Case Report

Salvage of a radiocephalic fistula by the palmar arch

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Abstract

We present a child with mild problems during haemodialysis due to stenosis of the proximal radial artery of his radiocephalic fistula. However, his problems spontaneously subsided. Follow-up sonography revealed arterial occlusion proximal to the fistula with retrograde flow in the distal segment. Kt/V and shunt flow were normal. Physical examination confirmed proximal radial artery occlusion with collateral blood supply via the palmar arch. There were no signs of steal. To our knowledge this is the first description of a patient experiencing adequate haemodialysis with arterial occlusion proximal to a radiocephalic fistula salvaged by collateral arterial supply via the palmar arch.

Keywords: palmar arch; radiocephalic fistula; steal

Background

Vascular access is of vital importance for haemodialysis, and the radiocephalic arteriovenous fistula (AVF) is the preferred access modality according to the KDQI guidelines. Nevertheless 12-month secondary patency is not good, ranging between 65% and 70% [1,2]. This is primarily due to vascular stenosis, prompting the need for endovascular or surgical intervention for salvaging the fistula. We present a child with severe access stenosis and a remarkable salvage of his AVF.

Case report

The boy had ESRD due to primary focal segmental glomerulosclerosis. At 4 years of age haemodialysis was started, using a tunnelled Hickmann catheter. After 1 year, a radiocephalic fistula was created in his left wrist with a side-to-side anastomosis. Four months later, the fistula demonstrated sufficient maturation and was successfully cannulated. Haemodialysis was performed three times a week for 4 h using a single-needle technique with a blood flow of 250 ml/min, resulting in a single-pool Kt/V between 1.7 and 2.1. After 2 years, a gradual increase in the negative arterial pressure was noted during dialysis with increasing difficulty in maintaining adequate blood flow (from −120 to −150 mmHg over 5 months). The Kt/V remained unremarkable. No abnormalities regarding pulse, bruit or thrill were noted during physical examination of the fistula. Duplex sonography showed no abnormalities. However, a fistulogram was performed and revealed 50% stenosis of the radial artery proximal to the fistula (Figure 1). Endovascular versus surgical treatment was considered but deemed difficult. In the mean time, a gradual decrease in the arterial pressure was noted during haemodialysis, returning to the initial values, and aforementioned problems subsided. Physical examination revealed an increase in distention of the arm veins.

Routine follow-up duplex sonography 1 year later, showed cessation of flow in the radial artery just proximal to the anastomosis and retrograde flow in the distal segment (Figure 2). The radiocephalic fistula and cephalic vein demonstrated a normal flow pattern. The ulnar artery appeared more robust but was not compared to previous investigations. Shunt flow was measured using an ultrasound dilution method (Transonic® Flow QC haemodialysis monitor; Ithaca, NY, USA) and was 580 ml/min (=1250 ml/min/1.73 m²; increased risk for thrombosis: <650 ml/min/1.73 m² [3,4]). Physical examination revealed a normal palpable pulse over the anastomosis and radial artery and a normal thrill over the downstream veins. The left hand had an adequate colour, temperature and capillary refill, similar to the other hand. Occlusion of the radial artery by applying pressure proximal to the anastomosis had no effect on pulse and thrill over the fistula. After occlusion of the ulnar artery, signs of blood flow through the fistula disappeared and his fingers demonstrated an inadequate capillary refill. Occlusion of the radial artery distal to anastomosis had the same effect on the fistula, but a normal capillary refill of the hand was observed.

We concluded that in our patient stenosis in the proximal radial artery initially compromised flow through the arteriovenous fistula. The decrease in pressure in the poststenotic section gave way to a steal phenomenon, increasing retrograde distal radial artery flow via the palmar arch and...
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Fig. 1. Fistulogram: catheter inserted into the cephalic vein and retrograde filling of contrast of the radiocephalic fistula. Stenosis in the proximal radial artery (indicated by an arrow).

Fig. 2. Duplex sonography of the radiocephalic fistula. (A) Stenosis in proximal radial artery designated by an arrow. (B) Retrograde blood flow from the distal radial artery into the arteriovenous connection.

ulnar artery. Over time stenosis in the proximal artery progressed to total occlusion but collateral retrograde arterial supply via the arch ‘matured’. This was sufficient for maintaining fistula patency and standard haemodialysis care. There were no complaints of limb ischaemia and his Kt/V remained unremarkable. No interventions were performed.

Discussion

The palmar arch consists of two arterial connections between the ulnar and radial artery, the so-called deep and superficial arch. Its main branches constitute the digital arteries delivering arterial blood to the fingers; furthermore, the palmar arch is capable of maintaining blood supply when flow through one of both feeding arteries is compromised. Collateral arterial flow via the palmar arch is common in patients with a radiocephalic fistula. Sivanesan et al. demonstrated retrograde flow in the distal radial artery in 23 out of 30 subjects 1 day after fistula construction [5]. Retrograde blood flow accounted for 26% of total flow through the fistula (range 5–50%). A similar paper reported retrograde flow in the distal radial artery in all of 21 patients with a radiocephalic fistula [6]. However, until now there was no report in the literature that solely collateral flow via the palmar arch could sustain haemodialysis. McGill et al. reported collateral flow via the palmar arch in three adults following severe radial artery stenosis; all had compromised urea kinetics, two underwent surgical revision, one declined and was put on nocturnal 8-h haemodialysis [7]. Proximal radial artery occlusion and the resulting increased retrograde blood flow via the palmar arch could cause ischaemic symptoms in the distal limb: a phenomenon called high-flow steal [8,9]. Steal can be defined as the enhanced arterial flow towards the low-resistance arteriovenous connection, compromising blood supply to the downstream limb. The associated ischaemia can cause symptoms such as pain, pallor, lower skin temperature, trophic lesions, diminished sensibility and loss of strength. Steal is reported in 1–20% of adults with an AVF. It is mainly observed in elderly patients with vascular disease and diabetes mellitus and is in >50% of cases related to arterial stenosis [8,10]. Steal is not often reported in children and this could be an indication of a low incidence in this age group. This in turn can be explained by their relatively healthy blood vessels that are probably better able to adapt to growth and demand and are less challenged by degenerative processes such as atherosclerosis or calcifications. Our paediatric patient was able to develop adequate flow via his palmar arch and sustain both dialysis and hand perfusion.

To our knowledge this is the first description of a patient experiencing adequate haemodialysis treatment with complete arterial stenosis proximal to a radiocephalic fistula salvaged by collateral arterial supply via the palmar arch. We conclude that in children the palmar arch can be capable of sustaining sufficient blood flow for haemodialysis and the presence of retrograde flow in the distal radial artery should be taken into consideration in evaluating vascular access stenosis.

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Conflict of interest statement. None declared.

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