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ORIGINAL ARTICLE

The Detection Rate of Cardiac Anomalies at 11–13+6 Week Scan Using Four Chamber View and Three Vessel View

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Abstract The primary aim of this study was to assess the feasibility of fetal cardiac evaluation at 11–13+6 weeks by assessing the four chamber and three vessel views. The secondary aim was to assess detection rates of cardiac anomalies at this gestational age. This was a prospective study done over 1 year. It included 355 patients who presented to a routine antenatal service and opted for prenatal genetic screening and anomaly scan at 11–13+6 weeks corresponding to a CRL of 45–84 mm. Four chamber view and three vessel view were examined in both gray scale and color Doppler using transabdominal scanning and transvaginal scanning. A follow-up was done at 18–22 weeks and at delivery. Major cardiac anomalies were seen in 5 (1.4 %) fetuses screened at 11–13+6 weeks. Two fetuses with cardiac anomalies (0.5 %) could not be detected at this gestation and were picked up at the 18–22 week scan. Extracardiac anomalies detected in the first trimester scan were 14 (3.9 %). Nuchal translucency (NT) of more than 3 mm was found in 19 (5.3 %) patients. Nuchal translucency of more than 3 mm was present in 3 (60 %) fetuses with cardiac defects seen at 11–13+6 weeks. Increased NT of more than 3 mm was found in 6 (43 %) patients having noncardiac anomalies. Four (1.1 %) patients had both cardiac and noncardiac anomalies detected at first trimester scan. When CRL was 76–85 mm, the cardiac anomaly detection rate was maximum (3.8 %) compared to detection at CRL 66–75 mm (1.2 %), 56–65 mm (0), 45–55 mm (2.2 %). Noncardiac defects had a detection rate of 2 (4.4 %) at CRL 45–55 mm, 4 (3.6 %) at CRL 56–65 mm, 7 (4.5 %) at CRL 66–75 mm, 1 (1.9 %) at CRL 76–85 mm. Overall detection of major fetal cardiac anomalies at 11–13+6 weeks was 1.4 % and noncardiac anomalies was 3.9 %. This supports the opinion that first trimester can be used for detection of major congenital heart diseases and noncardiac anomalies along with fetal aneuploidy screening. Detection of anomalies in the first trimester helps patient in early decision making and counseling for further management.

Keywords 11–14 week scan · Echocardiography · Congenital heart defects · Nuchal translucency · Four chamber view · Three vessel view

Introduction

With the current advances in the field of obstetric ultrasound, there has been a paradigm shift of the pyramid of antenatal care towards the first trimester. Congenital heart defects are the most common and severe congenital anomaly and have an overall incidence of 6/1000–18/1000 live births. Prenatal diagnosis made earlier in gestation is of advantage in management of the same, such as: (a) the possibility of scheduling additional examinations well before the limits for legal termination; (b) the option for an earlier and safer termination of pregnancy; (c) earlier reassurance and reduced anxiety; and (d) delivery at tertiary center where immediate care can be initiated. Furthermore, it appears that women prefer earlier screening, when possible.

Fetal echocardiography is usually done at 20–22 weeks as recommended by Fetal Medicine Foundation, ISUOG, American Institute of Ultrasound in Medicine, in patients

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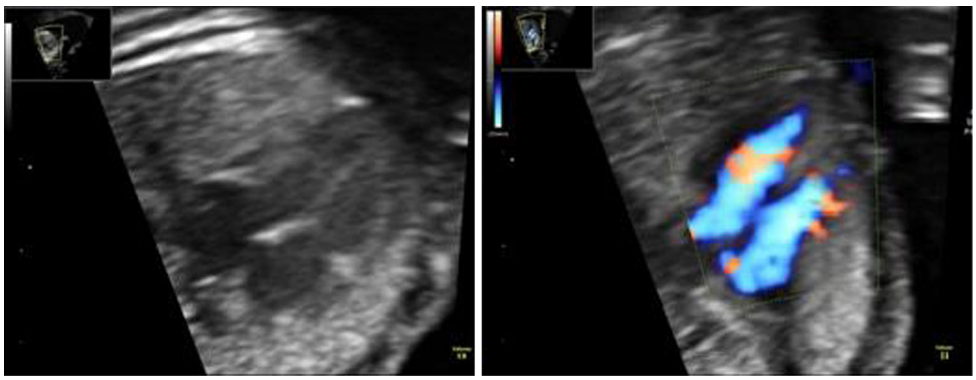

Fig. 1 Four chamber view of normal heart in gray scale and color Doppler mode at 13+5 weeks

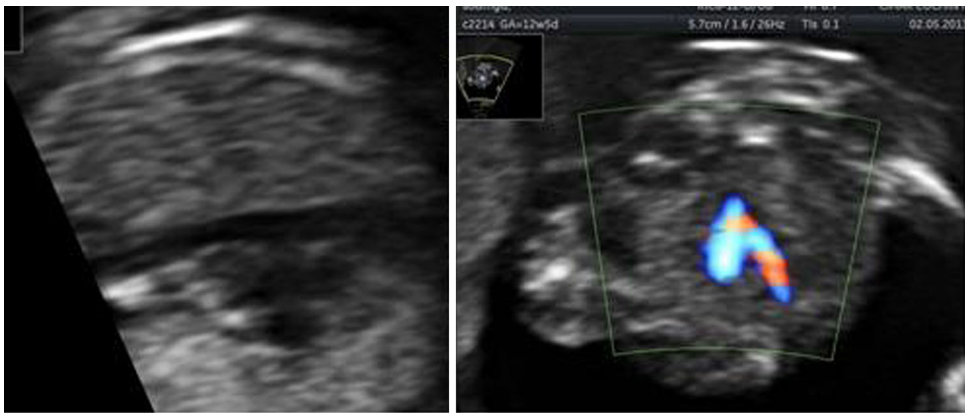

Fig. 2 Three vessel view of normal heart in gray scale and color Doppler mode at 12+5 weeks

with high risk for fetal cardiac defects. But earlier evaluation of heart at 11–13+6 weeks is now being used to screen low risk population to detect or at least suspect cardiac defects, which can be later confirmed by standard 20–22 weeks echocardiography or an early fetal echocardiography. So looking for structural and cardiac defects at the time of nuchal translucency (NT) scan seems practical solution for early detection of fetal defects. Prenatal detection rates vary according to examiner expertise, maternal obesity, transducer frequency, abdominal scans, gestational age, amniotic fluid volume and fetal position.

Materials and Methods

This prospective study was carried out at the Feto-maternal unit at CIMAR Fertility Centre, Cochin, Kerala, from April 2012 to April 2013. After taking consent, 355 patients attending the outpatient clinic were enrolled in the study. CRL and NT were measured with the fetus in mid-sagittal view as per guidelines issued by Fetal Medicine Foundation [1]. Cardiac evaluation was done in the same visit by both transabdominal and transvaginal route. It included the basic cardiac examination with the four chamber view and the three vessel trachea view, done in both 2D gray scale mode and color Doppler mode. Anatomic characters studied in the four chamber view (Fig. 1) were apex of the heart, atrial size, ventricular size, crux, atrioventricular valves and the interventricular septum. In the three vessel view (Fig. 2), the authors evaluated the pulmonary artery, aorta and superior vena cava (SVC). In color Doppler, pulmonary trunk and aorta take the same color and the SVC does not take color. After tilting the probe cephalad, the "V" sign can be demonstrated.

Results

The study included 355 patients. Total cardiac anomalies in the present study group were 7/355 (1.9 %). Of the seven, 5/355 (1.4 %) were picked up at 11–13+6 week scan and 2/355 (0.5 %) cardiac defects were not picked up in first trimester. Those which were not picked up at 11–13+6 week scan were detected at 18–22 week scan. Cardiac anomalies detected in 11–13+6 week scan were hypoplastic left heart syndrome ($n = 2$), truncusarteriosis ($n = 1$), ventricular septal defects ($n = 1$), and pulmonary stenosis ($n = 1$). Karyotyping was done in all fetuses with heart defects and only one fetus with hypoplastic left heart had a karyotypic

abnormality (45, X). The rest of the fetuses were chromosomally normal.

Nuchal translucency of more than 3 mm was present in 3 (60 %) fetuses with cardiac defects seen at 11–13+6 weeks. Increased NT of more than 3 mm was found in 6 (43 %) patients having noncardiac anomalies. Four (1.1 %) patients had both cardiac and noncardiac anomalies detected at first trimester scan. Seventeen (4.7 %) pregnant females were with overt diabetes and two (0.5 %) of these patients had fetuses with cardiac anomalies detected in the first trimester at the 11–13+6 week scan. Of the pregnant females, 34 (10 %) were found to be in the advanced maternal age group (more than 35 years) and no cardiac defects were detected in this group.

Nuchal translucency of more than 4 mm was found in seven fetuses, of which, 2 (28 %) fetuses had cardiac defects. In patients with NT value of 3–4 mm, 1 (8.3 %) out of 12 fetuses had heart defects. When NT was 2–3 mm, 1 (1.4 %) fetus had cardiac defects among 69 patients and with 266 fetuses having NT of 1–2 mm, only 1 (0.3 %) had heart defects (Fig. 3).

When incidence of heart disease in relation to CRL was seen, maximum number of cases i.e., 2 (3.8 %) had CRL between 76 and 85 mm. In the group with CRL between 66 and 75 mm, 2 (1.2 %) fetuses had heart disease. In the group with CRL between 56 and 65 mm, no heart defect was visualized and at CRL between 45 and 55 mm only 1 (0.22 %) patient had cardiac defect. The cardiac anomaly detection rate in the present study was 71.4 % in the first trimester. The authors could detect all major cardiac defects in the first trimester except the cases that were missed being ventricular septal defects.

The five cases with heart anomalies that were picked up at the 12 week scan opted for termination of pregnancy after undergoing chorionic villous sampling (CVS) to rule out aneuploidies. Only one fetus out of the five was found to have karyotypic abnormality i.e., Turner syndrome. Two cases were missed in the first trimester and were picked up at follow-up scans between 16 and 18 weeks of gestation, the cases that were missed being ventricular septal defects. Both the patients opted for amniocentesis which revealed no karyotypic abnormality. But still one patient terminated the pregnancy at a local hospital and the second patient was lost to follow-up. The authors support the view that a single visit at 11–13+6 weeks can be used to screen the fetus for aneuploidies and major cardiac defects.

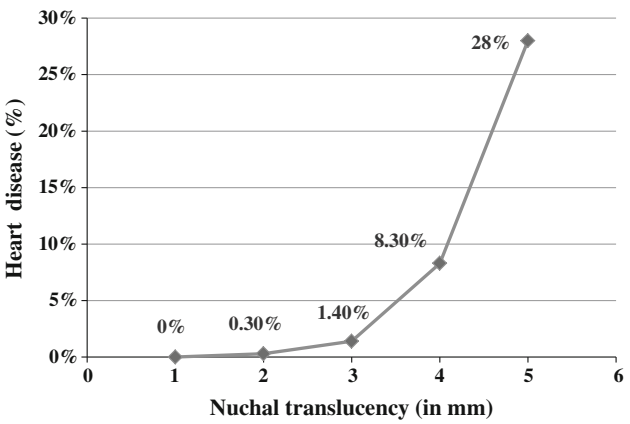

Fig. 3 Distribution of heart disease (in %) in fetuses in relation to NT (in mm)

Discussion

At 11–14 weeks, it is possible to reasonably assess the fetal heart for major complex cardiac defects. It can at least lead to some suspicion which can be later confirmed by an early echocardiography or targeted scan with echocardiography. The total incidence of cardiac anomalies in the study population was 7 (1.9 %). Becker and Wegner [2] and Syngelaki et al. [3] documented prevalence of cardiac defects in the first trimester scan to be 1.4 % and 1.39 % respectively. Transvaginal scanning (TVS) in addition to transabdominal scanning (TAS) increased the visualization and anomaly detection. TVS helped visualization of cardiac anatomy better due to enhanced image resolution and quality [4]. Cardiac defects that were picked up at 11–13+6 week scan were 1.4 % ($n = 5$) in the present study. Becker and Wegner [2] studied a low risk population and reported the prevalence of cardiac defects in first trimester echocardiography to be 1.4 % which is close to the prevalence rate in the present study. Detection rate for heart defects in the present study was seen to be 71.4 %. Various studies had detection rates in the range 25–93 % in the first trimester as shown in Table 1.

In the present study, the authors had cardiac anomaly prevalence rate increasing as the CRL increased. The maximum detection rate was for CRL of 76–85 mm i.e., 3.8 %. Studies done in the same context show the detection of cardiac anomalies to be better as the CRL increases [9]. The authors found that it was feasible to screen the heart for the anomalies by looking at the two standard views in the first trimester. Although, the authors support the view that

Table 1 Comparison of detection rates of cardiac anomalies in various studies at 11–14 weeks

Reference	Gestational age (weeks)	Detection rate
Iliescu et al. [13]	11–14	27/30 (90 %)
Ghi et al. [5]	12–15	57/89 (64 %)
Becker and Wegner [2]	11–14	32/38 (84.2 %)
The present study	11–13+6	5/7 (71.4 %)

adequate training is required. The cases that were missed were ventricular septal defects both muscular and perimembranous type. Ventricular septal defects are always difficult to detect at early gestation unless they are too large defects [6, 7].

When the NT thickness was more than 3 mm, the prevalence of cardiac defects increased to 60 % [8]. High NT is associated with cardiac defects and a wide range of other fetal malformations and genetic syndromes [10–12]. As the maternal age increases the incidence of cardiac defects also increases as reported in various studies [14] but in the present study, the authors did not see an increase in heart defects even though 10 % of the pregnant females were above 35 years of age. Seventeen (4.7 %) pregnant females were with overt diabetes and among them, 2 (0.5 %) patients had cardiac disease detected in the first trimester at 11–13+6 week scan. Rowland et al. showed an increased association of heart disease with patients with pregestational diabetes having poor glycemic control. It is therefore recommended to get fetal echocardiography in pregestational diabetes [15].

Conflict of Interest None.

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