

CASE STUDY

Familial atrial fibrillation with fetal onset

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Abstract

A woman presented during two pregnancies (at 25 and 23 weeks' gestation, respectively) because the fetuses had rapid, irregular tachycardia and hydrops. After maternal drug treatment and achievement of slower fetal heart rates, the hydrops gradually resolved. Both babies were born full term with continuing atrial fibrillation. In the first, an ectopic atrial rhythm was temporarily achieved during high dose flecainide treatment but, in the younger sibling, all medications and repeated cardioversions failed even temporarily to convert the atrial fibrillation with an almost isoelectric baseline in ECG to sinus rhythm. Good rate control has been achieved with digoxin in both patients. No infective, immunological, or structural cause was found in either case, and thus an inherited aetiology is probable.

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Atrial fibrillation is rarely diagnosed in the fetus. No published data exist on the success rates of medical rhythm conversion during fetal life. In adults, it is known that the chances of maintain-

ing sinus rhythm are small after a long period of atrial fibrillation.¹ Atrial tachycardia with an early fetal onset may cause extensive remodeling of the atria. These antepartum changes can impair postnatal cardiac structural and functional development. We report a case of two siblings, both with fetal atrial fibrillation and hydrops, whose ventricular heart rates were controlled with maternal drug treatment, and who were born full term in good clinical condition. In both patients, atrial fibrillation continued postnatally as the permanent rhythm.

Patients

Fetal tachycardia was noticed at a routine antenatal visit at 25 weeks' gestation in a 24 year old woman. The ventricular rate of the fetus was irregular at 180–240 beats/min and the frequency of atrial contractions was 400 beats/min according to M mode echocardiographic recording of the fetal heart—that is, there was atrial flutter with a varying atrioventricular block. Later, no clear atrial contractions could be documented (fig 1). The ventricular rhythm remained irregular but with only slightly varying intervals between the beats (fig 2). A small pericardial effusion was present during the first weeks of treatment. Later no signs of hydrops were observed. With maternal digitalisation the fetal heart rate fell to 210 beats/min and after adding flecainide it fell to 160–200 beats/min. The mother had serum drug concentrations in the therapeutic range when receiving digoxin 0.75 mg and flecainide 200 mg daily. Delivery occurred at 40 + 6 weeks of gestation by caesarean section because of prolonged labour and declining scalp pH values, and an accelerated fetal heart rate (210 beats/min).

After birth the heart rate of the female baby was irregular at an average of 180 beats/min. Intravenous loading with flecainide resulted in a drop in heart rate to 105 beats/min with a fairly regular rhythm (fig 3A). No P waves were observed on a surface ECG. However, on an oesophageal ECG small P waves from different focuses were seen with a varying ventricular response (fig 4). During follow up while receiving flecainide treatment (5 mg/kg/day) there was a regular supraventricular rhythm with no visible P waves on a surface ECG (fig 3B). At one year old drug treatment was discontinued and the child remained asymptomatic. After the birth of her sister two years later, the child was reexamined. She had atrial

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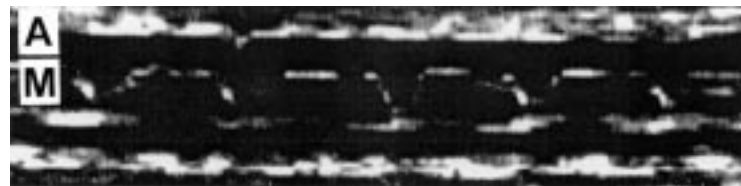


Figure 1 M mode echocardiographic recording of the fetal heart during the first pregnancy at 27 weeks of gestation. Fetal heart rate was 206 beats/min at the time of recording. A, left atrial wall; M, mitral valve movement.

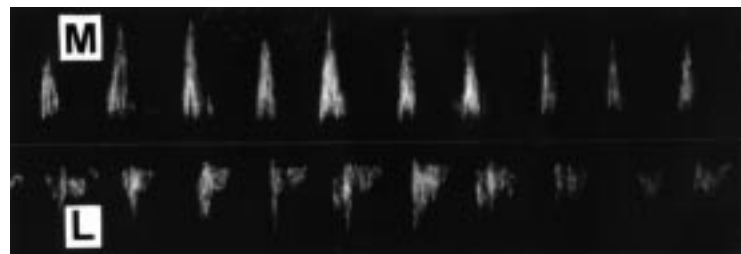


Figure 2 Doppler echocardiographic recording of mitral inflow and left ventricular outflow at 27 weeks of gestation during the first pregnancy. The fetal heart rate was 210 beats/min at the time of recording, with beat intervals varying between 250 and 320 ms. M, mitral inflow; L, left ventricular outflow.

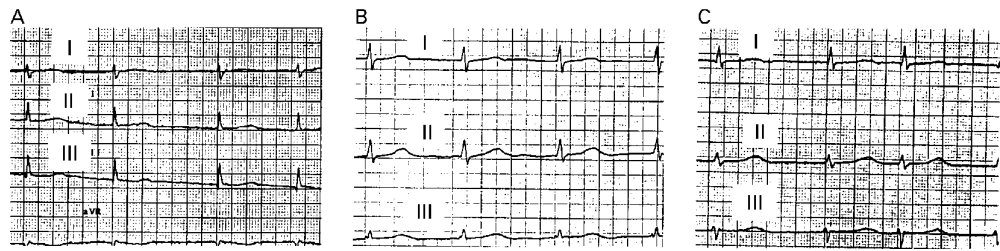


Figure 3 Postnatal ECG recordings of the first baby: (A) on the day of birth after intravenous flecainide loading (mean QT time corrected according to Bazett's formula (QTc) 0.35 seconds); (B) at five months old (mean QTc 0.42 seconds); (C) at two years old (mean QTc 0.41 seconds). (Paper speed 50 mm/s.)

fibrillation with a heart rate averaging 110 beats/min (fig 3C). Both atria were enlarged on echocardiography and the cardiac volume measured by radiography was increased (490 ml/m²). The child was given digoxin. Her exercise capacity had always been normal.

During the second pregnancy, irregular fetal tachycardia (130–220 beats/min) was observed at 23 weeks of gestation (fig 5). Maternal flecainide treatment started at 25 weeks of gestation did not effect the fetal heart rhythm and severe hydrops appeared concomitantly (fig 6). Digoxin (0.75 mg/day) combined with sotalol (160 mg/day) resulted in good heart rate control of the fetus (irregular rhythm 170 beats/min). Pronounced hydrops with pericardial, pleural, and abdominal effusions remained for three weeks, which gradually resolved by 36 weeks of gestation. Elective caesarean section was performed at 38 weeks.

The female baby was born in good general condition. Heart rate was irregular, average 150 beats/min (fig 7A). No P waves were observed on either surface or oesophageal ECG. After an adenosine bolus there was a temporary decrease in the ventricular response rate and some proarrhythmia but no atrial activity became apparent (fig 7B). Direct current cardioversion was attempted repeatedly: during oral digoxin and sotalol treatment;

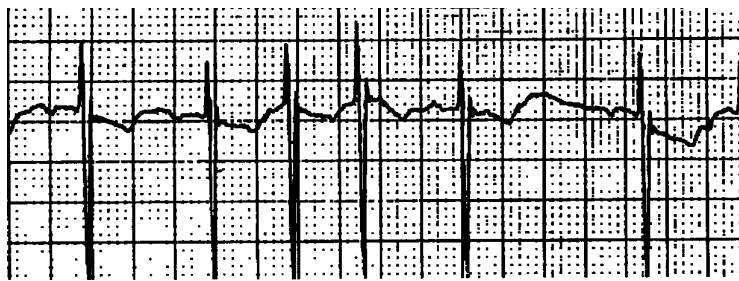


Figure 4 Oesophageal ECG recording of the first baby at one day old. Note the varying polarity of the small P waves. (Paper speed 25 mm/s.)

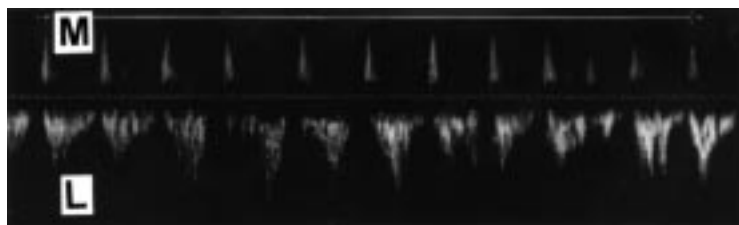


Figure 5 Doppler echocardiographic recording of mitral inflow and left ventricular outflow of the second baby at 23 weeks of gestation. Fetal heart rate was 218 beats/min at the time of recording, with beat intervals varying between 210 and 340 ms. M, mitral inflow; L, left ventricular outflow.

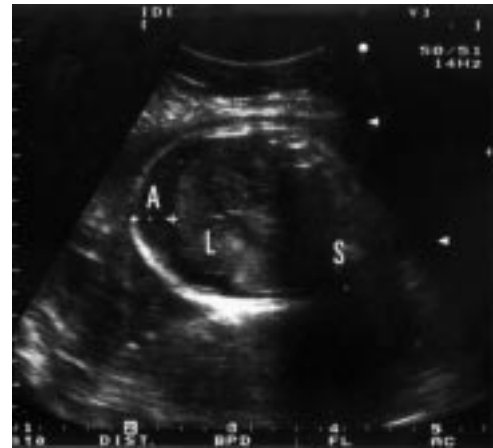


Figure 6 Ultrasonographic cross sectional image of the fetal abdomen of the younger sibling during the 28th gestational week. A, ascites; S, spine; L, liver.

during intravenous high dose flecainide infusion; during intravenous amiodarone infusion; and after two months of oral amiodarone treatment. On no occasion was even temporary regular supraventricular rhythm gained. At three months old, atrial fibrillation continued without haemodynamic problems (fig 7C). Echocardiography showed enlarged atria and a distended foramen ovale (5 mm). There was no AV valve regurgitation and the contractility of the ventricles was good. A small apical ventricular septal defect was seen with colour Doppler echocardiography but no murmur could be heard on auscultation. The child was continued on digoxin treatment.

The hearts of both parents were normal, and comprehensive immunological and serological studies taken from the mother during each pregnancy gave normal results.

Discussion

Atrial fibrillation is a rare disorder in children, especially in the fetus. There are no previous reports of familial atrial fibrillation with fetal onset. However, familial neonatal atrial tachycardia was reported recently by Balaji *et al.*,² and a genetic locus of familial atrial fibrillation has been identified at 10q22-q24, D10S1694-D10S1786.³ In the family presented by Balaji *et al.* the father probably had neonatal atrial flutter that developed into sustained atrial fibrillation. He will probably need cardiac transplantation in the future because of dilated cardiomyopathy. His first son had transposition of the great arteries and supraventricular tachycardia originating from the lateral right atrium. The

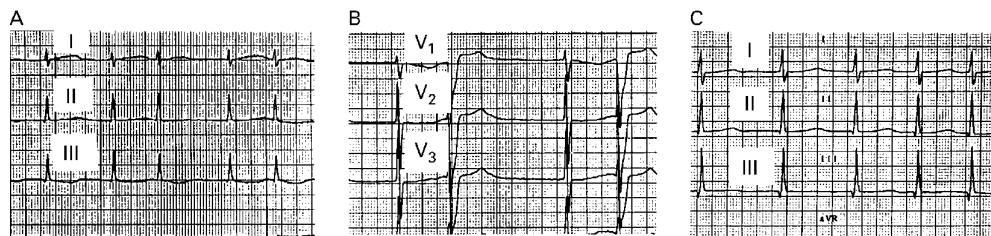


Figure 7 Postnatal ECG recordings of the second baby: (A) on the day of birth (mean QTc 0.42 seconds); (B) after intravenous adenosine bolus; (C) at three months old (mean QTc 0.42 seconds). (Paper speed 50 mm/s.)

second son had prenatal tachycardia with P wave appearance on ECG postnatally similar to the first son. The family described by Balaji *et al* and the siblings in this report have obvious similarities. In both families there was an early onset of arrhythmia of similar type. As the children in both families are still very young, their risks of developing dilated cardiomyopathy are difficult to estimate; however, we are concerned about the future of the siblings with ongoing atrial fibrillation and dilated atria.

Recently it was shown that in some patients with lone atrial fibrillation there is a rapidly acting atrial focus. Thus radiofrequency catheter ablation may be curative although a surface ECG is typical of atrial fibrillation.¹ The older sibling had rapid ectopic atrial activations on oesophageal tracing as a neonate as well as a regular supraventricular ectopic rhythm temporarily during flecainide treatment. Thus, she could benefit from an electrophysiological examination and catheter ablation in the future.

Familial appearance of atrial fibrillation⁴⁻⁶ and atrial flutter⁷ have been described previously. Atrial arrhythmias have been associated with familial arrhythmogenic right ventricular dysplasia⁸ and with familial atrioventricular block.⁹ Rapid development of gene technology will probably shed further light on the possible associations between different types of cardiomyopathy and various types of arrhythmia.

The effective treatment of fetal arrhythmias via the mother is now readily available in the Western world. With active treatment the prognosis of fetuses with tachyarrhythmia seems to be much better than in the past.¹⁰⁻¹² Digoxin and flecainide are effective both in tachycardias using atrioventricular reentry mechanisms and in atrial flutter.¹⁰⁻¹² Sotalol is also considered useful.¹⁰ Amiodarone is a very effective drug in atrial fibrillation, but has poor transplacental transfer and thus must be administered directly in to the umbilical vein or the fetal peritoneal cavity.¹³ It also has poten-

tially serious side effects both to mother and child,¹⁴ therefore, we decided not to use it in our patients during fetal life as acceptable rate control and disappearance of hydrops was achieved with other drugs. However, early conversion of atrial fibrillation could have resulted in better long term control of the arrhythmias in our patients.

In summary, we believe that this is the first report of an apparently familial form of atrial fibrillation presenting by the second trimester of pregnancy. With active treatment a successful clinical outcome was reached although the rhythm disorder persisted postnatally in both children. The long term prognosis of these children is unknown.

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