

The use of an inner branch endograft for the treatment of failed chimney endovascular aortic repair

Avner Bar Dayan, MD, Daniel Silverberg, MD, Chen Speter, MD, and Moshe Halak, MD, Ramat Gan, Israel

ABSTRACT

The chimney endovascular aortic repair technique is an established option for the treatment of juxtarenal aortic aneurysms. Failure of this repair represents a major surgical challenge. We report the case of a patient treated previously with chimney endovascular aortic repair (for a juxtarenal aortic aneurysm), who had developed a large type IA endoleak. The patient was treated with a custom-made endograft with three inner branches. All vessels were successfully cannulated and bridged, no evidence of endoleak was seen on the completion angiogram, and the patient had an uneventful recovery. (*J Vasc Surg Cases and Innovative Techniques* 2021;7:120-2.)

Keywords: Aneurysm; BEVAR; CHEVAR; Endoleak; Inner branch; Fenestration

The chimney endovascular aortic repair (CHEVAR) technique has become an acceptable method for the treatment of complex aortic pathologies, including juxta- and pararenal abdominal aortic aneurysms, penetrating aortic ulcers, type IA endoleaks after endovascular aortic repair, and para-anastomotic aneurysms after previous open repair.¹⁻³ One of the major disadvantages of CHEVAR includes the occurrence of proximal endoleaks due to gutters or neck degeneration and chimney graft stenosis or occlusions.³ The repair of these types of complications is challenging, and, at present, no clear guidelines are available on their management. We report the case of a patient previously treated with CHEVAR who had developed a delayed type IA endoleak and sac enlargement due to aneurysmal degeneration of the proximal neck. The patient provided written informed consent for the report of his case.

CASE REPORT

A 73-year-old man had presented with a juxtarenal aortic aneurysm (JRAAA). The right renal artery was occluded, and the right kidney was atrophic. The aneurysm diameter was 71 mm. Endovascular repair with a custom-made fenestrated device was not considered an option because manufacture of such a device would have required a period of ≥ 4 weeks. Open thoracoabdominal repair was considered a very high risk option for the patient. Therefore, the patient underwent CHEVAR with parallel stents

From the Department of Vascular Surgery, Chaim Sheba Medical Center at Tel Hashomer.

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Correspondence: Avner Bar Dayan, MD, Department of Vascular Surgery, Chaim Sheba Medical Center at Tel Hashomer, Ramat Gan 5265601, Israel (e-mail: avner.bardayan@sheba.health.gov.il).

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placed in the superior mesenteric artery (SMA) and left renal artery. At 6 weeks after surgery, computed tomography angiography (CTA) was performed and showed good positioning of the stent graft and chimneys. The patient continued surveillance with duplex ultrasound scans performed every 6 months. Routine CTA at 3 years postoperatively revealed enlargement of the aneurysmal sac and a type IA endoleak originating from the aneurysm neck (Fig 1, A and B). A custom-made branched JOTEC endograft (JOTEC GmbH, Hechingen, Germany) was manufactured using the findings from the CTA with central line imaging and three-dimensional reconstruction. The planned device had a single inner branch for the celiac artery (CA) and another large common inner branch containing two smaller inner branches for the two chimneys of the SMA and left renal artery. This design was chosen owing to the close proximity of the two parallel stents to each other (Fig 2).

With the patient under general anesthesia, both common femoral arteries and the left brachial artery were exposed. The main module was introduced, followed by cannulation and stenting of the CA. The SMA and left renal chimney stents were then sequentially cannulated and stented. The gap between the inner branches (IBs) and the parallel grafts (PGs) were bridged with VBX covered stents (W. L. Gore and Associates, Flagstaff, Ariz). All visceral cannulations were performed through the left brachial artery. After stenting of the visceral vessels, a bifurcated JOTEC E-tegra stent graft (JOTEC GmbH) was placed, with extensions into the iliac limbs of the previously placed stent graft. A completion angiogram showed good positioning of the stent graft and all branches, a patent CA, SMA, and left renal artery, and total exclusion of the aneurysm sac (Fig 3, A). The total radiation time was 98.46 minutes, and the cumulative dose was 1730 mGy. CTA performed before discharge showed similar findings (Fig 3, B). The patient's course was uneventful, and he was discharged on postoperative day 4. Follow-up CTA performed at 6 months after the procedure revealed no evidence of a type I or III endoleak.

DISCUSSION

The use of parallel stent grafts in the treatment of JRAAAs and type IA endoleaks has become widely

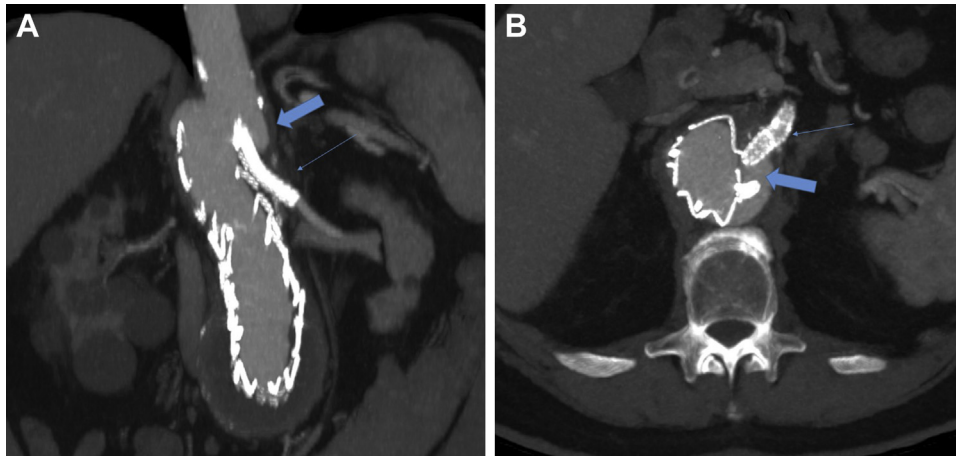


Fig 1. Preprocedural computed tomography angiography (CTA) coronal (A) and axial (B) images showing renal artery chimney stent graft (*thin arrow*) and type IA endoleak (*thick arrow*).

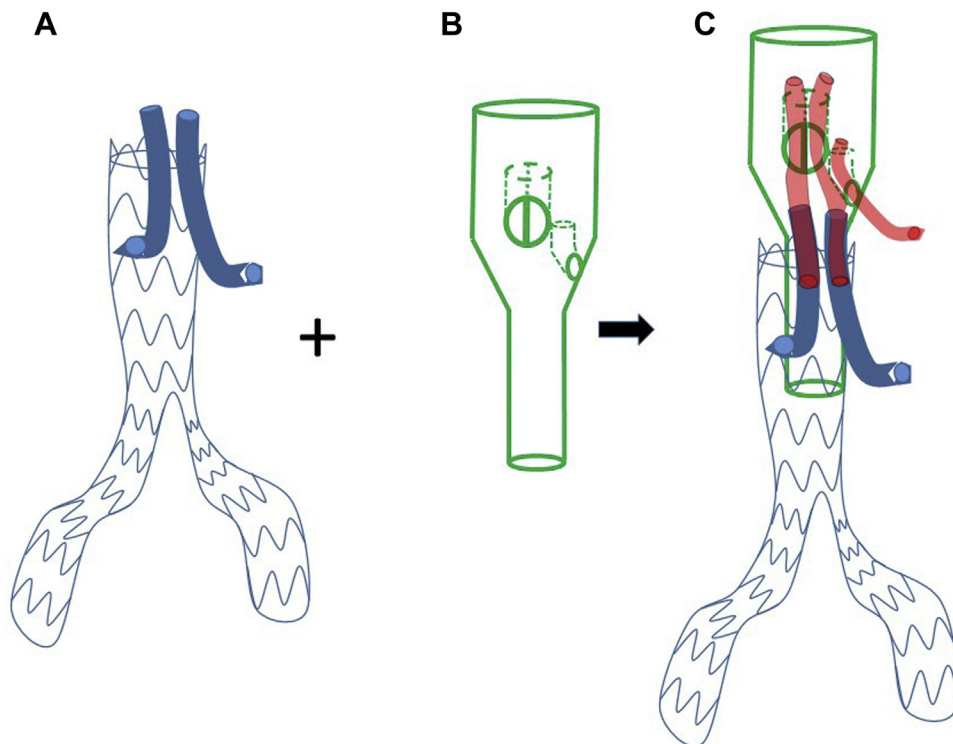


Fig 2. Illustration showing preoperative chimney endovascular aortic repair (CHEVAR) configuration (A), custom-made inner branch device configuration (B), and postoperative, final configuration of the repair (C).

accepted since its first description in 2007.^{1,4} Residual or de novo type I endoleaks occurring after CHEVAR are a challenging therapeutic problem. Endovascular repair of failed CHEVAR has been rarely described. A single report by Mylonas et al⁵ described placing extensions into the existing aortic module and into the parallel stents. Although technically feasible, adding an additional PG to the CA or SMA might be a source of a new gutter endoleak.⁶ An attempt to solve the problem with endovascular aortic sealing would have

theoretically been an option. However, because of recent studies of the limitations and problems associated with the endovascular aortic sealing technique, we preferred to avoid its use when managing such a complex aortic repair.^{7,8} The use of a custom-made fenestrated or branched device for this type of repair, to the best of our knowledge, has yet to be reported. A fenestrated device might not be applicable owing to the cephalad-pointing PGs and the challenge of cannulating them through the fenestrations. The use of custom-made

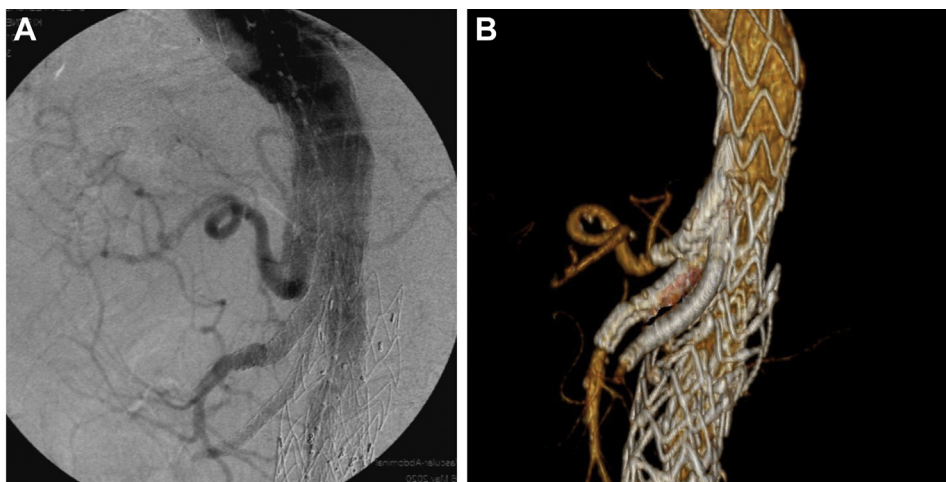


Fig 3. Intraoperative completion angiography (A) and volume-rendering three-dimensional reconstruction image (B) of the stent graft displaying a patent celiac trunk, superior mesenteric artery (SMA), and left renal artery branches with no evidence of an endoleak.

devices with outer directional branches will frequently not be an option for JRAAAs, because these will require wide aortic diameters for full deployment. We have presented a novel solution to treat a type IA endoleak that occurred after CHEVAR using a custom-made inner branch endograft. IBs in this setting offer several advantages. Because of their cephalad-pointing configuration, they can be cannulated from the arm and through them, the corresponding PG can be stented. Endografts with IBs can be used in relatively narrow aortas; thus, making them an option in anatomic situations in which the outer branches cannot be used. In general, the minimal diameter of the aorta must be ≥ 18 mm in diameter for inner branch devices, with no more than two inner branches planned at the same level. It is possible to use four inner branches at different levels based on the anatomy. Because the diameter of the inner branches will usually be no more than 7 mm, the flow within the graft lumen will not be compromised. One of the challenging aspects of this repair is the cannulation of the PG through the IB. For this to be possible, the IBs must be designed to align almost directly above the PG.

The supply time of the custom-made device used in this procedure was ~ 18 working days after approval of the plane by the surgical team. The procedure is complex and requires an experienced surgical and anesthesia team, a hybrid operating theater, and intensive care unit support for postoperative care.

CONCLUSIONS

The cases of patients with failed CHEVAR present the surgeon with a challenging situation. Realignment of the proximal aorta with a custom-made IB endograft, which allows bridging to the existing PGs, offers a new

approach. With this technique, the type IA endoleak can be successfully treated and preserve flow to the mesenteric tree.

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