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Predicting Big Babies: Using Amniotic Fluid and Baby Weight Estimates

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ABSTRACT

Background: Macrosomia or big baby is defined as a newborn with a birth weight of more than 4kg. Amniotic fluid index (AFI) which is estimated by adding length of deepest vertical pool in four corners of liquor in uterus is an indicator of fetal well-being. This parameter when combined with ultrasonographic estimated fetal weight can predict macrosomia accurately. **Objective:** To evaluate diagnostic accuracy of integrated examination with amniotic fluid index (AFI) and estimated fetal weight (EFW) for prediction of macrosomia. **Study Design:** Cross sectional study. **Settings:** Department of Obstetrics and Gynecology, Combined Military Hospital (CMH), Rawalpindi Pakistan. **Duration:** 6 months from 29th October 2019 to 28th April 2020. **Methods:** After meeting the inclusion criteria 250 females were enrolled. All patients underwent sonographic evaluation for AFI and EFW estimation. Patients were categorized as positive or negative for macrosomia. Then all females were followed-up in OPD till delivery. If birth weight was ≥4000 grams, then macrosomia was confirmed. **Results:** The average age of the females was 27.21 ± 4.59 years, there were 55(22%) females as nulliparous. The sensitivity, specificity, and diagnostic accuracy of integrated examination of AFI & EFW were 50%, 98.78%, & 98% for definition of macrosomia as base line. **Conclusion:** This study showed good diagnostic accuracy of integrated amniotic fluid index and ultrasound baby weight estimates as predictor of macrosomia having low sensitivity.

Keywords: *Macrosomia, Amniotic fluid index, Estimated fetal weight.*

INTRODUCTION

Macrosomia, described as birthweight 4 kg or above is linked with an increase in obstetrical complications like high perinatal mortality, birth asphyxia, aspiration of muconium stained liquor , second stage arrest in labor, shoulder dystocia, maternal perineal lacerations, fetal bony and nerve injuries.[1,2,3] These risks increase with birthweight 4500 g or above.[4,5] There are few maternal and fetal factors associated with fetal macrosomia like maternal diabetes mellitus, previous macrosomic birth , polyhydramnios etc.[6] Overall fetal macrosomia exist from 5 to 20% of all births.[7]

The certainty of fetal weight by ultrasonic examination alone for prediction of macrosomia is insignificant.[8,9] The evaluation of biophysical profile of fetus in last trimester constitute the ultrasound guided measurement of amniotic fluid for fetal growth. Liqour or amniotic fluid is generated by fetal urinary system and other excretory metabolic processes in utero.[10,11]

Amniotic fluid index (AFI) which is calculated by sum of deepest vertical pool of liquor in four corners of uterus and fetal weight are well documented parameters for fetal assessment in literature. When both parameters are combined together, the sensitivity and specificity approximates to 37.5% and 99.6% for prediction of fetal macrosomia.[8]

This is supported by another study in literature documenting sensitivity of 36.4% and specificity of 96.7% for prediction of fetal macrosomia.[12] This local study will help to implement the results in local settings for

prediction of macrosomia. This study objective was to evaluate diagnostic accuracy of integrated examination with amniotic fluid index (AFI) and estimated fetal weight (EFW) for prediction of macrosomia.

OPERATIONAL DEFINITIONS

Macrosomia: On ultrasound if AFI≥95mm and EFW≥4000grams, then case was labeled as positive and if AFI<95mm and EFW<4000grams, then case was labeled as negative. On birth, it was labeled as positive if birth weight ≥4000grams on weighing machine and was labeled as negative if birth weight <4000grams on weighing machine.

True Positive: If case is positive on both; AFI+EFW and on birth. **True Negative:** If case is negative on both; AFI+EFW and on birth. **False Positive:** If case is positive on AFI+EFW but negative on birth. **False Negative:** If case is negative on AFI+EFW but positive on birth

METHODS

It was a cross sectional study carried out in Obstetrics and Gynecology unit, CMH Rawalpindi from 29th October 2019 to 28th April 2020. Sample size of 250 was calculated with 95% confidence level, taking expected percentage of macrosomia i.e., 20% with sensitivity of AFI plus EFW i.e., 36.4% with 13.5% margin of error and specificity of AFI plus EFW i.e., 96.7% with 2.5% margin of error. Sampling technique is non-probability consecutive sampling.

Females of aged 18-40years, parity <5, presenting at gestational age>36 weeks (by LMP) for antenatal check-up were included in study.

Women with pre-gestational and gestational diabetes (BSR>186mg/dl), maternal hypertension (BP≥140/90mmHg) or proteinuria >+1 on dipstick method, having multiple gestation, or genetic or congenital malformations (on ultrasound) were excluded.

250 females were included in the study whose Informed written consent was taken and demographic information (name, age, parity, BMI, gestational age) was recorded. All patients underwent sonographic evaluation which was performed by experienced obstetric sonographers with assistance of researcher. AFI and EFW was estimated. Patients were divided as positive or negative for macrosomia.

All enrolled pregnant females were followed-up in OPD till delivery. If birth weight was ≥4000grams on delivery, then macrosomia was confirmed. All these information's were recorded.

The data was entered and analyzed using SPSS version 21. Mean ± Standard deviation was calculated for quantitative variables like age, gestational age, BMI, AFI and estimated fetal weight. Frequency and percentage were calculated for parity and macrosomia (on AFI plus estimated fetal weight on ultrasound and actual weight on birth). 2x2 table was generated to calculate the sensitivity, specificity, PPV, NPV and diagnostic accuracy of combined effect of AFI plus estimated fetal weight on ultrasound taking actual birth weight as base line. Effect modifiers like age, gestational age, parity and BMI was addressed by stratification. Post stratification, 2x2 table was generated to calculate the sensitivity, specificity, PPV, NPV and diagnostic accuracy of combined effect of AFI plus estimated fetal weight on ultrasound taking actual birth weight as gold standard in each stratum.

RESULTS

Out of 150 female the average age was 27.21±4.59 years with 20 years as minimum and 35 years as maximum respectively. The average BMI of the females was 27.64±3.46 kg/m2 with minimum and maximum BMI of 21 & 33.98 kg/m2 respectively. Out of 250 pregnant females, 55(22%) were nulliparous, 61(24.40%) had parity 1, 49(19.60%) had parity 2, and 43(17.20%) had parity 3 & 42(16.80%) had parity 4. The average gestational age of the females was 37.99±1.36 weeks with minimum and maximum gestational ages of 36 & 40 weeks respectively. In this study on ultrasound ≥95 mm AFI was observed in 5(2.0%) pregnancies and <95 mm AFI was noted in 245(98%) pregnant females. The study result showed that the mean EFW of the babies was 3302.91±393.77 grams. In our study the macrosomia was diagnosed by AFI & EFW in 5(2%) babies while the average birth weight of the babies was 3375.68±374.14 grams. In this study the macrosomia diagnosed by birth weight was noted in 4(1.60%) babies. In this study the sensitivity, specificity, PPV, NPV and diagnostic accuracy of combined AFI & fetal birth weight was 50%, 98.78%, 40%, 99.18% & 98% respectively taking actual Macrosomia as gold standard. (Table 1)

Table 1: Validity of combined AFI & EFW for detection of macrosomia

		Actual Macrosomia		Total
		Positive	Negative	
Macrosomia by AFI & EFW	Positive	2	3	5
	Negative	2	243	245
Total		4	246	250

Sensitivity	50%
Specificity	98.78%
PPV	40%
NPV	99.18%
Diagnostic Accuracy	98%

The study results showed that among females of age ≤ 25 years the diagnostic accuracy of combined AFI & EFW for detection of Macrosomia was 96.04%. Similarly, among females of age > 25 years the diagnostic accuracy of combined AFI & EFW for detection of Macrosomia was 99.33%. (Table 2)

Table 2: Validity of combined AFI & EFW for detection of macrosomia stratified by age

Age (years)	Macrosomia on Screening	Actual Macrosomia		Total
		Positive	Negative	
≤ 25	Positive	1	2	3
	Negative	2	96	98
>25	Positive	1	1	2
	Negative	0	147	147

Age (years)	≤ 25	>25
Sensitivity	33.33%	100%
Specificity	97.96%	99.32%
PPV	33.33%	50%
NPV	97.96%	100%
Diagnostic Accuracy	96.04%	99.33%

The study results showed that among females of BMI ≤ 25 years the diagnostic accuracy of combined AFI & EFW for detection of Macrosomia was 97.18%. Similarly, among females of BMI < 25 years the diagnostic accuracy of combined AFI & EFW for detection of Macrosomia was 98.32%. (Table 3)

Table 3: Validity of combined AFI &EFW for detection of macrosomia stratified by BMI

BMI	Macrosomia on Screening	Actual Macrosomia		Total
		Positive	Negative	
≤ 25	Positive	1	2	3
	Negative	0	68	68
>25	Positive	1	1	2
	Negative	2	175	177

BMI	≤ 25	>25
Sensitivity	100%	33.33%
Specificity	97.14%	99.43%
PPV	33.33%	50%
NPV	100%	98.87%
Diagnostic Accuracy	97.18%	98.32%

In our study among females of gestational age 36-37 weeks the diagnostic evaluation of combined AFI & EFW for detection of Macrosomia was 96.94%. Similarly, among females of gestational age 38-40 weeks the diagnostic accuracy of combined AFI & EFW for detection of Macrosomia was 98.68%. (Table 4)

Table 4: Validity of combined AFI &EFW for detection of macrosomia stratified by gestational age

Gestational Age	Macrosomia on Screening	Actual Macrosomia		Total
		Positive	Negative	
36-37	Positive	0	2	2
	Negative	1	95	96
38-40	Positive	2	1	3
	Negative	1	148	149

Gestational age	36-37	38-40
Sensitivity	0.0%	66.67%
Specificity	97.94%	99.33%
PPV	0.0%	66.67%
NPV	98.96%	99.33%
Diagnostic Accuracy	96.94%	98.68%

In our study among females with null & primary parity the sensitivity, specificity, PPV, NPV and diagnostic accuracy of combined AFI & EFW was 100%, 97.37%, 40%, 100% & 97.41% respectively taking actual Macrosomia as gold standard. (Table 5)

Table 5: Validity of combined AFI & EFW for detection of macrosomia in null & primary parity females

Parity	Macrosomia on Screening	Actual Macrosomia		Total
		Positive	Negative	
Primi	Positive	2	3	5
	Negative	0	111	111
	Total	2	114	116
Multi	Positive	0	0	0
	Negative	2	132	134
	Total	2	132	134

Parity	Primi	Multi
Sensitivity	100%	0%
Specificity	97.37%	100%
PPV	40.0%	0%
NPV	100%	98.51%
Diagnostic Accuracy	97.41%	98.51%

DISCUSSION

Birth of macrosomic babies is a professional challenge for obstetricians for decades. Pregnancy with suspected macrosomia is at higher risk of many maternal and neonatal complications. Macrosomia well known as fetal growth above a specific centile is an obstetrical complication. Acoording to the statement of ACOG, all fetuses with birth weight of 4500 grams are determined as macrosomia. However, other guidelines use 4000 grams or above as macrosomia regardless of gestation.[13,14,15]

This study had the sensitivity, specificity, PPV, NPV and diagnostic accuracy of combined AFI & EFW as 50%,

98.78%, 40%, 99.18% & 98% respectively taking actual Macrosomia as base line. The sensitivity of combined AFI & EFW was low which may be due very small positive cases of Macrosomia.

Amniotic fluid is produced by fetal urination and in last trimester ultrasound assessment of liquor is considered as essential part fetal biophysical profile for fetal well-being.[16] Hackmon R *et al*[17] in their study documented a remarkable association between AFI and birth weight in last trimester. AFI > or = 60th percentile and estimated fetal weight > or = 71st percentile in last trimester and can predict macrosomia at birth. Receiver-operating characteristic analysis recognized AFI > or = 60th percentile and EFW > or = 71st percentile as prgnostic of birth of macrosomic baby. The collaborative analysis of AFI 60th percentile and EFW 71st percentile estimates a PPV of 85%.

Myles and Nguyen[18] performed a study over 231 women after 37 weeks of pregnancy, with AFI between 5 and 24 cm. They observed an equivalence connection between AFI and birth weight stating that AFI > 15cm predicts twice the possibility of macrosomia and AFI > 18cm increases the risk up to six times.

Another study conducted by Avi Ben-Haroush *et al*[12] about ultrasonic estimated fetal weight and AFI near expected date of delivery up to 10 days for prediction of macrosomia at birth found higher macrosomia with higher AFI (P < .001). An ultrasound estimated fetal weight of 4 kg or higher had a positive predictive value of 46.6% for macrosomia, however their findings stated that combined use of ultrasonographic EFW and AFI in lieu the EFW alone does not have significant prediction value for macrosomia at birth.

One observational study by El Khouly NI, Elkelani concluded the same findings of good prediction value of combined use of AFI and EFW with higher AFI in the macrosomia group (p = 0.001). The area under ROC (Receiver operating curve) for EFW was 0.93 and that of AFI was 0.67. The limit for estimated fetal weight was 4kg and for AFI it was 16.4 cm. The positive predictive value for integrated variables was 92.3% while for EFW alone 75% and AFI alone 27%.[8]

Benson CB, Coughlin BF in their study stated that high amniotic fluid index of > 15cm and 18cm has a two times and six times more risk of macrosomia respectively.[19]

On the other hand, no connection was found between AFI and EFW by ultrasound for prediction of macrosomia when performed in last trimester of pregnancy by Owen *et al*.[20]

CONCLUSION

This study showed good diagnostic accuracy of integrated examination of amniotic fluid index and ultrasound baby weight estimates as predictor of macrosomia having low sensitivity.

LIMITATIONS

The main limitation of this study was small sample size. The results can be affected by other variables like ethnicity, caste, parental BMI and socioeconomic status.

SUGGESTIONS / RECOMMENDATIONS

This study provides a valuable insight about the combined use of amniotic fluid index and EFW for prediction of macrosomia in local setting. More studies are required with large sample size to further prove the diagnostic accuracy of these parameters. Other variables like maternal or paternal BMI, caste and ethnicity can be further included for better analysis.

CONFLICT OF INTEREST / DISCLOSURE

None.

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None declared.

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