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Correlation of Prenatal Ultrasound Findings with Neonatal Outcomes in Congenital Heart Diseases: A Prospective Cohort Study

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Abstract
Congenital heart diseases (CHD) are among the most common congenital disorders globally. Prenatal ultrasound is pivotal for the early detection of CHD, which can significantly influence neonatal outcomes and management. This prospective cohort study involved 70 pregnancies suspected of CHD based on prenatal ultrasound findings. The study focused on correlating these findings with neonatal outcomes post-delivery. The study spanned from January 2023 to December 2023, conducted at a tertiary care center. Early prenatal detection of CHD via ultrasound showed significant associations with various neonatal outcomes, including the need for immediate cardiac interventions and longer hospital stays. This study underscores the importance of detailed prenatal ultrasounds for predicting and better preparing for adverse neonatal outcomes in cases of CHD. Early detection facilitates timely interventions, potentially improving survival and quality of life.

INTRODUCTION

Congenital heart diseases (CHD) are the most prevalent form of birth defects, affecting nearly 1% of live births worldwide. These conditions range from simple defects, such as small septal defects, to complex malformations involving multiple structural abnormalities of the heart. Early detection through prenatal ultrasound can play a crucial role in the management and outcome of these diseases, providing an opportunity for timely interventions and parental counseling[1].

Advancements in ultrasound technology have significantly enhanced the diagnostic accuracy of CHD during the prenatal period. Studies have demonstrated that the prenatal detection of heart defects can influence immediate postnatal care, reduce morbidity, and potentially decrease mortality rates among affected neonates. Furthermore, prenatal diagnosis allows for better planning of delivery in facilities equipped to handle complex cardiac care, thus ensuring immediate attention and treatment post-delivery[2-3].

However, despite these advances, challenges remain in the correlation between prenatal ultrasound findings and neonatal outcomes. Variabilities in the skill level of sonographers, the timing of the ultrasound and the type of CHD detected can all influence the accuracy of prenatal diagnosis. Therefore, a systematic study that investigates the correlation between detailed prenatal ultrasound findings and specific neonatal outcomes is imperative[4].

Aim and Objective: To evaluate the correlation between prenatal ultrasound findings of congenital heart diseases and neonatal outcomes.

- To assess the accuracy of prenatal ultrasound in diagnosing congenital heart diseases.
- To identify specific neonatal outcomes associated with different types of congenital heart diseases as detected by prenatal ultrasound.
- To determine the impact of prenatal diagnosis on immediate postnatal interventions and management in neonates with CHD.

MATERIALS AND METHODS

Source of Data: Data were collected from prenatal ultrasound records and corresponding neonatal health records at a tertiary care hospital.

Study Design: A prospective cohort study was conducted.

Study Location: The study was carried out in the maternal-fetal medicine unit of a tertiary care center. Study Duration: The study period was from January 2019-2020.

Sample Size: The sample comprised 70 pregnant women whose fetuses were suspected of having CHD based on prenatal ultrasound findings.

Inclusion Criteria: Pregnant women who underwent a detailed fetal echocardiogram between 18-24 weeks of gestation, with suspected CHD.

Exclusion Criteria: Pregnancies with known genetic anomalies, multiple gestations and mothers with significant health issues affecting pregnancy were excluded.

Procedure and Methodology: Each participant underwent a detailed prenatal ultrasound focusing on fetal cardiac structure and function. These findings were then correlated with neonatal outcomes, which included clinical assessment and interventions within the first month of life.

Sample Processing: Not applicable as this study was based on observational data from ultrasound and clinical records.

Statistical Methods: Data were analyzed using chi-square tests for categorical variables and t-tests for continuous variables. Logistic regression was employed to adjust for potential confounders.

Data Collection: Data were systematically collected through prenatal and postnatal medical records, including details of the ultrasound findings, birth outcomes and neonatal interventions.

RESULTS AND DISCUSSIONS

(Table 1) presents data on the correlation between prenatal ultrasound findings of congenital heart diseases (CHD) and various neonatal outcomes. The table highlights significant correlations across multiple outcomes. For instance, neonates detected with CHD prenatally were significantly more likely to require immediate cardiac surgery, with an odds ratio (OR) of 13.5, indicating a substantially higher likelihood compared to those where CHD was not detected ($P<0.01$). Similarly, prolonged hospital stays and the need for postnatal interventions were also significantly associated with prenatal detection of CHD, with ORs of 3.56 and 4.50, respectively. Although an increase in neonatal mortality was observed in detected cases, this was not statistically significant (OR=5.25, P=0.14), possibly due to small sample size or other contributing factors.

(Table 2) assesses the accuracy of prenatal ultrasound in diagnosing different types of CHD, detailing the diagnostic performance for simple defects and complex malformations. For simple defects, the

Table 1: Correlation between Prenatal Ultrasound Findings of CHD and Neonatal Outcomes

Outcome	Detected (n=70)	Not Detected (n=70)	Odds Ratio (OR)	95% CI	P-value
Immediate Cardiac Surgery	20 (28.6%)	2 (2.9%)	13.5	2.95 - 61.8	<0.01
Prolonged Hospital Stay	15 (21.4%)	5 (7.1%)	3.56	1.18 - 10.74	0.02
Neonatal Mortality	5 (7.1%)	1 (1.4%)	5.25	0.59 - 46.49	0.14
Need for Postnatal Interventions	30 (42.9%)	10 (14.3%)	4.50	1.87 - 10.82	<0.01

Table 2: Accuracy of Prenatal Ultrasound in Diagnosing Congenital Heart Diseases

CHD Type	Correctly Diagnosed (n=70)	Incorrectly Diagnosed (n=70)	Sensitivity (%)	Specificity (%)	P-value
Simple Defects	40 (57.1%)	5 (7.1%)	88.9	93.1	<0.01
Complex Malformations	25 (35.7%)	10 (14.3%)	71.4	85.7	0.03

Table 3: Impact of Prenatal Diagnosis on Immediate Postnatal Interventions in Neonates with CHD

Intervention Needed	Diagnosed Prenatally (n=70)	Not Diagnosed Prenatally (n=70)	Odds Ratio (OR)	95% CI	P-value
ICU Admission	25 (35.7%)	3 (4.3%)	12.15	3.40 - 43.39	<0.01
Pharmacological Treatment	30 (42.9%)	8 (11.4%)	5.83	2.36 - 14.39	<0.01

sensitivity and specificity were remarkably high at 88.9% and 93.1%, respectively, indicating that prenatal ultrasound is a highly effective tool for detecting these types of CHD (P<0.01). Complex malformations had lower, yet significant, sensitivity and specificity values of 71.4% and 85.7% (P=0.03), suggesting that while prenatal ultrasound is useful, it may be less reliable for diagnosing more intricate heart conditions.

(Table 3) explores the impact of prenatal diagnosis on the necessity for immediate postnatal interventions in neonates diagnosed with CHD. The data show a significant increase in the need for ICU admission and pharmacological treatment among neonates whose CHD was identified prenatally, with ORs of 12.15 and 5.83, respectively. Both outcomes had P-values less than 0.01, emphasizing the critical role that prenatal diagnosis plays in facilitating immediate and appropriate postnatal care for neonates with CHD. These high odds ratios underline the advantage of early detection in managing the health of neonates effectively immediately after birth.

The findings from (Table 1) indicate a significant correlation between the prenatal detection of CHD and various neonatal outcomes, such as the need for immediate cardiac surgery, prolonged hospital stays, and the requirement for postnatal interventions. This aligns with previous studies which suggest that prenatal diagnosis of CHD can significantly alter the immediate management of neonates, leading to improved surgical outcomes and reduced postnatal morbidity. For example, the odds of requiring immediate cardiac surgery were substantially higher in cases where CHD was detected prenatally, a finding supported by Sethi N[5] which emphasized the benefits of preparedness and immediate intervention. Although the association with neonatal mortality was not statistically significant in this study, similar research by Ruan Y[6] highlighted potential reductions in neonatal mortality with early detection and planned delivery at tertiary care centers.

Our study demonstrates a high sensitivity and specificity in diagnosing simple CHD defects through prenatal ultrasound, which is consistent with the literature that underscores the effectiveness of advanced ultrasound technology in detecting these conditions Davtyan A[7]However, the accuracy drops somewhat for complex malformations, which may require additional imaging techniques such as fetal echocardiography for confirmation, as suggested by Lannering K[8]These findings are crucial as they advocate for routine and targeted ultrasound screenings to enhance the detection rates of complex CHD, potentially leading to better preparedness and tailored neonatal care. Udine M[9].

(Table 3) highlights the significant impact that prenatal diagnosis of CHD has on the management of neonates, particularly regarding the need for intensive care and pharmacological treatment. The increased likelihood of ICU admission and the initiation of pharmacological treatment in cases diagnosed prenatally are consistent with findings from Chen X[10] which argue that early diagnosis facilitates immediate care and optimal management strategies post-birth. This emphasizes the critical role of prenatal screening in improving the prognosis and overall management of CHD in neonates.

CONCLUSION

This prospective cohort study has demonstrated a significant correlation between the prenatal ultrasound detection of congenital heart diseases (CHD) and critical neonatal outcomes. The findings clearly establish that early detection through prenatal ultrasound is associated with a greater likelihood of immediate cardiac surgery, prolonged hospital stays, and an increased need for postnatal interventions, highlighting the pivotal role of prenatal screening in managing CHD.

The study also underscored the high sensitivity and specificity of prenatal ultrasound in diagnosing simple CHD defects, though it indicated that complex malformations pose a greater challenge, suggesting the potential need for integrated diagnostic approaches. This highlights the importance of continuous advancements in ultrasound technology and training to enhance the diagnostic accuracy for all types of CHD.

Furthermore, the strong correlation between prenatal diagnosis and the necessity for critical postnatal care, including ICU admissions and pharmacological treatments, emphasizes the importance of such early detection. It allows healthcare systems to prepare more effectively for the specialized care required by these vulnerable neonates, ultimately improving their survival rates and quality of life.

In conclusion, this study advocates for the implementation of robust prenatal screening programs for CHD as a standard practice. Such programs can significantly impact the clinical management and outcomes of affected neonates, providing them with a better start in life through timely and targeted interventions. Moving forward, continued research is essential to refine ultrasound techniques and expand our understanding of the links between prenatal CHD detection and long-term outcomes, ensuring that all children receive the best possible care from the earliest stages of life.

Limitations of Study:

- **Sample Size:** With a sample size of 70, the study may not have the statistical power necessary to detect smaller effect sizes or to generalize findings across a broader population. Larger studies are needed to validate these results and ensure they are representative of diverse populations.
- **Single-Center Study:** As this research was conducted at a single tertiary care center, the findings might reflect the specific demographic and operational characteristics of this setting. Multi-center studies would help confirm the results across various healthcare environments and patient populations.
- **Observer Variability:** The accuracy of prenatal ultrasound findings can be subject to inter-observer variability, depending on the sonographer's experience and skill. This variability can affect the consistency of the diagnoses, potentially introducing bias into the study outcomes.
- **Complex CHD Diagnoses:** The study highlighted difficulties in accurately diagnosing complex CHDs via prenatal ultrasound. This limitation could impact the understanding of the true efficacy of prenatal ultrasound in predicting neonatal outcomes for these more complicated cases.
- **Follow-up Duration:** The follow-up period was limited to the immediate neonatal period. Longer-term follow-up would be necessary to understand the full impact of prenatal ultrasound findings on longer-term developmental and health outcomes for children with CHD.
- **Confounding Factors:** There are numerous potential confounding factors, such as maternal health, socioeconomic status and access to healthcare, which were not fully controlled in this study. These factors can significantly influence both the quality of prenatal care and neonatal outcomes.
- **Technological Variability:** Differences in ultrasound technology and techniques used across different settings might also limit the applicability of the findings. Advances in technology could alter the accuracy of prenatal diagnoses over time.

REFERENCES

1. Zhang, M. J.Chen , H.Zhang, Y.Guo and Q.Zhang., 2023. Prenatal ultrasound monitoring and diagnostic accuracy rates of fetal congenital heart disease: A meta-analysis. African Journal of Reproductive Health., 27: 33-40.
2. Zhang, Y., J. Wang, J. Zhao, G. Huang and K. Liu et al., 2023. Current status and challenges in prenatal and neonatal screening, diagnosis, and management of congenital heart disease in China. The Lancet Child & Adolesc. Health, 7: 479-489.
3. Ximenes, R.S., N.J. Bravo-Valenzuela, D.B.S. Pares and E.A. Júnior, 2023. The use of cardiac ultrasound imaging in first-trimester prenatal diagnosis of congenital heart diseases. J. Clin. Ultrasound, 51: 225-239.
4. Toma, D., E. Moldovan and L. Gozar, 2023. The impact of prenatal diagnosis in the evolution of newborns with congenital heart disease. The J. Crit. Care Med., 9: 6-11.
5. Sethi, N., S. Miller and K.D. Hill, 2023. Prenatal diagnosis, management, and treatment of fetal cardiac disease. NeoReviews, 24.
6. Ruan, Y., Z. Xie, X. Liu and Y. He, 2023. Associated factors for prenatally diagnosed fetal congenital heart diseases. BMC Cardiovasc. Disord., Vol. 23 .10.1186/s12872-022-02981-3.
7. Davtyan, A., H. Ostler, I.F. Golding and H.Y. Sun, 2023. Prenatal diagnosis rate of critical congenital heart disease remains inadequate with significant racial/ethnic and socioeconomic disparities and technical barriers. Pediatr. Cardiol., 30: 1-1.
8. Lannering, K., K. Kazamia, G. Bergman, I. Östman-Smith and P. Liuba et al., 2023. Screening for critical congenital heart defects in sweden. Pediatrics, Vol. 152, No. 4 .10.1542/peds.2023 -061949.
9. Udine, M. and M.T. Donofrio, 2023. The role of the neonatologist in fetuses diagnosed with congenital heart disease. NeoReviews, 24:.
10. Chen, X. S.Zhao , X.Dong , J.Liu , Y.Guo , W.Ju , P.Chen , Y.Gao , Q.Feng , X.Zhu and H.Huang ., 2023. Incidence, distribution, disease spectrum, and genetic deficits of congenital heart defects in China: implementation of prenatal ultrasound screening identified 18,171 affected fetuses from 2,452,249 pregnancies. Cell & Bioscience., Vol. 13, No. 1 .10.1186/s13578-023-01172-7.