THE 'TRAP' SEQUENCE – LIFE THREATENING CONSEQUENCES TO THE PUMP TWIN

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ABSTRACT

The acardius foetal malformation is a rare abnormality occurring in monozygotic multiple pregnancies. This is a case report of a pair of twins with the "twin reversed arterial perfusion (TRAP)" sequence and its complications. The recipient twin was born acardius acephalus. The pump twin had problems of prematurity, disseminated intravascular coagulation, sclerema and right ventricular hypertrophy. On follow-up at seven months he has failure to thrive, spastic quadriplegia and developmental delay. An awareness of the TRAP sequence may lead to better antenatal diagnosis and optimal management of the twin pregnancy.

Keywords: acardius, disseminated intravascular coagulation, cardiac failure, ventricular hypertrophy, prematurity

SINGAPORE MED J 1994; Vol 35:329-331

INTRODUCTION

The acardius foetal malformation is a rare abnormality occurring once in every 35,000 births[1]. It is seen only in monozygotic multiple pregnancies. Most are found in twin pregnancies where one twin has no heart and is entirely dependent on the blood supply of its normal and identical twin. The anomaly is thought to result from an umbilical artery-to-artery anastomosis between twin foetuses in the presence of a fused placenta, and the term "twin reversed arterial perfusion (TRAP)" sequence has been used to describe the defect[2]. If these haemodynamic demands do not abate, they result in right ventricular hypertrophy and cardiac failure. This is a report of a set of twins with the TRAP sequence which resulted in life-threatening complications to the normal twin.

CASE REPORT

A 26-year-old woman, TLM, was diagnosed to have a twin pregnancy by antenatal ultrasound at 15 weeks of amenorrhoea. She had two previous abortions and one normal child. She was well during the pregnancy with no significant medical history. A repeat ultrasound at 21 weeks showed that Twin 1 was normal but Twin 2 had no cardiac pulsations identified. She was admitted at 29 weeks of amenorrhoea for premature labour. Twin 1 delivered vaginally with an Apgar score of 8 at one and five minutes. Birth weight was 1090 gm. Twin 2 was delivered by caesarean section as there was difficulty delivering the baby vaginally. A grossly abnormal acephalic monster was delivered. This consisted of an amorphous mass with identifiable left upper limb, umbilical cord and both lower extremities (Fig 1) and male external genitalia (Fig 2). A post-mortem done revealed acardia.

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Fig 1 – Twin 2 was an amorphous mass with no identifiable head but identifiable left upper limb, umbilical cord and both lower extremities.

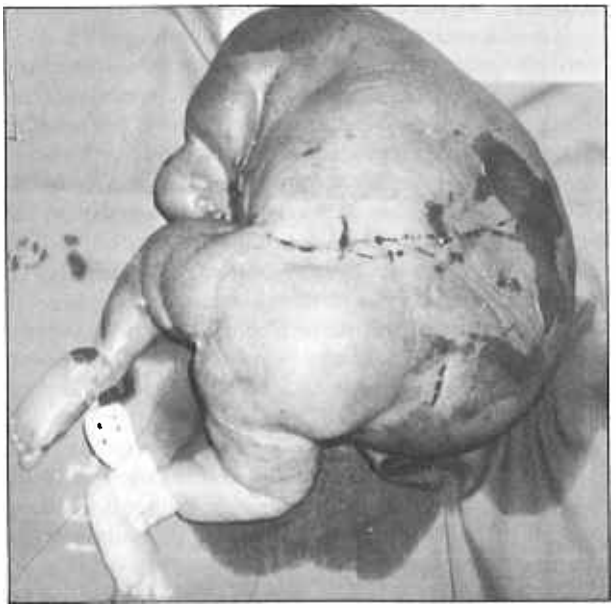
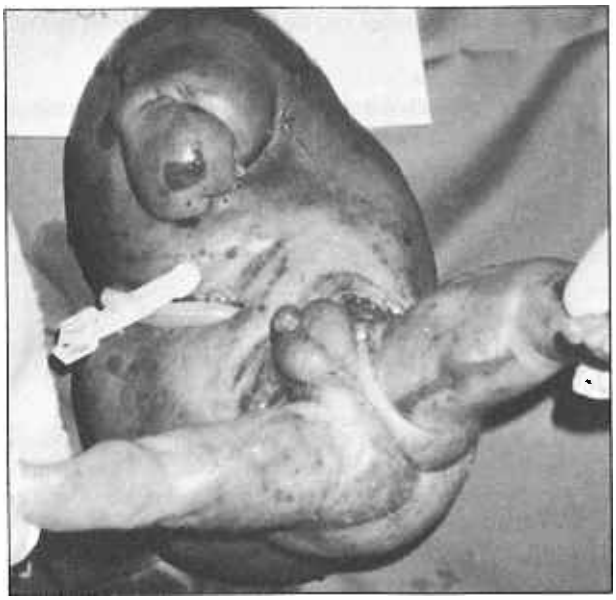


Fig 2 – Male external genitalia was present.



Twin 1 was a male infant weighing 1090 gms. He was initially well. There was no hyaline membrane disease and no umbilical artery catheter was inserted. He was managed in the neonatal intensive care unit in view of his prematurity and the abnormal twin. On the second day of life, he was lethargic with abdominal distension, blood-stained gastric aspirates, hypotension, sclerema and persistent metabolic acidosis. Investigations revealed leucopenia (total leucocyte count = 5.7 x 10^9/L), and thrombocytopenia (platelet count = 32 x 10^9/L). A coagulation profile done showed a prolonged partial thromboplastin time (activated) of 47.6 secs (normal: 38 secs). Prothrombin time was normal at 21.6 seconds (normal: 12-21 secs). An abdominal X-ray revealed gaseous distension. There was no evidence of pneumatosis intestinalis. He was diagnosed to have necrotising enterocolitis with disseminated intravascular coagulation and presumed sepsis. He had been given only one milk feed prior to onset of symptoms. He was intubated and ventilated. Ampicillin, gentamicin and metronidazole were started and he was also given fresh frozen plasma and platelet tranfusions. Four single-volume exchange transfusions were performed. Blood cultures done did not yield any bacterial growth. He subsequently recovered and feeds were started after 14 days of nil by mouth.

A cardiac murmur was detected on the third day of life. A 2D echocardiogram revealed a small persistent ductus arteriosus which closed spontaneously on a repeat 2D echocardiogram done a week later. Marked ventricular hypertrophy was also noted on the 2D echocardiogram of the heart. However, his blood pressure was normal and he was not in cardiac failure. A third 2D echocardiogram was done at 3 months of age, which showed that the ventricular hypertrophy noted earlier had resolved.

He progressed uneventfully till the third week of life when he had a nosocomial infection. *Methicillin-resistant Staphylococcal Epidermidis* was isolated from his blood cultures. He was treated with vancomycin for 2 weeks following which he recovered well.

He was discharged home after 81 days when he attained a weight of 2 kg.

At seven months of age correcting for prematurity, his growth parameters are below the third percentile. Developmentally he is delayed as he cannot turn over or sit up, and he has spasticity of all his limbs. He is currently undergoing physiotherapy and occupational therapy and will be enrolled in a stimulation programme soon.

DISCUSSION

Acardiac anomalies were first described in 1533 by Benedetti. They have been classified into the following categories by Das:

1. Acardius anceps
   There is a partially developed head. The body and extremities are developed. There is never a formed heart found.
2. Acardius acephalus
   This is the most common variety of the acardiacs. They are headless and lack thoracic organs. The lower limbs are well developed but the upper extremities may or may not be present.
3. Acardius acormus
   This is the rarest form of acardia. There is a head without a body.
4. Acardius amorphus
   The foetus is not recognisable as a human form but appears as an irregular skin-covered mass. The acardius myelocephalus is a subgroup where suggestions of one or more limbs may be present.

Multiple aetiologies may be involved in the production of the TRAP sequence. However, the majority of cases can be explained under one aetiology, that is, reversed arterial perfusion, where the pathogenesis of the defects would appear to be the disruption of early developmental events as a result of disrupted vascular supply, rather than the degeneration of formed structures[3]. The anomaly is thought to result from an umbilical artery to artery anastomosis between twin foetus in the presence of a fused placenta. Due to the nature of the artery-to-artery anastomosis, the twin with the haemodynamic advantage serves as the "pump" twin. For the "recipient" twin, this results in a retrograde perfusion of deoxygenated blood from the pump twin that would normally have returned to the placenta. This reversed umbilical artery blood flow leads to a preferential blood flow via the umbilical arteries to the abdominal aorta resulting in a wide array of structural abnormalities in the recipient twin[4]. Studies done suggest that chromosomal defects are not the cause of the anomaly[5].

There is an increased frequency of disruptive structural defects in association with monozygotic twinning which is secondary to intrauterine vascular connections between the twins. In 1961, Benirschke first suggested that some structural defects noted in one member of a monozygotic twin pair were caused by an intrauterine vascular accident[6]. He postulated that embolisation and infarction of various organs occurred due to transfer of thromboplastin-rich blood from a dead to a living monozygotic twin through placental vascular anastomosis resulting in defects in the central nervous system, gastro-intestinal tract, renal system and the musculo-skeletal system. Our patient had none of these structural defects. Barium enema, barium meal and follow-through had been done during his hospital stay and this excluded gastrointestinal atresia.

Foetal disseminated intravascular coagulation has been suggested to occur after intrauterine death of one twin[7]. These findings were attributed to the passage of thromboplastic material from the dead twin to the circulation of the live twin. This however has not been previously reported in the pump twin in TRAP. Our patient, Twin 1, did develop signs of early disseminated intravascular coagulation on the second day of life as evidenced by a clinically ill infant with gastric bleeding and laboratory evidence of thrombocytopenia, and a prolonged partial thromboplastin time. The precipitating factor was presumed sepsis. However, the blood cultures taken before antibiotics were given were negative. This may imply that the pump twin may have had a disseminated intravascular coagulopathy from thromboplastins secreted from the recipient twin which was undergoing degradation.

In a significantly high percentage of cases of the acardiac anomaly, the normal twin develops cardiac failure. This is the haemodynamic consequence of the normal heart having to pump an excessive amount of blood for a long period of time[8]. As a result, ventricular hypertrophy occurs, which was present in our patient. However, the ventricular hypertrophy does improve postnatally when the extra load, that is the second twin, is removed, as demonstrated by a reduction in the ventricular muscle thickness on a repeat 2D echocardiogram done 3 months after birth in our patient.

The TRAP sequence is associated with a high mortality rate of 50% among the normal twin[4]. Prematurity seems to be the most important factor in the high mortality rate, and in-utero congestive heart failure of the pump twin has been cited as the most likely cause of premature delivery[2]. In view of this complication, the best chance of survival of this twin is to carefully assess the cardiovascular status of the normal twin by antenatal sonography. Some researchers advocate in-utero intervention by interrupting the umbilical circulation between the twins before intrauterine heart failure develops in the pump

twin[9]. This procedure seems to eliminate the extra cardiac load and also reduce the amount of hydramnios and subsequently prolong the pregnancy. In contrast, others have recommended surgical intervention only after medical therapy has failed[4]. Successful treatment of heart failure in the pump twin by administering oral digoxin to the mother has also been reported[10].

In summary, the TRAP sequence is a rare abnormality, but if undiagnosed antenatally may result in a high mortality in the normal pump twin. The pump twin is also in increased risk of complications, particularly from prematurity and cardiac failure and possible disseminated intravascular coagulation. The importance of antenatal diagnosis of this condition is for optimal management of the pregnancy with a view to intact survival of the normal pump twin.

ACKNOWLEDGEMENT

Many thanks to Mrs K A Nathan for typing the manuscript.

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ANSWER TO ELECTROCARDIOGRAPHIC CASE

Diagnosis: Digoxin toxicity

DISCUSSION

The basic rhythm of this electrocardiogram is atrial fibrillation with a slow ventricular response of 60 per minute. This is indicated by the absence of P waves and random oscillation of the baseline due to fibrillatory (f) waves. The rhythm strip shows a remarkedly regular ventricular response and ventricular bigeminy.

In untreated atrial fibrillation, the ventricular rate is usually between 100 and 180 per minute. Atrial impulses are conducted through the atrioventricular junction resulting in an irregularly irregular rhythm. A slow ventricular rate below 70 per minute can occur in the presence of disease affecting the atrioventricular junction eg sick sinus syndrome. In our case, complete atrioventricular block is indicated by a slow ventricular rate with regular RR interval. The level of the block is proximal to the bifurcation of the His bundle as shown by the narrow QRS complexes. Digoxin causes delay in conduction at the AV junction and can produce various degree of AV block. When the ventricular rhythm in patients who have atrial fibrillation and receiving digoxin becomes regular, digoxin toxicity should be suspected[1]. In addition, ventricular premature contraction is often the earliest manifestation of digoxin toxicity. As illustrated by this patient, bigeminal and trigeminal rhythms are particularly common. Furthermore, characteristic sagging of the ST segment and T wave inversion are seen in the inferior and lateral leads.

Digoxin toxicity can cause almost any type of arrhythmia as a result of disturbances in both impulse formation and impulse conduction[2]. Common digoxin-induced arrhythmias are atrial tachycardia with AV block, junctional tachycardia, fascicular ventricular tachycardia (including bidirectional ventricular tachycardia) and ventricular bigeminy. Digoxin toxicity has to be suspected whenever both increased automaticity and impaired conduction are present simultaneously, especially in the diseased heart[2]. Predisposing factors for digoxin toxicity include advanced age, severe heart disease, renal insufficiency, chronic lung disease with hypoxia, liver disease, hypokalaemia and hypomagnesemia[3]. Although serum digoxin level is useful in the diagnosis of digoxin-induced arrhythmia, considerable overlap is found in toxic and non-toxic patients.

This patient had a digoxin level of 4.6 ng/ml. He also had renal impairment, a mjaor factor predisposing to digoxin toxicity. He was admitted for continuous ECG monitoring and the drug was discontinued. The ventricular bigeminy subsequently disappeared with restoration of an irregular ventricular rhythm. The key to successful treatment of digoxin toxicity is early recognition. Most cases resolve with withdrawal of the drug, monitoring of ECG and subsequent adjustment of dosage. Ventricular pacing is indicated in symptomatic bradycardia. Ventricular arrhythmias causing haemodynamic instability can be treated with phenytoin[4]. DC cardioversion should only be used with extreme caution as life threatening ventricular arrhythmias may result[5]. In life-threatening instances, digoxin-specific antibody can be used[2]. Hypokalaemia and hypomagnesemia must be corrected.

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