A custom-made endograft for the treatment of an abdominal aortic aneurysm with an ectopic pelvic kidney

Andreas M. Lazaris, MD[1], Aikaterini Poulou, MD[1], Nikolaos Krinos, MD[1], Konstantina Katseni, MD[1], Patrick Bohan[2], Stavros Spiliopoulos, MD[3], Elias Brountzos, MD[3], Georgios Geroulakos, MD[1]

[1] Vascular Surgery Department, School of Medicine, National and Kapodistrian University of Athens, Attikon Teaching Hospital, Athens, Greece
[2] Medical Affairs, Terumo Aortic, Sunrise, FL, USA
[3] 2nd Department of Radiology, Division of Intereventional Radiology, School of Medicine, National and Kapodistrian University of Athens, Attikon Teaching Hospital, Athens, Greece

Abstract:

Purpose: To describe a custom-made endovascular treatment for a patient with an abdominal aortic aneurysm and a pelvic kidney.

Case report: A 75-year-old male with a history of abdominoperineal resection with an abdominal stoma, and a large abdominal incisional hernia, was admitted for the treatment of an abdominal aortic aneurysm. Despite the existence of sufficient proximal and distal landing zones, the left renal artery emerged from the proximal part of the common iliac artery perfusing an ectopic pelvic kidney, this rendering a standard endovascular treatment impossible. To preserve the functioning pelvic kidney, a custom-made aortic endograft was designed consisting of a custom-made main body and an iliac-branched device for the perfusion of the pelvic kidney. The procedure was successful and at 3-years follow-up there is no endoleak and the pelvic kidney is well-perfused.

Conclusion: The iliac-branch platform can be used as a custom-made solution for the treatment of the rare case of abdominal aortic aneurysm with pelvic renal ectopia.

INTRODUCTION

Renal ectopia is an atypically placed kidney (crossed, abdominal, lumbar or pelvic) due to an abnormal migration from the fetal pelvis during development of the embryo[1]. Incidence of pelvic kidney has been estimated at between one in 2200 and one in 3000[2]. It does not usually have clinical significance but on the rare occasions that it coincides with abdominal aortic aneurysm (AAA) repair, it presents a significant technical challenge to preserve renal function of both kidneys and minimize ischemic insult[3, 4].

The unusual position of the kidney causes vascular anomalies. Ectopic kidney's vascularization can be from the aneurysm sac, the aortic bifurcation, or even the iliac vessels. In a recent literature review, an algorithm was proposed for the choice of the proper type of treatment[5]. The first step is to establish the patient's general risk level. Endovascular treatment should be the first choice for a high-risk patient, even sacrificing the ectopic kidney's arterial perfusion. If the surgical risk is not considered high, the surgical environment for open repair should be assessed. If the patient does not have a hostile abdomen, then open repair should be first choice. If there is a hostile abdomen, an endovascular or a hybrid approach may be used aiming to preserve the perfusion of the functioning pelvic kidney[5].

We describe a patient with an AAA and a left pelvic kidney unsuitable for an open repair due to a hostile abdomen. The patient underwent a complete endovascular repair with a custom-made endograft.

DESCRIPTION OF CASE

A 75-year-old man was admitted for the elective treatment of an AAA. He had a history of abdominoperineal resection for rectal carcinoma 10 years previously. Following his initial operation, he developed a large midline incisional hernia. The computed tomography angiography scan of his aorta (CT aorta scan) demonstrated an AAA with 55 mm maximum diameter, extended to the aortic bifurcation. Although there was 12 mm proximal neck to the right renal artery with thrombus formation, the left renal artery (4.5 mm in diameter) emerged from the common iliac artery just below the aortic bifurcation due to a pelvic kidney (Figure 1).

Author for correspondence:

Andreas M. Lazaris

Vascular Surgery Department, School of Medicine, National and Kapodistrian University of Athens, Attikon Teaching Hospital, Athens, Greece, 72, Sevastopoulou str – 11524, Athens - Greece
E-mail: amlazaris@med.uoa.gr, andreaslazaris@hotmail.com
ISSN 2732-7175 / 2022 Hellenic Society of Vascular and Endovascular Surgery Published by Rotonda Publications

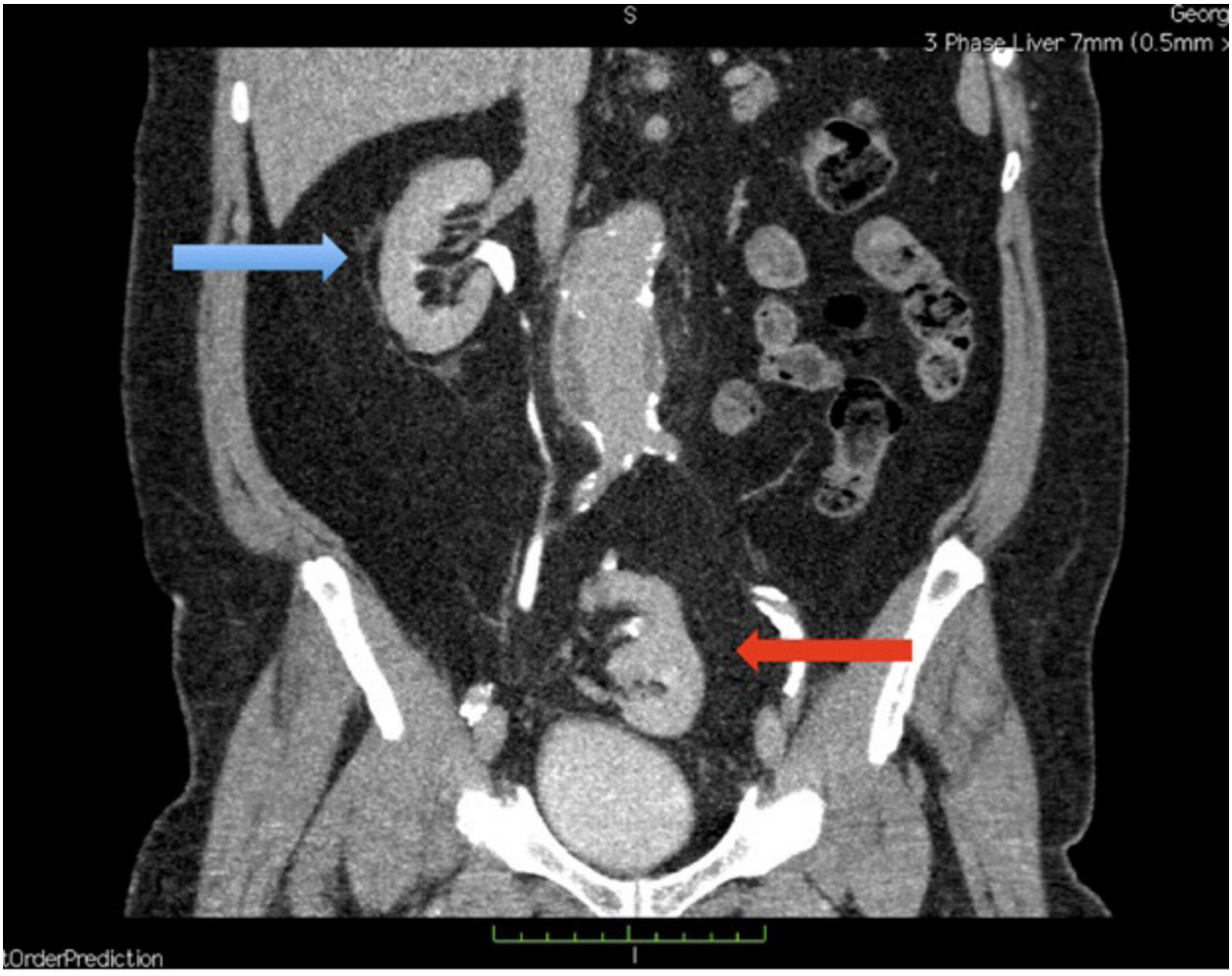

Figure 1: Preoperative CT scan: arrows indicate the normal right kidney (left blue arrow) and ectopic pelvic kidney (right red arrow).

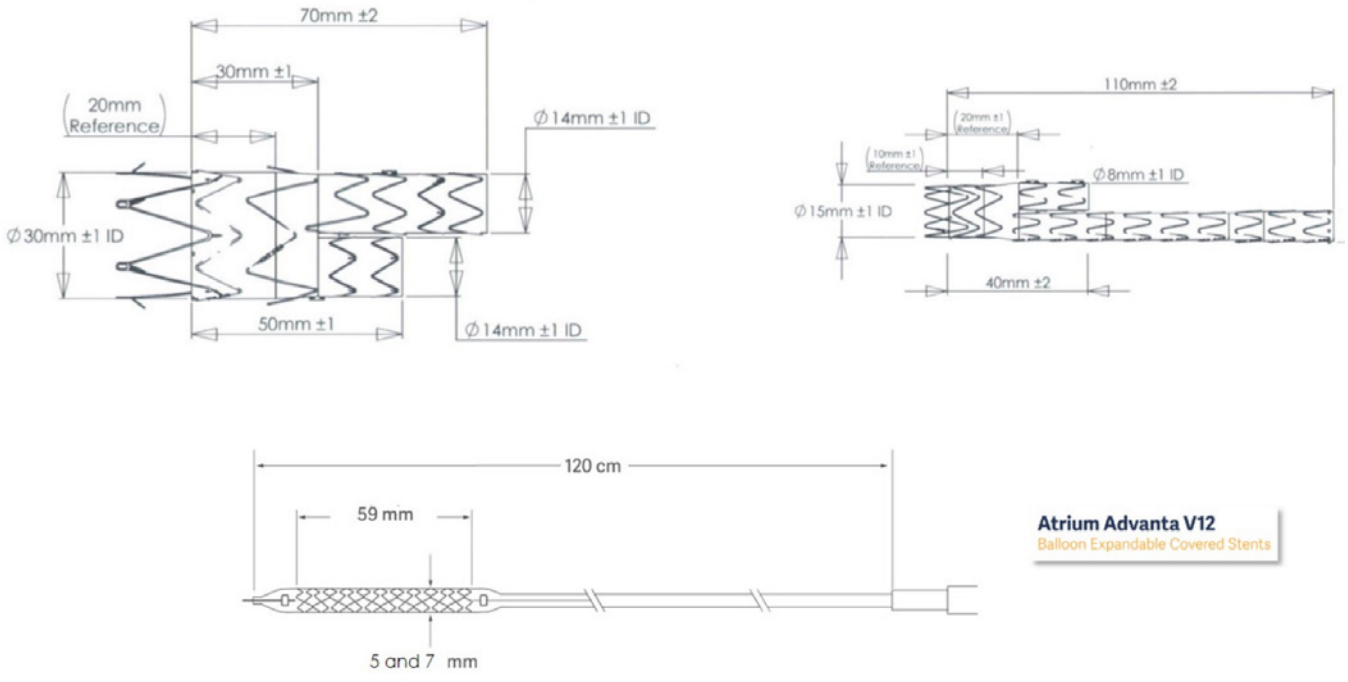

Figure 2: Components used for the custom-made endograft solution

The patient was considered unfit for an open repair due to a hostile abdomen (previous abdominal procedure, large incisional hernia, and stoma), so a decision for an endovascular approach was made. The proximal landing zone at the right renal artery had some thrombus, thus an endograft with suprarenal fixation was chosen due to the risk of dislodgement and possible distal embolization. As the distance from the orthotopic renal artery to bifurcation was quite short (85 mm), a custom-made endograft with a short main body was considered necessary. The common iliac arteries had around 25 mm diameter in healthier vessels but were severely calcified elsewhere with diameter in certain areas of less than 6 mm. The length of the main trunk of the renal artery of the ectopic kidney was 12 mm after which it was bifurcated into two smaller branches.

A custom-made endovascular solution was designed using a Terumo Aortic™ (formerly Bolton Medical) short TREO™ main body (30 mm from the top of the graft to the flow divider), extended with an iliac branched device (IBD) on ipsilateral side (7 mm inner diameter × 40 mm), to preserve the pelvic renal artery. Balloon-expandable stent-grafts were preferred over self-expanding stent-grafts for more accurate positioning. Two long (59 mm) Atrium Advanta V12™ Balloon Expandable Covered Stents (Maquet, Getinge Group©) were used to bridge the IBD device to the pelvic renal artery, achieving adequate over-lapping to each other, the first one with a proximal diameter of 7 mm (flared inside the IBD) and a distal of 5 mm diameter inside the renal artery to avoid excessive oversizing (Figure 2). The catheterization of the renal artery of the pelvic kidney was achieved through a left axillary artery approach, thus long shaft stent-grafts of 120 cm length were chosen. The first main body was inserted from the left iliac axis, while the second custom-made bifurcated graft from the right iliac axis. Finally, an iliac extension was inserted in the left common iliac artery. The steps of the plan of the procedure are depicted in Figure 3. The completion angiography demonstrated good flow on both renal arteries, the orthotopic and the pelvic one, without any obvious endoleak.

The patient had an uneventful recovery and was discharged on the postoperative day 4. On his 3-years follow-up, his creatinine level has been unchanged, and a CT scan shows that the AAA is completely excluded with no endoleak and both kidneys are well perfused (Figure 4).

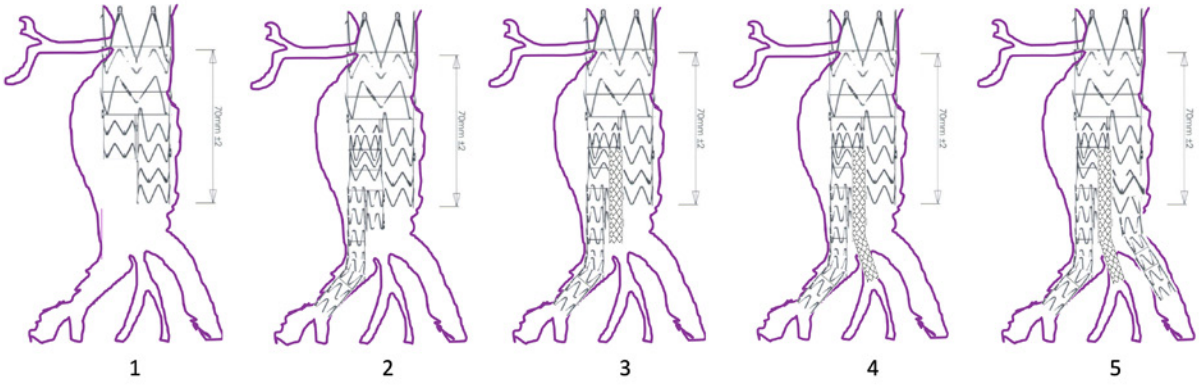

Figure 3: Schematic plan of the procedure: 1. Short-length custom-made main body in the proximal aorta. 2. Custom-made iliac branched device for the perfusion of the pelvic kidney. 3. First balloon expandable covered stent (7 mm) emerging from iliac branch device, 4. Second balloon expandable covered stent (5 mm) into the pelvic renal artery, 5. Iliac extension on the left common iliac artery.

Figure 4: Three-dimensional reconstructions of the preoperative (left) and 3-year post-operative (right) CT scans.

DISCUSSION

The co-existence of renal ectopia and AAA presents formidable challenges for aortic surgery, as the surgeons must be prepared to preserve or revascularize the anomalous renal arteries[6, 7]. This was the aim with this patient whose history of previous laparotomy for an extensive colon procedure and the presence of a large incisional hernia together with a stoma presented a seriously hostile environment for an open repair and imposed the implementation of an endovascular solution. Preoperatively, 3 endovascular solutions were considered: first, a standard endovascular repair (EVAR) sacrificing the pelvic kidney; second, a parallel stents approach (chimney technique); and third, a tailored solution with a fenestrated or other custom-made endograft. The third option was chosen as the most anatomical solution and potentially the best one regarding long-term results.

Complex endovascular repair has become increasingly common in treating aortic aneurysmal disease[8,9]. This is obviously demonstrated by the 673 custom-manufactured grafts, 604 off-the-shelf fenestrated devices, 189 physician-modified devices, and 197 snorkel/chimney repair cases, reported in the Vascular Quality Initiative between 2012 to 2017[10]. In our case, two custom-made main bodies, based on the concept of internal iliac branched device addressed a complex aortoiliac geometry and allowed for pelvic kidney preservation.

A few similar reports exist in the literature. Kfoury et al successfully used EVAR with chimney stenting of an ectopic renal artery on an octogenarian AAA patient with crossed fused renal ectopia[11]. The authors suggested the use of self-expandable stent-grafts as chimney grafts due to their flexibility as opposed to the more rigid balloon-expandable stent-grafts that might kink in acute angles of the renal artery. Another report of a patient with AAA and crossed fused renal ectopia described EVAR after preoperative coiling of an ectopic aberrant renal artery with no adverse effect on renal function[12]. However, although occlusion is an option with an aberrant artery, it cannot be an option when there is a single renal artery. Spear et al used fenestrated and branched endografts in 9 patients with challenging renal artery anatomies including pelvic and horseshoe kidneys, in patients unfit for open repair[13]. Morales et al described the use of a customized endovascular prosthesis for the treatment of type IV thoracoabdominal aortic aneurysm and a congenital pelvic kidney[14]. Finally, Majumder et al described the use of a custom-made fenestrated endograft for the treatment of and AAA with a congenital pelvic kidney[15]. Their technique was enhanced by additional prototype testing prior to surgery providing greater detailed information about the deployment of the branched endograft.

From a health economic perspective, the cost of a complex EVAR is significantly higher than both standard EVAR and open repair[16, 17]. In the WINDOW trial whch assessed the cost-effectiveness of complex EVAR versus open repair, the complex EVAR group did not show any survival benefit and was also more expensive and less effective in patients with pararenal or juxtarenal aneurysms[18]. Nevertheless, in rare cases where there is no open surgery alternative, as in our case, complex EVAR may be considered an acceptable solution.

A possible problem with our solution has been the need to use two long successive stent-grafts to the pelvic renal artery. We chose to use two stent-grafts of different sizes, a larger proximally and a smaller distally, in order to achieve a better sealing on the different sizes' proximal and distal landing areas. The potentially unstable position of the kidney inside the pelvis may be a risk for graft occlusion or proximal migration in the future. As with all endovascular treatment, surveillance is required: at his last follow-up at three years post the procedure, the patient was in optimal clinical shape with a well-perfused pelvic kidney on the CT scan.

CONCLUSION

A custom-made stent-graft based on the iliac branch platform, seems a feasible solution for the rare case of concomitant AAA and pelvic kidney. Endovascular treatment may be considered a therapeutic alternative in patients with AAA and renal arteries anomalies, especially when open repair is impossible.

ACKNOWLEDGEMENTS

Medical writing support was provided by Patrick Bohan, Terumo Aortic, technical support by Nikos Komichilis, Terumo Aortic, and medical imaging care by Andreas Tzouras, Canas Pharmaceutical Laboratories S.A.

REFERENCES

1 Bhoil R, Sood D, Singh YP, et al. An Ectopic Pelvic Kidney. Pol J Radiol. 2015;80:425-7.

2 Cinman NM, Okeke Z, Smith AD. Pelvic kidney: associated diseases and treatment. J Endourol. 2007;21(8):836-42.

3 Hanif MA, Chandrasekar R, Blair SD. Pelvic kidney and aorto-iliac aneurysm--a rare association--case report and literature review. Eur J Vasc Endovasc Surg. 2005;30(5):531-3.

4 Makris SA, Kanellopoulos E, Chronopoulos A, et al. A double shunt technique for the prevention of ischaemia of a congenital, solitary, pelvic kidney during abdominal aortic aneurysm repair: a case report. J Med Case Rep. 2011;5:92.

5 Lazaris AM, Moulakakis K, Mantas G, et al. Hepatorenal revascularization enables EVAR repair on a patient with AAA and an ectopic right renal artery. Ann Vasc Surg. 2018.

6 Bigley HA, Jr., Barreca JP, Chenault OW, Jr. Crossed renal ectopia and abdominal aortic aneurysm. Urology. 1977;10(6):573-5.

7 O'Donnell JA, Brener BJ, Brief DK, et al. Renal artery stenosis and ectopic kidney associated with abdominal aortic aneurysm. J Med Soc N J. 1978;75(6):479-81.

8 Georgiadis GS, Argyriou C, Valsamidou CD, et al. A Custom-Made Treovance((R)) Abdominal Aortic Aneurysm Endograft to Correct Late Failure of Trombone Technique with a Tube Endograft. Ann Vasc Surg. 2018;49:311 e1-e9.

9 Natalicchio G, Biello A, Castriotta G, et al. Endovascular Repair of a Penetrating Aortic Ulcer with a Custom-made Relay Stent Graft Featuring a Single Celiac Trunk Fenestration and a Superior Mesenteric Artery Scallop. Ann Vasc Surg. 2018.

10 O'Donnell TFX, Patel VI, Deery SE, et al. IP035. The State of Complex Endovascular Abdominal Aortic Aneurysm Repairs in the Vascular Quality Initiative. J Vasc Surg. 2018;67(6):e98.

11 Kfoury E, Almanfi A, Dougherty KG, et al. Endovascular Abdominal Aortic Aneurysm Repair by Means of the Chimney Technique in a Patient with Crossed Fused Renal Ectopia. Tex Heart Inst J. 2016;43(3):232-5.

12 Schneider JR, Patel NH, Kim S, et al. Preemptive coil occlusion of major aberrant renal artery to allow endovascular repair of abdominal aortic aneurysm with crossed fused renal ectopia. Ann Vasc Surg. 2014;28(5):1318 e1-6.

13 Spear R, Maurel B, Sobocinski J, et al. Technical note and results in the management of anatomical variants of renal vascularisation during endovascular aneurysm repair. Eur J Vasc Endovasc Surg. 2012;43(4):398-403.

14 Morales JP, Greenberg RK. Customised stent graft for complex thoraco-abdominal aneurysm associated with congenital pelvic kidney. Eur J Vasc Endovasc Surg. 2009;37(5):557-9.

15 Majumder B, Perera AH, Browning N, et al. Fenestrated Endograft as a New Perspective for the Treatment of Infrarenal Abdominal Aortic Aneurysm with a Congenital Pelvic Kidney-A Case Report and Review of Literature. Ann Vasc Surg. 2017;45:266 e1- e4.

16 Mani K, Melissano G. Complex Endovascular Aneurysm Repair: Patient Benefit or a Waste of Money? Eur J Vasc Endovasc Surg. 2018;56(1):1-2.

17 O'Donnell TFX, Boitano LT, Deery SE, et al. PC028. Open versus Fenestrated Endovascular Repair of Complex Abdominal Aortic Aneurysms. J Vasc Surg. 2018;67(6):e181.

18 Michel M, Becquemin JP, Marzelle J, et al. Editor's Choice - A Study of the Cost-effectiveness of Fenestrated/branched EVAR Compared with Open Surgery for Patients with Complex Aortic Aneurysms at 2 Years. Eur J Vasc Endovasc Surg. 2018;56(1):15-21.