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Accuracy of Polyhydramnios for Detection of Fetal Anomalies on Ultrasound

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ABSTRACT

***Objective*:** To determine the diagnostic accuracy of polyhydramnios for detecting fetal anomalies on ultrasound in singleton pregnancies.

Study Design: Cross-sectional study.

Place and Duration: Armed Forces Institute of Radiology and Imaging, Military Hospital, Rawalpindi Pakistan, from Oct 2018 to Apr 2019.

Methodology: A total of 145 pregnant females coming for antenatal/anomaly scans, aged 18 to 45 years, were included. All scans were obtained with a 3.5-5 MHz curvilinear transducer and obstetric settings of the ultrasound machine. AFI was calculated as the sum of the deepest, unobstructed, vertical length of each pocket of fluid measured in cm in all four quadrants and then added to the others. The radiologist observed fetal structural anomalies.

Results: Polyhydramnios was present in 15(10.34%) patients. The congenital fetal anomaly on ultrasound was present in 6(4.14%) cases. In polyhydramnios-positive patients, 05(3.4%) had a congenital fetal anomaly, and 10(6.8%) had no congenital fetal anomaly. Among 130 polyhydramnios-negative patients, 01(0.7%) had a congenital fetal anomaly, whereas 129(88.9%) had no congenital fetal anomaly. Overall sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of polyhydramnios for detecting fetal anomalies on ultrasound were 83.33%, 91.41%, 29.4%, 99.23% and 92.41%, respectively.

Conclusion: This study concluded that the diagnostic accuracy of polyhydramnios , significantly moderate to severe forms, is relatively high for detecting fetal anomalies on ultrasound.

Keywords: Fetal anomalies, Polyhydramnios, Ultrasonography.

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INTRODUCTION

The amniotic fluid, also known as the liquor, surrounds the fetus during intrauterine life and is essential for the progressive development of the fetus.[1] Sonographic assessment of amniotic fluid volume by four quadrant Amniotic Fluid Index (AFI) or single deepest vertical pocket (SDVP) is the method of choice for detecting amniotic fluid volume abnormalities and is part of the fetal biophysical profile.[2,3] It is estimated that 0.4-3.3% of all pregnancies have an excess amount of fluid meeting the criteria for polyhydramnios.[4] However, recent advances in antenatal fetal imaging, including detailed sonographic assessment for prenatal diagnosis of congenital fetal anomalies, have changed the relative frequency of these etiologies and significantly reduced the number of idiopathic cases, with fetal malformations and genetic anomalies now accounting for about 8-45 % of the cases among various populations.[5,6] Well-known malformations associated with polyhydramnios include gastrointestinal and central nervous system malformations.[7]

A study result shows the incidence of fetal anomalies associated with polyhydramnios to be 21.3% with a sensitivity of 87.3%, specificity of 99.5%, positive predictive value of 76.4% and negative predictive value of 99.5%.[8] This study aimed to propose sonographic detection of polyhydramnios and assessment of its severity as a warning sign for an underlying congenital fetal malformation, requiring a careful and focused ultrasonographic fetal assessment, thereby significantly improving fetal anomaly detection rate on prenatal imaging. Polyhydramnios should be considered as a warning for a radiologist for the presence of a sinister underlying congenital fetal anomaly.

METHODOLOGY

The cross-sectional study was conducted at the Armed Forces Institute of Radiology and Imaging, Military Hospital Rawalpindi after IERB approval (letter no-062) from October 2018 to April 2019. The

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sample size was calculated keeping a prevalence of polyhydramnios in singleton pregnancies as 3.3% with 87.3 % sensitivity and 99.5 % specificity of ultrasound to diagnose fetal structural anomalies in polyhydramnios.[1] The sample was collected using a non-probability, consecutive sampling technique.

Inclusion Criteria: Patients presenting to the Radiology Department for fetal anomaly scanning or routine antenatal ultrasound, aged 18 to 45 years, and having singleton pregnancies with a gestational age of 20 to 40 weeks, were included in the study**.**

Exclusion Criteria: Patients who were unsure of dates, irregular cycles, multiple gestations and patients on diuretics therapy, were excluded from the study.

All patients coming for antenatal ultrasonography examination for routine workup or follow-up scans, meeting our inclusion criteria, were enrolled for the acquisition study after taking informed written consent. Due respect was given to the patient, and the examination was conducted in a private and comfortable environment. All effect modifiers were excluded by keeping them in the exclusion criteria. All scans were obtained with a 3.5-5 MHz curvilinear transducer and obstetric settings of the ultrasound machine. AFI was calculated as the sum of the deepest, unobstructed, vertical length of each pocket of fluid measured in cm in all four quadrants and then added to the others. The radiologist observed fetal structural anomalies. Results were recorded on data collection performance.

Data were analyzed using Statistical Package for Social Sciences (SPSS) version 21:00. Quantitative variables were expressed as Mean±SD and qualitative variables were expressed as frequency and percentages. The 2 x 2 table was generated for sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of polyhydramnios for detecting congenital fetal anomalies.

RESULTS

One hundred forty-five patients with singleton pregnancies were subjected to sonographic examination. The age range in this study was from 18-45 years, with a mean age of 29.10±5.42 years. The mean gestational age was 29.01±3.77 weeks. Polyhydramnios was present in 15(10.34%) patients. The congenital fetal anomaly on ultrasound was present in 06(4.14%) cases. In polyhydramnios-positive patients, 05(3.4%) had a congenital fetal anomaly, and 10(6.8%) had no congenital fetal anomaly. Among 130 polyhydramnios-negative patients, 01(0.7%) had a congenital fetal anomaly, whereas 129(88.9%) had no congenital fetal anomaly (Table-I). Overall sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of polyhydramnios for detecting fetal anomalies on ultrasound were 83.33%, 92.81%, 29.4%, 99.23% and 92.41%, respectively (Table-II). The most frequently observed anomaly associated with polyhydramnios was neural tube defects (Table-III).

Table- I: Distribution Polyhydramnios for Detection of Fetal Anomalies (n=145)

		Congenital Fetal Anomaly on Ultrasound	
		Present	**Absent**
Polyhydramnios	Present	05 (TP)*	10 (FP)**
	Absent	01 (FN)***	129 (TN)****

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

Table-II: Diagnostic Accuracy of Polyhydramnios for Detection of Fetal Anomalies (n=145)

Sensitivity	83.33%
Specificity	91.41%
Positive Predictive Value (PPV)	29.41%
Negative Predictive Value (NPV)	99.23%
Diagnostic Accuracy	92.41%

Table-III: Distribution of Fetal Anomalies (n=145)

Central Nervous System	Anencephaly	01(TP)*
	Spina bifida	01(TP)*
Cardiovascular System	Hydrops fetalis	01(TP)*
Gastrointestinal System	Duodenal Atresia	01(TP)*
Musculoskeletal System	Diaphragmatic Hernia	01(TP)*
Genitourinary System	Multicystic dysplastic kidney	01(FN)**

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

DISCUSSION

The current literature describes polyhydramnios to complicate in 1.3 to 6.0% of singleton pregnancies.[9,10] The incidence of polyhydramnios in our study was 10.3%. A similar incidence of 10% has also been reported among patients from a previous study, which is close to our patient's data.[10] The similarity in the incidence between these two populations could be explained by similar socioeconomic dynamics and deficiency of structured primary health care setups for early detection and treatment.

Considering the degree of severity, our study reports mild polyhydramnios in 66.7% of cases and moderate to severe polyhydramnios in 33.3% of the patients. Another study reported 78.74% mild cases and 21.26% moderate to severe cases of polyhydramnios, comparable to our results.[11] Similar findings have also been reported in a local study by Shaikh

et al. observed mild polyhydramnios in 66.6%, moderate polyhydramnios in 23.3% and severe polyhydramnios in 10% of cases.[12]

Although considered idiopathic in 50% to 60% of cases, other etiological factors include gestational diabetes mellitus, multiparty, chromosomal aberrations and congenital structural defects such as neural tube defects or musculoskeletal disorders, fetal anaemia leading to hydrops fetalis and gastrointestinal malformation.[13] The most common cause in our study was idiopathy, accounting for 46.6% of cases; 20% were attributable to maternal causes, including gestational diabetes, and 33.3% were due to congenital fetal anomalies. Hamza *et al*. also reported that the incidence of gestational diabetes-associated polyhydramnios is 26%, with up to 45% of cases associated with anomalous fetuses.[14]

Most of our patients belonged to the younger age group, with 61% of patients under 30. However, the overall incidence of polyhydramnios was slightly greater, up to 53.3 % among patients above 30 years of age, compared to 46.6% in patients under 30 years. This slight discrepancy can be accounted for by the increased risk of developing gestational diabetes, with advancing maternal age as a contributory factor. This is in keeping with the findings of Baksh *et al*., reported no significant effect of maternal age on the incidence or degree of polyhydramnios, however, reports diabetes mellitus and gestational diabetes as the most significant maternal risk factor for the development of this condition.[15] In our study, congenital fetal abnormalities were seen in 33.3% of cases, most associated with moderate to severe polyhydramnios. The most common congenital fetal anomaly in our study was neural tube defects, including anencephaly and spina bifida. Different to our study, Walter et al. reported congenital diaphragmatic hernia as the single most common isolated anomaly in 41.7% of cases, while cardiac malformations were noted in 29.2% of cases.[16]

Overall, diagnostic accuracy in our study was 92.41%, with sensitivity, specificity, positive predictive value and negative predictive value of polyhydramnios for detecting fetal anomalies of 83.3%, 91.41%, 29.4% and 99.2%, respectively. Eshiba *et al*. have reported the overall diagnostic accuracy using sonographic methods to be 76%, with diagnostic accuracy reaching up to 100% when combined with MRI.[17]

One of the studies reports the diagnostic accuracy of ultrasound to be comparable to MRI assessment for non-central nervous system anomalies with a sensitivity of 72.2%, specificity of 92.2%, and a higher false positive rate for subtle central nervous system ano-malies by MRI.[18] Pardy *et al*. has reported sensitivity of 89.9% and specificity of 99.6% for oesophagal atresia with polyhydramnios present in 56.6% cases.[19]

LIMITATION OF STUDY

Nevertheless, certain limitations to the study were also observed. Firstly, the sonographic calculation of AFI was not considered against gestational age-specific values. Secondly, patients were not followed up postnatally for confirmation of anomalies.

CONCLUSION

This study concluded that the diagnostic accuracy of polyhydramnios for detecting fetal anomalies on ultrasound is relatively high. We recommend that sonographic detection of polyhydramnios and assessment of its severity should be used as a warning sign for an underlying congenital fetal malformation, requiring a careful and focused ultrasonographic fetal assessment, thereby significantly improving fetal anomaly detection rate on prenatal imaging.

Conflict of Interest: None.

Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

IM & SA: Data analysis, drafting the manuscript, critical review, approval of the final version to be published.

IA: Study design, drafting the manuscript, data interpretation, critical review, approval of the final version to be published.

SA & PH: Critical review, concept, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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