Cardiac ultrasound of the fetus

Advances in ultrasound imaging techniques in the past 10 years have produced dramatic changes in both obstetric and cardiological practice. Improvements in the resolution of ultrasound scanners allow the anatomical structure of the fetus or heart to be seen in hitherto unimaginable detail. As a result, structural abnormalities have now been described in nearly every system in the fetus.¹ Also, cardiac ultrasound or echocardiography is increasingly used as a diagnostic tool in congenital heart disease in children. A painless, harmless technique, which can be repeated as often as necessary, it is ideal for delineating the anatomical malformations characteristic of congenital heart disease. The reliability of echocardiography in providing definitive diagnosis has become such that it has in many cases supplanted invasive techniques, particularly in the investigation and management of affected infants.² By combining the techniques of obstetric scanning with those of postnatal echocardiography the structure of the fetal heart can be recognised between 16 weeks' gestation and term.^{3,4} The connections of the heart, whether normal or abnormal, can be established before 20 weeks' gestation; more minor defects can be seen mainly when optimum image quality is obtained between about 20 and 28 weeks' gestation but small septal defects or minor valvular abnormalities will probably be overlooked. These minor defects are also frequently not detectable in postnatal life on echocardiography. It is, however, the major abnormalities of cardiac connection that are important to identify prenatally.

A further application of the fetal echocardiographic technique is in the investigation of fetal arrhythmias. They are increasingly recognised as heart monitoring becomes more widely used in obstetric practice as an index of fetal well being.

Prenatal detection of congenital heart disease

Congenital heart disease is the most common congenital anomaly, affecting about 1 in 120 live births in this country at the present time.⁵ But several groups of pregnancies are at increased risk of congenital heart disease; those with a family history, maternal diabetes, or exposure to teratogens or the discovery of fetal ascites, arrhythmia, or extracardiac anomaly in a particular pregnancy. Where one child has been affected in a family the risk of recurrence is 1 in 50; where one parent is affected the incidence in the offspring lies between 1 in 10

and 1 in 20.^{6,7} Maternal diabetes is said to double the risk of congenital heart disease.⁸ Some drugs such as lithium and oestrogens are known cardiac teratogens if taken in early pregnancy.⁹ Infection with rubella virus may also damage the fetal heart. Fetal ascites or fetal hydrops, a readily detectable condition ultrasonically, can be secondary to intrauterine cardiac failure, either from structural heart disease or cardiac arrhythmia. Where arrhythmias are detected in intrauterine life, congenital heart disease should be excluded. When an extracardiac anomaly is found on ultrasound the fetal heart should also be examined. Multisystem disorders in the fetus may suggest a chromosomal abnormality or a syndrome diagnosis. Multiple abnormalities will alter the prognosis for the individual fetus and may lead to changes in obstetric management.

Where a major fetal cardiac anomaly is discovered in early pregnancy the option of termination can be considered. Most parents with experience of serious congenital heart disease in a previous child are unwilling to tread this path again if informed of the recurrence early in pregnancy. In only a tiny minority of high risk mothers does such a problem present itself. In our series of nearly 500 mothers with a family history of congenital heart disease,⁵ reassurance could be provided that *no* cardiac abnormality was detectable, only 8 being found to have a recurrence. Alternatively, when an abnormality is predicted, the mother can be prepared for the problem and delivery can take place in a centre where facilities are available for the immediate care of an affected child thus optimising the chance of survival.

Fetal arrhythmias

The echocardiogram can also be used to evaluate arrhythmias detected in prenatal life. Where a bradycardia of less than 100 beats per minute is identified, a sinus bradycardia may be distinguished from complete heart block by examining the M mode echocardiographic tracing.¹⁰ Structural heart disease is associated with complete heart block in about 25% of cases¹¹ and this association will adversely influence the prognosis. Isolated, complete heart block usually has a good outlook and is important to recognise in order to avoid the erroneous interpretation of the bradycardia as fetal distress. The other arrhythmias, an irregular rhythm, or the tachycardias are rarely associated

with structural anomalies. It is important, however, to exclude structural defects in these cases. Ectopic beats of atrial or ventricular origin are commonly observed and rarely of importance in terms of morbidity or mortality. The tachycardias (rates of over 200 beats per minute), on the other hand are commonly associated with fetal loss. If this fast rhythm becomes sustained, intrauterine cardiac failure will ensue, probably within hours. Therefore, once correctly identified, an attempt should be made to control a tachycardia prenatally by giving the appropriate drug treatment to the mother. Success has been achieved using digoxin, verapamil, or procainamide.¹⁰⁻¹² Intrauterine cardiac failure, as evidenced by fetal ascites on ultrasound, can resolve in utero once an arrhythmia has been controlled, allowing delivery of a healthy term infant.

Future prospects for cardiac ultrasound

An increasing number of referrals to our department are apparently normal pregnancies where a routine obstetric scan has drawn attention to possible cardiac anomaly. Once the ultrasonographer is familiar with the appearance of the normal fetal heart, an abnormality, although difficult to define precisely, is readily recognisable. This, therefore, extends fetal heart screening to a much wider population of pregnancies. It is to be hoped that this will continue to increase in the future as good image quality scanning equipment comes within the resources of every obstetric department in the country.

Currently available, cross sectional scanning equipment gives anatomical information but the more recently developed addition of Doppler ultrasound to these machines will provide functional information about blood flow. In the past information about functional aspects of the fetal circulation has been derived from animal studies but this equipment will allow the normal human fetal circulation to be studied. This will not only be of

interest in studying the normal and abnormal heart but may also provide data on altered blood flow in abnormal obstetric states, for example in intrauterine growth retardation.

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