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Case Report Open Access

Endovascular Repair of a Type III Renal Artery Aneurysm using the Multilayer Flow Modulator: A Clinical Case Report

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Abstract

Background: Our aim was to describe our experience of the multilayer flow modulator (Cardiatis, Isnes, Belgium) used in the treatment of renal artery aneurysms.

Case report: A female patient, aged 42 years underwent treatment of a renal artery aneurysm using the multilayer flow modulator. Contrast-enhanced computed tomography revealed a 23.9 mm type III renal artery aneurysm at the bifurcation of the upper and lower pole vessels, with four side branches. Follow up was assessed by postoperative computed tomography scan at 6 and 19 months postoperatively. There were no immediate postoperative complications or mortality. A normal estimated glomerular filtration rate of > 90 ml/min, which was recorded preoperatively, decreased to 77 ml/min on the day of surgery, and returned to > 90 ml/min 1 day postoperatively. The aneurysm initial decreased in size by 23% at 6 months, and by 16% at 19 months. Overall aneurysm shrinkage was 36% (8.6 mm), with all four side-branches remaining patent throughout follow up.

Conclusion: The MFM may provide less operative trauma for patients where complex surgical intervention is the only other feasible treatment option. Longer follow-up, a larger sample size, and comparative studies are required to prove the efficacy of this emerging technology.

Keywords: Multilayer Flow Modulator; Renal artery aneurysm; Patency; Shrinkage

Abbreviations:

MFM: Multilayer Flow Modulator; RAA: Renal Artery Aneurysm; CT: Computed Tomography; eGFR: Glomerular Filtration Rate

Introduction

Renal Artery Aneurysms (RAA) are a rare but serious pathology, found in 0.3 - 0.7% of autopsies and up to 1 % of angiographic investigations [1]. Rupture of RAA is associated with a significant mortality or loss of a kidney [2]. Type III RAA are located distally, affecting the small segmental or intraparenchymal artery, and believed to be caused by arterial fibrodysplasia. Vasculitides, phakomatoses, collagen related diseases, degenerative aneurysms and trauma are also known causes for this pathology. It is generally accepted that aneurysms of 20 mm or greater in diameter should be treated as a preventative measure [3]. An alternative endovascular approach to management of RAA, the Multilayer Flow Modulator (MFM, Cardiatis, Isnes, Belgium, Figure 1) has been used successfully in aortic [4], visceral [5], and peripheral aneurysm repair [6]. Our aim was to describe our experience of the MFM, used in the treatment of a distal RAA, assessing patency of side branches, aneurysm shrinkage and renal function.

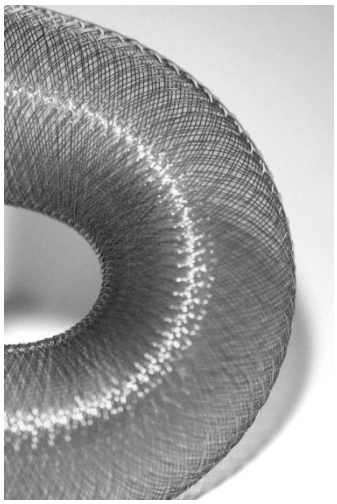

Figure 1: The Multilayer flow modulator (Cardiatis, Isnes, France).

Case Report

A female patient aged 42 years presented to the urology service complaining of constant pain in the right side of the abdomen. Preoperative work-up consisted of a contrast-enhanced computed tomography (CT) scan with 1-mm axial slices, which revealed a 23.9

mm type III right juxta renal aneurysm at the bifurcation of the upper and lower pole vessels, with four side-branches (Figure 2). There was a family history of hypertension and diabetes mellitus, however the patient herself had no comorbidities, or history of aneurysm or fibrodysplasia. The patient elected for surgery since she had ongoing pain and no quality of life, secondary to the worry that her aneurysm would rupture. The diameter and length of the aneurysm, and the arterial landing zones were measured via CT angiography, and a 6 × 60 mm (diameter x length) MFM device was selected.

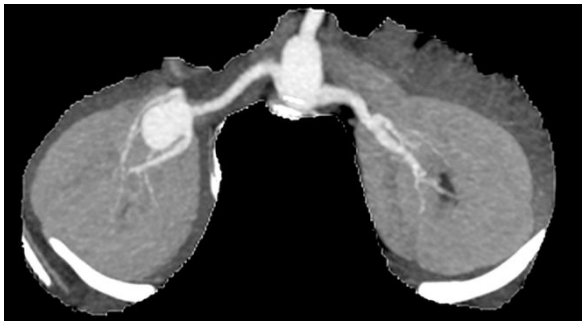

Figure 2: Preoperative computed tomography angiography of a type III right juxta RAA.

Figure 3: Three dimensional computed tomography reconstruction of a type III right juxta RAA, treated with the multilayer flow modulator.

MFM intervention was performed under endotracheal general anaesthesia. An intraoperative loading dose of heparin was given to the patient. Duplex-guided cannulation of right common femoral artery with 5F sheath was then carried out percutaneously. The Terumo (TKY, Japan) guidewire was advanced into the aorta and then replaced with a larger 7F destination sheath. The renal vessel was cannulated with a paediatric selective visceral catheter. The 7F sheath was then advanced inside the renal artery. The MFM was deployed in the target vessel with oversizing by 15%, and landed distally in the largest side branch (Figure 3). Once the procedure was complete, the guidewires were withdrawn and closure of the right femoral puncture was carried out with a Perclose device (Abbott Laboratories, Illinois, USA).

Estimated Glomerular Filtration Rates (eGFR) were measured preoperatively, on the day of surgery, and 1 day postoperatively to assess renal function. Follow up CT angiography was carried out a 6 and 19 months postoperatively. Arterial and graft patency, aneurysm and kidney size were measured using CT angiography. CT estimate of kidney length was defined as the maximum longitudinal length in the coronal section, and kidney width was measured at the maximum width in the transverse section.

A normal estimated glomerular filtration rate of >90 ml/min, which was recorded preoperatively, decreased to 77 ml/min on the day of surgery, and returned to >90 ml/min 1 day postoperatively. Blood pressures of 103/66 mm Hg, and 111/67 mm Hg were recorded pre and perioperatively. Preoperative maximum aneurysm diameter was 23.9 mm. Preoperative maximum longitudinal length of the kidney was 120.2 mm, and maximum width was 47.9 mm. It was noted during 6-week follow up that the patient's pain was no longer present and there was no evidence of tenderness or soreness. Maximum aneurysm diameter at 6 months follow up was 18.3 mm, showing a decrease of 23% (5.6 mm). All 4 side-branches remained patent. Maximum longitudinal length of the kidney was 118.4 mm, and maximum width was 47.4 mm. During 6 month follow up examination, the patient complained of headaches and light-headedness, and was prescribed 100 mg Teva-Losartan/HCTZ, and 75 mg Aspirin once daily. The 100 mg Teva-Losartan/HCTZ was stopped 12 months postoperatively, with continuation of the 75 mg Aspirin.

Maximum aneurysm diameter at 19 months follow up was 15.3 mm, showing a decrease of 16% (3 mm). Overall aneurysm shrinkage of 36% (8.6 mm) occurred, when compared to preoperative measurements. All 4 side-branches remained patent. Maximum longitudinal length of the kidney was 121.5 mm, and maximum width was 47.0 mm. At a 40 month examination the patient was stable but a blood pressure of 160/93 mm Hg was recorded. It was noted that the patient had a "tense work meeting" prior to the examination. 75 mg Aspirin once daily was continued.

Discussion

Currently, treatment options for RAA include open surgery such as nephrectomy, aneurysmectomy, renal artery reconstruction with or without bypass (autologous conduit), and endovascular treatment with stenting and catheter directed embolization [7,8]. Open surgery to treat these aneurysms involves major abdominal surgery with its concomitant morbidities and mortalities [7]. The endovascular approach is becoming an increasingly popular route of repair, however, if an RAA has single or multiple arterial branches exiting directly from the aneurysm sac, endovascular methods of treatment would result in obstruction of the branch or branches, reducing perfusion to the kidney. In these complex cases, extracorporeal vascular reconstruction with auto-transplantation is often the only feasible option of repair. The MFM may therefore provide a viable new off-the-shelf endovascular treatment option for RAA with its porous uncovered mesh design, leading to less operative trauma, a shorter procedure time and reduced hospital stay.

The MFM has the ability to harness the body's innate physiological process by slowing blood flow as it perfuses through the mesh,

encouraging an organized thrombus formation within the aneurysm sac, while maintaining collateral branch patency [4-6,9]. From this case report, treatment of RAA with the MFM may prove to be a promising avenue. Surgery was performed via a percutaneous femoral approach with the stent being deployed without any complication. The four collateral branches arising from the aneurysm remained patent postoperatively, and there was no compromise to renal function. Progressive aneurysm shrinkage also occurred, with an initially larger decrease in aneurysm size in the first 6 months, when compared to 6 to 19 months. According to Ruffino et al., differing aneurysm morphology can influence shrinkage, and there are also differences in shrinkage timing for peripheral and visceral aneurysms treated with the MFM [8].

Conclusion

Overall postoperative follow-up showed that the patient was stable, and CT angiography showed freedom of aneurysm rupture, aneurysm shrinkage, no graft failures or postoperative complications including stent thrombosis, migration and infection. There was no deterioration in renal function. The MFM may provide less operative trauma for patients where complex surgical intervention is the only other feasible treatment option. Longer follow-up, a larger sample size, and comparative studies are required to prove the efficacy of this emerging technology.

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