AIMS Medical Science, 3(1): 96-102.
DOI: 10.3934/medsci.2016.1.96
Received 29 September 2015,
Accepted 25 January 2016,
Published 28 January 2016

http://www.aimspress.com/journal/medicalScience

Case Report

Neuro-endovascular Embolic Agent for Treatment of a Renal Arteriovenous Fistula

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Abstract: Renal arteriovenous fistula is a known complication following a renal biopsy, and may require catheter based embolization. Distal location of these fistulas in the renal parenchyma in many a case may necessitate non-traditional embolic materials. Liquid embolic agents that allow a controlled delivery may be suitable in this situation, as demonstrated in this case report.

1. Introduction

An arteriovenous (AV) fistula is reported to occur in up to 15 per cent (range 0.9–15) of patients after a renal biopsy; this complication is higher in renal allografts [1–3]. A large majority of these close spontaneously. Treatment is, however, warranted if the patient experiences hematuria, hypertension, renal failure, high output cardiac failure, or thromboembolic complications. An endovascular embolization procedure is the treatment of choice [4]. Embolization techniques and materials continue to evolve. We present the first case wherein we used a novel embolic agent to successfully close a traumatic renal AV fistula in a transplanted kidney.

2. Case Description

A 59-year-old diabetic male with coronary artery disease and a remote renal transplant presented with uncontrolled hypertension and pulmonary edema. He had undergone a renal biopsy

two months earlier, and a follow-up ultrasound with Doppler detected a renal parenchymal AV fistula in the upper/inter-polar region of the transplanted kidney. Prior to renal biopsy, blood pressure was well controlled with Metoprolol. Following the biopsy, however, despite five antihypertensive agents he had a suboptimal control of the same. Uncontrolled hypertension and pulmonary edema necessitated an invasive evaluation to investigate and possibly treat the underlying AV fistula.

Right femoral artery access was obtained and the transplant renal arteriogram was done using a 6 French LIMA guiding catheter. Carbon-dioxide angiography was used to select the appropriate views; final digital subtraction angiography images were obtained using iodixanol. There was no transplant renal artery stenosis. A small AV fistula was noted in one of the tertiary branches (Figure 1). Given the small size of the feeder vessel, a decision was made to use a liquid embolic material rather than a coil to close the fistula.

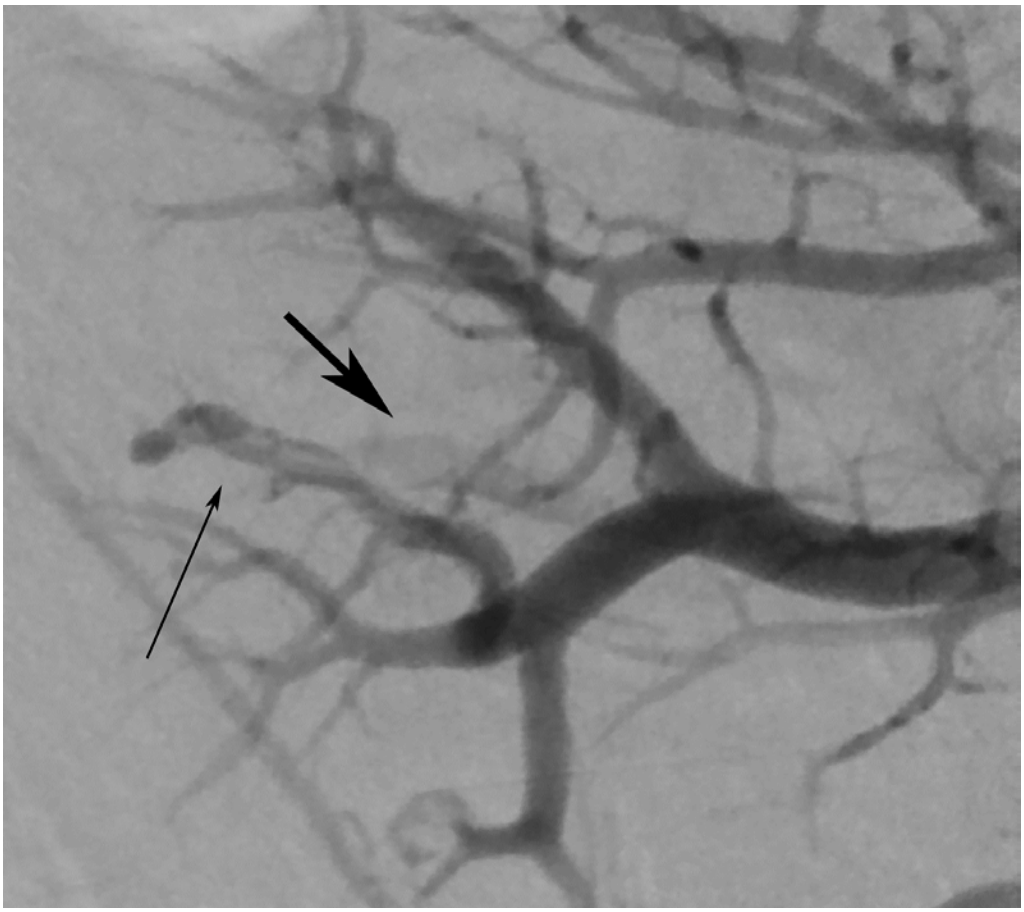

Figure 1. Selective renal angiography showing an arteriovenous fistula draining from a segmental peripheral artery (thin arrow). Also visualized is early filling of the vein from fistula (thick arrow).

A 2.1 French Echelon-10 micro-catheter (Covidien/ev3, Irvine, CA, USA) was advanced over a 0.010” Synchro-10 wire (Stryker Neurovascular, Fremont, CA, USA) into the feeder vessel. After removal of the micro-wire, to fill the dead space, the micro-catheter was flushed with 0.34 mL of

dimethyl sulfoxide (DMSO), an organic solvent. Half a milliliter of Onyx® (Covidien/ev3, Irvine CA, USA) was introduced slowly through the micro-catheter to occlude the vessel feeding the fistula (Figure 2). While injecting care was taken to avoid excessive reflux. In present case, this agent was particularly suitable because target of deployment was quite distal and there was no danger of reflux into other significant vessel branches. Onyx® is a cohesive but non-adhesive liquid embolic agent; it contains ethylene vinyl alcohol copolymer and tantalum powder (for radio-opacity) suspended in DMSO. Following deployment of Onyx®, angiography showed complete exclusion of the fistula, stable position of Onyx® material, no vasospasm, and no contrast entering the draining vein (Figure 3). There were no complications, and by the one month follow up visit, the patient was able to discontinue all antihypertensive medications.

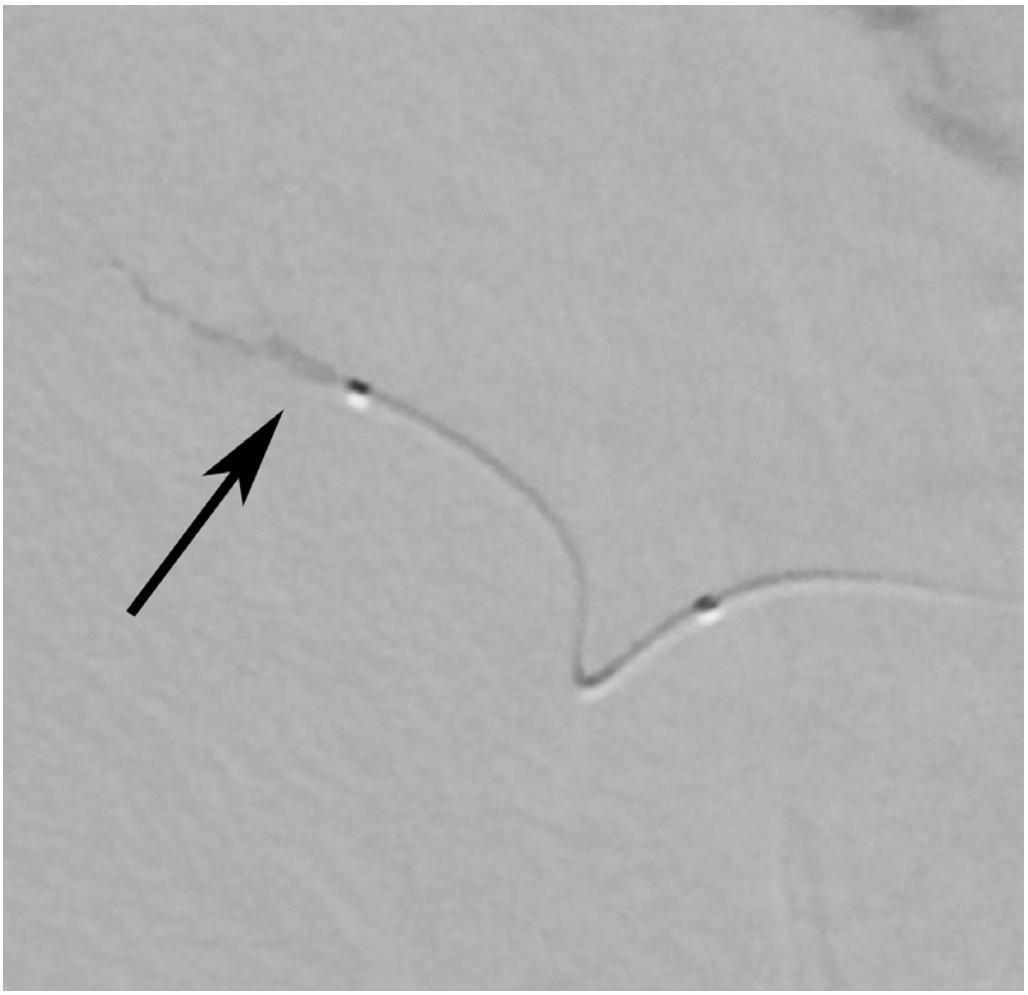

Figure 2. Digital subtraction angiography showing Onyx® deployment (arrow) after coaxial engagement of feeding vessel with micro catheter.

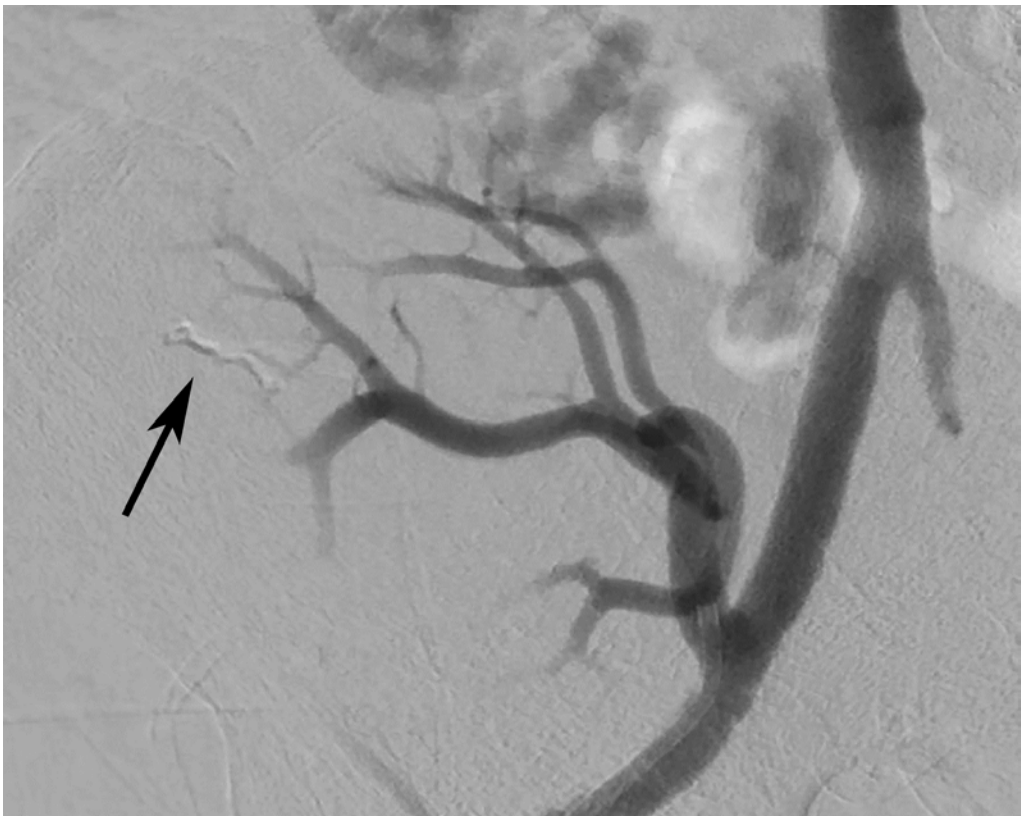

Figure 3. Digital subtraction angiography showing occluded arteriovenous fistula (arrow).

3. Discussion

Hypertension is considered as one of the indication to close renal arteriovenous fistulas. Hypertension is found in about 40–50% of patients with renal fistulae, and the proposed hypothesis is that it is caused by local renal ischemia resulting from a short circuit of blood with increased renin secretion [5]. Therefore we decided to close the AV fistula with a hope that this will help control hypertension and prolong graft life.

With increasing therapeutic options for kidney disorders and increasing renal transplants, renal biopsy has become a very common procedure. Arteriovenous fistulas are a common complication, even though a large majority close spontaneously. In addition, it has been shown that this occurs more frequently in transplanted kidneys. Most of these fistulas are first diagnosed by Doppler ultrasound [6]. Angiographic confirmation is required if closure is planned [7]. Contrast induced nephrotoxicity is a major concern for these patients, especially the transplant recipients. Contrast dose reduction strategies include imaging using carbon dioxide, as was done in our case [8].

Multitudes of therapeutic interventions are possible to treat AV fistulas. Open surgical treatment is usually a last resort and is reserved for patients in whom a more conservative therapy has failed or if the fistula is due to malignancy. In renal transplant patients, surgery is particularly unfavorable due to associated renal tissue loss. Percutaneous treatment options are considered standard of care.

Technical success rates have shown a steady increase over time and now approach nearly 100% [9,10]. Stainless steel coils, self-expanding plugs, bucrylate glue, and alcohol have all been used [9]. With coils and glues there is a risk of distal embolization and migration. In addition, it is technically difficult to place coils and self-expanding plugs in small sized vessels.

In our case we wanted to have a precise deployment of the embolic agent, so as to avoid any more renal parenchymal ischemia. It has been suggested that controlled delivery, which is possible with Onyx® can reduce ischemic complications [11]. Onyx® is a non-absorbable, cohesive, non-adhesive, injectable liquid that acts as a permanent embolic agent. It consists of an ethylene vinyl alcohol copolymer which is dissolved in anhydrous dimethyl sulfoxide (DMSO). Tantalum powder is added to make it radiopaque. Contact with blood leads to formation of spongy embolus [12]. Its physical attributes make it possible for it to penetrate vessels as small as 5 micrometers in diameter [13]. It is approved by the FDA for embolization of intracranial arteriovenous malformations. It has, however, been used in a variety of pathologies such as aortic stent graft endoleaks, acute gastrointestinal bleeding, and peripheral pseudo aneurysms [14,15]. Onyx® should be used with DMSO compatible micro-catheters to avoid damage to plastic. Slow injection is preferred to avoid vasospasm and excessive reflux.

There has been some safety concerns regarding Onyx®. The most prominent one is regarding micro-catheter getting stuck. Weber et al reported a retained catheter rate of 4% for brain arteriovenous malformations [16]. The overall incidence of retained micro-catheters in unknown, yet the increase in reports resulted in the US Food and Drug Administration (FDA) releasing a Safety Communication. The factors that may predispose to micro-catheters being retained during Onyx embolization are large amount of reflux along the micro-catheter, prolonged injection times, tortuosity of the feeding artery and steam-shaping of the catheter [17]. Retained catheter may need surgical removal and possibly anticoagulation in the interim. There is about 2% reported rate of distal vessel perforation, when treating intracranial AV malformations, which can be treated with immediate injection of Onyx® [16].

Treatment of renal AV fistula by Onyx® has not been widely reported. Only three case reports have been published [11,18,19]. Our case is unique because procedure was done on a transplanted kidney and due to very distal location of the target site needing occlusion. Such distally located and small sized fistulas require use of an agent which can be delivered in a slow and controlled manner; Onyx® was therefore chosen. We achieved the desired result in renal vasculature using an embolic agent generally reserved for neurovascular application.

4. Conclusion

Use of Onyx for endovascular treatment of renal arteriovenous fistula is feasible and can be used for small distal vessels. It has potential advantages over alternative embolic agents and coils, and should be investigated further for this indication.

Acknowledgement

The authors acknowledge the contribution of Andrew Johnson, MD, in preparation of the manuscript.

Conflict of Interest

Gurpreet Singh and Neeraj Jolly have no conflict of interest to disclose regarding this case report. Dr Demeterius Lopes is on advisory board for Covidien, is Onyx proctor/trainer, and is principal investigator for SWIFT PRIME, PREMIER and APOLLO trials.

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