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Brief Report

Successful transluminal angioplasty of renal arterial stenosis using the transcarotid approach

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Abstract We successfully performed percutaneous transluminal angioplasty to treat severe renovascular hypertension with left ventricular failure in a 5-month-old infant. Using the transcarotid approach, we dilated the stenotic left renal artery without any difficulties, using progressively larger balloons designed for dilation of coronary arteries.

Keywords: Renovascular hypertension; interventional catheterisation; balloon dilation

RENAL ARTERIAL STENOSIS IS RARE BUT significant as a cause of severe systemic hypertension in children.[1,2] Recently, percutaneous transluminal angioplasty of such stenosis has been widely performed in both adults and children with renovascular hypertension. Technical difficulties beset this approach in infants with renovascular hypertension, specifically the small size of the renal arteries, and their steep angle of branching from the descending aorta, limiting to date the utility of the technique in infants. Using the transcarotid approach, we have now successfully performed the technique in a 5 month-old boy with renovascular hypertension and left ventricular dysfunction.

Case report

A 5-month-old boy was referred to us because of poor weight gain and feeding difficulties. Systemic hypertension was noted, with pressures of 192/156 mmHg being measured in all four limbs. Family history was not contributory. On admission, he weighed 5.6 kg, this representing the 3rd percentile of our charts. Physical examination demonstrated gallop rhythm, and the liver was palpable 3 cm below the right costal margin. Laboratory investigations revealed normal electrolytes and blood chemistry, including serum creatinine and urea. Urinalysis showed gross hematuria and heavy proteinuria. Levels of rennin, human atrial natriuretic peptide, and brain natriuretic peptide were all markedly elevated in the plasma, at 270 ng/ml/hr compared to the normal values of 0.3–2.9 ng/ml/hr, 260 pg/ml versus less than 40 pg/ml, and 305 pg/ml versus less than 20 pg/ml, respectively. The chest X-ray revealed cardiomegaly, with the cardiothoracic ratio at 60%. Magnetic resonance imaging, and ultrasonography, of the kidneys demonstrated atrophy of the left kidney, with compensatory hypertrophy of the right kidney. The echocardiogram showed remarkable left ventricular hypertrophy, with the left ventricular posterior wall being 10 mm thick at the end of diastole. The motion of the left ventricular wall was generally hypokinetic, with a fractional shortening of only 0.16. Mild mitral regurgitation was recognized. The captopril enhanced renal scintigraphy demonstrated extensive deterioration of the left kidney in both its vascular and secretory phases. Cardiac catheterization confirmed the diagnosis of left ventricular dysfunction caused by afterload mismatch secondary to renovascular hypertension. The pressure of left ventricle, ascending aorta, and descending aorta were 160/e0, 158/106, and 160/106 mmHg, respectively. Left renal angiography demonstrated a tight short segment of virtually complete stenosis with poststenotic dilation. (Fig. 1a) At an initial attempt to perform percutaneous transluminal angioplasty of the stenotic artery through the right femoral artery, a 0.014

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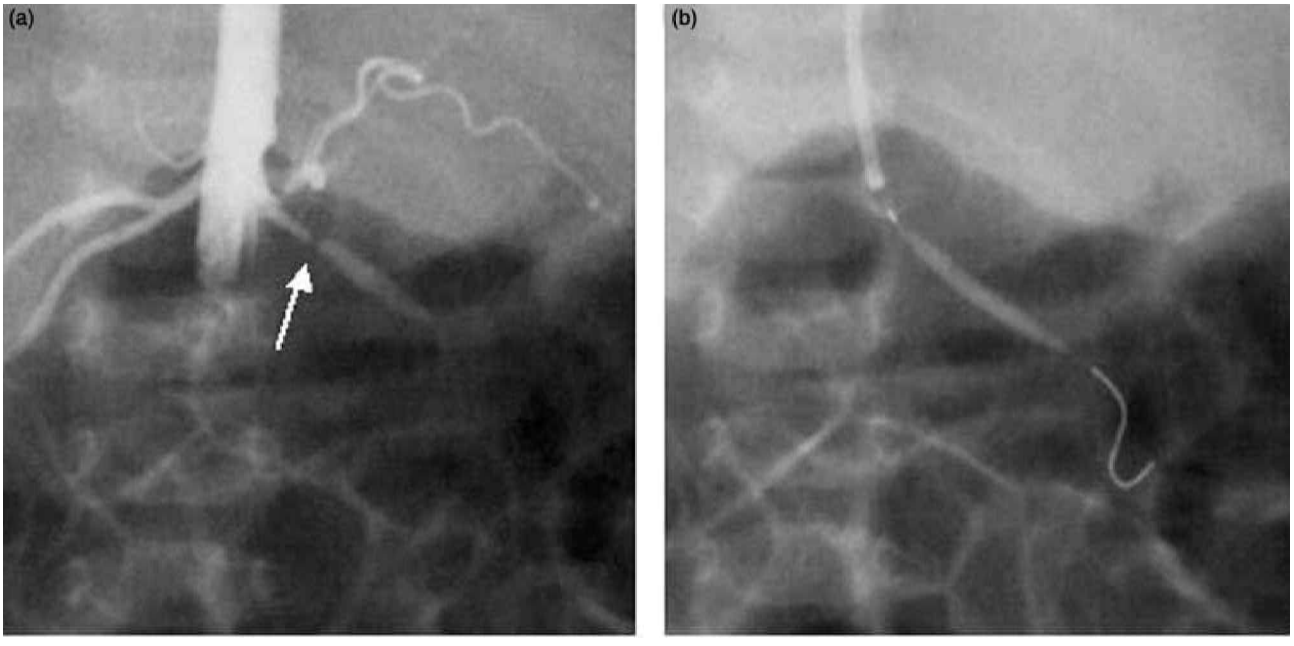

Figure 1.
Prior to dilation (a) an abdominal aortogram shows the short stenotic lesion, almost complete (99%) when compared to the diameter of the adjacent healthy segment of the left renal artery. During angioplasty (b) the catheter, mounting a 2.5 mm balloon, was passed across the site of stenosis and inflated until the waist of the balloon disappeared.

floppy guidewire could not be passed across the stenotic lesion because of the steep angle of branching of the artery from the descending aorta. The second attempt at transluminal angioplasty was performed under general anesthesia five days after the first catheterization. A 5 French sheath was introduced via a cutdown into the right carotid artery. A 5 French multi-purpose catheter was easily inserted into the stenosed left renal artery. A 1.5 mm fixed balloon catheter (PIVOT®, Boston Scientific, Boston, USA) was first advanced and dilated by hand-inflation at the site of stenosis until the waist of balloon disappeared. Balloon dilations were then performed in stepwise fashion using 2 mm and 2.5 mm fixed balloons, inflating the balloons for 30 to 60 s at pressures of 3 to 6 atmospheres (Fig. 1b). The maximum size of the balloon was judged relative to the diameter of the proximal site of the stenosis. After the stepwise dilation, the ratio of the stenotic segment compared to the adjacent healthy segment decreased from 99% to 50%. (Fig. 2) No complication occurred either during or after the procedure. Heparin was infused continuously at a dose of 10 IU/kg/hour for 3 days to prevent thromboembolism, followed by administration of oral aspirin at 5 mg per kg per day for 6 months. The systemic blood pressure immediately dropped to 140/75 mmHg after the procedure. He was discharged to home 11 days after the procedure. His blood pressure was 104/60 mmHg,

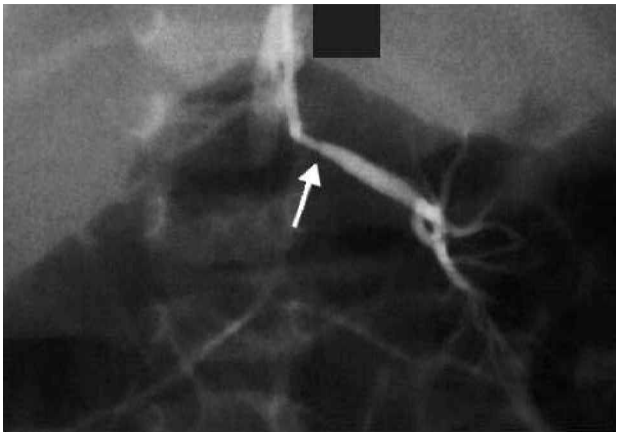

Figure 2.
After the angioplasty, the ratio of stenosis was reduced from 99% to 50%.

and he was free from the clinical symptoms of congestive heart failure. He required only oral diuretics and inhibitors of angiotensin converting enzyme. At 8 months after discharge, the systemic blood pressure remained within the normal range, at 108/65 mmHg, despite the antihypertensive drugs being discontinued. The cardiothoracic ratio on the chest X ray had decreased to 50%. The left renal function was remarkably improved on the captopril enhanced renal scintigram. Echocardiography revealed hyperdynamic left

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ventricular contraction, with fractional shortening of 0.53, and showed regression of ventricular hypertrophy, with the left ventricular posterior wall now being only 4.5 mm thick.

Discussion

Renovascular hypertension accounts for up to one-quarter of all cases of systemic hypertension seen in children.[3–5] In particular, the incidence of renovascular hypertension in children under the age of 5 years old is approximately four times higher than that seen in adolescence,[4] and renovascular hypertension complicating congestive heart failure is usually a critical condition. If unrecognized, the treatment for the cardiac failure may be inappropriate, and can lead to death. In this sense, renal arterial stenosis should always be considered as a cause of systemic hypertension, besides the other possibilities of aortic coactation, renal parenchymal disease, and so on.

The most frequent etiology of renovascular hypertension in children is fibromuscular dysplasia.[6] The short and isolated stenosis produced by such fibromuscular dysplasia provides an ideal indication for balloon angioplasty. Attempts at percutaneous transluminal angioplasty for renal arterial stenosis in infants, however, have previously failed because of technical difficulities.[7] To the best of our knowledge, only a single patient, aged 9 months, has been treated successfully by transluminal angioplasty.[8] This low rate of success relates in part to the characteristics of the renal arterial pathology.[9] In addition to the smaller caliber of the abdominal aorta, the steep angle of branching of small renal arteries from the abdominal aorta makes it difficult to pass balloon catheters over the stenotic lesion via the femoral artery. This was the main reason for the failure of our first attempt made via femoral artery. A transcarotid approach is superior to the transfemoral approach because of the straighter angle of the catheter course to the renal artery, so we approached through the right carotid artery at our second attempt, permitting successful balloon angioplasty. Courtel et al.[7] had suggested the use of a similar approach, arguing that an antegrade transarterial approach via the left brachial or subclavian arteries could overcome most of the problems encountered in attempting balloon dilation in small infants with renovascular hypertension. The transcarotid approach, as used by us, also avoided the arterial occlusion that represents a major complication of the femoral arterial approach, especially in neonates or infants. The transcarotid approach is already recognized as a safe and effective procedure for performing balloon dilation of critically stenotic aortic valves without inducing any neurological sequences.[10]

To the best of our knowledge, our patient is the youngest thus far to have undergone successful transluminal angioplasty for renal arterial stenosis without complication. We suggest that the transcarotid approach should be considered as the first choice of treatment for infants with renovascular hypertension, even at the age of 5 months.

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