IMAGES IN CARDIOLOGY

A juxtarenal aneurysm treated with ovation abdominal stent graft system and simultaneous left renal artery stenting (Vent technique)

Mihai Ursu[1], Costica Baba[1], Narcis Filipescu[1], Gianmarco de Donato[2]

INTRODUCTION

Abdominal aortic aneurysms (AAAs) represent a common cause of morbidity and mortality in the world, becoming more frecvent with ageing of the population. Endovascular aneurysm repair (EVAR) represents a minimally invasive therapeutic alternative to treat AAAs, and in the last decade represent the standard of care in this pathology[1].

One of the most important condition to perform EVAR is a suitable aortic, renal, iliac and femoral artery anatomy and also the aneurysm location. Available devices have evolved continuously from the initial handmade stent grafts manufactured by vascular surgeons to the first commercially available devices released in 1994 and finally to the fourth generation of endografts currently available[2].

Continuous evolution and improved redesigning of AAA endografts allows for the inclusion of more complex anatomies in EVAR's indications.

The Ovation Abdominal Stent Graft System (Endologix., Santa Rosa, CA) is a modular endograft designed for the treatment of AAAs. It is a new device intended to overcome the limitations of currently available stent grafts and to accommodate a different aortic morphologies by addressing the two most important issues in EVAR: access and seal[3]. This is a trimodular endoprosthesis consisting of a 14-Fr outer diameter aortic body and two iliac limbs. It uses a unique O-ring sealing mechanism to deal with challenging aortic necks in the same time that it can navigate through complex iliac and femoral access[1].

CASE REPORT

A 65 year old man was admitted in our hospital for cardio-vascular evaluation. In his medical history he was underwent to aortic biological valvular prothesis

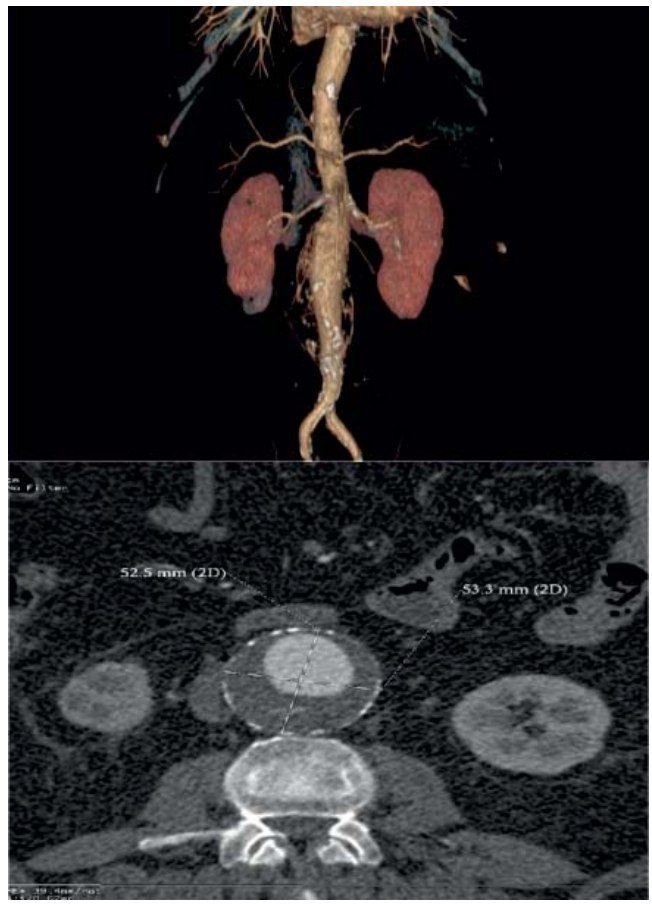

Figure 1. Infrarenal aortic aneurysm. AngioCT with contrast.

[1] Clinicco Hospital, Brasov, Romania
[2] Vascular Surgery Department of Medicine, University of Siena, Italy

Contact address:
Mihai Ursu, MD
Clinicco Hospital, Brasov, Romania.

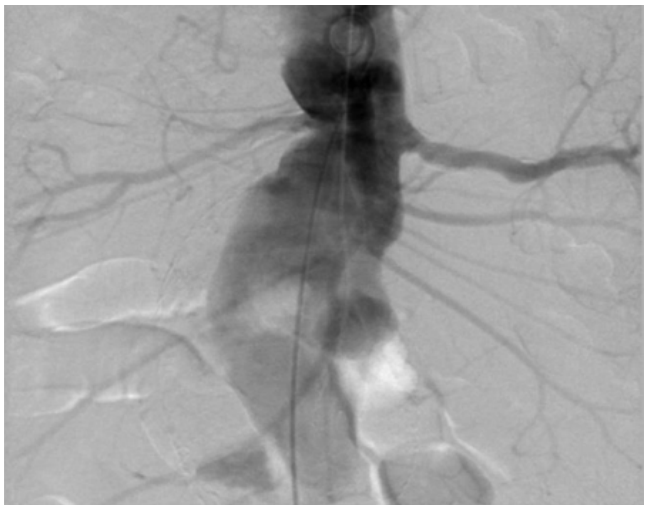

Figure 2. Infrarenal aortic aneurysm. Angiography with contrast.

6 years ago, right carotid endarterectomy 3 years ago. Also he was a hypertensive patient, with descendent thoracic aorta ectasia (40 mm) and infrarenal abdominal aortic aneurysm. A multi-slice angio-CT targeting abdominal segment of the aorta and peripheric arteries was performed in order to obtain a better anatomic characterization of the aneurysm and more accurate measurements of the aneurysm and the ilio-femural arteries diameters. The aneurysm was located infrarenal with a short hostile neck and circumferential trombus. The maximum size of dilatation was 5.25/5.33 cm with an inner lumen diameter of 2.39/2.52 cm (Figure 1, 2).

The proximal aortic neck diameter at 1, 5 and 13 mm below the lowermost renal artery was 2.53/2.35 cm, 2.47/2.7cm respectively 3.02/3.41cm (Figure 3).

The aneurysm distal landing zone was located 2 cm above aortic bifurcation. The Aortic bifurcation diameter was 2.06/1.84 cm. Both iliac and common femoral arteries were calcified but normally sized with mild tortuosities (Figure 4). The lowest renal to hypogastric artery length was 197 mm for right side and 185 mm for left side.

According to the measurements obtained with CTA (computed tomographic angiogram) we could assess the appropriate diameter and length of the stent graft to be used: one module, a main body of 29×80 mm, and two extensions for iliac arteries respectively right and left, ipsilateral to the main body 14×160 mm and 12×140 mm contralateral. The Ovation stent graft was implanted using a 14-F sheath outer diameter (O.D.) under general anesthesia. Bilateral femoral surgical cut-down access. 105 ml amount of dye along the procedure which lasted for 90 min.

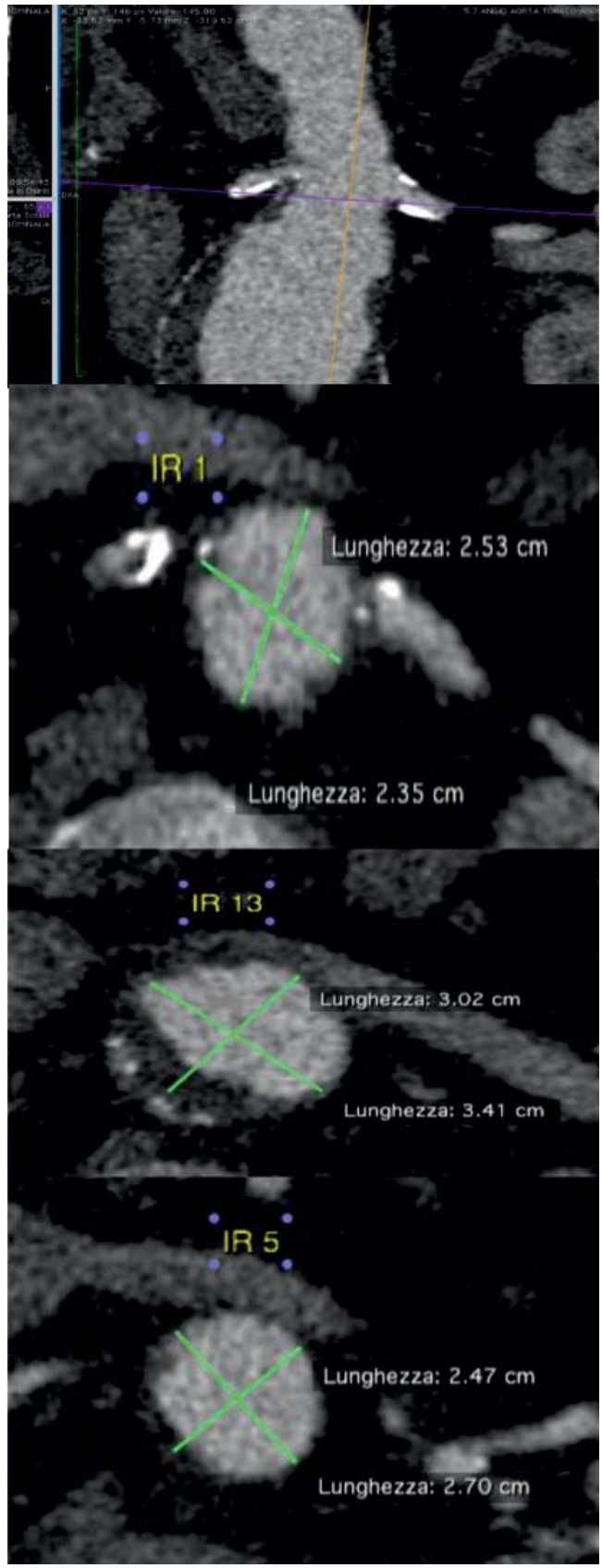

Figure 3. Infrarenal aortic neck diameter. Dye AngioCT.

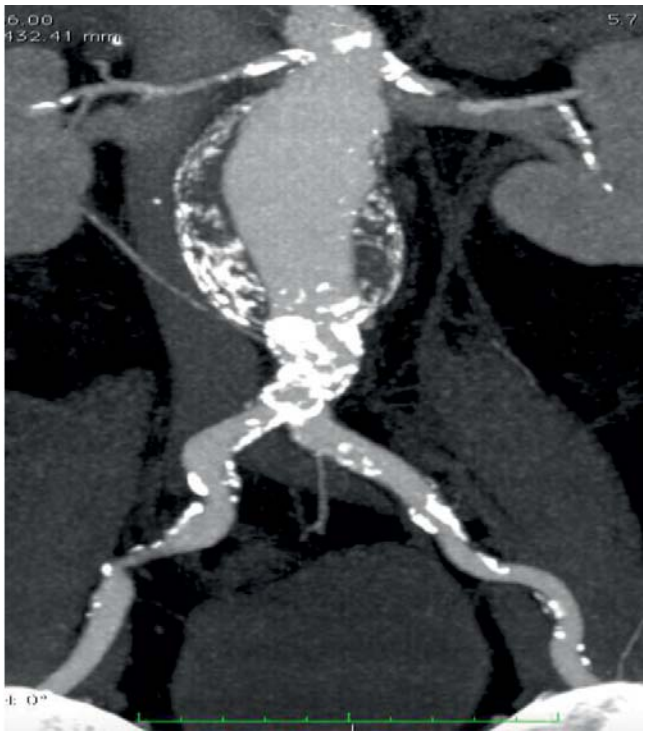

Figure 4. Infrarenal aortic aneurysm. AngioCT with contrast.

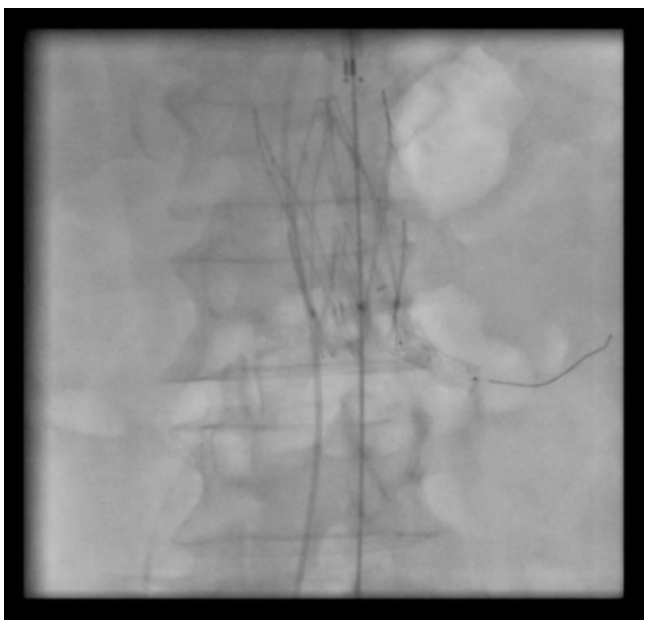

Figure 5. Renal stent deployment and first step of the Ovation main body deployment.

The Ovation endograft main body was accurate positioned in the planned position from the right side, with no specific reason (both iliac arteries were similarly tortuous and angled). The renal bare metal stent (Dynamic Biotronik 6.0/19 mm) reached the position from a left brachial access through a 5F introducer sheet at the left renal ostium level. Simultaneous renal

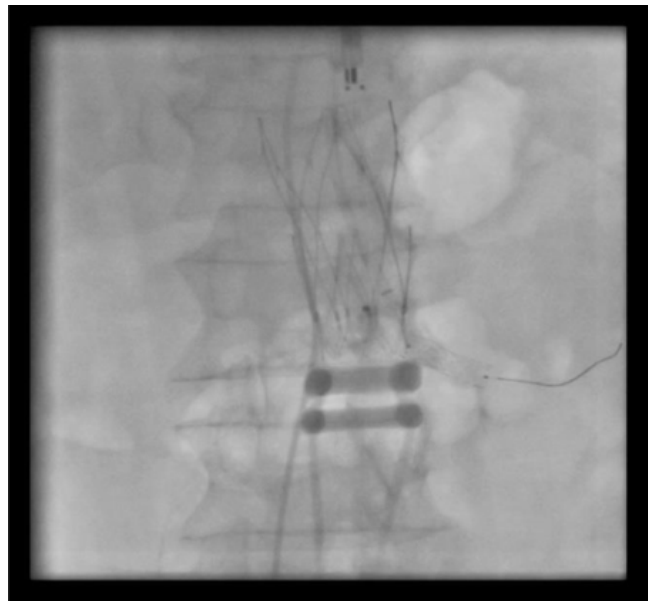

Figure 6. Deployment of the main body and injection of polimer.

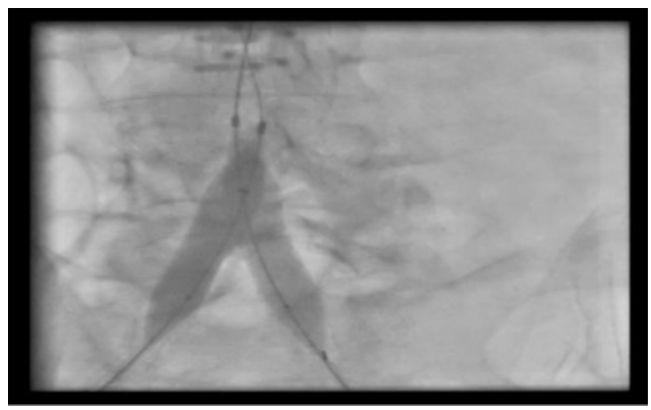

Figure 7. Kissing balloon postdilatation.

stent and first step of main body Ovation endograft deployment is shown in Figure 5 (Vent/Ovation technique).

The Ovation endograft was released with the sealing ring landing precisely at the level of the short infrarenal neck (Figure 6).

The synchronized release of the short renal bare-metal stent, which protrudes just a couple of millimeters into the aortic lumen, allows the "ventilation" of the left renal artery by moving the thin fabric of the collar zone.[4] Of note, the renal stent and the first ring of the Ovation endograft are strictly in contact but do not compete for the same room. The ring filled with radioopaque polymer is responsible for the circumferential sealing at the level of the short neck (1-3 mm below the left renal artery), while the renal stent is preserving the renal perfusion by moving the thin and flexible fabric of the collar zone.[4]

Figure 8. Final angiography; the renal stent and first ring of the Ovation endograft are strictly in contact but do not compete for the same room.

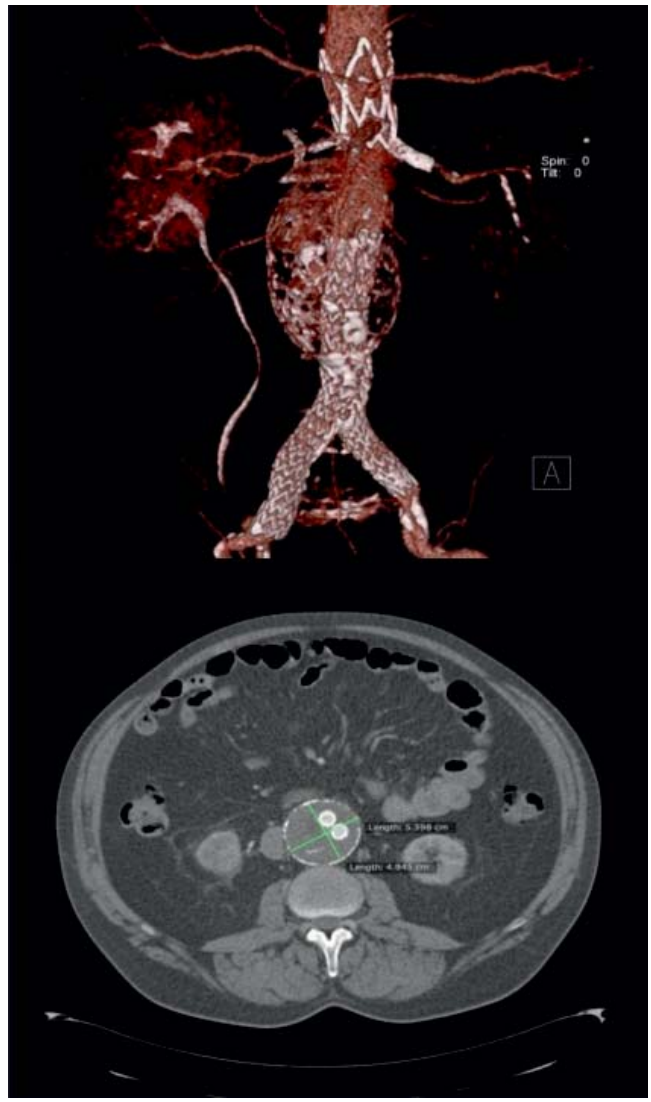

Figure 9. 3D image on a 1-month follow-up CTA examination.

Before filling stent graft with radio-opaque polymer one must be cautious to retract guidewire, then polymer will fill the body of stent graft slowly. In our next step, we confirmed measurements of iliacs extensions using a marker catheter before its release. A kissing balloon postdilatation was performed at level of junction and the origine of comun iliacs for better apposition (Figure 7).

Complete sac exclusion and left renal artery patency are demonstrated at final angiography, with total absence of endoleak (Figure 8).

The patient showed clinical improvement right away on postoperative period and was discharged in 72 h. An ultrasound examination of the aorta and branches was performed at discharge and revealed a normal triphasic flux at the level of both iliac and femoral artery.

The routine angio-CT examination performed at one month follow-up showed permeability of renal stent, a patent endograft with no endoleak or any desirable alteration (Figures 9).

DISCUSSION

The Ovation endograft has a trimodular design consisting of the main body and two iliac limbs. The main body includes a suprarenal by a 35-mm-long nitinol stent with anchors to achieve active fixation to the aortic wall and a low-permeability polytetrafluoroethylene (PTFE) graft, which unlike other devices is not supported by a metallic endoskeleton but contains a network of inflatable channels and sealing rings that are filled during deployment with a low-viscosity, radio-opaque fill polymer. The proximal stent and the anchors are delivered in a staged way, allowing preci-

se placement particularly in situations with short neck anatomies. The main body is 80 mm long and designed as one 50-mm long cylinder that splits into two 30-mm long legs.

Sealing at the proximal infrarenal aortic neck is performed by a unique mechanism of two inflatable O-rings that cure in situ and conform to the patient specific neck anatomy. The polymer filled ring network conforms to the patient`s aortic neck creating an uninterrupted concentric seal. Being casted in situ to form a custom molded O-ring seal at the margin of aneurysm, the polymer guarantees a very high seal conformability of the Ovation to irregular surfaces, such as in presence of calcium or thrombus[4].

To achieve seal in proximal aortic necks the polymer-filled O-rings do no apply the chronic outward radial force on the aorta, which is typically seen to traditional self-expanding stent grafts.

The iliac limbs consist of highly flexible nitinol stents encapsulated in low-permeability PTFE. Due to the unique concept of separation of the endografts' fabric and metal portions, delivery is achieved through ultra-low profile delivery system (catheter of only 4.66mm). The original sealing mechanism allows sealing in infrarenal necks as short as 7 mm, which makes this the only device that has been approved to treat aneurysms with aortic neck <10 mm.[1,2,3]

With respect to the Ovation device, de Donato et al. report freedom from type Ia endoleak at 98% and 96.8% for AAA aortic neck length >7 mm and <7 mm, retrospectively[5].

Because of the ultra-low profile, the Ovation system can be used in patients with iliac or femoral artery access of less than 7 mm[6].

According to medical literature up to 30% to 40% of patients are unsuitable candidates for conventional endovascular aneurysm repair, most commonly due to challenging proximal aortic neck anatomy[7]. An adequate proximal landing zone is one of the absolute requirements for successful EVAR. According to most manufacturer instructions for use (IFU), hostile anatomy is defined as the presence of one or all of the following characteristics: neck length <15 mm, diameter >28 mm, and neck angulation >60°. Other adverse morphological parameters include proximal neck circumferential thrombus or calcification (>50%) or a tapered/conical neck, wherein the diameter progressively increases between the renal arteries and the sac with a >2- to 3-mm change over the first 15 mm of proximal neck[8].

The VENT technique consists in deployment of the sealing ring of the Ovation stent graft in a range between 1 and 3 mm below the lowermost renal artery rather than 13 mm as suggested by IFU, with the proximal edge of the fabric lying above the orifice of the renal artery. Short bare-metal stent deployed simultaneously in the renal orifice and protruding few millimeters into the aorta allows renal patency preservation by moving the proximal edge of the fabric present just above the first ring (so-called collar zone)[4].

In cases of challenging infrarenal aortic necks or juxtarenal aortic aneurysm, endovascular aortic repair usually involves the use of custom-made fenestrated stent grafts, which could necessity larger arteries in diameter for access, higher cost, and several weeks between graft planning and intervention.

We decide to use Ovation endograft System in Vent/Ovation technique for some important reasons:

- the ultra-low 14F OD profile system enables smooth access to the aneurysm;
- staged deployment of suprarenal stent allows simple, precise placement;
- polymer-filled sealing ring creates a custom seal and protects the aortic neck;
- low permeability PTFE enables effective aneurysm exclusion and device patency;
- conformable, kink resistant iliac limb designed to reduce risk of occlusion;
- facilitates reliable contralateral gate access even in challenging anatomies;
- considering the special design of Ovation endoprosthesis, the three-modular graft with a suprarenal fixation by a 35-mm long nitinol stent enriched by several hooks, it's possible to maintains renal perfusion and assuring the stability of the entire device
- to prevent eventual complications in regard to the challenge encountered from the short infrarenal neck, tapered and with thrombus.

CONCLUSION

The clinical and immediate radiological success of the Ovation abdominal stent graft suggests that it is a reliable option for treatment of abdominal aortic aneurysm with challenging anatomy.

The „VENT/OVATION„ is a new technique and concept as alternative to traditional chimney EVAR to treat challenging short-neck or juxtarenal aneurysm in patients with small iliac access vessels. This consists in implantation of the Ovation stent graft with a modified

technique that includes simultaneous placement of renal baremetal stents.

Conflict of interest: none declared.

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