Factors Affecting the Accuracy of Ultrasound Fetal Weight Assessment among Diabetic Patients

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Background: Antenatal ultrasound (US) Estimated Fetal Weight (EFW) is an important component of antenatal care.

Objective: To evaluate the accuracy and consequences of US EFW within one-week interval prior to delivery in diabetic Bahraini population.

Design: A Retrospective Cohort Study.

Setting: Bahrain Defence Force Hospital, Bahrain.

Method: Two hundred eighty-four diabetic women deliveries were reviewed. EFW, actual birth weight, gestational diabetes and mode of delivery were documented and analyzed via stats Direct. P-value of less than 0.05 was considered significant.

Result: The study population was divided into two groups. Twenty-eight (10%) yield an accurate EFW. Accurate fetal weight estimation was affected by GA, EFW and actual birthweight. Fetal gender, parity, diabetic status, maternal BMI, maternal age, mode of delivery and induction of labor was not altered by the inaccurate estimation.

Conclusion: Ultrasound EFW in diabetic patient is more accurate at early gestation and for smaller fetuses.

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Antenatal care reduces both maternal and fetal morbidity and mortality. Antenatal care is essential for the wellbeing of the mother and the unborn child. US EFW is an integral part of antenatal follow-up and plays a crucial role in obstetric practice and management[1]. Fetal weight is one of the determining factors of pregnancy outcomes as well as infant mortality during the first year of life. Moreover, it allows clinicians to prepare for anticipated preterm labor as well as planning the best mode of delivery. In addition, there are many documented maternal risks associated with the delivery of a baby who is large for a date, such as birth canal and pelvic floor injuries, postpartum hemorrhage, higher incidence of cephalopelvic disproportion (CPD), shoulder dystocia and instrumental deliveries[2]. Accordingly, an accurate and precise EFW is required for optimal practice.

The infant mortality rate is associated with both low and excessive fetal birth weight rather than gestational age[3]. In addition, late-onset fetal growth restriction is often missed and is responsible for most intrauterine fetal death[4]. However, the accuracy of US EFW has been debated due to the subjective elements of these measurements with great inter-observer variations documented in the literatures[5]. The accuracy of ultrasound in predicting fetal weight in-utero is more precise in the early weeks of gestation. US resolution decreases near term due to the reduction in the fetal level of fluid to body composition ratio, bony structures calcification and the vertex in the pelvis, making a measurement of head circumference and biparietal diameter (BPD) more difficult[4].

It is well known that diabetes is associated with Polyhydramnios and macrosomia; however, no significant differences of birthweight between infants of women with or without diabetes were found[6]. Inaccurate US EFW may result in unnecessary or even earlier interventions, fetal growth deviations, patient morbidities and medico-legal issues. For that reason, researchers have devoted more effort to investigate the best method to estimate fetal weight properly. Despite efforts to improve the accuracy of US EFW by reducing inter-observer variability, ultrasound has an error of up to 15%[7]. In spite of a long and well-known history of this variability in predicting fetal weight, only a few studies have been published.

The aim of this study was to evaluate the accuracy and consequences of US EFW performed within one-week interval prior to delivery for a diabetic population.

METHOD

All patients with singleton pregnancy who underwent an ultrasound examination within one week of delivery between January 2016 and December 2016 were included in the study. These patients were admitted for either vaginal delivery or cesarean section or induction of labor. Personal characteristics,

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such as maternal age, BMI, gestational age, parity, pre-diabetic status, mode of delivery, US EFW and actual birth weight were documented.

The participants had their gestational age confirmed by early scan performed before the 22nd week.

The first scan was performed at booking, the next scan was at 22 weeks to detect anomalies, and during the second and third trimester as required. More frequent scans were performed for diabetic patients (every two weeks) and intrauterine growth restriction (IUGR) features (weekly).

The fetus had measurements of head circumference (HC), abdominal circumference (AC), biparietal diameter (BPD) and femur length (FL). EFW were expressed in grams.

The inclusion criteria were live singleton pregnancy with a gestational age more than 34 weeks with a scan done within one week of delivery among patients with gestational diabetes or pre-existing diabetes, regardless of the amniotic fluid index.

Exclusion criteria were patients who had US EFW within 8 or more days prior to delivery and multiple pregnancies.

Data were analyzed using a StatsDirect statistical package (version: 3.0.141). Two-sided unpaired T-test was used to assess the difference in maternal age, BMI, gestational age at which scan was done prior to delivery and finally actual birthweight between the two groups. Two-sided Mann-Whitney was used to check the difference in diabetic status (preexisting diabetes and gestational diabetes) between the two groups. Chi-square was used for assessing the percentage of certain fetal gender and mode of delivery between the two groups in crosstabs. Finally, Fisher-Freeman-Halton exact was used for induction of labor and accurate ultrasonic fetal weight estimation. P-values of less than 0.05 were considered statistically significant.

RESULT

Two hundred eighty-four pregnant ladies who delivered single live-born infant and had US within one week were included in the study. Forty-eight (16.9%) patients were primiparous and 237 (83%) patients were multiparous. Twenty-eight 28 (10%) patients had an accurate estimation of fetal weight using ultrasound antenatally. Two hundred fifty-six (90%) patients the EFW was inaccurate, see figure 1.

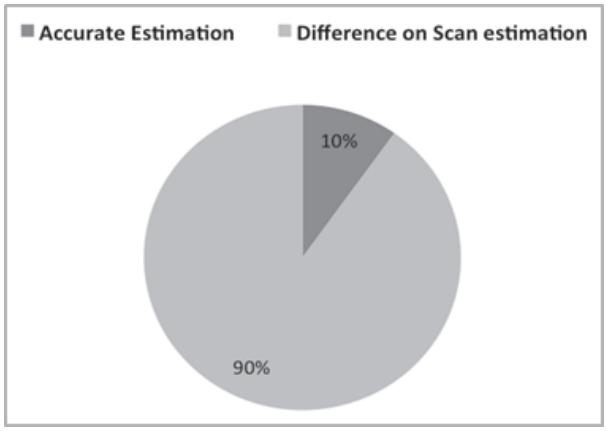

Figure 1: Percentage of Accurate versus Inaccurate US EFW

Table 1: Patient Characteristics

	Accurate estimation N 28	Difference on scan estimation N 256	P-value
Maternal age (years) mean ± SD	32.9 ± 5	32.4 ± 6.7	0.68
BMI (kg/m^2) mean ± SD	30.5 ± 5.9	32.6 ± 6.9	0.13
Parity median (range)	2.7 (8-0)	2.7 (12-0)	0.93
Pre-existing diabetes	5/28 (18%)	28/256 (11%)	0.28
Gestational diabetes	23/28 (82%)	228/256 (89%)	0.28

The mean maternal age for those with accurate estimation of fetal weight was 32.9 years whereas for those with inaccurate fetal weight estimation was 32.4 years which was not statistically different, see table 1.

BMI and parity for both groups were found not to be statistically different; however, it was found that heavier patients had less accurate scan reading. Neither pre-existing diabetes nor gestational diabetes was found to influence accurate antenatal EFW.

Mean EFW was 2.7 kg for those with accurate estimation with a mean actual birth weight of 2.8 kg, whereas, the EFW of the other group was 3.1 kg when the actual birth weight was 3.2 kg. It was noticed also that actual birthweight was accurately assessed in early pregnancy with a mean gestational age of 36.6 (P-value < 0.0001). No difference was found between the two fetal genders, male: female ratio was 1:1, see table 1.
The two groups had similar labor outcomes, see table 3.

Table 2: Fetal Factors

	Accurate estimation N 28	Difference on scan estimation N 256	P-value
Gestational age weeks mean ± SD	36.6 ± 2.7	37.7 ±1.6	P=0.002
Estimated Fetal weight kg mean ± SD	2.7 ± 0.6	3.1 ± 0.5	P=0.003
Delivery weight kg mean ± SD	2.8 ± 0.7	3.2 ± 0.6	P<0.0001
Male fetus	14/28 (50%)	137/256 (54%)	P=0.72
Female fetus	14/28 (50%)	119/256 (46%)	P=0.72

Seventeen out of twenty-eight (61%) patients in the accurate group reading had normal vaginal delivery compared to 166/256 (65%) in the other group (P-value 0.71). Furthermore, induction of labor was similar at 5/28 (18%) and 59/256 (23%), respectively (P-value 0.64). Eleven out of twenty-eight (39%) and 90/256 (35%) patients in each group ended up in lower (uterine) segment cesarean section (LSCS) either elective or emergency, respectively (P-value 0.71).

Table 3: Labor Outcome

	Accurate estimation N 28	Difference on scan estimation N 256	P value
Induction of labor	5/28 (18%)	59/256 (23%)	P=0.64
Normal delivery	17/28 (61%)	166/256 (65%)	P=0.71
Caesarean delivery	11/28 (39%)	90/256 (35%)	P=0.71

DISCUSSION

Accurate EFW has been of a great interest for optimal management of obstetric patients antenatally. Fetal weight could not be measured directly; it must be estimated by taking into account fetal and maternal anatomical characteristics. Failure to correctly estimate fetal weight may result in unnecessary or earlier intervention. Therefore, accurate EFW would lead to a reduction of perinatal morbidity and mortality.

In this study, US was performed within one week of delivery. A study showed that EFW would be accurate if performed within one-week interval prior to delivery[5]. However, Benharoush et al found that ultrasound performed 1-3 days before delivery would be significantly more accurate[8]. A similar finding was documented by Venket et al who reported accurate EFW for a scan performed with a time interval of 4.4 days prior to delivery[9]. Furthermore, a study of 6,406 births revealed accurate US estimation of fetal weight if performed 0 - 4 days prior to delivery; The author emphasized that most accurate assessment interval is the scan at 0 -1 day prior to delivery[10].

In our study, we found no effect of the type of diabetes on the accuracy of US EFW. However, we found that only 9% of gestational diabetes mellitus (GDM) and 5% of DM patients had an accurate assessment of fetal weight. Hasslein et al reported a similar outcome that the accuracy of US EFW at term in women with diet-controlled GDM (White's classification A1) seems to be as reliable as EFW in unaffected pregnancies[11]. Furthermore, a systematic review published in 2005 found no difference in the accuracy between US EFW and AC in the prediction of a macrosomic baby at birth[12]. Rashid found that the accuracy of intrapartum US-EFW was similar among all patients regardless of their diabetic status; however, the group excluded macrosomic babies with weight exceeding 4,500 gm[5]. Benharoush found that higher actual birthweight was associated with significant weight difference; whereas, lower birthweight yielded more accurate EFW[8]. The same findings were seen in our study, as EFW was more accurate among smaller fetuses with mean EFW and ABW of 2.7 and 2.8 kg consecutively, and mean GA of 36.6 weeks.

Benharoush noted that fetal weight had a significant influence on the accuracy of the scan, mean ABW was 2.8 +/- 0.7 kg among patients with accurate EFW[8]. In our study, we found lower EFW in the accurate group. Benharoush found that 74.4% of EFW was within 10% of actual birth weight in small gestational age group[8]. Oligohydramnios has no effect on EFW; therefore, US can be used reliably in patients with altered amniotic fluid volume. A study concluded that the identification of fetal growth retardation and accurate assessment of fetal weight is not influenced by the presence of oligohydramnios[12].

A systematic review found that maternal BMI, fetal sex and multiple pregnancies have no significant influence on the measurement error of fetal weight[13]. We found no influence of maternal BMI, fetal gender and parity on accurate US EFW. Farrel et al supported the concept of accurate fetal weight estimation irrespective of maternal obesity[14]. Ott et al had similar findings and that fetal gender had no influence on US EFW[15]. Contrary to our findings, Benharosh concluded that the accuracy of US EFW was negatively affected by low gestational age, heavier babies, anteriorly located placenta, elderly patients and younger maternal age[8].

Our study indicated that accurate assessment of fetal weight in diabetic patients had no effect on the induction of labor rate and mode of delivery. Little et al concluded that in a population where 3rd trimester ultrasound was not done routinely; there was no alteration in the mode of delivery for those who had or did not have a scan[16]. Another study found that US-EFW within one month of delivery was independent of cesarean delivery rate and was similar for both who had a scan after 36 weeks and those who did it earlier[17].

This study is retrospective in nature, which will limit full interpretation of its findings. The scan was performed by different levels of experience among residents and trainee. One of the limitations of our analysis is the window of accurate scan assessment utilized during data analysis. We used the exact EFW compared to the real birthweight without allowing any percentage difference in EFW. This obviously affected our accuracy rate, which was considerably low and will affect the use of our data in future searches.

CONCLUSION

Sonographic estimated fetal weight in diabetic mothers is more accurate among Early gestational age and low EFW.

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