# Cardiac tumours in intrauterine life

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**Abstract**

**Since 1980, 11 examples of cardiac tumour have been detected in the fetus out of a total of 794 congenital cardiac malformations. Patients were referred because of fetal hydrops in two, a family history of tuberous sclerosis in two, and because of the detection of a tumour mass during a scan at the local hospital in seven. The gestational age range at presentation was from 20–34 weeks. Of eight fetuses where death occurred, the histological type was rhabdomyoma in seven and teratoma in one. In seven cases, the lesion appeared single and in four there were multiple tumours. In two of the cases of rhabdomyoma, other family members had evidence of tuberous sclerosis. Termination of pregnancy took place in four cases; of seven continuing pregnancies, spontaneous intrauterine death occurred in four, and three children are still alive. Two of the three survivors has the clinical picture of tuberous sclerosis. The last case is as yet only 1 month old.**

**In summary, even where the lesion is single, the most likely diagnosis in fetal cardiac tumour is rhabdomyoma, with associated tuberous sclerosis. However, the characteristic features of this latter condition may not become evident until some months after birth.**

(*Arch Dis Child* 1992;**67**:1189–92)

Cardiac tumours are rare in infants and children and are reported in 0·08% of children presenting to a paediatric cardiac referral centre[1] and between 0·0017% and 0·25% of a necropsy series.[2 3] Of 444 primary tumours reported by McAllister and Fenoglio, the most frequent histological type was rhabdomyoma, occurring up to three times more frequently than teratoma and fibroma in infants. Myxomas were found rarely in children but not seen in infants. The first case reports of the detection of a cardiac tumour in prenatal life were published in 1983, using M mode and cross sectional echocardiography, to diagnose a teratoma and a rhabdomyoma respectively.[4 5] Since then several case reports have appeared in the literature.[6–8] Since 1980 we have seen 11 examples of cardiac tumours in fetal life. We have studied the presentation, the type, and outcome of these cases.

## Subjects and methods

From a series of over 10 000 fetal scans, heart disease was detected prenatally in 794. Of these, 11 fetuses had cardiac tumours. Intrapulmonary tumours were also found but differentiated from cardiac tumours by their position outside the pericardial cavity. Two fetuses were referred because of the detection of fetal hydrops, and two because of a family history of tuberous sclerosis. The remaining seven patients were referred because the tumour was suspected at the local hospital scan. In two patients, the diagnosis was made by sending a videotape of the scan recorded at the referral hospital. Patients were scanned using an Advanced Technical Laboratories Mark 3 or latterly Mark 4, and/or a Hewlett Packard 77020A phased array with colour flow mapping facility. Each videotape recording was examined retrospectively. The following features were noted: the presence of hydrops fetalis; the morphology and characteristics of the tumour; whether it was single or multiple; the position, and the presence or potential for obstruction to intracardiac flow. In four patients, successive examinations were performed during pregnancy. Any change in tumour characteristics were recorded. The outcome of each pregnancy was determined. In the eight fetuses in whom postmortem examination took place, the characteristics of the tumour were compared with the echocardiographic findings and histology obtained. The clinical findings in the three survivors were obtained.

## Results

In one case, scanned initially at 18 weeks' gestation for a family history of cardiac tumour, a normal scan was found. On rescan at 22 weeks' gestation, tumours were clearly seen. Two fetuses were hydropic on referral and two

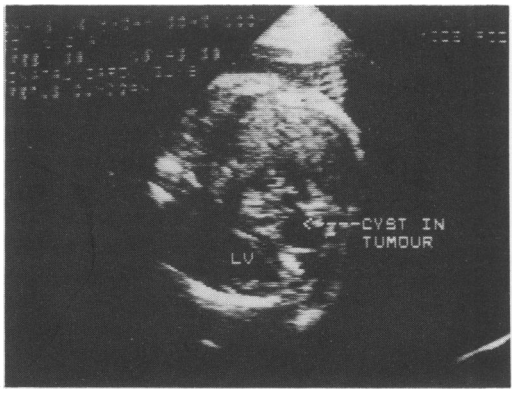


*Figure 1 This shows a four chamber view of the heart. The large cystic tumour compressing the right ventricle proved to be a teratoma LV, left ventricle.*

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Accepted 2 April 1992

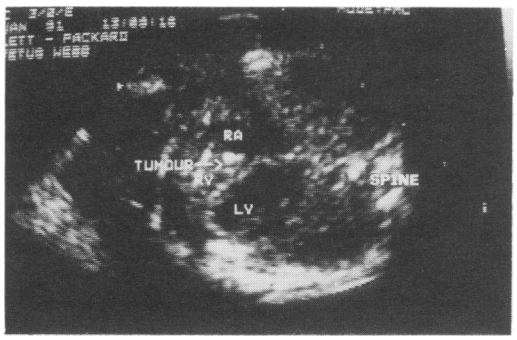


*Figure 2 Four chamber echocardiographic view of a fetal heart illustrating the presence of a rhabdomyoma in the wall of the right ventricle, which extended into the infundibulum. RV, right ventricle;RA, right atrium; LV, left ventricle.*

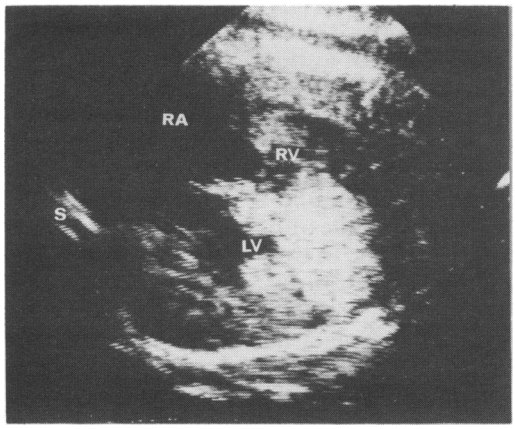


*Figure 3 This shows multiple rhabdomyomas on the four chamber view, with the right ventricular cavity (RV) almost obliterated by the tumour mass. RA, right atrium; LV, left ventricle; S, spine.*

became hydropic as pregnancy advanced. All but one of the 11 cases were solid tumours. The remaining case was intrapericardial in site and cystic in nature (fig 1), and a pericardial effusion developed with advancing gestation. Seven tumours were single (fig 2), including the one cystic lesion, and four were multiple (fig 3). Of the six solid single tumours, one was obstructing the mitral valve, one obstructing the tricuspid valve and pulmonary outflow tract, and the remainder involved the ventricular septum. Of these four septal tumours, one was causing fetal hydrops at the first study, one was potentially obstructive but the pregnancy was interrupted; two were not obstructive to blood flow and remained non-obstructive as pregnancy advanced.

## OUTCOME

Of the cases with multiple tumours, two sought termination, one case survives but the tumours have not become obstructive, and the remaining case resulted in spontaneous intrauterine death. This last case showed increasing tumour size and increasing left ventricular outflow tract obstruction with advancing gestation. Episodes of supraventricular tachycardia were also noted before fetal death. One other patient in our series was documented to show episodes of intermittent tachycardia.

In four patients, termination of pregnancy was requested by the parents after discussion of the outlook and likely underlying disease. One of the four had a severely handicapped older child with tuberous sclerosis, and a further patient had right heart obstruction with atresia and hypoplasia of the pulmonary artery. Spontaneous intrauterine death occurred in four, three of whom presented with or developed fetal hydrops.

Postmortem examination was performed in all eight fetuses who died. The echocardiographic features were confirmed in all cases, in particular the multicystic nature of the pericardial tumour (figs 4–6). The histology in seven cases proved to be that of a rhabdomyoma and was pathognomonic in all cases. The cystic tumour proved to be a teratoma. Three patients

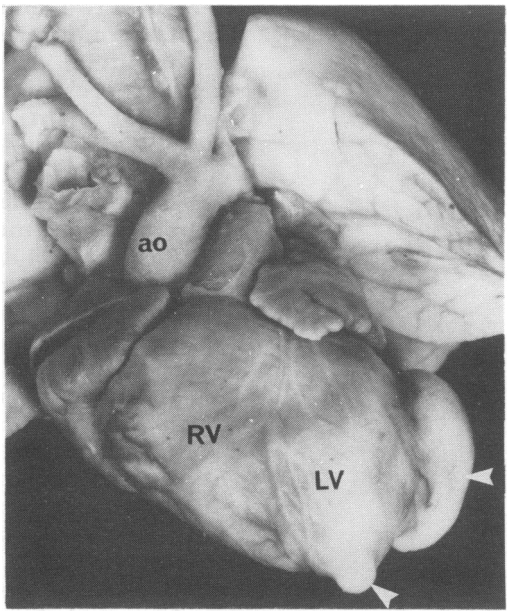


*Figure 4 This shows the pathological specimen in one of the cases of rhabdomyoma. Two tumours can be seen protruding from the wall of the left ventricle (V, arrows). Ao, aorta; RV, right ventricle.*

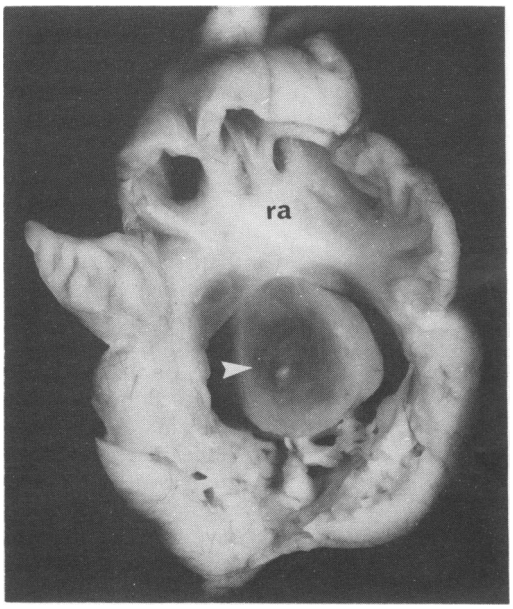


*Figure 5 The fetal heart opened at postmortem examination demonstrates a rhabdomyoma (ra) attached to and obstructing the orifice of the tricuspid valve (arrow). This correlated well with echocardiographic appearance.*

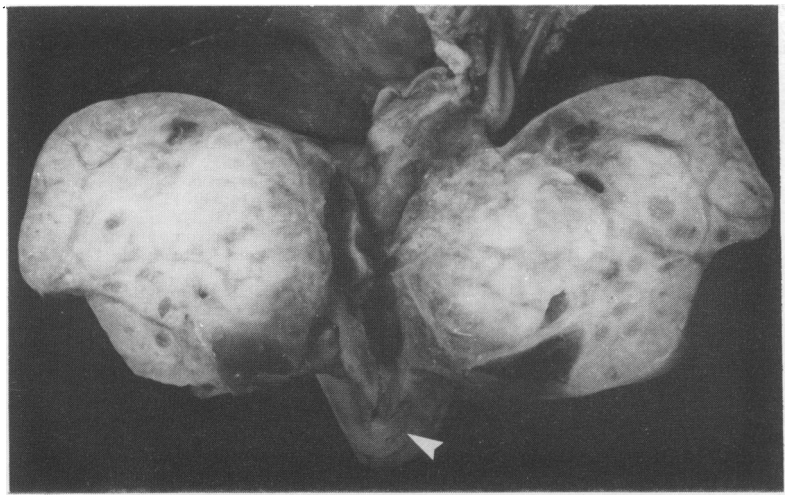

*Figure 6 The teratoma has been sectioned to show the varying density of tissue and cystic areas, which correlated well with the echocardigraphic findings. The right ventricle is arrowed.*

remain alive. Two (now aged 5 years and 16 months respectively) have developed the classic signs and symptoms of tuberous sclerosis. The last survivor is at present only 1 month old.

## Discussion

Cardiac tumours were detected in this series more frequently than is reported in necropsy series, but less frequently than in a clinical study of children seen in a paediatric referral centre. This last is surprising as there was a high rate of intrauterine death—in four of seven continuing pregnancies (57%), the fetus died spontaneously. Death appeared to be caused by obstruction to blood flow and fetal hydrops in three, a widely reported association.[9 10] Structural heart disease has been described in previous cases.[11 12] In our case, tricuspid incompetence and pulmonary outflow obstruction appeared to be direct consequences of tumour growth rather than primary malformation. In another case, an increasing aortic velocity on sequential Doppler examination suggested increasing left ventricular outflow tract obstruction. In this case, spontaneous intrauterine death occurred but episodes of tachycardia had been noted before fetal death and this has been reported to be the cause of death in childhood[13] and in fetal life.[14] The mechanism for this is unknown but would appear to be secondary to disruption of the conducting tissue by the tumour or tumours, positioned in the intraventricular septum. The rhabdomyomas are well circumscribed macroscopically and microscopically and it is unlikely that their high glycogen content acts as a substrate for re-entry tachycardias.

In one case in our series tumours developed, in terms of echocardiographic detection, between 18 and 22 weeks' gestation; this illustrates the importance of sequential examination throughout pregnancy in mothers at high risk of rhabdomyoma in the fetus. Other authors have also reported tumours becoming evident as pregnancy progressed.[15] Of the two other cases of rhabdomyoma studied sequentially, the tumours increased in size in one and remained the same in the other. There is no evidence of regression during intrauterine life and maternal hormones have been implicated in their development and in postnatal regression. The teratoma increased strikingly in size between 20 weeks and intrauterine death at 30 weeks' gestation. The echocardiographic appearance of the cystic nature of this tumour and its epicardial position were characteristic of teratoma and contrasted with the appearance of the more commonly occurring rhabdomyomas, none of which were cystic and all of which were intracardiac. The tumours in all our surviving cases have regressed in postnatal life, which is consistent with previous reports.[8 16]

The histological findings are consistent with previous reports and with the findings in children, in that rhabdomyoma was much the most common histological type of tumour. Rhabdomyomas are associated with tuberous sclerosis in between 50% and 78% of cases, according to different authors.[1 8] In none of the fetal necropsy specimens was evidence of tuberous sclerosis found elsewhere in the fetus despite the presence of proved tuberous sclerosis in one parent in each of two cases. Of the three surviving neonates, one developed the clinical features of tuberous sclerosis at 6 months of age and the second at almost 1 year of age. The remaining neonate is only 1 month old at present but we feel is highly likely to develop the picture of tuberous sclerosis in later infancy. This would suggest that apart from rhabdomyoma, the other signs of tuberous sclerosis are rarely found in fetal life or early infancy, although this will be the underlying diagnosis eventually.

The severity of the clinical picture, particularly of fits and developmental delay, although usually associated with significant handicap, can be variable.One of our affected parents had never had fits and was of normal intelligence. Similarly, family studies in cases of children with tuberous sclerosis have revealed unsuspected affected parents.[6 17 18] A family history of tuberous sclerosis is an unusual cause of referral to our unit. A total of five patients have been referred for this reason in 11 years, including the two which proved positive. Part of the explanation for this may be that the absence of cardiac tumours in the fetus does not guarantee absence of the disease. Geva *et al* suggested that intrauterine surgery for an obstructive cardiac rhabdomyoma might be beneficial and that a normal necropsy excludes tuberous sclerosis.[13] Our results indicate that this is not so and we do not feel that such treatment should be offered.

Despite the location of the gene for tuberous sclerosis on chromosome 9, multiple loci are suspected and diagnosis by gene mapping is not yet available. In view of this, and the spontaneous mutation rate of at least 60%,[19] echocardiographic examination of the high risk pregnancy for cardiac tumours may be the only method of detecting an affected fetus in the immediate future. However, the absence of cardiac tumours in a high risk fetus will not exclude the diagnosis of tuberous sclerosis.

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