Anterograde Transvenous Balloon Angioplasty of Recurrent Coarctation in Infancy

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Balloon angioplasty of a severe recurrent coarctation was performed in a 4-month-old infant using an anterograde approach not previously described for this lesion. The entire procedure was performed transvenously. After transseptal entry into the left atrium, the transseptal sheath was placed across the mitral valve and the angioplasty catheter advanced across the recurrent coarctation. Angioplasty reduced the systolic gradient from 65 mmHg to 22 mmHg, without acute complications. We feel that the anterograde transvenous approach should be considered as an alternative to retrograde transarterial angioplasty in infancy, since femoral artery injury is avoided. (J Interven Cardiol 1988:1:2)

Introduction

Percutaneous balloon angioplasty is effective in acutely relieving recurrent stenosis after surgical repair of coartation of the aorta.[1-3] If the procedure is performed in early infancy, however, the large size of the angioplasty catheter relative to the femoral artery may lead to signifcant vascular trauma. In this report we describe an anterograde transvenous approach, without femoral arterial catheterization, used successfully in a 4-month-old infant to dilate a recurrent postoperative coarctation. Injury to the mitral valve was avoided by performing the angioplasty through a transseptal sheath positioned in the left ventricle, thus effectively shielding the anterior mitral leaflet from the angioplasty catheter and wire.

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The Technique

The patient presented with congestive heart failure due to a large perimembranous ventricular septal defect and a long-segment coarctation. At 10 weeks of age she underwent a Goretex patch aortoplasty, ventricular septal defect repair and suture closure of a patent foramen ovale. The heart failure resolved postoperatively, and a small coarctation gradient persisted (< 20 mmHg) which was felt to reflect moderate tubular hypoplasia of the transverse aortic arch. Two months later a systolic gradient of 80 mmHg was detected between the arm and leg. The child had upper extremity hypertension of 170 mmHg with activity, absent femoral arterial pulses and left ventricular hypertrophy on echocardiography and electrocardiogram. Although congestive heart failure had not recurred, there was significant failure to thrive (weight 5.4 kg). Percutaneous balloon angioplasty was offered as an alternative to repeat surgery, and informed consent was obtained.

The entire procedure was performed transven-

ously. A right heart study documented absence of a significant residual shunt and normal cardiac output. The left atrium was entered using a Brockenbrough transseptal needle and a 6 French Mullins sheath and dilator. The patient was then heparinized (100 units/kg). The left ventricle, ascending and descending aorta were catheterized in an anterograde fashion. A 65 mmHg systolic coarctation gradient was measured (ascending aorta 100/40 mmHg, descending aorta 35/30 mmHg), and a discrete stenosis at the superior margin of the Goretex patch was documented by angiography (Fig. 1A).

Balloon angioplasty was performed using the anterograde transseptal approach. The transseptal sheath was positioned in the left ventricle to protect the mitral valve from the angioplasty catheter and wire. An 0.017 inch exchange wire was advanced through a 6 French end-hole catheter positioned across the coarctation in the descending aorta. The catheter was then removed and a 5 mm balloon angioplasty catheter (Schwarten, Advanced Cardiovascular Systems, Temecula, CA, USA) was guided over the wire through the transseptal sheath and across the coarctation. The balloon was inflated by hand several times until the waist of the coarctation was no longer apparent (Fig. 1B). The angioplasty catheter was withdrawn and an end-hole catheter advanced over the wire to the descending aorta. Marked improvement in the descending aorta pulse pressure was noted, and withdrawal of the catheter to the ascending aorta documented reduction of the coarctation gradient to 22 mmHg (ascending aorta 90/40 mmHg, de-

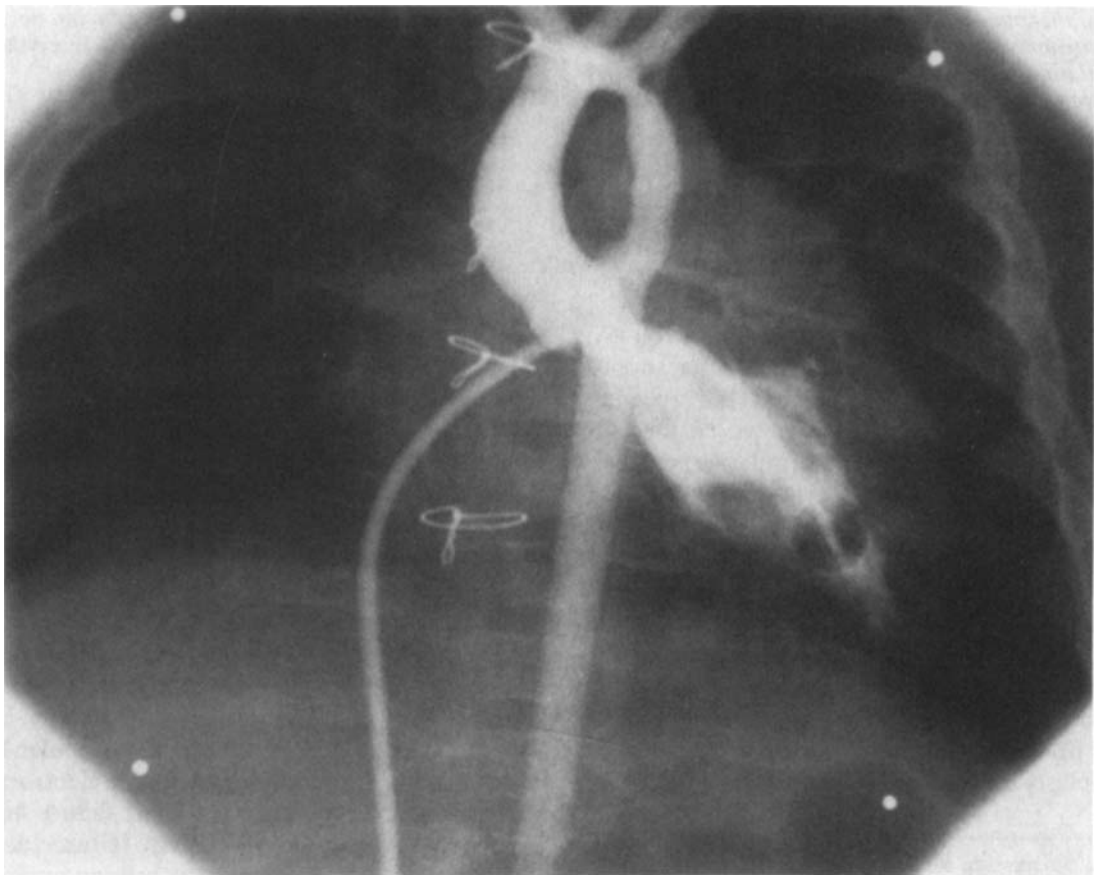

Figure 1A. Preangioplasty left ventricular angiogram showing a discrete stenosis just beyond the left subclavian artery, at the proximal margin of the Goretex patch.

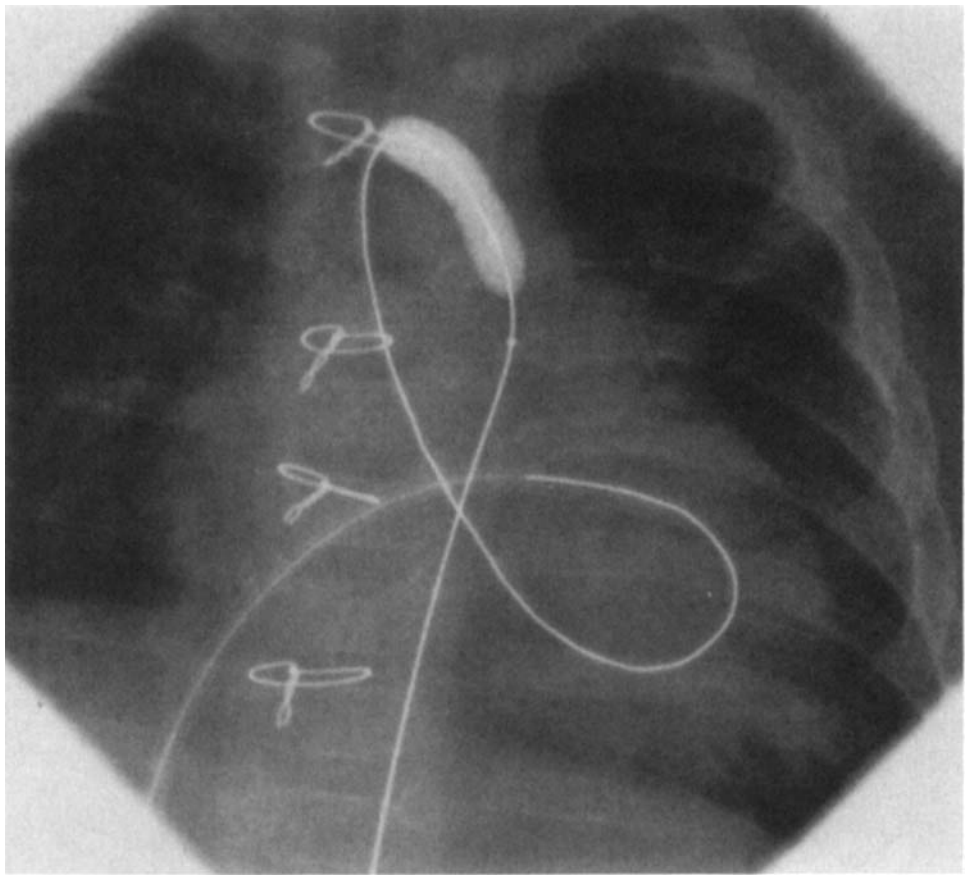

Figure 1B. A 5 mm angioplasty balloon is inflated across the coarctation site. The anterograde transvenous catheter course is shown. Note that the transseptal sheath has been positioned in the left ventricle to shield the mitral valve from the angioplasty catheter.

scending aorta 68/35 mmHg). An ascending aortogram confirmed relief of the discrete coarctation at the patch with no evidence of an aortic tear or aneurysm (Fig. 1C). The residual gradient was felt to be due in part to hypoplasia of the transverse aortic arch. Figure 2 demonstrates the marked improvement in the descending aorta pressure wave form following angioplasty. The venous catheter was removed and hemostasis achieved with local pressure. The procedure was tolerated well without significant arrhythmias, blood loss or the development of mitral regurgitation.

Comment

Percutaneous balloon angioplasty can effectively relieve recurrent stenosis following surgical repair of coarctation, but has been associated with significant femoral artery trauma when performed in infancy. In the present report we have described the first successful application of an anterograde transvenous approach to coarctation angioplasty. The procedure was performed in a 5.4 kg child using a 5 mm balloon catheter introduced through a 6 French transseptal sheath, and did not require entry into the infant's femoral arteries.

Other investigators have been concerned by the apparent hazard of catheterizing the femoral arteries of small infants with large angioplasty catheters.[3,4] Saul and co-workers[3] observed femoral arterial occlusion in 9 of 13 children 2 years of age or younger following retrograde balloon angioplasty of postoperative aortic obstructions, and significant hemorrhage (> 15 mL/kg) was common in

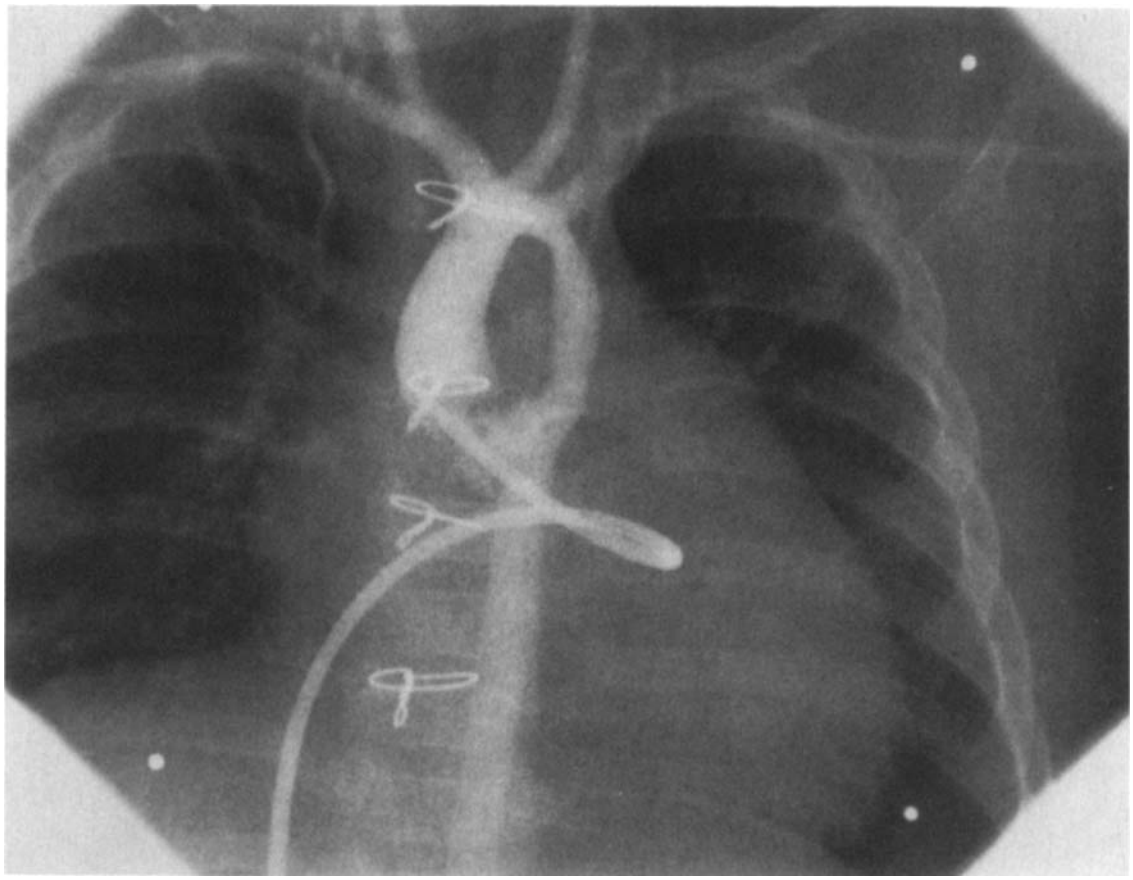

Figure 1C. Postangioplasty aortogram demonstrating relief of the discrete recurrent (postoperative) coarctation.

children who weighed less than 12 kg. Several strategies have been employed to avoid such damage to the femoral arteries.[3,5,6] Moore reported the use of a double balloon approach in a 9 kg child with recurrent coarctation following a subclavian flap repair.[5] Rather than using a single larger catheter, a small (3.5–4.2 mm) balloon angioplasty catheter was inserted into each femoral artery and the two balloons inflated simultaneously across the stenosis. Murphy and co-workers[6] reported performing balloon angioplasty via a thoracotomy in the operating room to avoid femoral artery trauma in eight infants with a coarctation following palliation of a hypoplastic left ventricle.

The anterograde transvenous technique described in this report is a third alternative to the retrograde arterial approach for coarctation angioplasty in infancy. The transvenous approach has not been described previously for coarctation, but has been advocated for ballon valvuloplasty in adults with calcific aortic stenosis.[7] It has also been utilized for valvuloplasty in three children with aortic stenosis, but one child required surgical repair of a anterior mitral leaflet tear produced by the angioplasty catheter.[4] The transvenous technique described in this report offers several advantages over retrograde arterial angioplasty of coarctation in infancy. First, neither femoral artery is entered. Arterial pressure is measured directly, before and after angioplasty, using an anterograde catheter. Second, access is obtained through the femoral vein which can accommodate angioplasty catheters larger than can be inserted safely into a femoral artery. Third, mitral valve injury may be avoided by positioning the transseptal sheath across the mitral valve throughout the angioplasty

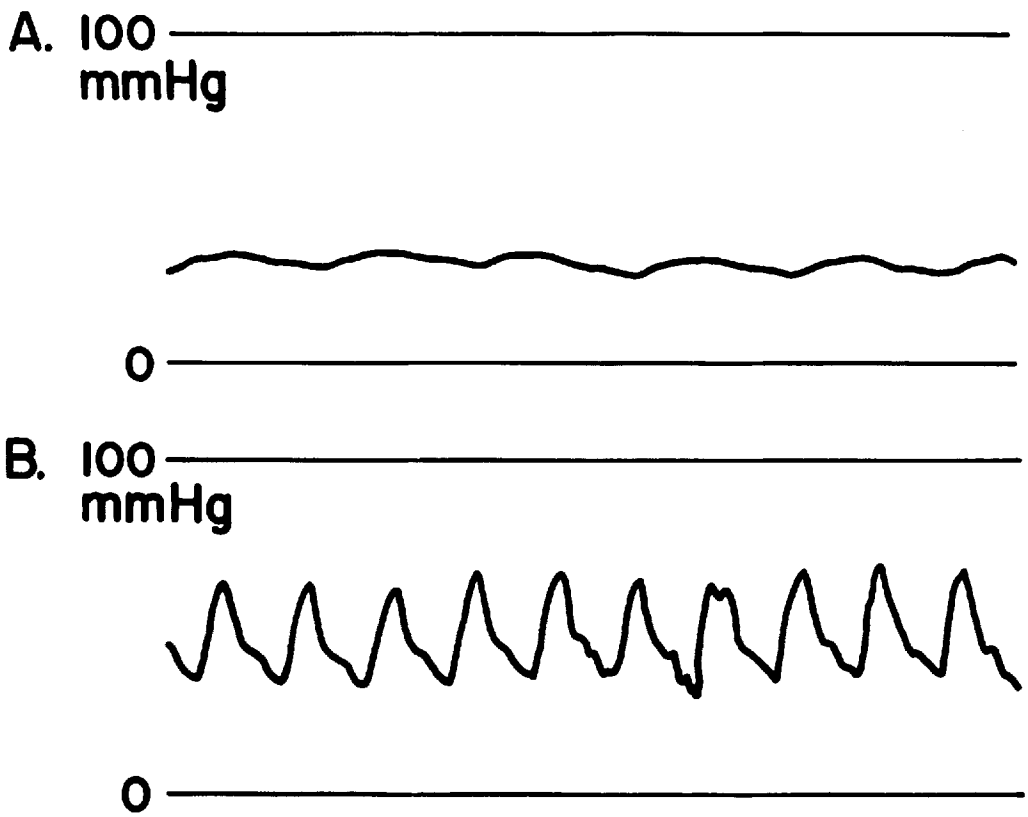

Figure 2. A: Descending aorta pressure tracing prior to angioplasty showing a very damped pulse pressure of 35/30 mmHg. B: Descending aorta pressure improved after angioplasty to 68/35 mmHg. Tracing A was recorded at a paper speed of 50 mm/sec and tracing B at 25 mm/sec.

procedure. A 6 French Mullins sheath will accommodate a 5 mm balloon angioplasty catheter which is generally of appropriate size for coarctation angioplasty in early infancy. The anterograde approach does have the disadvantage of requiring a transseptal left heart catheterization. If the child has a patent foramen ovale the transseptal sheath can be advanced through it, however if a transseptal needle puncture is required then there is a minimal risk of cardiac perforation. Finally, there exists a small risk of cerebral embolus whenever a catheter is manipulated through a left-sided transseptal sheath; systemic heparinization and careful flushing of the sheath's dead space should minimize this risk however. We recommend the anterograde transvenous approach be considered as an alternative to retrograde transarterial angioplasty in infancy, but it should be performed only by those experienced in angioplasty and transseptal left heart catheterization.

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