Fetal intracardiac transfusions in patients with severe rhesus isoimmunisation

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Abstract

Six patients with pregnancies of 19-31 weeks' duration showing evidence of erythroblastosis fetalis were treated with 25 fetal intracardiac blood transfusions. Complications related to the procedure occurred on five occasions in three patients. In two of the six patients the fetus died, but it was unlikely that death was related to the intracardiac transfusions.

Fetal intracardiac blood transfusion may result in potentially severe complications but offers an alternative when transfusion cannot be performed into the umbilical cord.

Introduction

Modern management of severely isoimmunised patients in early pregnancy is by fetal intravascular blood transfusion. Rodeck *et al* introduced the technique and gave the transfusion into the umbilical cord under fetoscopic control.[1] Later Bang *et al* carried out intravascular transfusion under ultrasound guidance,[2] and since then the method has been introduced in several perinatal units.[3-5]

An alternative route to the fetal intravascular space is by direct puncture of the fetal heart. Bang utilised this method to sample fetal blood for genetic diagnosis,[6] and later M E Hansmann reported using this route to deliver blood to the fetus (unpublished). We describe six patients treated with intracardiac transfusions in utero.

Patients and methods

Six patients with pregnancies of between 19 and 31 weeks' duration and showing evidence of erythroblastosis fetalis were treated with 25 transfusions into the fetal heart. All patients had histories of severe rhesus isoimmunisation and had experienced a total of 26 stillbirths as a result.

With our management protocol cardiac transfusion was carried out when it was not possible to perform the intravascular transfusion into the umbilical cord. Five of the six patients had a posterior placenta and one was obese (102 kg), so that cordocentesis was almost impossible with the ultrasound equipment available.

One hour before fetal intracardiac transfusion the mother was sedated with intramuscular morphine (10 mg) and promethazine (25 mg). A preheparinised 22 gauge spinal needle was guided into the fetal heart with use of continuous ultrasound monitoring (Philips SDR 1500, Sectorscanner). The puncture transducer allows a change in angularity, and two marker lines on the oscilloscope indicate the path of the needle. During puncture the heart was visualised in transverse section and the primary target for the needle was the left ventricle. Fetal blood was drawn for immediate analysis of haematological indices (Coulter Counter 5 Plus 3) and acid-base balance (Corning 178 pH blood gas analyser). The transfusion was then started with O Rh negative packed cells. The rate of infusion was about 1 ml/min and during the transfusion the needle tip and injected blood were readily seen on the screen. After the needle was withdrawn the fetal heart was monitored with ultrasound for 15-30 minutes, and thereafter continuous fetal heart rate recording with a cardiotocograph was performed for one to two hours.

All surviving infants had an echocardiogram and electrocardiogram recorded during the first week of life. Necropsy was not performed in the stillborn infants.

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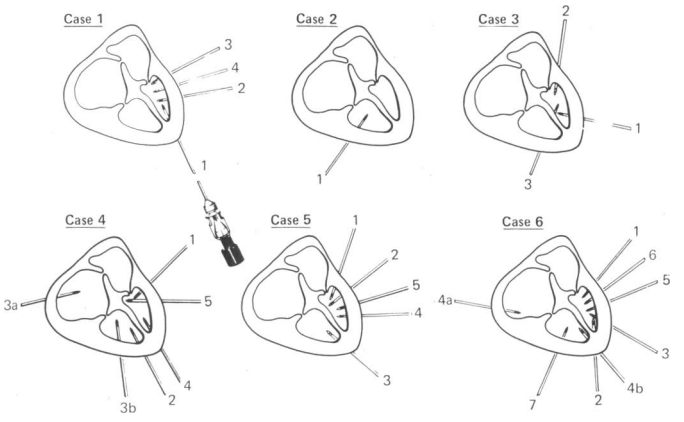
Results

A total of 25 intracardiac transfusions were performed in the six patients. The table and figure give details of the transfusions and the outcome of the pregnancies. Of the procedures, eight required a second needle insertion and three required three attempts at entering the fetal heart. The most common reasons for unsuccessful puncture were that the fetus moved or that the needle was inserted obliquely, which made it slide on the ribs of the fetus.



Sites of needle insertion for transfusion in the six cases. (Transfusion numbers correspond to table (a, b represent needle insertions at same transfusion).)

A total of five complications in three patients occurred in relation to the procedure. In case 1 severe bradycardia and asystole were seen immediately after the first transfusion. After about 30 seconds 0·1 ml adrenaline (1/10 000) was given through the needle and spontaneous cardiac activity resumed 10-20 seconds later. The second and third transfusions produced similar responses, which were also reversed with intracardiac adrenaline.

In case 4 the right atrium was accidentally punctured at the third transfusion. Within a few minutes it was obvious that the fetus had developed haemopericardium. The needle was withdrawn and the tip of the needle placed in the pericardial space, from which 7 ml blood was aspirated. The needle was reinserted, this time into the right ventricle, and the transfusion carried out without further problems.

In case 6 at the fourth transfusion it was initially difficult to puncture the heart with the result that the needle was inserted into the right atrium. Two millilitres of blood was aspirated and over the next 20-30 seconds the fetus developed severe bradycardia (10-20 beats/min). Adrenaline was given and the fetus responded with tachycardia instantaneously. The needle was then removed and reinserted into the right ventricle and transfusion carried out.

Four patients in the series had a favourable outcome. All these infants had an uneventful neonatal course in respect of cardiac function. Echocardiograms and electrocardiograms during the first week of life and before discharge were normal.

In two cases fetal death occurred three to six hours after intracardiac transfusion. In both, however, death seemed imminent before the transfusion. The first patient (case 1) had three consecutive fetal intracardiac transfusions complicated by fetal heart arrest, and the following two transfusions were therefore performed in the extrahepatic part of the umbilical vein in the abdominal cavity. After the last transfusion, in the 26th

Details of 25 fetal intracardiac transfusions and outcomes of pregnancy

Case No	Transfusion No	Gestational age (weeks)	Hydrops	No of attempts to puncture	Haemoglobin at start (g/l)	Transfusion volume (ml)	Haemoglobin at end (g/l)	Complications	Outcome
1	1	21	+	1	31	20		Asystole	
	2	23	+	3	28	11		Asystole	
	3	24		2	43	8		Asystole	
	4	26		1	23	5			Stillborn 26 weeks
2	1	22	+	1	20	5			Stillborn 22 weeks
3	1	25		2	78	10	98		
	2	27		1	72	17			Caesarean section 32 weeks
	3	30		1	78	19			Alive and well
4	1	24		1	76	9	104		
	2	26		3	81	8	99		
	3	28		2	62	10	81	Haemopericardium	
	4	30		3	48	15	80		Caesarean section 32 weeks
	5	31		1	59	14	75		Alive and well
5	1	25	+	1	44	15	70		
	2	26		1	50	13	72		
	3	27		2	62	11	85		
	4	29		4	65	18	82		Caesarean section 32 weeks
	5	31		2	54	18	72		Alive and well
6	1	19	+	1	23	18	104		
	2	20		1	56	13	93		
	3	23		2	49	14	73		
	4	25		1	37	12	66	Bradycardia	
	5	26		2	40	11	61		
	6	27		1	44	19	72		Caesarean section 31 weeks
	7	29		2	47	20	76		Alive and well

week of gestation, bleeding from the puncture site was observed on ultrasound for 10 minutes. The next day the mother felt no fetal movements and ultrasound disclosed a flat fetus with poor myocardial contractility. Fetal blood sampling showed severe anaemia and an intracardiac transfusion was performed. The fetus died three hours later. At delivery amniotic fluid was heavily bloodstained. At all six transfusions the fetus had shown thrombocytopenia with platelet counts in the range of $19\text{-}39\times10^9$/l.

The second patient (case 2) was referred in the 22nd week of gestation, and ultrasound showed signs of severe hydrops fetalis with pericardial effusion, distended heart, and poor myocardial contractility. An intracardiac transfusion was performed but the fetus died six hours later.

Necropsy was refused in both cases. Ultrasound used to establish fetal death, however, showed no evidence of fluid in the pericardial or pleural spaces in either case.

Discussion

The intracardiac route may be used for transfusing blood to a fetus with erythroblastosis fetalis but is potentially dangerous. Complications were frequent in this series. In the two fetuses that died death seemed to be imminent when the transfusions were carried out, and therefore in the absence of necropsy evidence we assume that the cause of death was not directly related to the method.

The most common complication was bradycardia and asystole. Though the cause was most probably the direct puncture of the heart, the same complication has been reported in cases of severe rhesus isoimmunisation during intravascular transfusions into the umbilical cord.[7,8] Thus bradycardia may reflect the response to transfusion in a severely compromised fetus rather than the method used for giving blood.

The small increments in volume of blood given at each transfusion in this series reflected our concern not to overload. In addition, it was sometimes difficult to keep the needle in the right position longer than 10-15 minutes. It may be that the risk from overload was exaggerated, as several workers have reported excellent outcomes with considerably larger transfusion volumes.[3-5] It remains to be established, however, whether these larger volumes may be used in heart transfusions.

The primary target for the cardiocentesis was the apical part of the left ventricle. The rationale was that the route should not endanger major arteries and that the transfused blood should be transported immediately to the placenta for oxygenation. We speculate, however, whether the right ventricle with its double cardiac output compared with the left might be a better transfusion site. Giving the blood into the right ventricle would avoid having transfused blood with a high packed cell volume and low pH and temperature entering the coronary artery circulation. On two occasions in our series the right atrium was punctured. This is easily done, as the right atrium is enlarged in fetal decompensation. Both procedures were complicated.

In conclusion, fetal intracardiac blood transfusion is possible but may be associated with potentially severe complications. Technical problems remain to be solved but we think that the approach offers an alternative when intravascular transfusions cannot be performed into the umbilical cord.

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