ORIGINAL RESEARCH

THREE VESSEL VIEW AND ITS SIGNIFICANCE IN FETAL ECHOCARDIOGRAPHY – A HOSPITAL BASED STUDY

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Received: 20 October, 2022 Accepted: 25 November, 2022

ABSTRACT
Background: Congenital heart disease is a leading cause of infant morbidity and mortality from birth defects with an estimated incidence of 6-12 per 1000 live births. The objectives of the study are to evaluate the effectiveness of three-vessel view (3VV)and three vessel trachea view in assessment of fetuses with antenatally diagnosed congenital heart disease. **Methods:** Fetal echocardiography was done as a prospective study during April to September 2021 in 100 fetuses referred to our Radiology department with high risk and suspicion of congenital heart defects. **Result:** We found presence of congenital cardiac anomalies in 30 fetuses. The most common indication for Fetal echo was Echogenic intracardiac focus. The most common anomaly was Ventricular septal defect in 5 cases. Three vessel view was abnormal in 20 cases. Addition of three vessel view in fetal echo showed detection rate of 66.6%. Extracardiac anomalies were found in 14 fetuses. **Conclusion:** Routine fetal echocardiography enables the detection and characterization of most of the cardiac anomalies. Addition of outflow tracts and three vessel view enhances the detection rate significantly. With moderate sensitivity and high specificity, Fetal echocardiography is a reliable prenatal diagnostic tool with high accuracy. 3VV and 3VT view is a reliable method to determine abnormalities in the upper mediastinum and should be incorporated as an adjunct to outflow tract views in routine fetal cardiac screening.

Key words: Fetal echocardiography, Congenital heart disease, Three vessel view, outflow tract views, three vessel trachea view, M-mode, Colour Doppler, extracardiac anomalies.

INTRODUCTION

Fetal echocardiography is defined as a detailed sonographic evaluation of fetal heart that is used to identify and characterize fetal cardiac anomalies prenatally[1]. Congenital heart disease is a leading cause of infant morbidity and mortality from birth defectswith an estimated incidence of 6-12 per 1000 live births[2-3].

Antenatal diagnosis of congenital heart disease (CHD) has shown to have a significant effect on prenatal and postnatal management and outcomes. In addition, Fetal echocardiography can provide prognostic information that helps for a smooth transition between the pre and post-natal states and the opportunity to provide immediate care at birth, thereby avoiding the onset of hemodynamic compromise.. Accurate prenatal diagnosis can also lead to additional testing of the fetus, including genetic evaluation and other anatomic imaging, which can yield valuable information in overall assessment of the fetus[4]. Early knowledge of CHD also allows further monitoring, testing for known associated non-cardiac structural and chromosomal anomalies and parental counselling about pregnancy management options including termination.

Ultrasound systems used for fetal echocardiography should have high spatial and temporal resolution given the small size of a rapidly beating fetal heart. Ultrasound machine used for fetal echo should have capabilities for performing excellent B-mode 2D, M-mode, Doppler imaging and good cine acquisition. The equipment also needs a good cine-loop facility so that one can scroll back frame by frame and capture the frame of interest. It should have colour Doppler, pulsed Doppler, and continuous wave Doppler. STIC, tissue Doppler, and multiplanar imaging are added advantages. Optimal timing for performance of comprehensive transabdominal fetal echocardiography is 18 to 22 weeks of gestation.

Basic Fetal echocardiography includes Abdominal situs, Four chamber view , Outflow tract views and M- mode colour doppler[15]. In order to improve the antenatal detection of CHD involving the ventricular outflow tracts and great arterial trunks, Yoo et al[5] proposed the three-vessel view, a transverse view of the fetal upper mediastinum. It can be easily obtained by moving the transducer cephalad from the four-chamber plane. Yagel et al[6] proposed the 3VT view. It is obtained by angling the transducer a few millimeters cephalad/ superiorly and perhaps slightly toward the fetal left shoulder until the aortic and ductal arches are seen to merge into the descending aorta, thus forming a "V" configuration to the left of the trachea. The trachea lies anterior to the spine and can be readily identified as a hypoechoic circular structure surrounded by an echogenic wall. Color Doppler Ultrasound at the level of the 3VT enables simultaneous visualization of the flow direction in both the aortic and ductal arches. Normally, color flow in the aortic and ductal arches is antegrade, laminar, and directed posteriorly toward the descending aorta.

The 3VV and 3VT have been found to improve detection of outflow tract abnormalities, abnormalities of the aortic arch, abnormalities of systemic veins, and even thymic abnormalities.

MATERIALS AND METHODS

Fetal echocardiography was done as a prospective study in our Radiology department during April to September 2021 in 100 fetuses referred to our department with high risk and suspicion of congenital heart defects. Demographic data, including maternal age, gestational age at diagnosis, high risk factors were also reviewed and studied. All fetal Ultrasound was performed in Samsung WS 80A and GE Voluson S10 ultrasound machine.

Ethical clearance was obtained from the Instituitional ethical committee.A detailed clinical history is obtained. After obtaining informed written consent, obstetric ultrasound is done followed by detailed fetal echocardiographic study in fetal echo settings.

Data entry was done using Microsoft Excel and Statistical analysis was performed using SPSS version 20.0for Windows

If fetal heart is not properly visualized due to baby's position, mother is made to wait till satisfactory image is obtained.

- A detailed fetal echocardiographic study includes the following

Situs and general aspects:
Four Chamber View:
Left Ventricular Outflow Tract
Right Ventricular Outflow Tract
Three Vessel View and Three Vessel Trachea View
Ductal and Aortic Arch View
M-Mode and colour Doppler if necessary.

RESULT

Fetal echocardiography was done as a prospective study in our Radiology department during April to September 2021 in 100 fetuses referred to our department with high risk and suspicion of congenital heart defects. 30 fetuses were diagnosed to have heart defects(30%)

Distribution of indications for fetal echo:

The most common indication for Fetal echo was Echogenic intracardiac focus in 38 patients followed by single umbilical artery in 21 cases.

Indications	No. of cases	Percentage(%)
Echogenic intracardiac focus	38	0.38
Single umbilical artery	21	0.21
Gestational diabetes Mellitus	15	0.15
Suspicious cardiac anomaly	14	0.14
Previous child with cardiac defects	12	0.12

Distribution Of Cardiac Anomalies

The most common anomaly was Ventricular septal defect in 5 cases

Cardiac anomaly	No of cases	Percentage(%)
Ventricular septal defect	5	16
Tetralogy of fallot with PS	4	13.3
DORV with PA	4	13.3
AVSD	4	13.3
PLSVC	3	10
ARSA	3	10

HLHS	2	15
Common Arterial trunk	1	0.33
Absent RSVC,	1	0.33
Ebsteins anomaly	1	0.33
Rhabdomyoma	1	0.33
Transposition of great vessels	1	0.33

Distribution of extracardiac anomalies

Extracardiac anomalies were found in 14 fetuses. Renal pelviectasis was the most common extracardiac anomaly seen in 4 fetuses.

EXTRACARDIAC SYSTEM	ANOMALIES
KUB	Pelviectasis– 4 (2.8 %) PUV – 1 (0.7%)
CNS	Occipital meningocele – 2 (1.4%) Choroid plexus cyst – 2 (1.4%) Arnold chiari malformation – 1 (0.7%)
ABDOMEN	Gastroschisis – 1 (0.7%) Duodenal atresia – 1 (0.7%)
MSK	CTEV – 1 (0.7%)
FACE	Cleft lip with cleft palate – 1(0.7%)

DISCUSSION

CATEGORIZATION OF CONGENITAL HEART ABNORMALITIES ACCORDING TO 3VV AND 3VT

Three vessel view was found to be abnormal in 20 cases of the total 30 cardiac anomalies. Addition of three vessel view in fetal echo showed detection rate of 66.6%.

The 3VT view has been extensively studied [8-12] and included in the routine anatomy scan by experienced sonographers, proving its utility time and time again.. The abnormalities detected in the three vessel view were classified according to the observations of Yoo et al[5]: abnormal vessel size, alignment, arrangement , number, colour flow and course of great vessels. Twenty out of the 30 fetuses showed an abnormal 3VV and 3VT view that could be classified into one of the groups.

1. Abnormal vessel size

Abnormal vessel size was found in 11 out of the 20 fetuses. The structures seen normally in the 3VT view in descending order of size from left to right are: pulmonary artery, aorta and SVC. The ductus arteriosus and the transverse aortic arch are similar in size. Size of the vessel reflects the amount of blood flow passing through it. When pulmonary artery is small, preferential blood flows to left side of heart as in pulmonary stenosis and tetralogy of fallot . When aortic arch is small, preferential blood flows to right side of heart as in aortic atresia or hypoplastic left heart syndrome. Dilatation of both arterial vessels can be seen in polyvalvular dysplasia. An enlarged SVC can be seen in interrupted IVC with azygos continuation draining to the SVC.

In our study, small pulmonary artery was seen in 2 cases of Tetralogy of fallot1 case of AVSD with PS. Small aorta was seen in 2 cases of Hypoplastic left heart syndrome.

FIG 1: showing small pulmonary artery in AVSD with PS

FIG 2: showing small caliber aorta in HLHS

2. Abnormal vessel alignment

Abnormal alignment is a condition in which the three vessels are not aligned in a straight line, but their overall left-right order is preserved. Abnormal alignment is more commonly caused by anterior

displacement of the ascending aorta with or without posterior displacement of the main pulmonary artery. It is seen mostly in Tetralogy of fallot, Double outlet right ventricle due to parallel orientation of great vessels and in some cases of Transposition of great vessels.

In our study, abnormal alignment was observed in 4 cases of TOF, 2 cases of DORV and 1 case of TGA.

FIG 3: showing abnormal alignment in DORV

3. Abnormal vessel arrangement

Abnormal arrangement is seen when the left-right order of the three vessels is grossly distorted. It may be seen in TGA, DORV and Right sided SVC

In our study, abnormal arrangement was seen in I case of TGA and in 1 case of Absent Right SVC with persistent LSVC.

FIG 4: showing abnormal vessel arrangement in Absent Right SVC with persistent Left SVC

4. Abnormal vessel number

The three-vessel view shows only two vessels in truncus arteriosus, DORV with pulmonary atresia with a ventricular septal defect when the main pulmonary artery is atretic or absent. Four vessels are seen when bilateral superior venae cavae are present

In our study, 2 vessels were seen in 1 case of Common arterial trunk and in 1 case of DORV with PA. Four vessels were seen in 3 cases of Persistent Left sided SVC draining into dilated coronary sinus.

FIG 5: showing 2 vessels in Common arterial trunk

FIG 6: showing 4 vessels in persistent Left SVC

5. Abnormal colour flow

In 3VT view, reversal flow in the Transverse aortic arch is seen in aortic atresia and coarctation of the aorta. Reversal of flow in the pulmonary trunk is seen in Double outlet right ventricle with pulmonary atresia. Color Doppler also reveals aberrant vessel coursing behind the trachea which is aberrant right subclavian artery.

In our study , abnormal colour flow was seen in 1 case of DORV with PA and 3 cases of Aberrant right subclavian artery.

FIG 7: showing colour flow in ARSA seen coursing behind trachea

6. Abnormal course of great vessels

The transverse aortic arch is seen normally in the posterior mediastinum at the left side where it joins the ductal arch. When the transverse aortic arch is seen on the right , right aortic arch is formed. In some cases double aortic arch may be seen.

In our study , we did not come across abnormally coursing aorta.

CONCLUSION

The main objective of the antenatal diagnosis of CHD is to reduce perinatal morbidity and mortality. With moderate sensitivity and high specificity, Fetal echocardiography is a reliable prenatal diagnostic tool for cardiovascular problems with high accuracy and has an impact on the management at prenatal, natal and postnatal period. Timely diagnostics of fetal heart malformations allows the family to choose whether to continue pregnancy or terminate it. By identifying infants prior to birth, these high risk patients can be delivered in a center where they have ready access to a pediatric cardiologist and cardiovascular surgeons and hopefully a better outcome. Thus ,the families are better prepared and know more of what can be expected once the infant is born.

3VV and 3VT view is a reliable method to determine abnormalities in the upper mediastinum. These views provides important clues to the diagnosis of most of the critical heart defects involving the outflow tracts and the aortic arch. These views are very easy to acquire and interpret and should be incorporated as an adjunct to outflow tract views in routine fetal cardiac screening.

Funding: No funding sources

Conflicts of Interest: There are no conflicts of interest.

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