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Fetal Macrosomia; Risk Factors And Validity Of Its Diagnostic Tools

Obstetrics and Gynecology

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ABSTRACT

Background: Macrosomia, defined as a birth weight of 4000 g or above, is one of the most frequent prenatal problems.
Aim of the work: To assess the accuracy of clinical evaluation and 2D ultrasound examination in prediction of fetal macrosomia.
Patients and methods: This study was carried out in the Obstetric and Gynecology Department of Al Azhar University Hospital. All pregnant who were admitted to our hospital and were delivered by CS indicated by prenatal diagnosis of fetal macrosomia were included in our study.
Results: Fetal macrosomia is a common cause of maternal and newborn morbidity, with a frequency of 5.5 percent. Multiparity, prior history of macrosomia, diabetes mellitus, overweight, gestational age of 40 weeks or more, and maternal age of 30 to 39 years were all shown to be maternal risk factors for foetal macrosomia in our research. The results of our cross-sectional observational research indicate that ultrasonography is considerably more accurate than Leopold's manoeuvres in estimating foetal weight in overweight pregnant women. In normal-weight pregnant women, however, there was only a small statistically significant difference between the two techniques. Absolute error of prenatal estimation of fetal macrosomia in our study was high with obese and/or diabetic mothers and polyhydramnios.
Conclusion: The data obtained in our cross sectional observational study showed ultrasound to have a significantly better accuracy in fetal weight estimation in overweight pregnant women than Leopold's manoeuvres. However, limited statistically significant difference between the two methods was observed in normal weight pregnant women.

Keywords:*Pregnancy,Macrosomia,Ultrasonography.*

INTRODUCTION

Macrosomia, defined as a birth weight of 4000 g or above, is one of the most frequent prenatal problems.

Depending on demographic factors and diagnostic criteria employed, macrosomia is predicted to afflict 0.9–12% of all pregnancies [1].

It is linked to a significantly increased risk of negative health consequences in both mothers and children.

For example, the majority of researches have shown that being born big is linked to both immediate and long-term health concerns for both the baby and the mother [2].

When the head size, belly circumference, and weight surpass the 90th percentile for the gestational age, macrosomia may be symmetric in post-term pregnancy or owing to hereditary causes. It was discovered that undiagnosed women with hyperglycemia birth 80 percent of macrosomic infants [3].

Excessive prenatal weight gain, poorly managed diabetes, and maternal obesity all result in foetal hyperglycemia, which stimulates foetal insulin release, insulin-like growth factors, and other growth factors and growth hormones. The foetal adipose tissue is more plentiful, the liver has more glycogen, and intrauterine development is accelerated as a result of hyperinsulinemia [4].

Studies of obese mothers' siblings born before and after bariatric surgery found that birth weight dropped when maternal BMI fell, and their genetic expression was different, indicating improvement in infants after surgery [5].

Because of the maternal, foetal, and neonatal consequences of macrosomia, pregnant women who are at risk should be counselled and monitored to follow a low-calorie, low-glycemic diet and avoid sedentary activity.

Because of the risk of obesity, diabetes, hypertension, and metabolic syndrome later in life, the mother and the macrosomic infant must be followed for a long time. Because prenatal foetal weight assessment is not always reliable, particularly in foetuses with macrosomia, this research will be conducted to determine the prevalence and predictability of foetal macrosomia.

The goal of this research was to see how often foetal macrosomia was at AL-Azhar University Hospital (Assuit). At addition, we wanted to see how accurate clinical assessment and 2D ultrasound examination were in predicting foetal macrosomia in the AL-Azhar University Hospital (Assuit).

PATIENTS AND METHODS

The present study was carried out in the Obstetrics and Gynecology department, in Al-Azhar (Assuit) University Hospital from May to October 2020. Ethical permission was sought from a Local Research Ethics Committee (REC) in the department. The patients were given a full and clear explanation about the study.

Cross sectional observational study; Antenatal diagnosis of fetal macrosomia (more than 4kg) was compared with neonatal pondal status to assess accuracy of clinical evaluation and ultrasound examination in diagnosis of these cases.

Inclusion criteria: All pregnant females who were admitted to our hospital and were delivered by CS indicated by prenatal diagnosis of fetal macrosomia.

Exclusion criteria:

All macrosomic babies caused by congenital fetal malformation such as hydrocephalus, fetal hydrops.

Multiple pregnancies.

Other obstetric indication of CS.

Abdominal and obstetric examination

Leopold's tactics were utilized by the examiners.

The symphysis-fundal height (SFH) was measured from the mid-point of the maternal pubic symphysis upper border to the highest point on the uterine fundus.

The umbilicus was used to measure the mother's belly circumference.

A flexible tape calibrated in cm was used to collect measurements.

Ultrasound examination

The most frequent technique of examining pregnant women is two-dimensional ultrasonography.

Using particular growth curves, indices, and formulae with varying degrees of sensitivity and specificity, the diagnosis of foetal macrosomia must be linked to the clinical condition.

Unfortunately, as foetal weight rises, so does the number of mistakes.

Two-dimensional ultrasonography was used to evaluate foetal weight, with a single sonographer assessing Bi Parietal Diameter (BPD), Head Circumference (HC), Abdominal Circumference (AC), and Femur Length (FL) before calculating foetal weight using the Hadlock method.

Details of pregnancy outcome were recorded in the form of:

Group A: females who delivered by CS indicated by fetal macrosomia and postnatal evaluation of baby approve our prenatal diagnosis.

Group B: females who delivered by CS indicated by fetal macrosomia, but postnatal evaluation of baby conflict our prenatal diagnosis.

Data analysis:

SPSS (Geometric set for societal skills) version 20 stood castoff during study. Standard t-tests or the Mann-Witney U tests were used for comparison of factors influencing perinatal mortality and different modalities of management.

RESULTS

Through the training retro from May to October 2020, there were a total of 3850 deliveries by Caesarean section 208 were due to macrosomia (took a mass larger than or like to 4000 g clinically and by US) . The prevalence of fetal macrosomia was 5.5%.

Demographic facts of 208 females involved in the training are exposed in (Table 1). The willful females took an age of 31.63±4.97 eons (19-42), Parity of 3.45±1.75 deliveries (1-8), A gestational age 40.05±1.63 weeks, Most of them were postdate. A BMI (kg/m2) 31.98±5.28, Most of them were overweight (84.6%). Most of them had a previous history of fetal macrosomia (71.6%). by routine screening of DM most of studied women are diabetic (69.2%). Most of studied women were Rural and House worker. Maternal and fetal characteristics and pregnancy outcomes obtained from CS indicated by prenatal diagnosis of fetal macrosomia according to actual fetal weight (weight after birth)

Variable	N (%)	Range	Mean ±SD
Maternal age (years)		19-42	**31.63±4.97**
Parity **Primi-para Multipara**	 45(21.6%) 163(78.4%)	1-8	**3.45±1.75**
Gestational age (weeks)		37-42	**40.05±1.63**
Postdate **Yes No**	 161(77.4%) 47(22.6%)		

BMI (kg/m^2)		23-40	**31.98±5.28**
Normal (18.5-24.9) **Overweight/ obese (>25)**	32(15.4%) 176(84.6%)		
Diabetic: **Yes No**	144(69.2%) 64(30.8%)		
Previous history of macro-somia **Yes No**	149(71.6%) 59(28.4%)		
Residence **Rural Urban**	115(55.2%) 93(44.7%)		
Occupation **Housework Others**	**128(61.5%)** **80(38.4%)**		

Table 1: Demographic data of studied sample (n=208)

There was a sturdy overtone amid fetal macrosomia and caring age bigger than 30 years 135(81.3%) and high parity134 (80.7%), advanced maternal age and high parity should be considered as important risk factors for macrosomia (Table 2).

	Macrosomic (AFW) Actual fetal weight ((weight after birth)) ≥4000g, n=166)	Normal (AFW) Actual fetal weight ((weight after birth))<4000g, n=42)	p-value
Maternal age (years)	32.04±4.67	30.05±5.81	**0.020***
>30 **<30**	135(81.3%) 31(18.7%)	24(57.1%) 18(42.9%)	**0.001****
Parity	3.46±.169	3.40±2.00	**0.862**
Prmipara **Multipara**	**32(19.3%)** **134(80.7%)**	**13(31%)** **29(69%)**	**0.101**

Table 2: Association between maternal age, parity and fetal macrosomia

Lying-in length superior than 40 weeks was also knowingly allied with fetal macrosomia, 134 (80.7%) of macrosomic cases are postdate (Table 3).

	Macrosomic (AFW ((weight after birth)) ≥4000g, n=166)	Normal (AFW ((weight after birth))<4000g, n=42)	p-value
GA	39.95±1.67	40.43±1.41	**0.091**
Postdate **Not**	**134(80.7%)** **32(19.3%)**	**27(64.3%)** **15(35.7%)**	**0.023***

Table 3: Association between gestational age and fetal macrosomia

Fetal macrosomia can be due to superior parental BMI at the time of start, extreme mass gain among conditions in addition to heft advance thru lying-in 135(81.3%) (Table 4).

	Macrosomic (AFW ((weight after birth)) ≥4000g, n=166)	Normal (AFW ((weight after birth))<4000g, n=42	p-value
BMI	31.86±5.52	32.45±4.21	**0.519**

Overweight	135(81.3%)	41(97.6%)	**0.009****
Normal	**31(18.7%)**	**1(2.4%)**	

Table 4: Maternal Obesity and Occurrence of Fetal Macrosomia

Maternal hyperglycemia should be considered a strong predictor of fetal macrosomia. A past of diabetes mellitus (pre-current or gestational) befell more often mid the bags, 111(86.7%) cases of macrosomic baby were of diabetic mother (Table 5).

	Macrosomic (AFW ((weight after birth)) ≥4000g, n=166)	Normal (AFW ((weight after birth))<4000g, n=42	p-value
DM	**111(86.7%)**	**30(71.4%)**	**0.730**
Not	**52(31.3%)**	**12(28.6%)**	

Table 5: Association between diabetes mellitus and macrosomia

Previous history of macrosomia likely contributes to macrosomia 120(72.3%). The tall manly to girlish percentage in the macrosomic set was stated 131(78.9%) but polyhydraminos not frequently associated with fetal macrosomia (46.4%) (Table 6).

	Macrosomic (AFW ((weight after birth)) ≥4000g, n=166)	Normal (AFW ((weight after birth))<4000g, n=42	p-value
History of macrosomia	120(72.3%)	29(69%)	**0.667**
No	46(27.7%)	13(31%)	
AFI	20.85±4.82	24.90±3.20	**<0.001*** **
Polyhydraminos Not	77(46.4%)	34(81%)	**<0.001*** **
	89(53.6%)	8(19%)	
Male	**131(78.9%)**	**27(64.3%)**	**0.047***
Females	**35(21.1%)**	**15(35.7%)**	

Table 6: Other determinants and risk factors of fetal macrosomia

Cruel utter fault (gm)= weight clinically or by US – AFW(weight after birth) Mean error percentages = Mean absolute error (gm) X 100/ AFW(weight after birth). When comparing absolute mean error at various gestational ages and absolute error > 500g between clinical and ultrasound techniques, the clinical approach had substantially greater absolute mean error at different gestational ages (Table 7).

	AUC (95% C.I.)	Sensitivity	Specificity	PPV	NPV	Cut-off	p-value
Clinical EFW	0.622 (0.529-0.716)	74.4%	39.1%	54.8%	60 %	4275	**0.014***
US EFW	**0.781 (0.702-0.861)**	**86.7%**	**67.1%**	**72.5%**	**83.75%**	**4125**	**<0.001*****

Table 7: Comparison between clinical and ultrasound methods in weight estimations regarding mean absolute error and mean error percentages, absolute mean error at different gestational ages and error percentages

The importance of clinical and ultrasound EFW determinations in predicting actual foetal weight > 4000 gm is shown in (Table 8). Ultrasound EFW showed a greater sensitivity and a higher AUC (0.781) and higher predictive values.PPV(72.5%) NPV (83.75%).

	Clinical	UltraSound	p-value
Mean absolute error (gm)	297.60±185.44	176.44±135.92	**<0.001*** **
Absolute error >500 gm	38(18.3%)	6(2.9%)	**<0.001*** **
Mean error percentages (%)	7.42±4.98	4.45±3.56	**<0.001*** **
Absolute mean error at different gestational ages			
37 Weeks (n=18)	216.66±104.31	158.33±62.42	**0.050**
38 Weeks (n=30)	293.33±197.71	186.66±125.89	**0.016***
39 Weeks (n=17)	191.17±120.20	135.29±89.72	**0.134**
40 Weeks (n=58)	268.96±183.73	168.10±138.50	**0.001****
41 Weeks (n=29)	406.89±210.74	177.58±201.59	**<0.001*** **
42 Weeks (n=56)	331.25±172.30	197.32±125.92	**<0.001*** **
Error percentages			
≤5%	93(44.7%)	146(70.2%)	**<0.001*** **
5-10%	67(32.2%)	41(19.7%)	**0.003****
10-15%	28(13.5%)	18(8.7%)	**0.119**
15-20%	17(8.2%)	1(0.5%)	**<0.001*** **
>20%	**3(1.4%)**	**2(1%)**	**0.708**

Table 8: ROC curve of value of clinical and ultrasound EFW determination in predicting actual fetal weight > 4000 gm.

In any absolute error estimates of normal weight women giving delivery, there was no statistically significant difference in the accuracy of foetal weight estimation done using Leopold's manoeuvres vs ultrasonography. At the moment of delivery registration, this may be shown in (Table 9).

	Clinical	US	p-value
Absolute error [g]	327.27±182.03	185.51±142.63	**<0.001*** **
Absolute error > 500g [%]	38(21.6%)	6(3.4%)	**<0.001*** **
Absolute % error [g]	8.18±4.95	4.71±3.75	**<0.001*** **
Absolute % error > 10% [%]	48(27.3%)	21(11.9%)	**<0.001*** **
Absolute % error > 20% [%]	**3(1.7%)**	**2(1.1%)**	**0.652**

Table 9: Accuracy of both weight estimations regarding effective birth weight in all normal weight pregnant women (n=32)

In all absolute error estimates conducted in overweight women giving delivery, there was a statistically significant difference in the accuracy of foetal weight estimation in favour of ultrasonography. At the moment of delivery registration, this may be seen in (Table 10) .

	Clinical	US	p-value
Absolute error [g]	327.27±182.03	185.51±142.63	**<0.001*** **
Absolute error > 500g [%]	38(21.6%)	6(3.4%)	**<0.001*** **
Absolute % error [g]	8.18±4.95	4.71±3.75	**<0.001*** **
Absolute % error > 10% [%]	48(27.3%)	21(11.9%)	**<0.001*** **
Absolute % error > 20%[%]	**3(1.7%)**	**2(1.1%)**	**0.652**

Table 10: Accuracy of both weight estimations regarding effective birth weight in overweight and obese pregnant women (n=176)

A statistically major change in the truth of fetal bulk estimate was observed in all absolute error calculations clinically and by US in diabetic and non diabetic women with higher absolute error in diabetic women especially in clinical estimation of fetal weight (Table 11& 12).

	Clinical	US	p-value
Absolute error [g]	317.36±192.27	180.55±146.77	**<0.001*** **
Absolute error > 500g [%]	34(23.6%)	4(2.8%)	**<0.001*** **
Absolute % error [g]	7.86±5.18	4.58±3.83	**<0.001*** **
Absolute % error > 10% [%]	40(27.8%)	16(11.1%)	**<0.001*** **
Absolute % error > 20% [%]	**3(2.1%)**	**2(1.4%)**	**0.652**

Table 11: Accuracy of both weight estimations regarding effective birth weight in diabetic pregnant women (n=144)

	Clinical	US	p-value
Absolute error [g]	253.12±161.80	167.18±108.09	**0.001****
Absolute error > 500g [%]	4(6.2%)	2(3.1%)	**0.403**
Absolute % error [g]	6.42±4.38	4.16±2.90	**0.001****
Absolute % error > 10% [%]	8(12.5%)	5(7.8%)	**0.380**
Absolute % error > 20% [%]	**0(0%)**	**0(0%)**	-

Table 12: Accuracy of both weight estimations regarding effective birth weight in non-diabetic pregnant women (n=64)

DISCUSSION

Maternal and foetal mortality and morbidity remain major public health concerns that are closely linked to foetal development patterns, a topic of scientific interest since foetal growth problems are linked to the risk of non-communicable illnesses in adulthood [6].

Fetal weight estimate by clinical and sonographic means is an essential part of prenatal treatment.

Undermining the accuracy of sonographic foetal weight estimate and, most likely, affecting clinical decision-making about pregnancy and delivery follow-up.

Ultrasound, on the other hand, was shown to be a more accurate technique for determining foetal weight at term and more constant throughout gestational periods [7].

The current research training meant to judge incidence and risk issues of fetal macrosomia and clinical and sonographic method in prediction of fetal macrosomia regarding sensitivity, specificity and accuracy.

In our research, foetal macrosomia was found in 5.5 percent of the participants.

Other investigations in Tanzania [8] and Nigeria [9] have found 2.3 percent and 3.5 percent, respectively.

This low prevalence may be explained by our population's lower pre-pregnancy weight and poor socio-economic position.

In our cross sectional observational study, A significant link was found between foetal macrosomia and maternal age of more than 30 years. This may be because rising maternal age has an impact on maternal metabolism, causing the fetus's growth velocity to increase.

Multiparity was found in 78.4% of women who gave birth to macrosomic babies. The findings were consistent with those of previous research.

Enhanced parity combined with reduced insulin sensitivity is thought to result in a larger quantity of glucose available for placental glucose transport and therefore increased foetal fat tissue deposition [10].

Fetal macrosomia was also strongly linked with pregnancy length longer than 40 weeks (77.4%). This impact persists even after accounting for glucose metabolism abnormalities [11].

Increased maternal BMI at the time of conception, excessive weight gain between pregnancies, and

weight increase throughout pregnancy may all contribute to foetal macrosomia recurrence [12].

Mothers with an overweight at delivery were more likely to have a macrosomic baby than their peers.

Increased pre-pregnancy BMI, as well as weight gain during pregnancy, beyond the Institute of Medicine (IOM) recommendations, have previously been linked to macrosomia [13].

Because the majority of the women booked late in pregnancy and were unaware of their pre-pregnancy weight, it was unable to establish if this connection existed in our group.

In our research, we discovered a statistically significant difference in foetal weight estimate accuracy favouring ultrasonography in all absolute error calculations performed on overweight women giving delivery.

When utilised in overweight pregnant women, a substantial difference was apparent between the two techniques when an absolute error > 500 g was clinically important for the obstetric decision-making process. These findings are consistent with prior research [14].

When compared to the controls, the cases had a higher rate of diabetes mellitus (pre-existing or gestational). The result of 69.2 percent was much greater than that of Ibadan, Nigeria.

Diabetes in this population is linked to obesity and, as a consequence, increased insulin resistance, which increases glucose availability to the foetus.

Minor changes in glucose metabolism during early and late pregnancy have also been found to increase the risk of foetal overgrowth in women without gestational diabetes mellitus (GDM).

Furthermore, if gestational diabetes is present, extending the pregnancy may expose the baby to greater amounts of glucose, insulin, and other metabolic changes and this may be associated with low socioeconomic level (housework 61.5%) [15].

Other research [16] also noted the increased male to female ratio in the macrosomic group.

The maternal glucose tolerance status was shown to be a significant predictor of foetal macrosomia in male but not female neonates by Ricart et al. [17]. Sexual dimorphism in insulin sensitivity, the growth hormone-insulin growth factor 1 axis, and cytokines may explain this.

Males had a substantially higher average birth weight than females, according to Catalano et al. [18]. Increased neonatal fat free mass in men was blamed for this.

The training recruited 208 women who were admitted to our hospital and were delivered by CS indicated by prenatal diagnosis of fetal macrosomia. Fetal bulk was assed clinically and by ultrasound. Together systems were studied.

In our study, both the real birth weight and clinical and ultrasound foetal weight estimations showed that both estimates are considerably greater than the actual birth weight. Furthermore, clinical estimates were shown to be substantially higher than ultrasonography estimates. This is in line with the findings of a study of 200 full-term pregnant mothers.

They utilized three formulas to estimate fetal weight at term: the Hadlock formula for USG and two separate formulas for clinical techniques, maternal symphesis-fundal height and abdominal circumference at the level of the umbilicus.

The scientists found that for the high and normal birth weight groups, all three techniques significantly overstated birth weight. However, a recent study comparing the accuracy of clinical and Sonographic techniques of estimating baby weights at term found that clinical foetal weight estimate was considerably higher actual weight and ultrasonic evaluation was significantly lower actual weight [19].

The disparity across studies may be attributable to the women being examined having varied BMIs, polyhydraminos and not awareness of pre pregnancy weight.

As regard absolute error and mean error percentages When comparing clinical and ultrasound techniques, it was shown that the clinical method had substantially greater mean absolute error and mean error percentages in the clinical method 297.60±185.44 and7.42±4.98 respectively.

Furthermore, we found that when comparing absolute mean error between clinical and ultrasound techniques at various gestational ages, the clinical approach had substantially greater absolute mean error at different gestational ages.

Furthermore, a comparison of clinical and ultrasound techniques in terms of mistake percentages revealed that clinical methods had a substantially greater frequency of high error percentages rates than ultrasound methods [20].

This is consistent with a previous study that evaluated the accuracy of clinical and ultrasound foetal weight estimate techniques in 200 consecutive term pregnancies.

When compared to clinical techniques, ultrasound evaluation showed substantially reduced absolute errors and error percentages [19].

A group of academics recently conducted a 6-month cross-sectional study.

The research included all singleton term women with cephalic presentation and intact membranes who had an ultrasound within a week.

In comparison to the actual weight of the examined infants, the research showed substantially reduced mean error, absolute error, and error percentages in ultrasonic weight measurement than clinical foetal weight evaluation [21].

Several prospective studies have demonstrated that clinical palpation, such as Leopold's manoeuvres, has an advantage in predicting prenatal macrosomia, and that the accuracy of foetal weight estimate using ultrasound biometry is no better than that of

Leopold's manoeuvres. Other studies have shown that they have an advantage in estimating foetal weight [22].

As regard accuracy of our diagnostic tools (clinical and US methods) we found lower AUC , sensitivity and specificity in clinical methods 0.622, 74.4%,39.1% respectively and 0.781, 86.7%,67.1% in our US method respectively Other study performed was shown high AUC, sensitivity and specificity in both methods 0.76, 66.7 %,82.9 % respectively in clinical and 0.85, 80.0 %,81.4 % in US methods.

CONCLUSION

Fetal macrosomia is a common cause of maternal and newborn morbidity, with a frequency of 5.5 percent .

Multiparity, prior history of macrosomia, diabetes mellitus, overweight, gestational age of 40 weeks or more, and maternal age of 30 to 39 years were all shown to be maternal risk factors for foetal macrosomia in our research .

In terms of absolute mistakes and error percentages, sonographic assessment of foetal weight outperformed the clinical method .

In addition, sonographic testing showed improved statistical sensitivity and specificity in detecting foetal weights more than 4000 gm .

The results of our cross-sectional observational research indicate that ultrasonography is considerably more accurate than Leopold's manoeuvres in estimating foetal weight in overweight pregnant women .

In normal-weight pregnant women, however, there was only a small statistically significant difference between the two techniques .

Absolute error of prenatal estimation of fetal macrosomia in our study was high with obese and/or diabetic mothers and polyhydramnios.

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