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Impact of Fetal Echocardiography on Altering Course of Action Following A Prenatal Diagnosis of Congenital Heart Disease-A Thought Analysis

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ABSTRACT

Objective: To assess the impact of fetal echocardiography in altering the course of action for neonatal cardiac expertise and services available in Pakistan following an antenatal diagnosis of congenital heart defect (CHD).

Study Design: Cross-sectional study.

Place and Duration of Study: Pediatric Cardiology Unit, Armed Forces Institute of Cardiology & National Institute of Heart Diseases, Rawalpindi Pakistan, from Feb 2020 to Sep 2021.

Methodology: Fetuses aged 18 to 38 weeks of gestational age referred to the Pediatric Cardiac Unit due to risk of or suspicion of congenital heart disease underwent fetal cardiac echo. Data were collected and reviewed retrospectively to seek any impact of the antenatal diagnosis on post-natal planning.

Results: The mean age of the mothers was 29.79±5.24 years (range, 17-47 years), and the mean gestational age at which the fetal echocardiography examination was performed was 27.29±4.47weeks (range: 12–38 years). Of the 609 pregnancies, fetal echocardiogram evaluation was performed, and sixty-three (10.3%) fetal echocardiograms were abnormal. Of the 63, only 06(9.5%) returned to the neonatal cardiac unit for follow-up and treatment in the first ten days of life.

Conclusion: The real impact of fetal echocardiography is possible only with the availability of well-developed, readily accessible fetal and neonatal cardiac services. Poverty and a struggling healthcare infrastructure confound the benefits.

Keywords: Cardiac anomaly, Fetal echocardiography, Neonatal cardiac care.

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INTRODUCTION

Fetal echocardiogram was introduced as part of the arsenal of antenatal care in 1964. It has become a necessary part of antenatal anomaly scans in a certain category of pregnant women.[1] It has resulted in an increased frequency of prenatal congenital heart defect (CHD) diagnosis and has changed the disease patterns observed in the neonate.[2,3] Almost 6-8% of neonates are born with cardiac defects every year, which is higher if minor cardiac defects are included.[4,5] Out of these,1 in 4 are critical heart lesions, which require support and treatment immediately after birth.[6]

Hence, the fetal echocardiogram is done at 22-24 weeks to get adequate ultrasound exposure and for an early intrauterine fetal intervention when possible to salvage the pregnancy.[7,8]

In low-income countries, the situation is very different. The client is poor, and the infrastructure needs to be more reliable and structured referral systems barely exist.[9] Lastly, most poorly resourced countries need to have the expertise to use the early detection of a fetal cardiac anomaly. The primary reason for a fetal echo in low or middle-income countries is to optimize delivery conditions.[10] The unfortunate client can barely be offered any treatment in the antenatal period. Therefore, this study was done in a quaternary care cardiac centre to see the impact of fetal echocardiograms on subsequent fetal and early neonatal care.

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METHODOLOGY

The cross-sectional study was conducted at the Pediatric Cardiology Unit at the Armed Forces Institute of Cardiology & National Institute of Heart Diseases, Rawalpindi Pakistan, from February 2020 to September 2021. Institutional Ethical Review Board (ERC/IERB) permission was taken (ERC/IERB certificate number: 3/22).

Inclusion Criteria: All the mothers being referred to our centre for suspicion or with risk of CHD from various obstetrical units were included in the study (fetal age ranged from 18 weeks to 38 weeks of gestation).

Exclusion Criteria: Mothers who presented at less than 18 weeks of gestation were excluded from the study.

Fetal hearts were examined by two-dimensional, pulsed wave and colour Doppler echocardiographic methods using Phillips IE 33 cardiovascular ultrasound system. All pregnant women whose fetal echo detected congenital heart defects were advised to deliver in an affiliated obstetrical unit and to return to the Pediatric cardiac unit within the first ten days of neonatal life for further evaluation and care. Data was collected from computer-recorded entries and reviewed retrospectively to seek any impact of the antenatal diagnosis on post-natal planning.

Data were analyzed using Statistical Package for the Social Sciences (SPSS) version 23.00 and MS Excel 2016 software. Mean±SD was calculated for the continuous variable. In addition, frequency and percentage were calculated for categorical variables.

RESULTS

The mean age of the mothers was 29.79±5.24 years (range, 17- 47 years), and the mean gestational age at which the fetal echocardiography examination was performed was 27.29±4.47 weeks (range of 12–38 Years). Of the 609 pregnancies, fetal echocardiogram evaluation was performed, 284(46.64%) mothers' examinations were performed up to the 27th week of pregnancy, while 325(53.36%) were performed after the 27th week of pregnancy. Out of 284 patients, only 23 (8.09%) fetal echoes had any abnormal findings up to the 27th week of pregnancy and out of 325 patients, 40(12.30%) fetal echoes detected abnormalities. The abnormalities are shown in Table-I.

Table-I: Frequency of Positive Fetal Echoes case according to Week Group (n=63)

Abnormalities	Week Groups	
	up to the 27th week (n=23)	after the 27th week (n=40)
Ventricular Septal Defect/ Atrial Septal Defect	4(17.39%)	4(10.00%)
Transposition of the Great Arteries	0	2(5.00%)
Tetralogy of Fallot/ Double Outlet Right Ventricle	0	4(10.00%)
Hypertrophy of Left Heart Syndrome	2(8.70%)	1(2.50%)
Arrhythmias	2(8.70%)	2(5.00%)
Atrio Ventricular Septal Defect	0	4(10.00%)
Indeterminate	7(30.43%)	4(10.00%)
Left Ventricular Hypertrophy	3(13.04%)	6(15.00%)
Pericardial Effusion	0	3(7.50%)
Univentricular Heart	5(21.71%)	10(25.00%)

Out of the 63 fetal, only 06(9.52%) returned to the neonatal cardiac unit for follow-up and treatment in the first ten days of life. Four abnormalities were closed mid-muscular VSD, Hypertrophic obstructive cardiomyopathy, mildly dilated RV and small ASD secundum and a restrictive mid-muscular VSD/ closing PDA/PFO. In addition, two neonates were rechecked because of fetal echo suspicion of a small VSD; The neonatal echoes were normal, and 57(90.48%) were no re returned in the first ten days of life to the neonatal cardiac unit for follow-up and treatment. A statistically significant association (p< 0.001) (Table-II).

Table-II: Association of the Neonatal Cardiac Unit for Follow up in First 10 Days Positive on Antenatal scan (n=609)

Positive on Antenatal scan	Follow up in First 10 Days		*p*-value
	Yes	No	
Yes(n=63)	6(9.52%)	57(90.48%)	<0.001
No(n=546)	0	546(100%)	

DISCUSSION

The fetal heart starts to develop as early as the fourth week of life, and by the ninth week, it has fully formed. Some anomalies develop early on, and some progress further to cause heart dysfunction, e.g. severe aortic stenosis progressing to HLHS (hypertrophic left heart syndrome).[11] Only 30 to 50% of cardiac defects are detected in anomaly scans in developed countries.[12] The most important lesions are the critical ones requiring urgent intervention post-delivery. Critical Cardiac Heart Disease can be further classified into three different types of lesions: right heart obstructive lesions, left heart obstructive lesions, and mixing lesions. Out of the different fetal cardiac anomalies, ¼ th are critical lesions .[13]

The current protocols for fetal echocardiography are based on the premise that early in-utero interventions may prevent the fetal cardiac lesion from progressing into a severe form or better prepare the neonatal team for receiving the baby. In addition, the in-utero transfer of a sick fetus is better than a post-natal transfer to a specialist unit for further care. This protocol sits well in high-income countries with adequate resources, robust referral systems, and a vigorous feto-maternal speciality that offers timely intrauterine interventions to affected pregnancies. [14]

In a country like Pakistan, the situation is very different. The healthcare system faces multiple challenges. Specialized care for Congenital and Paediatric heart disease is only in a handful of hospitals in major cities.[15] The referral system and agreed protocols for

Fetal echocardiograms need to be detailed. No intrauterine treatment can be offered to stabilize a fetal heart if the cardiac anomaly falls in that category. Obstetricians, as well as radiologists, both refer patients as per requirement.

The average pregnant patient is also from the low socioeconomic group, who already finds it hard to go through the rigours of a regular antenatal check-up.[14] Most of the population depends upon the basic health units for care or the private sector.[14,15] Therefore, they must travel from deep inland to tertiary/quaternary specialized centres for a fetal echocardiogram. This means considerable financial and logistic constraints for the couple. So, many have it done when they can, and many cannot come back for a follow-up. Still, others cannot be at a tertiary care facility for the delivery of an affected fetus, mainly for similar reasons. Similar observations were made by Kumar *et al*. of Amrita Institute of Medical Sciences and Research Centre, Kochi, Kerala, India**,** about the health infrastructure of this part of the world .[16]

The reasons and impact of a fetal echocardiogram seem to be different in a low-income country like Pakistan. Many fetuses with serious lesions do not get through the pregnancy because of intrauterine death. Religious convictions usually prevent couples from seeking termination beyond 20 weeks of gestation despite no treatment offered.[17] So an early fetal echo during the recommended 18-22 weeks has very little influence on the management plan. There are sometimes terminations if there are mid-trimester non-immune hydrops fetalis with polyhydramnios to prevent a difficult delivery later in the pregnancy. This sequence of events does not need a fetal echo also. In most European countries, the legal terms can be done up to 24 weeks of gestation. In Pakistan, the upper limit of legal termination is 20 weeks, though the medical termination of pregnancy (MTP) rules are somewhat flexible in this part of the world.[18]

In our study, the most obvious result is that more anomalies were detected in the third trimester. This was either because of the bigger size of the fetus and hence the heart or due to a progressive disease which made the lesion more visible.

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LIMITATIONS OF STUDY

Details of research as to why the patients did not use the fetal echo results to plan their delivery better is beyond the scope of this study and is its limitation.

CONCLUSION

With fetal echocardiography, a prenatal diagnosis of CHD can be made with reasonable accuracy. However, the belief that diagnosis of heart lesions in the fetus helps in the timely management of the newborn in a neonatal cardiac care centre has little meaning without ancillary support. This means a countrywide standard fetal registry program, widely available fetal echo facilities and robust fetal medicine training with in-utero intervention. Until then, fetal echo guidelines can be more suitable to our ground realities so that maximum feto-maternal benefit can be extracted.

Conflict of Interest: None.

Authors' Contribution

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

AAK: & AA: Study design, data analysis, drafting the manuscript, critical review, approval of the final version to be published.

KA: Data acquisition, interpretation of data, approval of the final version to be published.

SK: & UY: Conception, interpretation of data, drafting the manu-script, approval of the final version to be published.

JKK: Data acquisition, interpretation of data, 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.

REFERENCES

1. Kumar S, Lodge J. Prenatal therapy for fetal cardiac disorders. J Matern Fetal Neonatal Med 2019; 32(22): 3871-3881. doi: 10.1080/14767058.2018.1472224.
2. Maulik D, Nanda NC, Maulik D, Vilchez G. A brief history of fetal echocardiography and its impact on the management of congenital heart disease. Echocardiography 2017; 34(12): 1760-1767. doi: 10.1111/echo.13713. Erratum in: Echocardiography. 2018; 35(4): 581.
3. Li YF, Zhou KY, Fang J, Wang C, Hua YM, Mu DZ. Efficacy of prenatal diagnosis of major congenital heart disease on perinatal management and perioperative mortality: a meta-analysis. World J Pediatr 2016; 12(3): 298-307. doi: 10.1007/s12519-016-0016-z.
4. Han B, Tang Y, Qu X, Deng C, Wang X, Li J, et al. Comparison of the 1-year survival rate in infants with congenital heart disease diagnosed by prenatal and postnatal ultrasound: A retrospective study. Medicine (Baltimore) 2021; 100(4): e23325. doi: 10.1097/MD.0000000000023325.
5. Weissmann-Brenner A, Domniz N, Meyer R, Weissbach T, Elkan T, Salem Y, et al. Delivery Outcome of Fetuses with Congenital Heart Disease-Is It Influenced by Prenatal Diagnosis? J Clin Med 2022; 11(14): 4075. doi: 10.3390/jcm11144075.
6. Satomi G. Guidelines for fetal echocardiography. Pediatr Int 2015; 57(1): 1-21. doi: 10.1111/ped.12467.
7. Premani Z, Mithani Z. Analysis of the health care system of Pakistan: lessons learnt and way forward. J Ayub Med Coll Abbottabad 2016; 28(3): 601–604.

8. Zhang X, Sun Y, Zhu J, Zhu Y, Qiu L. Epidemiology, prenatal diagnosis, and neonatal outcomes of congenital heart defects in eastern China: a hospital-based multicenter study. BMC Pediatr 2020; 20(1): 416. doi: 10.1186/s12887-020-02313-4.
9. Zhang YF, Zeng XL, Zhao EF, Lu HW. Diagnostic Value of Fetal Echocardiography for Congenital Heart Disease: A Systematic Review and Meta-Analysis. Medicine (Baltimore) 2015; 94(42): e1759. doi: 10.1097/MD.0000000000001759.
10. Kulkarni S. Does fetal echo help the fetus? Ann Pediatr Cardiol 2013; 6(1): 21-23.
11. Patel N, Narasimhan E. Fetal Cardiac US: Techniques and Normal Anatomy Correlated with Adult CT and MR Imaging. Radio 2017; 37(4): 1290-1303. doi: 10.1148/ rg.2017160126.
12. Fratto VM, Chang A, Anton T, Sun HY, Lamale-Smith LM, Pretorius DH. Detailed Fetal Anatomic Ultrasound Examination: Effect of the 2014 Consensus Report on a Tertiary Referral Center. Ultrasound Q 2019; 35(1): 21-29. doi: 10.1097/RUQ. 0000000000000392.
13. van Nisselrooij AEL, Teunissen AKK, Clur SA, Rozendaal L. Why are congenital heart defects being missed? Ultrasound Obstet Gynecol 2020; 55(6): 747-757. doi: 10.1002/uog.20358.
14. Feroz A, Perveen S, Aftab W. Role of mHealth applications for improving antenatal and postnatal care in low and middle income countries: a systematic review. BMC Health Serv Res 2017; 17(1): 704. doi: 10.1186/s12913-017-2664-7.
15. Levy DJ, Pretorius DH, Rothman A, Gonzales M, Rao C, Nunes ME, et al. Improved prenatal detection of congenital heart disease in an integrated health care system. Pediatr Cardiol 2013; 34(3): 670-679. doi: 10.1007/s00246-012-0526-y.
16. Kumar RK. Screening for congenital heart disease in India: Rationale, practical challenges, and pragmatic strategies. Ann Pediatr Cardiol 2016; 9(2): 111-114. doi: 10.4103/0974-2069.181499.
17. Vaidyanathan B, Sathish G, Mohanan ST, Sundaram KR, Warrier KK, Kumar RK. Clinical screening for Congenital heart disease at birth: a prospective study in a community hospital in Kerala. Indian Pediatr 2011 ; 48(1): 25-30. doi: 10.1007/s13312-011-0021-1.
18. Holland BJ, Myers JA, Woods CR Jr. Prenatal diagnosis of critical congenital heart disease reduces risk of death from cardiovascular compromise prior to planned neonatal cardiac surgery: a meta-analysis. Ultrasound Obstet Gynecol 2015 ; 45(6): 631-638. doi: 10.1002/uog.14882.

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