ORIGINAL STUDY

Amniotic Fluid Level Effect on the Accuracy of Sonographic Estimated Fetal Weight at Term

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Abstract

Objective: **To study amniotic fluid index (AFI) effect on estimated fetal weight (EFW) measurement accuracy at term.**
Background: **Amniotic fluid assessment by ultrasound at full term is an essential factor of the fetal biophysical profile and confirms fetal well-being.**
Method: **We conducted a prospective cohort study on 129 medically free pregnant women divided into three groups according to AFI with ratio 1: 1: 1 oligohydramnios group (43 cases AFI <5 cm), polyhydramnios group (43 cases AFI>24 cm) and cases had normal volume of amniotic fluid (43 cases AFI between 5 cm and 24 cm).**
Results: **We found highly significant differences among studied groups regarding EFW, Birth weight (BW) and AFI (P value < 0.001), also significant positive good correlation was observed among AFI and EFW (r = 0.733, P value < 0.001) and there is a significant positive good correlation among AFI and BW (r = 0.640, P value < 0.001), and there is significant correlation among EFW and BW (P value < 0.001) in addition to significant difference among the studied groups regarding absolute error, absolute percentage error and substantial error (P value < 0.001).**
Conclusion: **Amniotic fluid level does not affect sonographic EFW accuracy at full term. However, there is a positive relation between AFI and EFW, and BW also there is an overestimation tendency of EFW in all groups.**

Keywords: Amniotic fluid index, Birth weight, Estimated fetal weight

1. Introduction

Despite major progress in obstetrics the amniotic fluid level effect on estimated fetal weight (EFW) remains disputed.

Amniotic fluid assessment ultrasonographical at full term is a basic factor of the fetal biophysical profile additionally it is essential in establishing fetal well-being [1].

There are many methods by ultrasound to estimate amniotic fluid volume which are: amniotic fluid index (AFI), two diameter pocket measurement, largest vertical pocket measurement and largest transverse pocket.

AFI is estimated by the largest vertical pocket of amniotic fluid measurement in the four areas with taking care of that the measurement in each pocket should be clear of umbilical cord and fetal small parts. AFI is the total of these four quadrants [2].

The sample of the study was categorized into three groups regarding AFI: Normal AFI (from 51 to 249 mm), Oligohydramnios (<50 mm), and polyhydramnios (>250 mm) [3].

Ultrasound fetal weight estimation, mainly at full term is an important tool in obstetric care. Mostly when handling growth restricted or macrosomic infants. With this knowledge, choices about labor may be made, therefore reducing perinatal morbidity and death [4]. By measuring the biparietal diameter, abdomen circumference, and femur length, fetal biometry was computed. EFW is a fundamental metric in pregnancy management regimens [5]. EFW was calculated by the Hadlock IV

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formulas which had a greater accuracy in measurement of EFW as proved by previous studies [6].

In this study we aimed to study the amniotic fluid index (AFI) effect on estimated fetal weight (EFW) measurement accuracy at term.

2. Patients and methods

We conducted this prospective cohort research on 129 medically free pregnant women divided into three groups according to AFI with ratio 1 : 1: 1, oligohydramnios group (43 cases AFI <5 cm), polyhydramnios group (43 cases AFI>24 cm) and cases had a normal volume of amniotic fluid (43 cases AFI between 5 cm and 24 cm).

Inclusion criteria: Pregnant females with a gestation age range from 38 to 40 weeks with a singleton healthy fetus, Body mass index less than 30, and Medical free pregnant women.

Exclusion criteria: twin pregnancy, fetal congenital anomalies, body mass index greater than or equal to 30, and any medical disorder such as diabetes mellitus, hypertension, and endocrine diseases.

All cases of the study were exposed to patient counselling.

The sonographic examination was done by the machine IBE2500D with the curvilinear probe of (3.5 : 5.5 MHZ) frequency, by the same individual, all fetal biometry and AFI measures were taken. EFW was estimated with the Hadlock IV formula: $\log10EFW = 1.3596 + 0.0064$ (head circumference)+ 0.0424 (AC)+0.174 (FL)+0.00061 (AC) −0.00386 (AC) (FL).

AFI was utilized to assess the amniotic fluid level. AFI was calculated using the four-quadrant measurements of the vertical pocket.

Using measurements of biparietal diameter, belly circumference, and femur length, fetal biometry was computed. Biparietal diameter was derived from a cranial cross-section utilizing the cavum of the septum pellucidum and the thalami as anatomical markers and measuring from the outer leading edge to the inner leading edge. We estimated the abdominal circumference by taking a cross-section of the abdomen at the fetal liver level, utilizing the umbilical part of the portal vein as a reference point, and placement of an ellipse at the outside margin of the abdominal soft tissues. Finally, we measured femur length from the large trochanter to the distal metaphysis (Fig. 1).

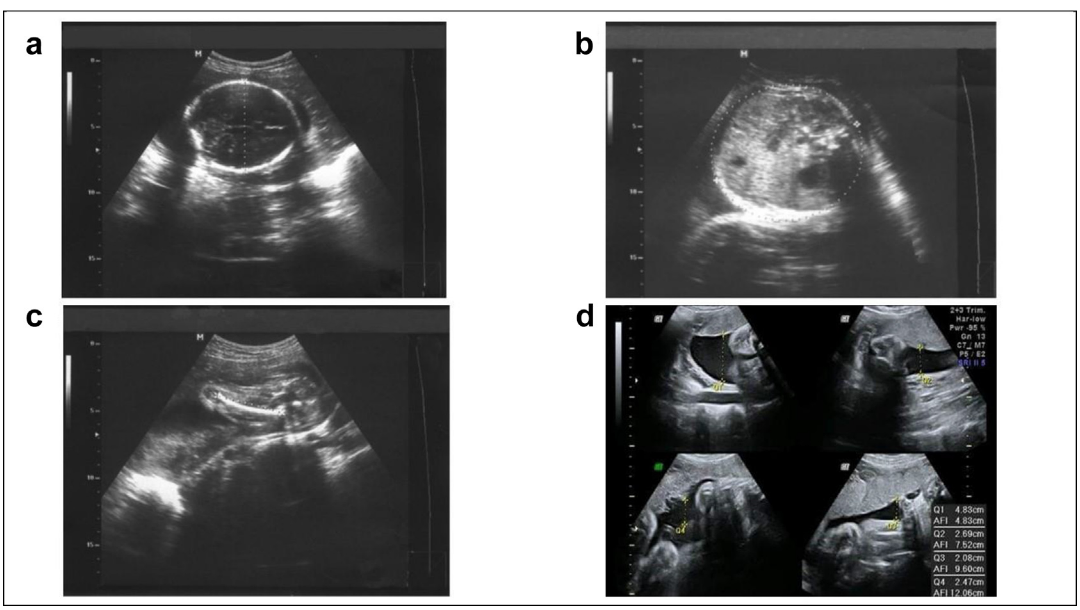

Fig. 1. (a) Ultrasound scan shows how biparietal diameter is measured. (b): Ultrasound scan shows how to measure fetal trunk cross sectional included area, using the four chamber view of the heart. (c): Ultrasound scan shows how to measure femur length, with the 'hook' from the greater trochanter to the distal metaphysis. (d): Ultrasound scan shows the standard 4-quadrant measurement of the vertical pocket will be used to calculate amniotic fluid index.

Our research was accepted by the local Ethics committee, faculty of medicine, Menoufia University (under code No: 4/2018 OBSG 6). Written consent is taken from every case before participation after a full research explanation.

2.1. Statistical analysis

Data was collected and analyzed by (SPSS version 23, Armonk, NY: IBM Corp.). Qualitative data were expressed in number and percentages, while quantitative data were expressed as mean and standard deviation (SD) in addition to Analytic statistics e.g., ANOVA test, Kruskal Wallis test, χ^2 test and Pearson correlation. We quoted significant results as two-tailed probabilities. We judged the significance of the accomplished results at *P* less than 0.05.

3. Results

The variance among the studied groups regarding age and occupation was nonsignificant (Table 1). The variance among our studied groups as regard BMI, gravidity, parity, cesarean section, and normal vaginal delivery (NVD) was also nonsignificant and the variance among the studied groups regarding gestational weeks was nonsignificant but there is a significant difference as regard EFW, Birth weight (BW) and AFI (*P* value < 0.001) (Table 2). There was a significant positive good correlation between AFI and EFW (r = 0.733, *P* value < 0.001 (Fig. 2). There was a significant positive good correlation between AFI and BW (r = 0.640, *P* value < 0.001) (Table 3). There was a significant correlation among EFW and BW (*P* value < 0.001) (Table 4) (Fig. 2).

Comparison between studied groups regarding an absolute error, absolute percentage error, substantial error as an absolute error (AE) = EFW-BW, Absolute percentage error (APE) = $\frac{EFW-BW}{BW} \times 100\%$, substantial error (SE) defined as APE greater than 10 % and estimation of EFW and BW was done to define the prevalence underestimated and overestimated EFW findings that are showed that there is tendency for overestimation in the studied groups. There was a significant variance among the studied groups as regard absolute error, absolute percentage error, and substantial error (*P* value < 0.001) (Table 5).

Comparison between studied groups regarding inaccurate EFW was done as inaccurate EFW was postulated if there was higher than absolute 15 %

Table 1. Socio-demographic characteristics of studied groups.

Variable	Normal amniotic fluid index N = 43	Oligo-hydraminos N = 43	Poly-hydraminos N = 43	Test of significance	*P* value
Age					
X⁻±SD	26 ± 2.35	25.81 ± 3.32	26.74 ± 3.71		
Median	26	26	27	ANOVA = 1.031	0.359
Range (minimum−maximum)	22−32	20−35	20−35		
Occupation N (%)					
Not working (Housewife)	18 (41.9)	20 (46.5)	20 (46.5)		
Working	25 (58.1)	23 (53.5)	23 (53.5)	X^2 = 0.251	0.882

N, number of cases; **SD**, standard deviation; **X**, mean.
ANOVA, analysis of variance; X^2, Pearson chi-square test.
P value:less than 0.05 significant.
Less than 0.001 highly significant.
Greater than 0.05 nonsignificant.

Table 2. Sonographic characteristics and birth weight of the studied groups.

Variable	Normal amniotic fluid index N = 43	Oligo-hydraminos N = 43	Poly-hydraminos N = 43	Test of significance	*P* value
EFW					
X⁻±SD	3452.58 ± 319.88	3140 ± 251.95	3927.8 ± 289.8	ANOVA = 81.269	<0.001[a]
Median	3437	3100	3889		
Range (minimum−maximum)	2900−4126	2400−3700	3180−4500		
BW					
X⁻±SD	3234.88 ± 288.37	2960.63 ± 238.38	3503.02 ± 277.98	ANOVA = 43.673	**<0.001**[a]
AFI					
X⁻±SD	15.21 ± 4.8	2.92 ± 0.96	28.45 ± 2.37	ANOVA = 710.951	**<0.001**[a]
Median	15	3	28		
Range (minimum−maximum)	5−24	1−4.5	25.5−35		

AFI, amniotic fluid index; **BW**, birth weight; **EFW**, estimated fetal weight.
[a] Highly significant difference.

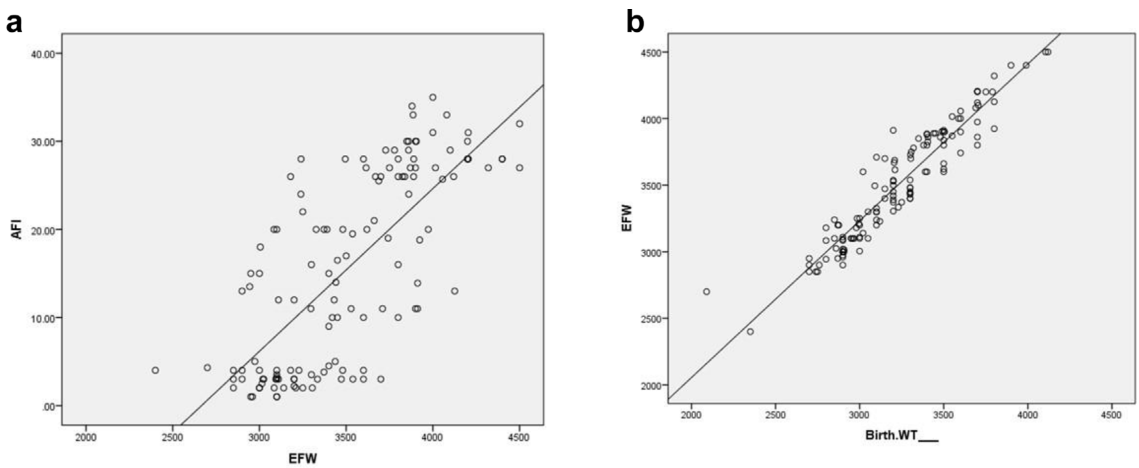

Fig. 2. (a) Correlation between estimated fetal weight and amniotic fluid index (b) Correlation between estimated fetal weight and birth weight.

Table 3. Correlation between amniotic fluid index and both estimated fetal weight and birth weight in studied groups.

	Amniotic fluid index	
	r	*P* value
EFW	0.733	**<0.001**[a]
Birth weight	0.640	**<0.001**[a]

r: Pearson correlation coefficient.
[a] Highly significant difference.

Table 4. Correlation between estimated fetal weight and birth weight in studied groups.

	Estimated fetal weight	
	r	*P* value
Birth weight	0.945	**<0.001**[a]

[a] Highly significant difference.

variance among EFW and BW, calculated as follows; (BW-EFW)/EFW *x* 100, There was nonsignificant variance among studied groups as regard inaccurate EFW.

4. Discussion

In our research, we revealed that the sonographic EFW accuracy is not affected by the amniotic fluid level at term. However, there was a positive relation among the AFI and EFW and BW also there was an overestimation tendency of EFW in all groups. We observed that sonographic EFW and birthweight exhibited a strong positive correlation (0.76−0.88) within the amniotic fluid level [3].

Our results were also correlated with Milner and Arezina who observed a positive relationship between AFI and EFW in certain gestational ages [7].

Table 5. Comparison between studied groups regarding Absolute error, Absolute percentage error, Substantial error and Estimation of estimated fetal weight and actual birth weight.

Variable	Normal amniotic fluid index *N* = 43	Oligo-hydraminos *N* = 43	Poly-hydraminos *N* = 43	Test of significance	*P* value
Absolute error (AE)					
X¯±SD	217.69 ± 129.5	179.37 ± 133.98	424.81 ± 57.01		
Median	197.00	133.00	420.00	K−W = 65.096	**>0.001****
Range (minimum−maximum)	5−712	0−610	210−520		
Absolute percentage error (%) (APE)					
X¯±SD	6.77 ± 4.07	6.19 ± 5.22	12.19 ± 1.79	K−W = 60.432	**>0.001****
Median	5.94	4.48	12.62		
Range (minimum−maximum)	0.17−22.25	0−29.19	6.19−14.96		
Substantial error (SE)				**Chi square test**	***P*-value**
Yes	6 (14.0 %)	6 (14.0 %)	38 (88.4 %)	66.884	**<0.001****
No	37 (86 %)	37 (86 %)	5 (11.6 %)		
Estimation of EFW and ABW					
EFW = ABW	0	1 (2.3 %)	0		
Underestimation	0	0	0	2.016	**0.365**
Overestimation	43 (100 %)	42 (97.7 %)	43 (100 %)		

ABW: actual birth weight.

Our results were also correlated with Nohuz and colleagues who found that the ultrasonographic accuracy was not affected by maternal weight and low AFI [8].

Our study is also correlated with Tsantekidou and colleagues who thought that AFI with EFW in a mid-third trimester measured by ultrasound may be highly representative of severe macrosomia in newborns [1].

Our results are similar with Karahanoglu and colleagues who found that there was no difference in EFW accuracy among oligohydramnios and polyhydramnios groups and there was an overestimation tendency in the two groups [5].

Our study agrees with Fuchs and colleagues who showed that the measurement of amniotic fluid by the different methods is significantly related to EFW as the single deepest vertical pocket measurement or the calculation of AFI [9].

Our study is also in agreement with Declercq and colleagues in which their results appeared to find a relation between amniotic fluid level and macrosomia in full-term pregnant women, especially if the amniotic fluid was more than average or polyhydramnios [10].

Smith et al. found a significant correlation between oligohydramnios and low BW babies ($P = 0.001$) [11]. Although our results are not correlated with their result showed that combined assessment of the EFW and AFI rather than only assessing EFW did not improve the prediction of macrosomia at birth.

Janas and colleagues did not observe any significant difference among EFW and BW in the oligohydramnios group and normal AFI group so they revealed that there was no link among low amniotic fluid volume and the EFW accuracy at term pregnancies [6].

There is a tendency to overestimate EFW in conditions of oligohydramnios. There was a positive correlation among AFI and the abdominal circumference measurement and among AFI and EFW [12].

The analysis included 28 650 pregnancies that demonstrated a positive relation among AFI, EFW, and AC. A positive correlation between fetal weight and amniotic fluid volume correlates with our results. However they postulated that AFI correlated with EFW in female fetuses at full term. They did not observe significant correlations among AFI and EFW in male fetuses of different gestational age groups [13].

However, Parveen and colleagues said there was a significant positive correlation between AFI and EFW in male fetuses at gestational age above 38 weeks [14]. AFI was positively correlated with EFW in both, male and female; however, the degree of association was small. A moderate association among AFV and EFW was observed mainly during mid-to late-gestation [15].

Bakhsh and colleagues demonstrated that oligohydramnios was observed in gestational age at term with low neonatal BW while polyhydramnios was observed in gestational age at late term with high BW that represented a positive correlation between AFI and EFW [16]. According to Rauh and colleagues accuracy of EFW in pregnant women with an hydramnios was the same as in matched cases with normal amniotic fluid volume [17].

In contrast, there was no association between low normal AFI and a growth-restricted infant was found [18]. Our results are not correlated with Wadnere and colleagues who found that no significant relation existed between EFW and AFI in a range of values of these parameters in Central India [19]. Our results are not in agreement with Owen and colleagues who showed that a progressive decline in AFI in late gestation was observed but there was no significant correlation between AFI and EFW [20]. Our study is not also correlated with Preyer et al. as there was nonsignificant effect of AFI on EFW in this research [21]. Martins et al. found that there was overestimation of EFW with oligohydramnios at the opposite side there was an underestimation of EFW with polyhydramnios [22]. There was nonsignificant rate of low BW among the borderline oligohydramnios group and the normal AFI group [23]. Krispin and colleagues did not mention the AFI on the factors that affect EFW Accuracy but it depended on the presentation of the fetus, position of the spine and site of the placenta [24]. They reported a weak negative relation between with EFW and AFI as measured in mean percentage error, suggesting overestimation of fetal weight at low amniotic fluid volumes and underestimation at high amniotic volumes [25].

4.1. Conclusion

In our study, we found that the amniotic fluid level has no impact on the EFW accuracy at term. However, there is a positive relation between the AFI and EFW, and BW also there is a tendency for EFW to be overestimated in all groups.

Conflicts of interest

No conflict of interests.

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