FETAL ECHOCARDIOGRAPHY: 12 YEARS EXPERIENCE AT AFIC /NIHD

Hajira Akbar, Asma Ansari*, Sadaf Nawaz, Hafsa Khalil, Khurram Akhter, Amjad Mehmood, Nadeem Sadiq, Mehboob Sultan***, Shahid Nafees**

Armed Forces Institute of Cardiology/National Institute of Heart Disease (AFIC/NIHD)/National University of Medical Sciences (NUMS) Rawalpindi Pakistan, *Combined Military Hospital/National University of Medical Sciences (NUMS) Rawalpindi Pakistan, **Combined Military Hospital Giligit/National University of Medical Sciences (NUMS) Pakistan, ***Army Cardiac Center Lahore/ National University of Medical Sciences (NUMS) Pakistan

ABSTRACT

Objective: To determine the frequency of congenital cardiac lesions in pregnant women reporting for fetal echocardiogram and correlate with obstetrical risk factors.

Study Design: Descriptive cross-sectional study.

Place and Duration of Study: To be conducted at pediatric cardiology and obstetrical unit of AFIC/NIHD and CMH Rawalpindi, from Jan 2009 to Jan 2020.

Methodology: Pregnant women referred for fetal echocardiogram from 19-49 years of age were enrolled. Echo was done between 20 to 36 weeks gestation. Primary outcome was the nature of cardiac lesion and gestation at diagnosis. Neonatal scan was done at follow up to confirm cardiac diagnosis. Secondary outcome was obstetrical risk factors which were the reason for referral. This included age consanguinity, family history, previous history of intrauterine death or early neonatal death, maternal and paternal diseases. Data was collected and analyzed n frequencies and percentage. Chi-square was applied for association between variable and *p*-valve 0.05 was considered significant.

Results: A total of n=967 pregnant women referred to outpatient department for fetal echocardiogram. Congenital cardiac lesion were detected in n=83 patients. Majority of patients had CAVSD (1.2%) CCAVB (1.2%) followed by ASD (1.1%) VSD (0.9%) Abnormal heart rate (0.8%) Single ventricle (0.3%). Most significant maternal age group was between 21 to 30 and 30-40 years (43.7 and 46.2%). Only 3% below 20 years and 6.7% above 40 years of age. Most important maternal risk factor was previous off spring 0.5% past family history 0.3% and abnormal obstetrical ultrasound 0.3% Followed by maternal diabetes 0.1% and maternal hypertension 0.1%. The yield of detection of congenital cardiac lesions was 8.3%.

Conclusions: Congenital cardiac diseases are the second most common congenital anomaly and huge burden n pediatric population. Timely diagnosis and referral can be lifesaving.

Keywords: Congenital heart diseases, Fetal echocardiogram, Obstetrical risks.

INTRODUCTON

Congenital cardiac defects are reported as 0.8% per 1000 live births and accounts for 27 per 1000 still births with serious congenital cardiac lesions[13]. Most of the complex lesions requires intervention of some form in first year of life. Fetal echocardiography is a useful analytical tool for detection of congenital cardiac diseases. The advances in early diagnosis and timely referral to tertiary care hospital have been tremendously helpful in detection and management of congenital heart diseases[5]. A large number of patents report to obstetrics and pediatric cardiology departments with a variety of abnormal findings and often necessitate the need of detailed fetal echocardiogram[17]. It can be carried out at 22 weeks and 32 weeks gestation but due to recent advances in echocardiography equipment and improved operator skills early fetal cardiac structure, fetal cardiac rhythm and doppler evaluation at 20 weeks can be done as well but requires a follow up neonatal scan.

A Large group of pregnant women belonging to high risk group of pregnancy require timely detection of congenital heart defects rhythm disturbances and developmental progress.

Correspondence: Dr Hajira Akbar, Department of Cardiology, AFIC/NIHD Rawalpindi Pakistan

Fetal echocardiogram when combined with an anomaly scan and relevant biochemical investigations; e: Alpha fetoprotein levels and nuchal translucency evaluation is a reliable tool for decision management for obstretcians and parents. A variety of protocol scans are done and our study followed the laid down guidelines[2,12]. Which include BCEE, ECEE, 3VV, RVOT, LVOT views with reported 98.8% specificity and sensitivity 97.6%.

Fetal cardiac diseases detected at an early age result in better obstetrical care; planning modes of delivery 'offering therapeutic options and counseling of patents regarding termination of pregnancy. Mothers who have had repeated abortions 'early neonatal deaths and intrauterine deaths are undergoing immense emotional and social burden regarding motherhood experience. The information of having a normal fetal well-being result brings tremendous joy and elevates the mental health status of pregnant women. A large cohort of women with prosthetic valves having taken Warfarin therapy are also benefitting from early diagnosis and follow up neonatal scan faculty.

METHODOLOGY

After permission of ethics review committee we carried out fetal echocardiogram at our institute from 2009 to 2020 according to the guidelines' of American institute of ultrasound and medics (AUM) and international society of ultrasound obstetrics and gynecology[2]. Women who were primarily screened by radiologists and obstetricians and referred to our department for fetal anatomical study from 20 weeks to 36 weeks 'gestation. We excluded the women with gross fetal anomalies like anencephaly 'limbdeformities. We included the women with echogenic mass in LV' abnormal two vessel view and choroid plexus. A total of 967 pregnancies were screened using GE Toshiba S9 echocardiography machine and pulps E 33 echocardiography machine. The following 11 echocardiographic planes: (1) abdominal view; (2) four chamber view; (3) five-chamber view; (4) three-vessel view; (5) three-vessel and trachea view; (6) transverseaortic arch; (7) long axis of the ductal arch; (8) long axis of the aortic arch; (9) long caval view; (10) left ventricular outflow tract (LVOT); and (11) short axis view of the great vessels were obtained and shown in fig-1. Fetal heart rate was calculated with M mode. P/W C/W and color Doppler we applied and measurments taken of various chambers. Maternal and paternal risk factors were calculated. Repeat 32 weeps scan was done in all patents with abnormal fetal echocardiogram at 22 weeks. All the patients had follow up neonatal scan. All the data was maintained in SPSS 23 data sheet.

RESULTS

We screened a total of 967 pregnancies. In 882 pregnancies were found to be normal. Out of 83 pregnant women were detected to have congenital cardiac defects. The most dominant lesion to be diagnosed was CAVSD. Second most common abnormality was CCAVB followed by VSD and ASD. There was a significant number of babies diagnosed as having serous lesion such as IAA' HLHS' Ebstien anomaly. And cardiac tumors such as Cardiac Rhabdomyoms and Myxomas. Only 2 babies were diagnosed as having TOF and TGA. There were also a significant number of fetuses which were intrauterine death (1.0%) and twin pregnancy was reported as well (1.2%).

The most significant maternal age was 29.2 ± 4.7 years and paternal age was 34.6 ± 6.7 years. The mean gestational weeks were 28.9 ± 7.8 weeks. The most significant maternal risk factor was previous offspring having Congenital heart defects 0.5% followed by family history 0.3% and abnormal obstetrical ultrasound 0.3%. The other significant maternal risk factors were maternal diabetes 0.2% and maternal hypertension 0.1%. The women with age less than 20 years were 3% between 21-30 years 43.5% 31-40 years 46.7% and 6.7% were above 40 years of age.

DISCUSSION

In our study fetal echocardiography performed between 20 to 36 weeks gestation has proved to be significant benefit for pregnant population.

A vast variety of complex cardiac lesion were detected when there was high index of suspicion

Table-I: Essential Components of Fetal Echocardiogram.

Anatomical view	**Fetal position Sites determination Cardiac location**	**Doppler Exam**	**Aortic valve flow Pulmonary artery flow Atrioventriculer valve flow Inferior and superior vena cava flow Aortic arch flow Branch pulmonary arteries flow**
Biometric imaging	Cardiothoracic ratio Partial diameter Femur length	Measurement data	AV vale diameter Semilunar valve diameter Man pulmonary artery diameter Arch diameter Brach PA diameter Ventricular diameter
Cardiac view imaging	Four chamber view Five chamber view Three vessel view Bicaval view Two chamber view Ductal arch view Aortic arch view Outlet view Pericardial and pleural spaces view	Rhythm and rate	M mode of atria M mode of AV vales and ventricles Fetal heart rate estimation

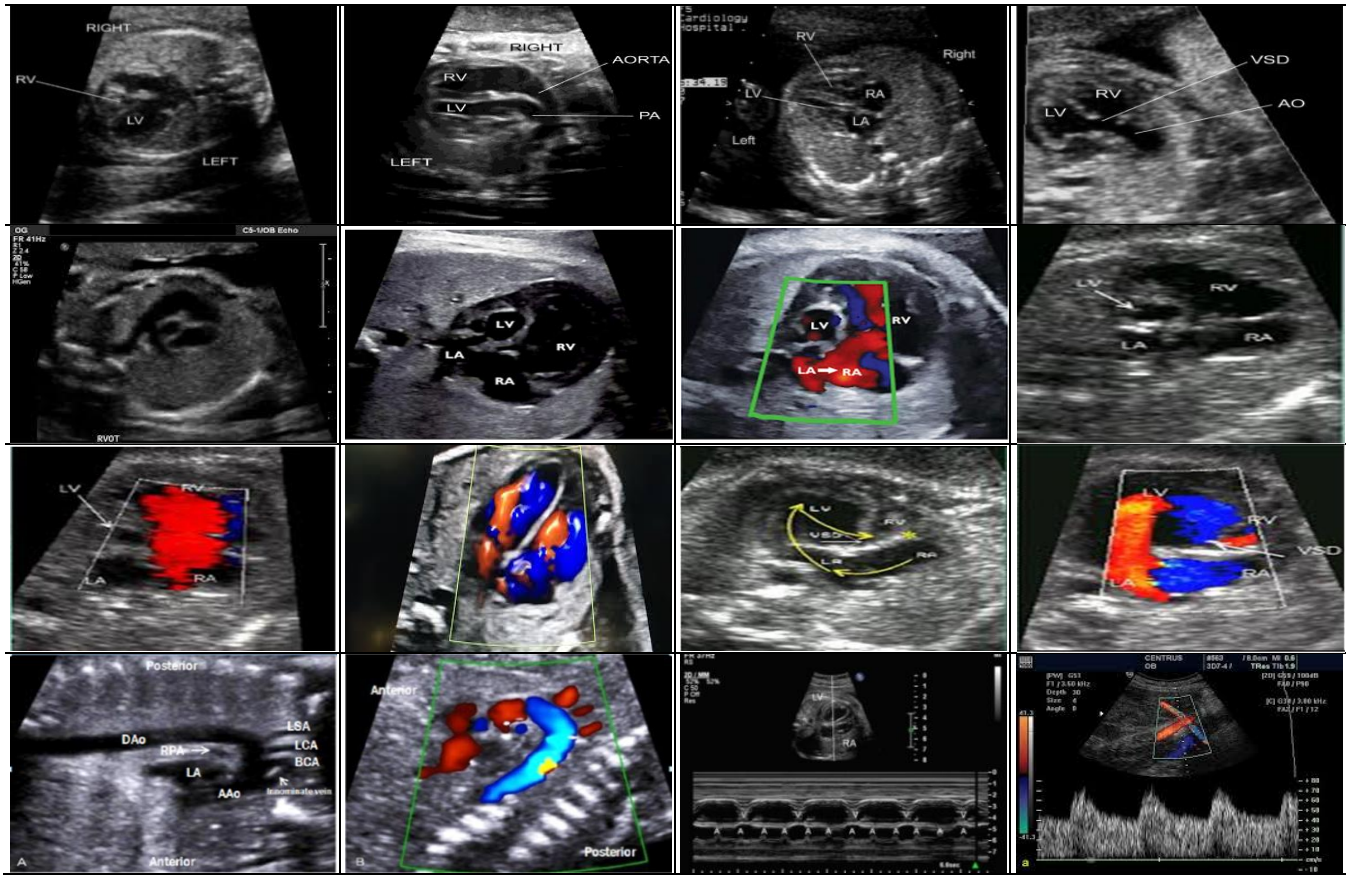

Figure-1: Multiple views of fetal echocardiogram.

by the treating obstretcians. The history of having previous offspring with CHD and the abnormal

Table-II: Congenital diseases (abnormal neonatal ECHO) n=83.

Cardiac Lesions Cardiac	n (%)
Down syndrome	1 (0.1%)
Echogenic mass in LV	5 (0.5%)
IUD	10 (1.0%)
Twin pregnancy	12 (1.2%)
Common atrium, PAVSD	1 (0.1%)
Ebstien anomaly	1 (0.1%)
CCAVB	12 (1.2%)
CAVSD,PS	12 (1.2%)
Tricuspid Artesia	2 (0.2%)
ParoxysmalAtrial Tachycardia	1 (0.1%)
VSD	9 (0.9%)
PDA	5 (0.5%)
Fetal Hydrops	2 (0.2%)
PPHN	2 (0.2%)
Small ASD/PFO/PDA	11 (1.1%)
Abnormal heart rate	8 (0.8%)
HLHS	1 (0.1%)
CHD	1 (0.1%)
DCM	1 (0.1%)
Mitral Atresia	1 (0.1%)
Complex congenital heart	4 (0.4%)
Cardiac tumors	3 (0.3%)
Ectopia cordis	1 (0.1%)
Interrupted aortic arch	1 (0.1%)
TGA	1 (0.1%)
TOF	2 (0.2%)

obstretical ultrasound have proven to be dominant factors in detection of CHD in pregnant women. The high detection rate is due to increased skill of performing echocardiography at experienced hands. A significant number of parents were counseled regarding the management and treatment modalities for babies with CHD. The option of TOP was discussed with expectant women and the babies diagnosed with correctable lesions were offered appropriate interventions.

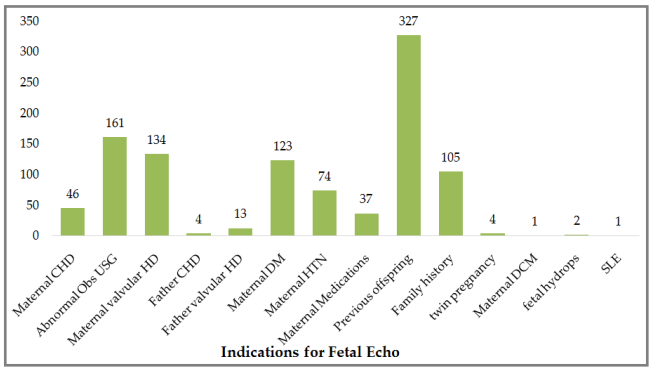

Figure-2: Indications of Fetal ECHO.

As compared to Jodi *et al*[1], our study yields a high number of defects being diagnosed and confirmed on neonatal scan. There were intrauterine deaths observed in fetuses with complex congenital defects. Our study included a later gestational period from 20 to 36 weeks with specific disease outcome as well. A large no of pregnant women opt for TOP due to high accuracy of fetal echocardiogram as well[16].

Prabharker rajah *et al*[3], reported various methods of fetal echocardiography for specific

Table-III: Comparison of fetal ECHO outcome with indications.

Indication/risk factor for fetal echo	Final outcome fetal echo						*p*-value
	Normal fetal, No neonatal	Normal fetal - normal neonatal	Normal fetal - Abnormal neonatal	Abnormal fetal, No neonatal	Abnormal fetal - normal neonatal	Abnormal fetal - abnormal neonatal	
Maternal CHD	28	0	1	0	0	0	<0.0001
Abnormal Obstetrical USG	89	5	1	40	9	3	
Maternal alular HD	108	10	0	2	0	0	
Father CHD	3	1	0	0	0	0	
Father Valvular HD	13	0	0	0	0	0	
Maternal DM	106	12	0	3	0	1	
Maternal HTN	67	1	2	2	0	2	
Maternal Medications	31	3	0	0	0	0	
Previous offspring	277	18	4	9	2	5	
Family history	94	4	2	1	1	3	
Total	818	54	10	57	12	14	

lesions and we followed the protocols i: e; 4 chamber view, 3 vessels view, LVOT, RVOT view bicaval and Doppler evaluation as well as M mode. Our study utilized ECEE, 3VT, RVOT and LVOT plus bicaval views[9], as reported by Nithin *et al*.

Rosemary *et al*[7], reported in AM perinatology low yield of detection of congenital defects as compared to our study. As vast majority of our patients were referred from obtratrcians and radiologist who had done detailed scan for these high risk pregnancies. Our scan confirmed these findings and we offered appropriate treatment at tertiary care hospital.

Lucaine elvis *et al*[14], Lindsey *et al*[15], reported 9.9% AND 7.3% yield of fetal echocardiogram as compared to our results of 8.3% yield of detection of complex cardiac lesions. Lauren tague *et al*[3], reported in AIUM the incidence of physiologicalvariationsat 34 weeks gestation in 43 pregnancies due to high referral rate and sensitivity of anomaly scan which can also be applied in our population if we conducted regular fetal echocardiograms with better expertise. They reported the prominence of aortic isthmus 'milddisproportion of AV vales 'tapering of PDA 'aneurysms of premium septum etc. Greater anatomical details have been reported due to enhanced technology and higher under-standing of fetal cardiac lesions[10], interoperating 4 dimensional scan with Spatiotemporal image correlation (STIC) for volume assessment[18]. Recent years have seen 3 and 4 Dimensional fetal echocardiograms[11]. Our study which spanned 12 years and had a significant number of patients diagnosed with congenital cardiac defects. The variety of diseases we diagnosed helped in follow up and further management of patents and improved the survival outcome. The study is limited in being conducted at tertiary care hospital and limited patents reaching the hospital plus limited understanding of interpretation of fetal echocardiogram[8]. A significant number of pregnant women were referred for abnormal findings in obstetrical scans which turned out to be normal neonatal scans and provided relief to expectant parents. As our study was conducted by a single operator and laid down protocol was followed and most of the neonates were followed up after delivery which resulted in greater confidence in detection and diagnosis. We recommend that second and third trimester fetal echocardiogram be carried out by specialized operators for better care and survival benefit of neonates with congenital cardiac defects.

CONFLICT OF INTEREST

This study has no conflict of interest to be declared by any author.

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