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Original Research

Successful endovascular management of renal artery aneurysm containing several outflow vessels supplying significant part of the renal parenchyma

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Background: Complex renal artery aneurysms (RAAs) represent a therapeutic challenge, especially in those who contain branches of the renal artery. Treating the RAA may compromise renal perfusion, cause ischemia, and significant parenchymal loss. Purpose: The current report describes a rare case of complex RAA with three dependent arterial branches, successfully managed by a flow diverting stent (FDS) which is usually indicated for the treatment of large and giant cerebral aneurysms. Methods: We report a case of a 61-year-old male who presented with a 2.3 cm left RAA which contained the origin of three major arterial branches that provide a significant part of the blood supply to the entire left kidney. Due to the existence of these three branching blood vessels within the aneurysm, a standard stent-graft or an open procedure were not considered as adequate therapeutic alternatives in this case. To overcome this challenge, we have elected to use an FDS which is commonly used in the treatment of cerebral aneurysms. This unique type of stent promotes gradual thrombosis of the aneurysmal sac with the advantage of maintaining flow in regional side branches. Results: At 6 months of follow up, creatinine level was 1.3 mg/dL (baseline was 1.1) and upon follow up CT – the renal parenchyma was well preserved. Conclusions: This case report presents a unique solution for treating complex RAA by using an FDS that is routinely used for the treatment of large and giant cerebral aneurysms. FDS is a valuable treatment option for complex RAAs since it can treat the aneurysm without compromising the branching blood vessels.

Keywords

Renal artery aneurysm; endovascular; flow diverting stent; acute kidney injury

1. Introduction

The published incidence of RAAs is approximately 0.1% in the general population and the majority of cases are asymptomatic at the time of diagnosis [1]. Due to the widespread use of non-invasive imaging modalities (CT, MRI and US), RAAs are nowadays being increasingly detected [2]. Although most cases of RAAs are asymptomatic, they can present with uncontrolled hypertension (HTN), abdominal or flank pain or life-threatening hemorrhage due to rupture of the RAA [1]. Currently accepted indications for RAA intervention include an RAA size $>$ 2 cm, female gender within childbearing age, symptoms (pain and hematuria), medically refractory HTN, thromboembolism, dissection, and RAA rupture [3].

Complex RAAs, particularly those involving branches of the main renal artery represent a therapeutic challenge since treating the RAA may compromise the perfusion to the kidney and cause deterioration in renal function. This can even be more challenging when the RAA includes main branches of the renal artery [4].

The most accepted approaches to repair RAAs include: open surgery, laparoscopic repair and endovascular management [5, 6]. In the past, open repair methods were considered the gold standard therapy. However, along with the improvement of the available endovascular devices, currently there is an emerging trend towards minimally invasive endovascular treatment [7].

Anatomic factors may limit the application of stent grafts for the treatment of arterial aneurysms mainly because they can block the blood flow to dependent arterial branches. Flow diverting stents (FDSs) are specially designed devices that reduce flow velocity in the aneurysm sac and promote thrombosis, while maintaining flow in the main artery and in branch vessels [8]. These stents were originally designed for cerebral aneurysms where tissue ischemia cannot be tolerated. Since there are no FDS designed for RAA we have adopted their use in our unique case.

Herein we report a rare case of complex RAA with three dependent arterial branches, successfully managed by a FDS which is usually indicated for the treatment of large and giant cerebral aneurysms.

2. Case presentation

A 61-years old male with unremarkable past medical history, presented with diffuse abdominal pain for the past three months.

No abnormal findings were noted on physical examination and all laboratory tests were within normal limits. Abdominal CT angiography revealed a 2.3 cm left RAA located approximately 1.5 cm proximal to the renal hilum. This aneurysm contained the origin of three major branches that provide a significant part of the blood supply of the entire left kidney (Fig. 1).

Figure 1. Abdominal CT angiography demonstrating a 2.3 cm RAA (*black arrow*) with 3 main renal artery branches supplying a significant portion of the blood flow to the left kidney.

Due to the complexity and location of the aneurysm and considering the risk of sacrificing vital renal parenchyma with an endovascular stent, a FDS was thought to be the optimal solution in this case, since it could promote thrombosis in the aneurysm sac, while maintaining flow in the main artery and in branch vessels. Prior to the procedure, the patient was given a loading dose of Aspirin 300 mg. The procedure was carried out under local anesthesia in the endovascular radiology unit where the patient was treated with 5,000 IU IV Heparin. A contralateral access was performed through the right common femoral artery and a 6F Destination® - Peripheral guiding sheath was placed at the left renal artery orifice. Following contrast injection, the left RAA was demonstrated with its three dependent branches (Fig. 2a). A 5 $\times$ 50 mm GORE® VIABAHN® Endoprosthesis was deployed at the site of the aneurysm and due to its limited length, a second identical 5 $\times$ 25 mm Endoprosthesis was used as a proximal extension towards the renal artery ostium at the level of the aorta. A Marksman™ micro catheter (Medtronic Neurovascular, Irvine, CA) was passed through the Endoprosthesis and into the middle depending renal artery branch. Through this catheter, a 5 $\times$ 35 mm Pipeline™ Flex Embolization Device (a type of FDS) was then deployed under fluoroscopic guidance (Fig. 3). The longer VIABAHN Endoprosthesis was deployed with its free distal end in the aneurysm sac such that the Flex Embolization Device could be inserted at the same level. Upon completion of the procedure, selective angiography revealed correct positioning of the endoprosthesis, reduced flow within the aneurysm and adequate perfusion of the entire renal parenchyma (Fig. 2b, 2c).

Post-operative, the patient was treated with single S.C. dose of 60 mg Clexane (single dose). The recovery was uneventful and the patient was discharged the following day in satisfactory condition with life-long Aspirin 100 mg and Plavix 75 mg for 6 months. At 6 months of follow up, creatinine level was 1.3 mg/dL (baseline was 1.1) and upon follow up CT - the renal parenchyma was well preserved (Fig. 4).

3. Discussion

With the advances of technology, there is a trend towards minimally invasive endovascular repair of RAA. Endovascular treatments, include coil embolization of the aneurysm, stenting, or combination of both. These methods are often associated with decreased operative time and fewer complications, especially in patients with increased comorbidities [9].

The indications for endovascular repair have expanded with the introduction of three-dimensional detachable coils, non-adhesive liquid embolic agents, remodeling techniques (which include balloon- and stent-assisted coiling), and FDSs [10].

Several retrospective studies compared open surgery vs endovascular procedures. For example, in a large study, Buck et al., [11] investigated 6,234 RAA repairs between 1988 and 2011. They have concluded that although there is evidence supporting a significantly lower rate of post-operative complications and a shorter length of hospital stay with endovascular repair, there has not been a reduction in operative mortality nor has there been a reduction in open surgical procedures [11].

Treatment of complex RAAs includes: open procedures and endovascular management. The traditional open surgical correction requires vascular clamping with the consequence of ischemic injury and risk of acute kidney injury (AKI); moreover, the need for several anastomoses may further complicate the procedure [1]. Endovascular techniques include: embolization (coils and liquid agents) and remodeling (balloon and stent-assisted coiling) [12]. In addition, stent-grafts have a restricted use in the treatment of RAAs because of inflexibility or high-profile devices making it impossible to navigate in tiny or tortuous vessels or because of coverage of important branches, leading to renal infarction. Due to the existence of three branching vessels within the aneurysm in our current study, a stent-graft or an open procedure, were not considered as an adequate therapeutic alternative [12].

In the current case, in order to overcome the limitations of the RAA associated with the location (proximity to the renal hilum) and complexity (multiple dependent branches), we decided to use a combination of a stent graft and a FDS. In contrast to traditional covered stents, FDSs do not exclude the aneurysm sac but they reduce the flow velocity vortex within the aneurysm, promoting gradual thrombosis with the advantage of maintaining flow in regional side branches [13].

Since there are no FDSs designed for renal arteries and in order to overcome this obstacle, we have elected to use a FDS that is routinely used for large and giant cerebral aneurysms: The Pipeline™ Flex Embolization Device (PED, Medtronic 53 Neurovascular, Irvine, CA). This FDS was specifically developed for endovascular treatment of intracranial aneurysms where tissue ischemia cannot be tolerated like the brain. It is a self-expanding microcatheter, composed of a mesh tube woven wire, made of 25% platinum tungsten and 75% cobalt-chromium alloy [14]. Since this FDS was designed for cerebral aneurysms, there is no specific in-

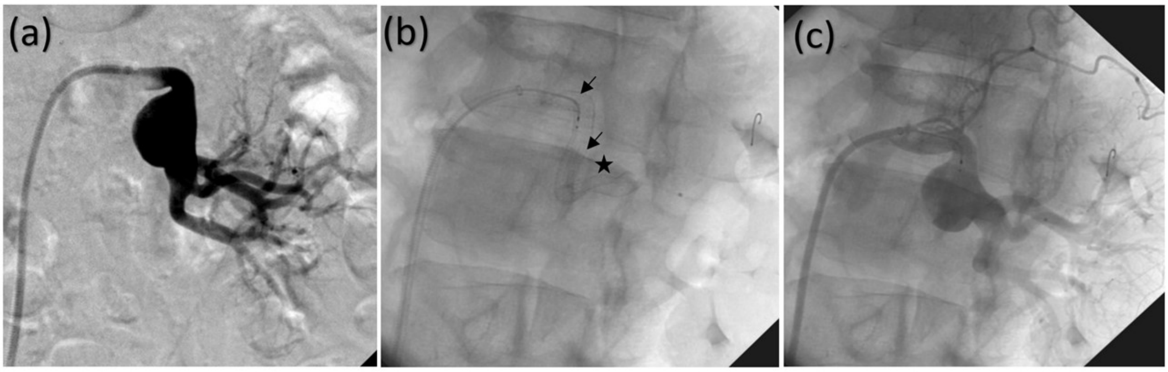

Figure 2. (a) Fluoroscopic image of the RAA after injection of contrast media demonstrating three dependent arteries. (b) Fluoroscopic image of the RAA after a successful insertion of the GORE® VIABAHN® Endoprosthesis (arrows) and the Pipeline™ Embolization Device (star). (c) Post-operative fluoroscopic image after injection of contrast media demonstrating perfusion of all three main renal artery branches exiting the RAA.

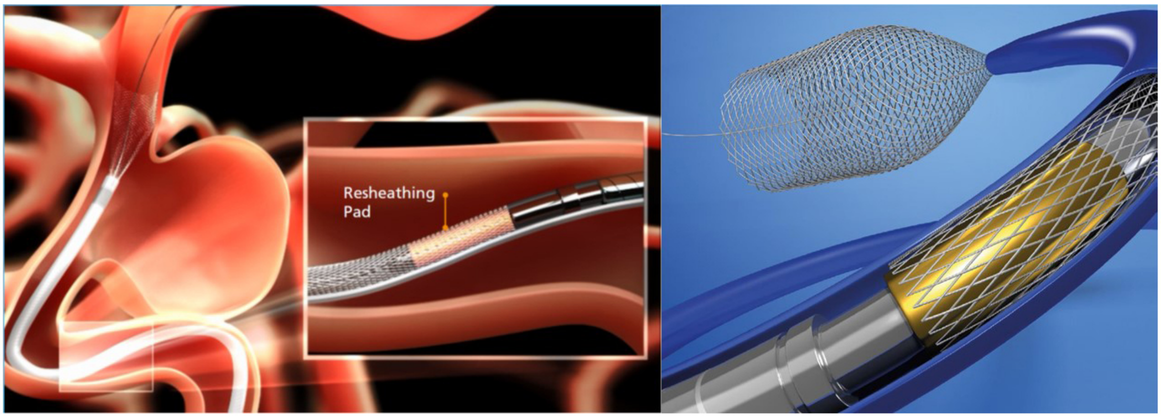

Figure 3. Illustration of the Pipeline™ Flex Embolization Device.

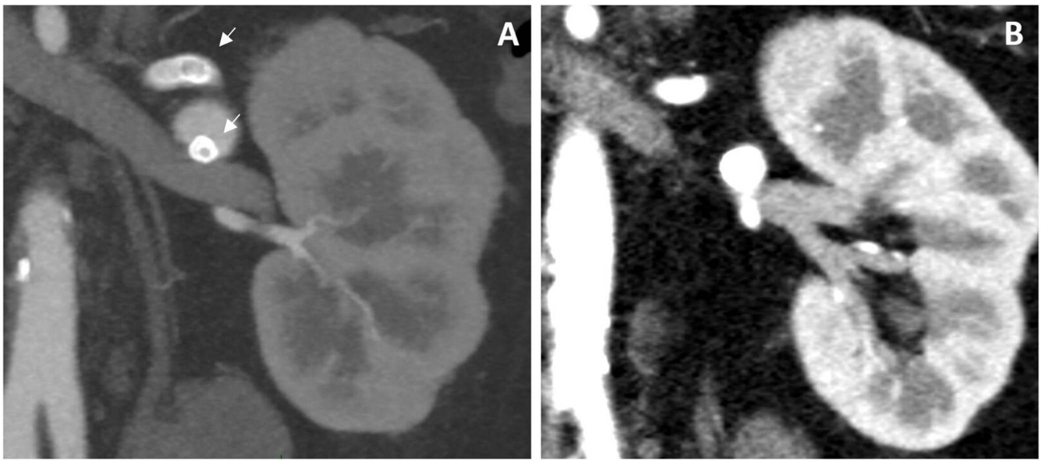

Figure 4. Six months follow up CT: arterial and nephrographic phase (A and B, respectively). The stent is well positioned (arrows) and the renal parenchyma demonstrates proper enhancement.

dication for its use in visceral artery aneurysms (VAAs). However, a recent review by Colombi et al., who inserted FDSs in visceral artery aneurysms of four patients, concluded that FDSs could represent an option for the treatment of VAAs or visceral artery pseudoaneurysms in selected patients [15].

4. Conclusion

FDSs are a valuable treatment option for complex RAAs. It is a minimally invasive approach that prevents the need for multiple anastomoses of small arterial blood vessels and omits the risk of ischemia reperfusion injury of the involved kidney. They provide a good solution for complex RAAs where renal perfusion is at compromise. Further studies are necessary to evaluate the long-term results of using this device for the treatment of RAAs.

Informed consent

Informed consent was obtained from all individual participants included in the study.

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Conflict of Interest

None of the contributing authors have any conflict of interest, including specific financial interests or relationships and affiliations relevant to the subject matter or materials discussed in this case report.

References

[1] Gonzalez J, Esteban M, Andres G, Linares E, Martinez-Salamanca JI. Renal artery aneurysms. *Current Urology Reports*, 2014; 15: 376.

[2] Tham G, Ekelund L, Herrlin K, Lindstedt EL, Olin T, Bergentz SE. Renal artery aneurysms. *Natural History and Prognosis. Annals of Surgery,* 1983; 197: 348–352.

[3] Coleman DM, Stanley JC. Renal artery aneurysms. *Journal of Vascular Surgery*, 2015; 62: 779-785.

[4] Tsilimparis N, Reeves JG, Dayama A, Perez SD, Debus ES, Ricotta JJ. Endovascular vs open repair of renal artery aneurysms: outcomes of repair and long-term renal function. *Journal of the American College of Surgeons*, 2013; 217: 263–269.

[5] Hupp T, Allenberg JR, Post K, Roeren T, Meier M, Clorius JH. Renal artery aneurysm: surgical indications and results. *European Journal of Vascular Surgery*, 1992; 6: 477–486.

[6] Robinson WP, Bafford R, Belkin M, Menard MT. Favorable outcomes with in situ techniques for surgical repair of complex renal artery aneurysms. *Journal of Vascular Surgery*, 2011; 53: 684–691.

[7] Zhang Z, Yang M, Song L, Tong X, Zou Y. Endovascular treatment of renal artery aneurysms and renal arteriovenous fistulas. *Journal of Vascular Surgery*, 2013; 57: 765–770.

[8] George S. Sfyroeras MD, Ilias Dalainas MD, Triantafyllos G. Giannakopoulos MD, Konstantinos Antonopoulos MD, John D. Kakisis MD, and Christos D. Liapis MD. Flow-diverting stents for the treatment of arterial aneurysms. *Journal of Vascular Surgery*, 2012; 56: 839-846.

[9] Orion KC, Abularrage CJ. Renal artery aneurysms: movement toward endovascular repair. *Seminars in Vascular Surgery*, 2013; 26: 226-232.

[10] Chung R, Touska P, Morgan R, Belli A-M. Endovascular management of true renal arterial aneurysms: results from a single Centre. *Cardiovascular Interventional Radiology*, 2015; 39: 36-43.

[11] Buck DB, Curran T, McCallum JC, Darling J, Mamtani R, van Herwaarden JA, *et al*. Management and Outcomes of Isolated Renal Artery Aneurysms in the Endovascular Era. *Journal of Vascular Surgery*, 2016; 63: 77–81.

[12] Carsten M, Frauke V, Gunther W, Kai W. Endovascular management of complex renal artery aneurysms using the multilayer stent. *Cardiovascular Interventional Radiology*, 2011; 34: 637-641.

[13] Nelson PK, Lylyk P, Szikora I, Wetzel SG, Wanke I, Fiorella D. The pipeline embolization device for the intracranial treatment of aneurysms trial. *AJNR American Journal of Neuroradiology*, 2011; 32: 34-40.

[14] Wong GK, Kwan MC, Ng RY, Yu SC, Poon WS. Flow diverters for treatment of intracranial aneurysms: current status and ongoing clinical trials. *Journal of Clinical Neuroscience*, 2011; 18: 737-740.

[15] Colombi D, Bodini FC, Bossalini M, Rossi B, Michieletti E. Extracranial visceral artery aneurysms/pseudoaneurysms repaired with flow diverter device developed for cerebral aneurysms: preliminary results. *Annals of Vascular Surgery*, 2018; 53: 272.