New Chimney after Chimney EVAR for the Treatment of Type Ia Endoleak

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Abstract

Keywords

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The chimney graft (CG) technique can be a useful alternative in treating aortic aneurysms with challenging anatomy, regarding the proximal sealing zone. We describe the case of a patient who developed a type Ia endoleak after chimney endovascular aneurysm repair for a juxtarenal AAA and underwent a proximal CG reconfiguration and implantation of an aortic cuff. The crossing configuration of the CGs should be avoided as it may compromise the circumferential apposition of the endograft and impede the thrombosis of the perigraft gutters. A proximal reconfiguration of the CGs, in case of type Ia endoleak is a useful option. The long-term efficacy of this option should be evaluated by meticulous follow-up.

The chimney graft (CG) technique can be a useful alternative in treating aortic aneurysms with challenging anatomy, regarding the proximal sealing zone.¹ Greenberg et al first described the “chimney” or “snorkel” graft technique as a bail out procedure to preserve renal arteries during endovascular aneurysm repair (EVAR) when the proximal edge of stent graft fabric protruded into the renal artery ostium.²

Several recent studies have shown promising results by electively using this technique for the treatment of pararenal and thoracoabdominal aneurysms.^{1,3} However, long-term endograft durability and proximal fixation remain significant concerns. A proximal type I endoleak, represents the Achilles heel of the technique and may require secondary interventions.⁴

We describe a case of a patient who developed a type Ia endoleak after chimney EVAR (Ch-EVAR) for a juxtarenal AAA and underwent new proximal chimneys and placement of an aortic cuff.

Case Report

A 66-year-old male patient was referred to our institution because of a symptomatic juxtarenal AAA (6.3 cm in maximal

diameter, proximal neck length 0.3 cm, and neck diameter 24 mm) (►Fig. 1a). The patient suffered from coronary artery disease (history of myocardial infarction and previous coronary artery bypass graft), moderate chronic obstructive pulmonary disease (FEV₁ 61% pred. and FVC 66% pred.), and hypothyroidism; a TIA and a transperitoneal left nephrectomy were also recorded in his medical history.

Because of the patient's comorbidities, an endovascular approach was chosen to exclude the juxtarenal AAA. The option of a branched or fenestrated endograft was declined given the emergent nature of the case. With the intention of proximal landing zone extending and preserving the blood flow in superior mesenteric artery (SMA) and right renal artery (RRA), a Ch-EVAR procedure was planned. In the operation theater, under general anesthesia, access through both common femoral arteries was gained, after surgical exposure. The SMA was subsequently accessed through a percutaneously inserted 6F sheath in the left brachial artery and the RRA through the right brachial artery. Polytetrafluoroethylene covered self-expanding nitinol stents (Fluency, C.R. Bard, Murray Hill, NJ) were deployed into the SMA (7 × 60 mm) and RRA (7 × 60 mm). We estimated the main

Fig. 1 (a) Computed tomography angiography of the symptomatic juxtarenal AAA. The patient had undergone left nephrectomy in the past. (b) A chimney endovascular aneurysm repair was performed with two chimney grafts in the SMA and RRA (note the crossing configuration of the chimney graft [CGs]). (c,d) A completion angiography showed patent SMA and RRA CGs, with no endoleak. RRA, right renal artery; SMA, superior mesenteric artery.

body diameter taking into account the formula suggested by Lachat et al.¹ The main body, a 31 mm Gore Excluder C3 (W.L. Gore & Associates, Newark, DE) was deployed 10 mm above the SMA, with 30% oversizing; the aortic diameter at this level was 24 mm.

The aortic stent graft was subsequently ballooned, whereas the covered stents in the SMA and RRA were kept inflated (►Fig. 1b). A completion aortography showed patent SMA and RRA CGs, with crossing configuration and with no endoleak (►Fig. 1c). The patient was transferred from the intensive care unit to the ward on the second postoperative day (POD), had an uneventful postoperative course and was discharged on the POD 7.

On the 1-month follow-up CT scan, a proximal type I endoleak with increased aneurysm sac diameter (6.7 cm) was revealed (►Fig. 2a). The patient was transferred to the AngioSuite, and, under local anesthesia, a reballoon attempt of the CGs and the aortic endograft, through percutaneous access of the left femoral, left axillary, and left brachial

artery, was undertaken (►Fig. 2b). An angiogram at that time confirmed the unresolved type Ia endoleak (►Fig. 2c). Thus, we decided to extend the CGs proximally, after celiac artery (CA) embolization; the distance between CA ostium and SMA ostium was 1.3 cm. After CA balloon occlusion test, with 15 mm overlap of the previously placed stents, two Fluency stents (C.R. Bard, Murray Hill, NJ) were placed in the SMA (7 × 60 mm) and RRA (7 × 60 mm) whereas a 32-mm aortic cuff (Gore Excluder, W. L. Gore & Associates) was deployed 10 mm below the proximal edge of the CGs (►Fig. 2d). A concomitant ballooning of the aortic cuff and the CGs was followed. The completion angiogram showed patent SMA and RRA CGs, without type II endoleak from the embolized CA and no type I endoleak (►Fig. 2e).

The patient presented an asymptomatic arteriovenous fistula in the left arm during the postoperative course, which remains under surveillance and was discharged at home on the seventh POD under single antiplatelet therapy. The 6-month follow-up CT scan documented patent CGs to the SMA

Fig. 2 (a) A 1-month follow-up computed tomographic scan revealed a proximal type I endoleak (arrow), (b) a reballoon attempt was undertaken, (c) the type Ia endoleak was unresolved, (d) after celiac artery embolization two Fluency stents were placed in the superior mesenteric artery (SMA) and right renal artery (RRA) whereas an aortic cuff was deployed 10mm below the proximal edge of the chimney graft [CGs]. A concomitant ballooning of the aortic cuff and the CGs was followed. (e) The completion angiogram showed patent SMA and RRA CGs, without type Ia or II endoleak.

and RRA with no evidence of endoleak (►Fig. 3). Furthermore, the color Duplex follow-up examination 12 months postoperatively confirmed the patency of the CGs, the absence of any type of endoleak and the aneurysm sac shrinkage.

Discussion

It is difficult to explain how the chimney technique really works, but in the current literature there are several recent series with encouraging results.^{1,3,4} By virtue of its geometrical design, the CG technique leads to creation of gutters between the aortic wall and the conduits (CG and aortic graft). Blood flow through these gutters, causes a type Ia endoleak.^{3,5} A proximal type I endoleak, represents the Achilles heel of the CG technique.⁶ The more CGs implanted, the higher the endoleak risk. In a recent review analysis, including 93 patients, the type I endoleak rate was 7.0% among patients who received one CG and 15.6% among patients with two CGs.³

In our case, a type Ia endoleak was observed in the 1-month follow-up CT scan. The accurate assessment of the aortic diameter as well as the diameter of the CGs is of paramount importance for precise sizing and subsequently for prevention of type Ia endoleak. Taking into account that

an adequate oversizing of 30% was performed in the first operation and also the fact that the type Ia endoleak remained unresolved after reballoon, we assumed that the crossing configuration of the CGs compromised the circumferential apposition of the endograft and impeded the thrombosis of the gutters between the crossing CGs. In addition, crossing configuration of the CGs, has been described as a major predisposing factor for type Ia endoleak after Ch-EVAR.⁴

Treatment of type Ia endoleak after Ch-EVAR is challenging. Implantation of aortic extension cuff or Palmaz stent (Cordis Corporation, a Johnson & Johnson Company, Miami, FL) or thrombosis of the gutters by coil embolization or Amplatzer Occluder device (AGA Medical Corp., Minneapolis, MN) or even by biological glue infusion have been described.⁴ Recently, endostaples have been added to our armamentarium for the treatment of type Ia endoleaks. In particular, endoanchors have been in vitro evaluated in reducing the size of gutters in Ch-EVAR with promising results.^{7,8} In the past, we successfully sealed a type Ia endoleak after chimney technique by using coil embolization and biological glue infusion.⁹ However, multiple coil embolization sessions were required which resulted in an increased cost and endograft infection.^{10,11} As there was not adequate proximal sealing zone, we decided to

Fig. 3 A 6-month follow-up computed tomographic scan documented the patent superior mesenteric artery and right renal artery with no evidence of endoleak.

reconfigure the CGs proximally, after CA embolization. To evaluate the collateral pathways before definite CA occlusion, we performed selective mesenteric angiography during balloon occlusion of the CA.¹² Thus, we successfully excluded the aneurysm by extending the CGs of the RRA and SMA and implanting proximally an aortic cuff.

Long-term endograft and CG durability remains a concern. A recent study evaluating the midterm performance of chimney stent-graft technique, and its periscope variation, in the treatment of thoracoabdominal and pararenal aneurysms showed excellent success rate, high patency rate of CGs over a 2-year mean follow-up period whereas nearly all of the aneurysms showed no increase in diameter.¹ Interestingly, 26% of primary type I/III endoleaks were present at discharge whereas only 3.9% of them were still present at follow-up. It is speculated that type Ia endoleak after Ch-EVAR is usually of low flow and thus it has benign progression. However, in a recent case series of nine patients with juxtarenal AAA treated with Ch-EVAR, two patients developed a type Ia endoleak during follow-up, resulting in aneurysm rupture and death.¹³

Conclusion

When performing a chimney technique, a crossing configuration of the CGs should be avoided as may compromise the circumferential apposition of the endograft and impede the thrombosis of the perigraft channels and gutters between the crossing CGs. A “back to back” chimney-to-chimney technique, in case of type Ia endoleak is a feasible and efficient option. The long-term efficacy of this option should be evaluated by meticulous follow-up.

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