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Original Research Article

Routine fetal echocardiography for detection of congenital heart disease-mandatory or an optional tool?

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ABSTRACT

Background: Aim of the study was to assess the role of fetal echocardiography in identification of antenatal cardiac defects in a tertiary care centre in North India.
Methods: Prospective study done in a tertiary care centre in North India on female patients presenting to a tertiary care centre with pregnancy over a period of two years. All routine investigations were done and specific examination in the form of a screening fetal echocardiography was done in the selected two groups of patients, high and low risk.
Results: A sample size of 250 patients with intrauterine pregnancy of 18-28 weeks of gestation was analyzed. A detailed history, examination and fetal echocardiography was performed in all the patients. In group I-105 patients with elevated risk factors (for congenital heart disease) (CHD) were included whereas in group II-145 patients with low risk factors were taken. The various demographic parameters among the two groups were almost similar. The outcome was also similar in two groups with nil neonatal mortality. Except for the NICU admission between the two groups, rest all the parameters whether maternal or neonatal were not statistically significant.
Conclusions: In the present study, we tried to find out role of fetal echocardiography for detection of CHD in high and low risk cases. The results were almost similar in both high and low risk group. Indications of referral for fetal echocardiography cannot be listed as it was found that almost similar percentage of heart defects are seen in both groups I and II.

Keywords: CHD, Fetal echocardiography, Heart disease

INTRODUCTION

Out of the most common congenital malformation in humans, CHD tops the list, having an incidence of 8 to 12 per 1000 live births. It is recognized as a major cause of mortality and morbidity in the first year of life.[1] CHD is 6.5 times more prevalent than chromosomal abnormalities and 4 times more common than neural tube defects. It is responsible for 20-32% of perinatal deaths and 50% of childhood deaths.[2-8] So, CHD becomes a significant economic burden for the health care system of any society.

The spectrum of CHD ranges from a septal defect in heart, to more severe malformations. Approximately, 1/3rd of all the cases with CHD, are severe defects which require major cardiac surgery, and the patients, with severe valvular abnormalities in fetus in utero, will require proper perinatal management. Therefore, prenatal detection of CHD becomes important, which can help the obstetricians to plan proper perinatal management and place of delivery. A well-equipped tertiary care centre with NICU and paediatric cardiology facility becomes essential for management of these cases. A clear-cut prenatal diagnosis is of paramount importance in

relation to infant outcome, especially in cases, where prostaglandin infusion is needed to maintain ductus arteriosus patency.[9]

The objective of this study was to assess the role of fetal echocardiography in identification of antenatal cardiac defects.

METHODS

The study was carried out in the department of obstetrics and gynaecology and department of paediatrics, Holy family hospital, Delhi in North India from July 2017-March 2019. It was a prospective observational cohort study done over a period of two years. The sample size was 250 for reason chosen by the treating obstetrician. The ethical clearance from the institute was obtained before starting the study and written informed consents were taken before enrolling the patients.

Pregnant patients who underwent fetal echocardiography at gestational age of 18-28 weeks (calculated from the first day of last menstrual period and assessed by dating scan done in first trimester) were included in the study.

Data collection

A detailed history regarding age, parity, married life, exposure to infections (e.g., TORCH), teratogens (Lithium, alcohol, cocaine, anti-convulsant) exposure, exposure to prostaglandin synthetase inhibitors (e.g., ibuprofen, indomethacin), metabolic disorders [diabetes mellitus, gestational glucose intolerance (GGI), phenylketonuria (PKU)], autoimmune disorders [systemic lupus erythematous (SLE), Sjogren's syndrome, rheumatoid arthritis], Obstetric history, family history of CHD was taken. A detailed clinical examination including general physical examination, per abdominal examination for fundal height, lie, presentation, position and fetal heart rate was performed. Relevant investigations were done and any significant finding e.g., increased nuchal translucency, elevated risk in dual/ triple/ quadruple screen, echogenic focus / any abnormality in level II scan were noted. After analysing history, clinical examination and investigations, those patients who were, suspected to have elevated risk for some problem in the fetal heart, were sent for fetal echocardiography. According to this indication, the patients were divided into two groups.

Group I (High risk)-included patients who had a definite indication as per guidelines of paediatric council of the American society of echocardiography and group II included those patients who were referred for fetal echocardiography for some other reason like advanced age, GGI, bad obstetric history, difficult conception, repeated use of ovulation inducing drugs, intrauterine insemination (IUI).[10]

Fetal echocardiography was performed trans-abdominally between 18 to 28 weeks period of gestation using PHILIPS- EPIQ 7C, adult probe-X5-1, S8-3 by paediatric cardiologist.

The fetal echo views that were obtained were 4 chamber view, left ventricular outflow tract (LVOT), right ventricular outflow tract (RVOT), 3 vessel view, 3 vessel trachea view, aortic arch view, bicaval view and ductal arch view. Standard fetal echocardiography was performed according to international society of ultrasound in obstetrics and gynecology (ISUOG) guidelines.[11]

Pregnancy outcome was analysed in terms of mode of delivery, birth weight, Apgar score, need for neonatal resuscitation, NICU stay and requirement of repeat echo in neonatal period.

The newborns were followed up till the time of discharge.

Statistical analysis

Statistical tests were applied as follows-1: Quantitative variables were compared using Mann-Whitney test (as the data sets were not normally distributed) between the two groups; 2: Qualitative variables were correlated using Chi-square test/Fisher's exact test. A $p<0.05$ was considered statistically significant.

The data was entered in MS excel spreadsheet and analysis was done using statistical package for social sciences (SPSS) version 21.0.

RESULTS

A total of 250 patients were included in the study and they were divided into two groups: Group I-105 patients with elevated risk factors (for CHD). Group II-145 patients with low risk factors.

Table 1 shows the age and period of gestation and their comparison in the high and low risk group.

The mean age in the two groups were 28.77±4.36 and 28.24±4.2 years respectively. The mean period of gestation in group I vs group II were 25.82±2.36 and 24.91±2.18 weeks respectively. There was no statistical significant difference between the gravidity and mode of delivery in the two groups. The birth weight, APGAR score at 1 and 5 mins and need for neonatal admission was similar between the two groups. There was statistically significant difference between the need for NICU admission in group 1 (9%) vs group II (5.4%) with a p=0.047. The majority of indication for fetal echocardiography in high-risk group comprised of diabetes in pregnancy (68.6%) followed by *in vitro* fertilisation (8.6%), history of CHD in parents and siblings (10.5%), any drug intake (3 %), fetal arrythmias (6.7%), TORCH IgM positive (1.9%) and monochorionic

twins (0.7%). There was no significant difference between presence or absence of CHD in the two groups. (p=0.738).

Table 1: Demographic parameters of the study population.

Variables	Groups		P value
	Group I (High risk)	Group II (Low risk)	
Age (Years)			
Sample size	105	145	0.365
Mean ± SD	28.77±4.36	28.24±4.2	
Median	28	28	
Min-max	18-42	19-47	
Inter quartile range	26-32	25-31	
POG			
Sample size	105	145	0.0003
Mean ± SD	25.82±2.36	24.91± 2.18	
Median	26	25	
Min-Max	20-28	19-28	
Inter quartile range	24.750 - 28	24 - 26.250	

Table 2: Percentage wise different fetal echocardiographic findings in total studied population.

Variables	Group, n (%)	
	I	II
Thin layer of pericardial effusion	27 (24.32)	29 (19.46)
Thickened interventricular septum	1 (0.90)	2 (1.34)
Mild prominence of right ventricle	1 (0.90)	0 (0)
Increased echogenicity of inter-atrial septum	0 (0)	1 (0.67)
Aneurysmal atrial septum with multi-fenestrations	28 (25.23)	44 (29.53)
VSD	37 (33.33)	47 (31.54)
Tricuspid regurgitation	12 (10.81)	6 (4.03)
Mitral regurgitation	0 (0)	1 (0.67)
Pulmonary regurgitation	0 (0)	0 (0)
Mild narrowing at isthmus with accelerated doppler velocity	7 (6.31)	6 (4.03)

Table 2 shows the percentage wise distribution of the various specific echocardiographic findings among the two groups. The main CHD observed overall in both the groups was ventricular septal defect (VSD), comprising 32.3% of all observed defects. Among the birth cohort repeat echocardiography was done in 7 (9.58%) and 5 (5.26%) on the advice of the Paediatric cardiologist in the elevated risk and low risk group, respectively. Table 3 shows the comparison of antenatal and postnatal echocardiographic findings in the elevated risk and low risk groups, respectively.

Table 3: Comparison of antenatal and postnatal echocardiographic findings in group I (High risk) (7 cases underwent repeat echocardiography after birth) vs low risk group II (Low risk) (5 cases underwent repeat echocardiography after birth).

Comparison of antenatal and postnatal echocardiographic findings	
High risk cases	
Antenatal echocardiographic findings	Postnatal echocardiographic findings
Pericardial effusion	normal
Thickened interventricular septum, aneurysmal atrial septum with multi-fenestrations	Thickened interventricular septum
Pericardial effusion, VSD	VSD
Aneurysmal atrial septum with multi-fenestrations, VSD	Aneurysmal atrial septum with multi-fenestrations.
Aneurysmal atrial septum with multi-fenestrations	Aneurysmal atrial septum with multi-fenestrations, tricuspid regurgitation
VSD, tricuspid regurgitation	VSD, Tricuspid regurgitation
Pericardial effusion	Normal
Low risk cases	
Antenatal echocardiographic findings	Postnatal echocardiographic findings
Aneurysmal atrial septum with multi-fenestrations.	Normal
Aneurysmal atrial septum with multi-fenestrations, VSD	Aneurysmal atrial septum with multi-fenestrations
VSD	VSD
VSD	VSD
Pericardial effusion	Normal

DISCUSSION

In the present study, maximum patients in both group I (66.67%) and group II (73.10%), were in the age range of 21-30 years (Table 1). The mean maternal age in group I (High risk) was 28.77 years and in group II (Low risk) was 28.24 years. Mean maternal age of patients in the study done by Sharma et al was 27.61±4.68 years which was comparable with the present study whereas in the study done by Carvalho et al it was 27 years.[12,13] The average age of the women in a study conducted by Achiron et al was 24.6 years.[8] In the present study (Table 2), 44.76% patients in group I (High risk) were primigravida (44.76%), and 55.24% were multigravida. In Group II, 46.21% patients were primigravida and

53.79% were multigravida. Gravida and parity were comparable between the two groups (p>0.05). The mean Period of gestation in group I was 25.82±2.36 and in group II was 24.91± 2.18 weeks. The mean gestational age in the study done by Sharma S et al was 20.37±4.25 weeks while as in the study by Wittkopf et al and Achiron et al, it was 25 weeks and 21 weeks, respectively.[8,12,14] In the present study, the most common indication of referral for fetal echocardiography was diabetes in pregnancy (72 out of 105, ~68.57%) followed by history of CHD in parents and siblings (11 out of 105, ~10.48%) and IVF (8.57%). In the study conducted by Carvalho et al 20% of the cases were done for diabetes in pregnancy and a family history of CHD, another 20% for abnormal or unsatisfactory cardiac view at the routine fetal anomaly scan.[13] The most common indication was the detection of echogenic foci, ~26% In a study conducted by Ozkutle et al, 20% of the referrals were for history of cardiac anomaly in the earlier pregnancy.[15]

In the present study, 65.77% fetuses had positive echocardiographic findings (51.35% minor and 14.41% unspecified) in group I (High risk) and 63.76% fetuses had positive echocardiographic findings (53.02% minor and 10.74% unspecified) in group II (low risk). In the study done by Ozkutle et al (49) IUHD was detected in 152 cases (10.9%), structural CHD in 144 cases (10.3%) by fetal echo indeed, 43.4% of fetuses with intrauterine heart disease (IUHD) were born from pregnant females with elevated risk.[15] In the present study, the commonest finding was VSDs which was seen in ~50% (84 out of 168) of the patients antenatally. Various echocardiographic findings were almost similar in both the groups. In a study done by Sharma et al IVSD (Isolated VSD) was found in 44.44% of cases. This is also in parlance with study by Ozkutlu et al in which the most frequent structural cardiac defect VSD (16.7%).[12,15]

In the present study, in group I (High risk), majority of patients i.e., 60.95% had caesarean section and the remaining 39.05% had vaginal delivery. In group II (Low risk), 49.66% had caesarean section and 50.34% had vaginal delivery. As no major cardiac defects were found, the mode of delivery was almost similar between the two groups, p value not significant. Levi et al also found no significant difference in the rate of caesarean section between the antenatal and postnatal diagnosed groups.[16] In the present study, majority of the newborns i.e., 72.07% were born with a birth weight of 2.5-3.5 kg, 24.32% with birth weight of <2.5 kg and very few i.e., 3.6% with >3.5 kg birth weight in group I (High risk) and in group II also, majority of the newborns, i.e., 77.18% were born with a birth weight of 2.5-3.5 kg, 19.46% with birth weight of <2.5 kg and very few i.e., 3.36% with >3.5 kg birth weight. Regarding fetal outcome in terms of APGAR at 1 and 5 minutes, in the present study, there was no significant difference between group I and group II. At 1 minute, there were 7.21% newborn, with APGAR <7 in group I (High risk) and 5.37% newborn, with APGAR <7 in group II (Low risk). At 5 minutes, there were 2.7% newborn, with APGAR <7 in group I (High risk) and 1.34% newborn, with APGAR <7 in group II (Low risk). In the present study, Neonatal resuscitation was needed only in 9% in group I (elevated risk) and 5.4% in group II (low risk). As no major cardiac defects were found, number of cases requiring neonatal resuscitation were almost similar between the two groups, p value not significant. In the present study, there was no significant difference between the two groups with respect to admission to NICU at birth, it was 36.94% in group I (High risk) while 25.5% in group II (Low risk). Babies went to NICU, not for cardio-respiratory issues, they were taken to NICU for observation as they were born to diabetic mother. In the present study, there was zero mortality in both the groups. The cases were followed up to the time of delivery, in early neonatal period till the time of discharge from the hospital. The aim for this follow up was to find out whether the cases with positive findings needed any further evaluation. In the present study (Table 3), 7 patients out of 73 i.e.,9.58% in group I and 5 out of 95 i.e., 5.26% in group II underwent repeat echocardiography in neonatal period. Table 3 shows the comparison between antenatal and postnatal echocardiographic findings in group I and II. Agreement between antenatal and postnatal findings were seen in 71.4% in group I and 60% in group II. In a study conducted by Sharma et al they found complete agreement of 68.17% between prenatal echo findings and postnatal or autopsy findings.[12] Similarly, in a study conducted by Achiron et al detected 86% of major abnormalities in a low risk population by extended fetal heart examination.[8]

Limitations

Sample size was limited, and time was restricted therefore it may not reflect true magnitude of the problem. The study was done in a metro-city and private hospital catering to middle class. This is expensive test, so, it was done in select population and not all.

CONCLUSION

In the present study, we tried to find out role of fetal echocardiography for detection of CHD in high and low risk cases. In group I (High risk), 73 out of 111 i.e., 65.77% had positive findings in antenatal fetal echocardiography and in group II (Low risk) 95 out of 149 i.e., 63.76% had positive findings in antenatal fetal echocardiography. Seven patients out of 73 i.e.,9.58% in group I and 5 out of 95 i.e., 5.26% in group II needed repeat echocardiography after birth. Five cases out of 7 in group I and 3 out of 5 cases in group II had persistent anomaly. The results were almost similar in both high and low risk group. Indications of referral for fetal echocardiography cannot be listed as we have found in the present study that almost similar percentage of heart defects were seen in both groups I and II.

Recommendation

Since results are almost similar in both group I (high-risk) and group II (low-risk), antenatal fetal echocardiography, is not a necessary screening test to be performed for all antenatal patients. But, if it is possible to perform, it should be offered to all the antenatal patients and not just the high-risk cases.

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