Case reports

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Balloon atrial septostomy via the umbilical vein

H. H. Kaye¹ and Michael Tynan

From the Department of Cardiology, Newcastle General Hospital, Westgate Road, Newcastle upon Tyne

A case of transposition of the great arteries is presented in which an adequate balloon septostomy was performed through the umbilical vein. Some difficulty was experienced in traversing the ductus venosus. The possible complications of umbilical vein catheterization are reviewed but it is suggested that some of them may be avoided since the procedure is carried out under x-ray control.

The outlook for children with transposition of the great arteries has improved in recent years. Balloon atrial septostomy (Rashkind and Miller, 1966) has been shown to be the palliative treatment of choice (Tynan, 1971) and considerable success has been achieved by surgical correction (Clarkson *et al.*, 1972), particularly in infancy (Breckenridge *et al.*, 1972).

Technical difficulties, however, can be a problem in the catheter room and some authors have drawn attention to this when discussing balloon atrial septostomy via the femoral vein (Singh, Astley, and Burrows, 1969; Venables, 1970).

In this report a case is described in which septostomy was performed through the umbilical vein, as an alternative to the femoral route.

Case report

A male infant, who had been born normally weighing 3.8 kg, was transferred to Newcastle General Hospital when he was 1 day old because of persistent cyanosis and dyspnoea. His condition at birth was good (Apgar 10) but he had deteriorated from the age of 2 hours.

On examination he showed pronounced central cyanosis and dyspnoea. His heart rate was 150/min, both heart sounds were palpable, but there were no audible murmurs. Chest x-ray showed a normal sized heart and plethoric lung fields. The electrocardiogram showed sinus rhythm, a mean frontal QRS axis of $+110^\circ$, and right ventricular hypertrophy.

Cardiac catheterization and angiocardiography were performed on the day of admission; the haemodynamic data are shown in the Table. The diagnostic procedure was performed using a right saphenous vein cut down in the groin. It was complicated by an episode of complete heart block which occurred while the catheter was in the

left ventricle, but this reverted spontaneously to sinus rhythm. A diagnosis of transposition of the great arteries with only an interatrial communication was made. Bidirectional shunting was demonstrated before septostomy which could only have been taking place at atrial level. An unsuccessful attempt was then made to introduce a 5.5 French Rashkind catheter into the right femoral vein, and owing to extensive damage to the vein it had to be tied off. Because the baby's condition had deteriorated, it was decided to attempt a balloon septostomy via the umbilical vein thus saving time and limiting further surgical trauma. A 5.5 French Rashkind catheter was introduced into the umbilical vein at the umbilicus but could not be manipulated through the ductus venosus. However, a 4 French Rashkind catheter was similarly introduced and manipulated into the left atrium with little difficulty. The atrial septostomy was performed and the procedure terminated.

Three weeks later, because of poor clinical progress and persistent cyanosis, a further cardiac catheterization was carried out; the results are shown in the Table. There had been no significant rise in the aortic oxygen saturation, but it was at the mean value for late post-operative results quoted by Tynan (1972a), the left and right atrial mean pressures were similar, and the relation between the aortic oxygen saturation and the pulmonary to systemic flow ratio suggested that an adequate atrial septal defect was present (Tynan, 1972b).

One month after the original investigation several signs suggesting thromboembolism appeared. He was noticed to have a number of small areas of skin infarction on the right wrist and the left small toe, and at the same time developed a left hemiparesis which has persisted.

Subsequently the baby's condition slowly improved. Though he required considerable assistance with feeding initially, at the age of 6 months he was at home and gaining weight at a satisfactory rate. At follow-up he was found to be moderately cyanosed but with no signs of heart failure. Chest x-ray showed only minimal cardiac enlargement with no increase in pulmonary plethora and an electrocardiogram showed an expected degree of right

¹ Present address: The Royal Aberdeen Children's Hospital, Foresterhill, Aberdeen.

TABLE Cardiac catheterization data

	Before septostomy	Three weeks after septostomy
Oxygen saturations		
Aorta	57%	59%
Superior vena cava	47%	43%
Right atrium	46%	59%
Pulmonary artery	86%	88%
Pulmonary vein	95%	96%
Left atrium	83%	96%
Pulmonary : systemic flow ratio	1 : 1	2 : 1
Mean pressures		
Left atrium	3 mmHg	5 mmHg
Right atrium	1 mmHg	5 mmHg

ventricular hypertrophy for transposition of the great arteries.

Discussion

Catheterization of the umbilical vein is commonly employed in neonatal practice for therapeutic purposes but the use of this route in the diagnosis of congenital heart disease has seldom been described. Linde *et al.* (1966) investigated 50 neonates and were unable to reach the heart in 36 per cent of cases under the age of 6 days. The difficulty was encountered, as in our case, when trying to traverse the ductus venosus.

Complications of therapeutic umbilical vein catheterization have been reported frequently: Symansky and Fox (1972) found an overall complication rate of 35 per cent. The incidence of bacterial colonization of the catheter, with its accompanying risk of local or systemic infection, does not appear to be related to the duration of catheterization (Balagtas *et al.*, 1971), and it seems likely that organisms are introduced when the catheter is inserted. When considering the use of this route the special risks of bacteraemia in infants with congenital heart disease should be taken into account. There appears to be conflicting evidence concerning the relation between thrombosis of the umbilical vein and its immediate connexions and the length of time that the catheter is in place (Laroche, 1970; Symansky and Fox, 1972), but there is no doubt that umbilical vein catheterization can lead to pulmonary embolism (Scott, 1965) and portal phlebitis or portal vein thrombosis which may be followed by portal hypertension (Tizard, 1962) or hepatic necrosis (Scott, 1965).

We wish to draw attention to the occurrence of thromboembolic complications in our case, but

point out that there is no evidence that they were directly related to the umbilical vein catheterization. Enterocolitis and perforation of the bowel are now well-recognized complications of exchange transfusion via the umbilical vein. Their aetiology, however, remains obscure (Hey, Ellis, and Walker, 1972) but it is relevant to note one of the cases described by Orme and Eades (1968) in which intestinal perforation occurred following continuous infusion of dextrose via the umbilical vein. If retrograde injection of solutions into the portal vein play a part in the aetiology of this condition, the risk should be decreased if the procedure is carried out under x-ray control. However, even with the help of x-rays, local damage to the vein may occur during catheter insertion. This was probably the cause of the umbilical arteriovenous fistula described by Reagan, James, and Dutton (1970). Such damage may easily be caused using the relatively large and stiff Rashkind catheter.

Transumbilical balloon atrial septostomy has been performed at two centres in Israel (Abinader, Zeltzer, and Riss, 1970; Romney, Katzuni, and Aygen, 1972). To our knowledge the case described above is the first British report and taken together with the previous reports, demonstrates the possibility of performing an adequate balloon septostomy using the umbilical vein as an alternative to the femoral route. In view of the possibility of serious complications following even short-term umbilical vein catheterization, it is not recommended that this route be used as a routine.

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Requests for reprints to Dr. H. H. Kaye, The Royal Aberdeen Children's Hospital, Foresterhill, Aberdeen.