in those with abnormal birth weight [3]. Low birth weight is associated with the increasing risk for neonatal complications. Thus, in fetuses with growth restriction or macrosomia, accurate estimation of fetal weight is essential [4]. Unfortunately, growth standard graphs have little value in evaluating fetal deviations in the neonatal birth weight [5]. Nowadays, clinical examination has a special position in management of any growth restriction or delay, however the developmental parameters of the neonate can be clinical obtained inaccurately [6]. In other words, relying solely on

clinical assessment cannot be very useful for evaluation and prediction of neonatal death or complications. Recently, based on the close link between fetal sizes and post-delivery outcome, prenatal estimation by ultrasonography has been suggested to be valuable for prediction of neonatal birth weight [7,8]. In fact, ultrasonography performing at third trimester can be applicable for predicting low birth weight [9,10]. The present study aimed to determine the value of ultrasound fetal weight estimation for predicting birth weight. We also discovered an equation between fetal weight estimated by ultrasonography and birth weight.

MATERIALS ANS METHODS

This cohort study was performed on 125 singleton pregnant women with the gestation of 39 weeks and healthy fetus that referred to our hospital due to receive prenatal cares. The exclusion criteria were patient dissatisfaction for inclusion, no re-weighing up to 72 hours after delivery, or unhealthy embryo with any abnormality. All included women assessed initially by ultrasonography (Philips affinity 50G, diagnostic ultrasound system: GMDN 40761, USA, 22100 Bothell Everett highway, WA98021-8431, probe convex 2-5 MHZ) during the 72 hours before the estimated date of delivery. The Fetal biparietal diameter measurements were obtained simultaneously by gray scale and bistable ultrasonography and then the fetal weight was estimated using the hadlock formula. To avoid potential bias, all measurements were performed by a single person and a single machine. After birth, all neonates were weighted using a single calibrated balance (serial number: 5382130104893821317009). The study endpoint was to assess the agreement between fetal weight estimated by sonography and birth weight measured by the balance.

For statistical analysis, results were presented as mean ± standard deviation (SD) for quantitative variables and were summarized by frequency (percentage) for categorical variables. The association between the quantitative variables was assessed using the Pearson's or Spearman's correlation test. The ROC curve analysis was also used to determine the value of ultrasonic fetal weight measurement to predict LBW in neonates. P values of ≤ 0.05 were considered statistically significant. For the statistical analysis, the statistical software SPSS version 23.0 for windows (IBM, Armonk, New York) was used.

RESULTS

The average age of participants was 27.67 ± 6.94 years ranged 16 to 44 years. The mean BMI was also 30.17 ± 2.43 kg/m^2 ranged 24 to 36 kg/m^2. Of those, 20% had history of diabetes or gestational diabetes. The mean ultrasonic fetal weight was 3383.38 ± 614.43gr and the mean neonatal birth weight was also 3442.34 ± 684.05 gr. Based on the birth weight, the prevalence of LBW was 9.6%. There was a strong association between ultrasonic fetal weight before delivery and neonatal birth weight (r coefficient 0.875, $p < 0.001$) (Figure 1). This strong association was revealed in both diabetes women (r coefficient 0.847, $p < 0.001$) and non-diabetes women (r coefficient 0.884, $p < 0.001$). Also, the relation between ultrasonic fetal weight and birth weight was revealed in women ≤30 years (r coefficient 0.847, $p < 0.001$) and in older ones (r coefficient 0.859, $p < 0.001$). Also, considering two groups of women with BMI≤30 kg/m^2 and higher, the association between the two measured weights was strongly significant (r coefficients 0.854 and 0.765, $p < 0.001$ for both). Based on the area under the ROC curve (AUC) analysis (Figure 2), estimating ultrasonic fetal weight had high value for predicting LBW (AUC = 0.936, 95%CI: 0.865 – 1.008, $P < 0.001$). In this regard, the best cutoff point of ultrasonic fetal weight to discriminate LBW from normal weight was 2725 gr yielding a sensitivity of 92.9% and a specificity of 83.3%. The AUC in women ≤30 years and older ones was estimated to be 0.909 and 1.000 indicating higher value of ultrasonic fetal weight to discriminate LBW in women older than 30 years. The AUC in women with BMI≤30 kg/m^2 and BMI>30 kg/m^2 was also 0.948 and 0.958 respectively with no difference. In final, assessing the linear association between ultrasonic fetal weight and birth weight led to obtain the following equation to estimate neonatal birth weight: $BW = 0.97 \times UFW + 144.82$.

DISCUSSION

Early prediction of abnormal weight gain in each neonate particularly before delivery can effectively predict more post-delivery adverse events and physical and mental retardation. By development of imaging techniques especially safe and noninvasive procedures such as ultrasonography, accurate determination of the different dimensions

of fetuses can be possible. Recently, predicting neonatal birth weight based on fetal parameters assessed by the ultrasonography has been suggested. In fact, it is now hypothesized an association between fetal weight and neonatal weight. In the present study, we first show a strong association between ultrasonic estimated fetal weight and birth weight and thus by ultrasonic determination of fetal weight, early prediction of neonatal-related weight abnormalities such as LBW or macrosomy can be successfully done. In this regard, we could firstly introduce an equation between ultrasonic estimated fetal weight and birth weight. More importantly, we showed that the pointed association was completely independent to baseline factors such as age, BMI, or presence of diabetes. In total, by determining ultrasonic estimated fetal weight, predicting LBW in neonate can be effectively possible with high sensitivity and specificity.

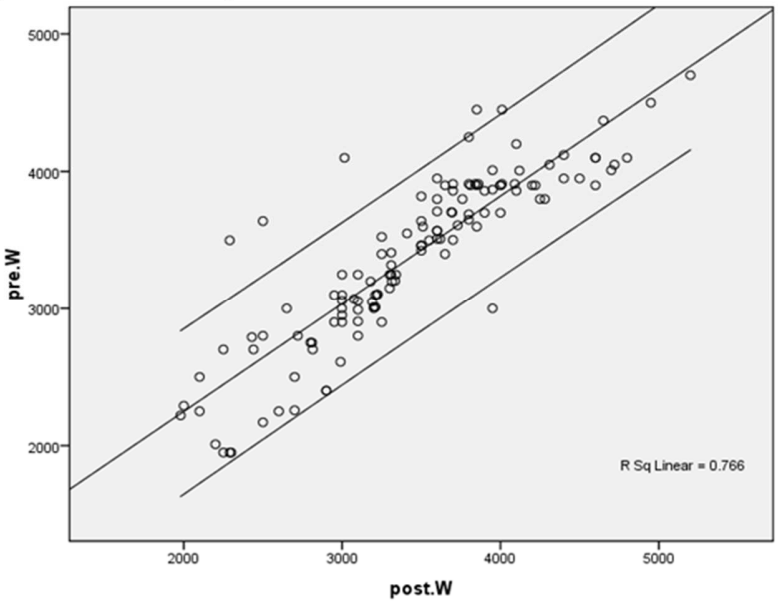

Figure 1. The association between ultrasonic estimated fetal weight and birth weight

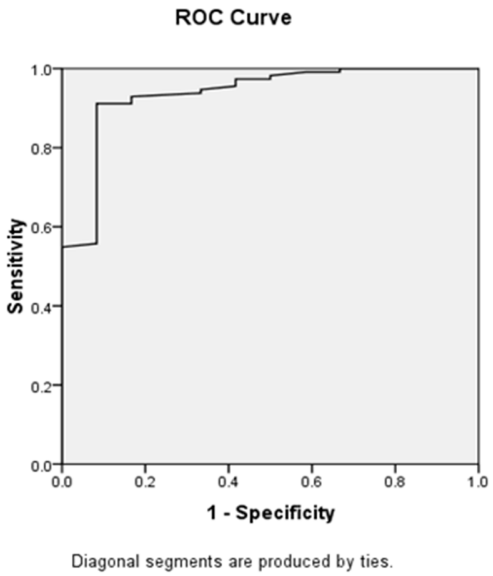

Figure 2. Based on the area under the ROC curve (AUC) analysis, estimating ultrasonic fetal weight had high value for predicting LBW (AUC = 0.936)

The present study was the first that could obtain a linear equation between ultrasonic estimated fetal weight and neonatal birth weight. In a study by Khani et al in 2006 [11], there was no significant difference between estimated fetal weight by ultrasound and actual birth weight and thus the accuracy of weight estimation using the clinical examination and ultrasound was found to be low in SGA and LGA groups. In another study by Secher et al [12], the agreement between fetal weight and birth weight was shown to be 97%. In another study by David et al [13], at a specificity of 90%, 46% of infants with a birth weight <10th percentile and five of six cases with adverse perinatal outcomes were predicted. Dudley et al [14] also showed that fetal weight estimation is more sensitive and specific than other measures in detecting small-for-gestational-age. In total, it can be concluded that due to strong association between ultrasonic estimated fetal weight and birth weight and thus by ultrasonic determination of fetal weight, early prediction of neonatal-related weight abnormalities such as LBW can be possible.

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