Editorial

Examination of the fetal heart by five short-axis views: a proposed screening method for comprehensive cardiac evaluation

S. YAGEL, S. M. COHEN and R. ACHIRON*

Department of Obstetrics and Gynecology, Hadassah University Hospital, Mt. Scopus, Jerusalem and *Department of Obstetrics and Gynecology, Chaim Sheba Medical Center, Tel Hashomer, Israel

Fetal cardiac malformations, with an incidence of 8 : 1000 among livebirths, are the most common congenital malformations. Their incidence is 6.5 times greater than chromosomal anomalies and 4 times that of neural tube defects. Furthermore, 4 : 1000 livebirths will be affected by severe congenital cardiac malformations which account for 20% of neonatal deaths and up to 30% of infant deaths attributed to congenital anomalies1–4. There is therefore a clear rationale for including complete fetal echocardiography in every targeted organ scan.

Moreover, nuchal translucency screening has been shown to be very effective in identifying fetuses at increased risk for both chromosomal anomalies and cardiac malformation. Three to five percent of tested fetuses will be defined as being at high risk for congenital heart disease following nuchal translucency examination5–7. This creates a new population of considerable size that would be candidates for complete fetal echocardiography. Centers offering nuchal translucency screening would therefore be expected to complement this with comprehensive echocardiography.

Though hailed as innovative and effective at its introduction, the four-chamber view of the fetal heart, when used alone as a screening tool, reveals only some cardiac anomalies8–13. Faced with discouraging false-negative rates, many centers introduced scanning of the great vessels’ outflow tracts as part of their screening programs. This improved detection rates. Most recently, some centers have started to include extensive fetal echocardiography as part of all targeted organ scanning, with significantly higher detection rates for cardiac malformations8–13. In 1998 the AIUM (American Institute of Ultrasound in Medicine) published a technical bulletin14 which put forth the institute’s recommendation for standardizing fetal echocardiography. Our method is a natural progression from this methodology, with several advantages: the AIUM recommends 18–22 weeks’ gestation as optimal timing for fetal cardiac examination, while our method is amenable to early second-trimester transvaginal ultrasound; ours includes scanning of the mediastinum; we propose that fetal echocardiography be offered to all gravidae presenting for routine screening.

The challenge today is to create a comprehensive and precise method to streamline fetal echocardiography. Traditionally, fetal echocardiography has relied on several short- and long-axis views of the fetal heart. Fetal lie may enable optimal visualization of the short-axis views, but make the long-axis planes difficult or impossible to obtain, or vice versa. Often the only recourse is to wait for the fetus to turn. This of course lengthens examination times considerably. The most difficult and time-consuming portion of the fetal echocardiographic examination is the visualization of the aortic arch, which on the one hand is indispensable in the diagnosis of aortic malformations, and on the other places the greatest demands on the sonographer, both in degree of difficulty and time required. These obstacles are particularly problematic in busy screening programs.

To improve and simplify comprehensive fetal heart examination, we suggest a fetal echocardiographic examination based on five transverse planes. The first and most caudal plane is a transverse view of the upper abdomen: moving cephalad. The next is the traditional four-chamber view, which remains the key to the fetal echocardiographic examination. The third is the plane commonly termed the five-chamber view, in which the aortic root is visualized. The fourth transverse view reveals the bifurcation of the pulmonary arteries. Yoo et al15,16 suggested the three-vessel view of the fetal upper mediastinum, a cross-sectional view of the major vessels, as a quick and accurate method to identify the great vessels and diagnose certain anomalies. However,
Figure 1  The five short-axis views for optimal fetal heart screening. The color image shows the trachea, heart and great vessels, liver, and stomach with the five planes of insonation superimposed. Polygons show the angle of the transducer and are assigned to the relevant gray-scale images (LT, left; RT, right) (I) The most caudal plane, showing the fetal stomach (ST), cross-section of the abdominal aorta (AO), spine (SP) and liver (LI). (II) The four-chamber view of the fetal heart, showing the right and left ventricles (RV, LV) and atria (RA, LA), foramen ovale (FO), and pulmonary veins (PV) to the right and left of the aorta (AO). (III) The “five-chamber” view, showing the aortic root (AO), left and right ventricles (LV, RV) and atria (LA, RA), and a cross-section of the descending aorta (AO with arrow). (IV) The slightly more cephalad view showing the main pulmonary artery (MPA) and the bifurcation of left and right pulmonary arteries (LPA, RPA) and cross-sections of the ascending and descending aortae (AO and AO with arrow, respectively). (V) The 3VT plane of insonation, showing the pulmonary trunk (P), proximal aorta (P Ao), ductus arteriosus (DA), distal aorta (D Ao), superior vena cava (SVC) and the trachea (T).
the aortic arch and trachea were not included, the former being perhaps the most demanding aspect of fetal heart examination. Following Yoo, we recently presented the three vessel and trachea (3VT) plane of insonation as the fifth short-axis view in fetal echocardiography, to complement the four traditional planes currently in use and expedite thorough fetal heart examination. The 3VT is the most cephalad transverse view, visualized on a plane crossing the fetal upper mediastinum. It is easily obtained by moving the transducer cephalad and slightly oblique from the four-chamber view. When properly executed, the 3VT reveals the main pulmonary trunk in direct communication with the ductus arteriosus. A transverse section of the aortic arch is seen to the right of the main pulmonary trunk and ductus arteriosus. Cross sections of the superior vena cava and, posterior to it, the trachea, are visualized (Figure 1).

We recently demonstrated the clinical applicability of the 3VT (submitted): in 99% of patients this view was quickly and easily obtained from the familiar four-chamber view. Its use shortened the time required to examine the aortic arch, the most time-consuming aspect of fetal echocardiography. We consider one of the greatest advantages of our novel approach the ease with which the examiner can scan the fetal heart, beginning with the caudal upper-abdomen view. By sliding the transducer cephalad in one continuous motion, all the pertinent views are readily visualized.

In our center we demonstrated that five short-axis views including the 3VT, simplified and streamlined fetal cardiac examination, without compromising diagnostic effectiveness. We see it as another step in the integration of complete fetal echocardiography in routine targeted organ studies.

REFERENCES

2 Young ID, Clarke M. Lethal malformations and perinatal mortality: a ten year review with comparison of ethnic difference. BMJ 1987; 295: 89–91
3 Ferencz C, Neill CA, Baughman JA, Rubin JD, Brenner JJ, Perry LW. Congenital cardiovascular malformations associated with chromo-

17 Yagel S. Examination of the fetal heart by five short axis views: The optimal screening method for fetal cardiac anomalies? Ultrasound Obstet Gynecol 2000; Abstracts of the 10th World Congress on Ultrasound in Obstetrics and Gynecology (Zagreb, October 2000): WS06–07