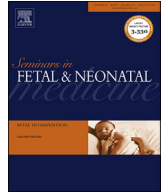




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## Advances in fetal echocardiography

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## A B S T R A C T

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The development of fetal echocardiography and success in prenatal cardiac screening programs over the past 30 years has been driven by technical innovation and influenced by the different approaches of the various specialties practicing it. Screening for congenital heart defects no longer focuses on examining a limited number of pregnant women thought to be at increased risk, but instead forms an integrated part of a high-quality anatomical ultrasound performed in the second trimester using the 'five-transverse view' protocol. A prenatal diagnosis is feasible in almost all cardiac lesions and the advantages to parents and to health professionals are well recognized. Prenatal evaluation can usually determine the level of care required at delivery, thereby reducing perinatal morbidity. However, only half of the babies undergoing surgery within the first year of life have a prenatal detection, and practical training programs to support and provide feedback to sonographers remain essential for continued improvement.

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## 1. Introduction

The development and growth of fetal echocardiography and success in prenatal cardiac screening programs over the past 30 years has been driven by technical innovation and, unlike most specialties with relatively homogeneous roots, has been influenced by the different approaches of the various specialties practicing it.

Its original practice was pioneered by obstetricians and radiologists, and biomedical engineers. More recently, it has been developed by specialists from fetal medicine, prenatal diagnosis, and pediatric cardiology. Screening programs for fetal abnormalities in different countries are performed by those with a technical training or by nurses with midwifery experience.

Software development and improved computer processing power have made ultrasound a powerful tool for prenatal diagnosis. Importantly the technology is relatively adaptable, not requiring an expensive environment as with magnetic resonance imaging or computed tomography, and so it has gained worldwide acceptance. This prenatal hybrid specialty grows at scientific gatherings where its practitioners meet to cross-fertilize ideas and produce outstanding research. These factors make the specialty barely

recognizable from 30 years ago and its growth is a tribute to the efforts of expert teams and the ultrasound manufacturers who work together to continue to push the boundaries of what can be seen and measured. This has permitted development of fetal cardiovascular medicine beyond its initial aim, the identification of structural congenital heart defects, and has opened up possibilities to observe development and function non-invasively in both normal and complicated pregnancies.

## 2. Second trimester screening

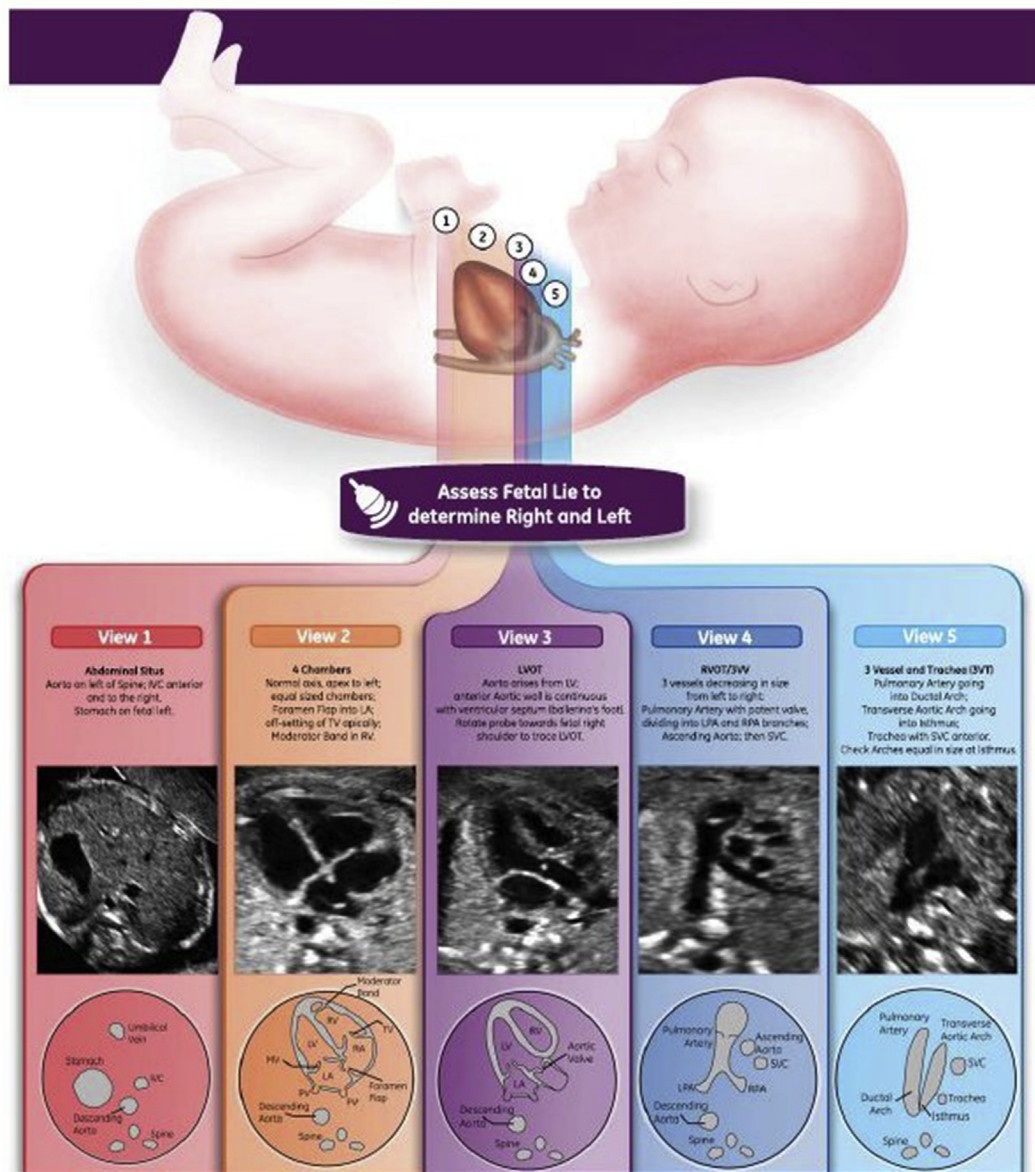
The birth of a baby with a congenital heart defect (CHD) is a relatively frequent occurrence given that CHD is one of the most prevalent birth defects, affecting almost 1% of all pregnancies. A prenatal diagnosis is feasible in almost all lesions and the advantages to parents and to health professionals are well recognized [1,2]. Prenatal diagnosis has been shown to improve morbidity and pre-surgical mortality and reduce costs associated with transportation and resuscitation of collapsed newborns [3,4]. Prenatal screening programs allow the pregnant woman to discuss further investigations including prenatal genetic testing and imaging and to inform reproductive decision-making. The family can come to terms with the perinatal management plan, including the prospect of cardiac surgery, over a period of months rather than in hours when a cardiac diagnosis is made only after delivery. However, prediction of quality of life for children with CHD remains difficult [5,6].

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**Fig. 1.** The five transverse views through the fetal body displaying the cardiac screening planes. This is an educational poster developed by Dr Gardiner and GE Healthcare.

### 2.1. Expectations and advantages

In most cases a baby with CHD can be born at term by vaginal delivery, ideally in a maternity unit within, or co-located, with the cardiac center. Cesarean section is indicated for fetuses with complete heart block who cannot be monitored safely during labor, or with poor cardiac function. However, in practice a prenatal diagnosis is associated with earlier delivery and higher rates of operative delivery for a variety of reasons, usually because of associated lesions or poor fetal growth [7,8]. There is also the option to plan for palliative perinatal management for fetuses that are extremely sick, or have multiple abnormalities, or life-limiting genetic disorders [9].

Prenatal evaluation can usually determine the level of care required at delivery, so health professionals with the appropriate skills can confidently manage the transitional circulation and any extra-cardiac malformations in the certainty of an accurate prenatal cardiac diagnosis and thereby reduce perinatal morbidity and

mortality [10].

### 2.2. Screening guidelines and referral

Screening for CHD no longer focuses on examining a limited number of pregnant women thought to be at increased risk of fetal CHD [11,12]. Fetal echocardiography forms an integrated part of a high-quality anatomical ultrasound performed in the second trimester using the 'five-transverse view' protocol [13]. This is a practical and effective population screening tool which uses five ultrasound planes through the fetal body to provide views of abdominal situs, the four-chamber view, the outflow tracts and the three-vessel and tracheal view (Fig. 1). The details of screening programs vary from country to country, but the most successful programs offer pregnant women a first trimester scan, followed by a detailed anatomical scan at around 20 gestational weeks [13–16]. Professional societies such as the International Society for Ultrasound in Obstetrics and Gynecology (ISUOG) and the American

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