Transcatheter renal ablation with absolute alcohol for resistant hypertension

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This case concerns a 7-year-old child (30 kg) with neurofibromatosis type 1. Assessment of this patient uncovered severe hypertension (HT) that remained resistant to dual therapy, which led to an angiogram being carried out. This revealed a vascularisation abnormality in the lower pole of the left kidney (Fig. 1a) consisting of a very severe stenosis in an arterial branch of the lower pole in the hilum together with a double sac intra-renal aneurysm (type 3 according to Rundback’s classification [1]) immediately downstream of this stenosis. The part of the kidney vascularised by this branch appeared to be small. There was a collateral circulation within the parenchyma of the lower pole from the middle branches of the renal artery.

After discussion, the decision was made to carry out endovascular aneurysm exclusion after ablation of the distal renal parenchyma, firstly to prevent the risk of aneurysm rupture, and secondly to avoid HT persisting that might result from residual ischaemia in the distal area vascularised by the intra-parenchymal collateral circulation.

The procedure was carried out under general anaesthesia. The left renal artery was catheterised using a 5F guiding catheter that allowed mapping contrast injections to be carried out, and these confirmed the lesions as described above. Superselective catheterisation of the lower polar branch using a 0.014-inch guidewire (Whisper ES Abbott) was then straightforward, and coaxial technique was used to insert a 2 mm Mini-Trek OTW (Abbott) balloon catheter. This temporarily obstructed the branch. We were able to assess the volume of the distal vasculature by slowly injecting the contrast product via the distal lumen of the balloon (Fig. 1b). We then very slowly (over a 2-minute period) injected this volume (estimated at 0.8 mL) of absolute alcohol. After the balloon was deflated and removed and the 0.014-inch guidewire left in situ, the repeat angiogram showed a defect in the area of the lower pole concerned that was not relieved by collateral circulation (Fig. 1c). A Progreat microcatheter (Terumo) was placed in situ which allowed us to deposit three 0.018-inch coils (Boston Scientific), occluding the polar branch above the aneurysm (Fig. 1d).

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Discussion

Although less common than it is in adults, HT in children must not be underestimated since it affects 1–5% of children as against 25–35% of adults. It leads to well-known complications later in life, and this is due in particular to prolonged exposure to HT from childhood. It can cause headaches and chronic pain that may have an effect on schoolwork and normal development in children. Finally, it can lead to cardiomyopathy or serious hypertensive encephalopathy with the risk of seizures or coma. Investigations of aetiology nevertheless lead to identification of a specific cause in over 80% of cases, while in adults this figure is 20%.

In our case study, the patient’s HT arose against a background of neurofibromatosis type I (NF1). This hereditary neurological and cutaneous disease that predisposes patients to developing benign or malignant tumours is one of the most common autosomal dominant diseases and it can manifest in very diverse ways, including vascular involvement [2]. For this reason, and although arterial hypertension in a patient with NF1 may possibly be secondary to an associated pheochromocytoma, it is also advisable in these patients, especially the very youngest, to look for a renovascular aetiology (renal artery stenosis or indeed extrinsic compression of the renal artery by retroperitoneal hamartomas, aortic coarctation). Involvement of the renal artery in NF1 can consist of both stenosis and aneurysms as seen in the case we report and it can be localised to any one of the arterial segments, including the intra-parenchymal branches. Surgical management or angioplasty is indicated in cases of renovascular HT that is resistant to the optimal medical treatment with the understanding that diffuse distal

Figure 1. Embolisation of a lower polar branch of the renal artery after alcohol ablation of the distal area: a: initial series of images showing a very severe stenosis of the lower polar branch of the renal artery (white arrow), the double aneurysmal sac (white star) distally and the intra-renal collateral circulation (black arrow); b: estimation of the volume of the vasculature for alcohol ablation after the occlusion balloon has been inflated (white arrowhead); c: repeat imaging after alcohol ablation showing that the vascularisation distal to the aneurysm has disappeared; d: final repeat imaging after coils have been deposited proximally to the aneurysm. Note the limited devascularisation of the renal parenchyma of the lower pole and the preservation of the ureteral artery (black arrowhead).
involvement of the intra-parenchymal arteries in NF1 can sometimes lead to therapeutic failure if only the proximal arteries are treated.

This patient’s hypertension was controlled indicating that the renal parenchyma downstream from the stenosis of the lower polar branch had been destroyed. The destruction of parenchyma required did seem to be minimal since the area vascularised by this artery accounted for less than 15% of the total left renal parenchyma. However, if our management had consisted only of occlusion of the lower polar branch using coils, this would on the contrary have risked allowing an area of ischaemia to persist downstream that was supplied by the intra-parenchymal collateral circulation. For the same reason, the therapeutic option of a stent (whether a covered stent or uncovered stent with coiling of the aneurysm through the mesh using a microcatheter) was rejected. An outcome of normalised HT in the short term could certainly be hoped for due to the stenosed area being widened while the aneurysm was also excluded. On the other hand, due to the narrow diameter of the artery, there was the risk of causing an early secondary obstruction to the artery with an area of ischaemia persisting distally and loss of direct endovascular access.

Alcohol was chosen because of its major toxicity for the capillary bed, which meant that we could perform distal vascular occlusion and parenchymal ablation. The option of using microparticles was rejected partly due to the risk that they could accumulate proximally to the area of very severe stenosis, and partly because they may be less reliable due to the formation of aggregates meaning that action in the parenchyma of the lower polar branch is less homogeneous. The use of a biological adhesive (n-butyl-2-cyanoacrylate), which must be handled delicately, poses the risk of adherence of the microcatheter due to stagnation and polymerisation of the cyanoacrylate proximally to the stenosis, and secondly the risk of embolisation away from the target due to reflux.

The use of alcohol to carry out angiographic nephrectomies is an old technique that has been used to treat both treatment resistant hypertension [3,4] and ureteral fistula [5,6]. Furthermore, the option of a superselective injection as needed via a microcatheter means that the ablation is focused, whether it is ablation of renal angiomylipomas [7], renal tumour ablation with absolute alcohol [8], or embolisation of intra-renal arteriovenous malformations [9]. Alcohol ablation can be very painful, meaning that sedation is required with an anaesthetist being present during the procedure and morphine-based pain control given as necessary during the first 24 hours. In our case, the intervention was always planned to be carried out under general anaesthesia in view of the patient’s age and no significant pain was observed during the course of the procedure.

The main drawback of alcohol is that it is radiolucent which gives rise to the risk of missing a diagnosis of reflux in the normal renal parenchyma or another site, and this could lead to a ureteral lesion, testicular infarction [10], or colonic infarction (via the aorta to the inferior mesenteric artery) [11]. Cases of cutaneous necrosis have also been described [12]. Mixing alcohol with a contrast product certainly improves visibility but this dilution can affect its efficacy [13]. For this patient, we chose to use absolute alcohol and to prevent reflux by using the balloon catheter for occlusion and estimating the quantity of alcohol to use by opacification of the vascular bed once the balloon was inflated. The injection with the balloon inflated furthermore increases the length of time for alcohol to impregnate into the cells. This balloon technique could also have been used for a microparticle embolisation in order to prevent embolisation away from the target.

The coils were placed proximally to the aneurysm to complete the embolisation but above all to exclude it and to eliminate the risk of secondary rupture.

Conclusion

When a young person is diagnosed with HT, a possible renovascular cause should be investigated, as this is potentially curable. Renal artery stenosis, sometimes of the distal branches, is among the most common manifestations, and may benefit from percutaneous angioplasty. In our case, the stenosis was associated with an aneurysm that also needed to be treated. The combination of aneurysm exclusion and ablation of the renal parenchyma was possible because this area accounted for barely 15% of the total left renal parenchyma. Alcohol, because of its distal and homogeneous action, was the embolisation agent of choice for this ablation.

Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

References


