

Original Article

Diagnostic Accuracy of Fetal Abdominal Circumference on Ultrasound in the Detection of Macrosomic Infants

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Abstract

Objective: To determine the diagnostic accuracy of fetal abdominal circumference on ultrasonography in the detection of macrosomic infants, taking birth weight as the gold standard.

Methodology: This descriptive, cross-sectional study was done at the Department of Radiology Pakistan Institute of Medical Sciences, Islamabad from May 2016 to October 2016. A total of 226 patients with females with a singleton pregnancy with suspected macrosomic infants and age 18-40 years were included. All the patients underwent ultrasonography and the presence or absence of macrosomia was noted as per fetal abdominal circumference. Fetal abdominal circumference ≥ 35 cm was considered as macrosomic. Ultrasonography findings were compared with birth weight in each patient. All the data was collected via study proforma.

Results: Mean age of study subjects was 31.20 ± 5.41 years and mean gestational age 38.06 ± 1.14 weeks. Out of all 144 (63.72%) fetus were diagnosed as macrosomic and as per birth weight observations 138 (61.06%) cases diagnosed as macrosomic. However ultrasound sensitivity and specificity were found to be 94.20%, 84.00%, and overall diagnostic accuracy was observed 90.27% in the detection of macrosomic infants, taking birth weight as the gold standard.

Conclusion: Fetal abdominal circumference on ultrasonography found to be a valuable and noninvasive diagnostic technique for macrosomic infants with a sensitivity of 94.2% and specificity 84%. Ultrasonography is a highly sensitive and reliable, simple, economical and readily available modality.

Keywords: Fetal abdominal circumference, ultrasonography, sensitivity

Cite this article as: Abid F N, Sahito A, Shahzad G, Jatoi A, Memon SA, Parveen F. Diagnostic Accuracy of Fetal Abdominal Circumference on Ultrasound in the Detection of Macrosomic Infants. J Soc Obstet Gynaecol Pak. 2021; 11(1):32-35.

Introduction

Macrosomia is characterized as a birth weight of more than 4 Kg regardless of gestational age or >90 th percentiles for gestational age upon adjusting for ethnicity and neonatal sex.¹ Macrosomia influences 3 – 15 percent of all pregnancies worldwide.² According to literature, various maternal and perinatal complications are linked to macrosomia and the existence of the large foetus, as described as large for gestational age (LGA) or by a weight cut-off value.³ Macrosomia has also been linked to shoulder dystocia, skeletal injuries, injury to brachial plexus, meconium aspiration, hypoglycaemia, prenatal asphyxia, and foetal death.⁴

Prolonged labour, caesarean delivery, augmentation of labour using oxytocin, postpartum haemorrhage, infection, perineal tears of 3rd & 4th degree, thromboembolic incidents, and anaesthetic events are all maternal complications associated with macrosomia.^{3,4} In adulthood, macrosomic babies are more likely to develop type 2 diabetes, obesity, and hypertension. Besides that, shoulder dystocia, intrapartum asphyxia, bone injuries and injury to brachial plexus are possible complications of vaginal childbirth, whereas maternal risks involve injuries to the pelvic floor and birth canal, postpartum haemorrhage

Authorship Contribution: ^{1,2} Write the first draft of manuscript and interpretation of data, ^{3,4} drafting and revision of manuscript and data analysis

Funding Source: none

Conflict of Interest: none

Received: Dec 24, 2020

Accepted: April 08, 2021

and increased incidence of caesarean and operative vaginal deliveries.⁵ Not just in labour management and delivery management, but also in the administration of growth monitoring and increased risk pregnancies, foetal weight evaluation is an essential and universal aspect of antenatal care.⁶ The precision of ultrasound-based fetal weight estimates has increased over the last 10 years, but there is still a poor consistency.⁷ Prenatal sonography tends to be more suitable than clinical approaches for conducting weight assessments before birth because ultrasound enables reliable and precise estimation of fetal body circumference and bone length.⁸ For individuals suspected of macrosomic foetus, accurate prenatal measurement of foetal weight in labour and late pregnancy is highly valuable in the administration of pregnancy and childbirth, allowing obstetricians to take decisions regarding instrumental vaginal birth, evaluation of labour following elective caesarean delivery, and caesarean section. So, keeping in mind all the above facts, this study has been conducted to determine the diagnostic accuracy of ultrasonography in the detection of macrosomic infants, taking birth weight as gold standard.

Methodology

This descriptive cross-sectional study was conducted at department of Radiology Pakistan Institute of Medical Sciences (PIMS/SZABMU), Islamabad. The study was conducted from May 2016 to October 2016 with ethical approval from the institutional review board. All pregnant females age between 18 to 40 years, gestational age 37-41 years having singleton pregnancy, and suspected for macrosomic infants were included. Women presented with Polyhydramnios, intrauterine fetal death, breech presentation, multiple pregnancies, and those who were not willing to participate in the study were excluded. Informed consent was taken from all the study subjects. All the women underwent ultrasonography for fetal wellbeing by 3.5 MHz machine. All the ultrasounds were conducted by senior radiologists having (at least 3 years post-fellowship experience). Fetal abdominal circumference ≥ 35 cm was considered as macrosomic and birth weights above 4000 g and above was considered as macrosomia after birth. Each ultrasonographic finding was compared with birth weight (taking as gold standard). All this data was recorded via study proforma. Data analysis was done by using SPSS version 20.

Results

In this study mean age of study participants was 31.20 ± 5.41 years, Majority of the patients 137 (60.62%) were between age group of 31 to 40 years. The average gestational age was 38.06 ± 1.14 weeks and mean parity was 03.34 ± 01.22 . Table I

As per ultrasound findings, 144 (63.72%) fetus were macrosomic and according to birth weight, 138(61.06%) cases diagnosed were observed as macrosomic. Table II

Overall sensitivity, positive predictive value, specificity, negative predictive value and diagnostic accuracy of fetal abdominal circumference on ultrasonography in the detection of macrosomic infants, taking birth weight as gold standard were found to be 94.20%, 90.28%, 84.00%, 90.24% and 90.27% respectively. Table II

Table I: Descriptive statistics of the patients (n=226)

Variables		Statistics
Age groups	18-30	89(39.38%)
	31-40	137(60.62%)
	Mean $\pm$ SD	31.20 ± 5.41 years
Gestational age	37-39 weeks	142 (62.83%)
	>39 weeks	84(37.17%)
	Mean $\pm$ SD	38.06 ± 1.14 weeks
Parity	1-2	103(45.58%)
	3-4	123(54.42%)
	Mean $\pm$ SD	03.34 ± 01.22

Table II: Diagnostic accuracy of fetal abdominal circumference on ultrasonography in the detection of macrosomic infants, taking birth weight as gold standard.

	Positive result on birth weight	Negative result on birth weight	Total	P-value
Positive on USG	130 (TP)*	14 (FP)***	144	0.545
Negative on USG	08 (FN)**	74 (TN)****	82	
Total	138	88		

*-TP=True positive **-FP=False positive ***-FN=False negative ****-TN=True negative

Sensitivity: 94.20%

Specificity: 84.09%

Positive Predictive Value (PPV): 90.28%

Negative Predictive Value (NPV):90.24%

Diagnostic Accuracy: 90.27%

Discussion

Prenatal care must include the detection of premature foetal development, and inability to do so may lead to higher perinatal mortality and morbidity, and also impact the neonate's long-term wellbeing.⁹ To avoid adverse perinatal outcomes, accurate screening approaches are needed to detect fetuses with LGA and foetal growth restriction (FGR).⁹ However in this study fetal abdominal circumference (AC) on ultrasonography showed sensitivity and specificity as 94.20% and 84.00% in the detection of macrosomic infants, taking birth weight as gold standard. Similarly in the study of Chaabane K et al¹⁰ reported that the abdominal circumference (AC) ≥ 350 mm on ultrasound showed in the fetal macrosomia prediction, revealed a 78.7% sensitivity, 76.8% specificity, 77% accuracy, 92.6% positive predictive value, and 49.2% negative predictive value. On the other hand in a published abstract of 18th world congress in Fetal Medicine observed that the abdominal circumference ≥ 350 mm was shown to have 78.7% sensitivity, 76.8% specificity, 77% precision, 92.6% positive predictive value, and 49.2 % negative predictive value.¹¹ On other hand Youssef AE et al¹² reported 35.5 cm AC cutoff value, 87.7% PPV for macrosomia prediction and 96.4% sensitivity with overall 96.83% of accuracy.

In this study maternal mean age was of 31.20 ± 5.41 years and mean gestational age 38.06 ± 1.14 weeks. On other hand Chaabane K et al¹⁰ reported that the maternal median age was 30.6 years among AC ≥ 350 mm group and 30.2 years among AC ≥ 350 mm group. Similarly, Li Y et al¹³ reported that the maternal age was 29.22 ± 4.32 in macrosomic fetal group and further they stated that the elevated maternal age can be a risk factor for macrosomia.¹³ Prenatal sonography tends to be more suitable than clinical approaches for conducting weight assessments before birth because ultrasound enables reliable and precise assessment of fetal body circumference and bone length. Though, since the fetus has an irregular 3-D body with varying tissue composition and density, it continues to be a concern. Sonographers need to remember that fetal AC has the highest influence on weight assessment. Several studies have been done to see how effective the AC is at detecting fetal macrosomia.¹⁴ Kehl S al¹⁵ devised a method for estimating fetal weight with 636 cm of AC. Besides that, serial biometric assessments can be utilized to produce an independent antenatal growth graph to improve the precision of the fetal measured weight. Repeated

measurements of foetal AC with sensitivity of 84 % and specificity of 100% predicted a birth weight > 90th percentile.⁸ Sonographic diagnosis is a specific and sensitive technique for the assessment of the fetal weight and consequently macrosomia. Abdominal circumference is vital parameter for Sonography for the prediction of macrosomic fetus and the big sized babies.¹⁶

Conclusion

Fetal abdominal circumference on ultrasonography found to be a valuable and noninvasive diagnostic technique for macrosomic infants with a sensitivity of 94.2% and specificity of 84%. Ultrasonography is a highly sensitive and reliable modality for diagnosing macrosomic infants, and has not only dramatically improved our ability to diagnose macrosomic infants but also be a simple, economical, and readily available modality. However, it is recommended that the pre-delivery ultrasonographic estimation of fetal weight can opt routinely in every term pregnant female for taking proper management decisions pre-operatively. Moreover, it can also help the clinicians for taking proper management plans for these particular infants in order to reduce perinatal morbidity and mortality.

Disclosure: This paper retracted from the FCPS dissertation. The Principal author was PG trainee in dept of Radiology Pakistan institute of medical Sciences, Islamabad.

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