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TECHNICAL NOTE ARTERIAL INTERVENTIONS

Endovascular Neck Stabilization Before EVAR for Infrarenal Aortic Aneurysm in Chronic Aortic Dissection

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Abstract

Background Endovascular treatment of infrarenal abdominal aortic aneurysm (AAA) with proximal chronic aortic dissection is challenging as a false and true lumen at the level of the infra-renal neck does not allow a sufficient landing zone. We describe staged endovascular neck stabilization prior to standard endovascular aortic repair (EVAR) for AAA with chronic aortic dissection.

Technique To create a stable proximal neck (PN) by closing entry tears, thereby resulting in total false lumen thrombosis (FLT) prior to standard EVAR. Case 1 false lumen fenestrations were present at the descending aorta, the right renal artery orifice and PN. After closing the entry tear by thoracic EVAR, an aortic cuff was placed in the true lumen of the PN and renal stenting for the right renal artery was performed. After 2 months, total FLT was achieved, and EVAR was performed. Case 2 false lumen fenestrations were present at the descending, super celiac aorta and PN. After closing the entry by TEVAR, aortic cuffs were placed at infrarenal aorta to close residual entries. After 1 month of achieving total FLT, EVAR was performed. Both cases had no type 1 endoleak during follow-up.

Conclusion The endovascular neck stabilization is a useful treatment option that facilitates standard EVAR for AAA in chronic aortic dissection.

Keywords Endovascular · Neck stabilization · Abdominal aortic aneurysm · EVAR · Chronic aortic dissection

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Introduction

Infrarenal abdominal aortic aneurysm (AAA) in the setting of chronic aortic dissection is a challenging situation, and it is not generally considered an anatomically suitable candidate for standard endovascular aortic repair (EVAR) as dual lumen flow within the proximal neck (PN) of AAA prevents adequate endograft fixation [1].

Open surgery has traditionally been a gold standard treatment, but it carries relatively high mortality or morbidity in these complex cases.

Previous endovascular techniques (percutaneous septectomy) for creating PN have been described to facilitate standard EVAR [1–3]. However, these techniques have potential risks of neck dilatation or branch vessel obstruction caused by a collapse of the divided flap.

We present an 'endovascular neck stabilization' as another endovascular treatment option for AAA with a PN dissection.

Technique

The technique is to achieve total false lumen thrombosis (FLT) before EVAR (Fig. 1).

First, all entries are closed by a combination of stent-graft placement, branch stenting and/or embolization (stage 1). After achieving total FLT on follow-up CT, standard EVAR is performed (stage 2). This technique is demonstrated in two patients. Both were thought to be high risk for open surgery after consultation with cardiovascular surgeons. All procedures were performed in the hybrid operating room using an Infinix Celeve^{TM}-i (Toshiba Medical, Tochigi, Japan) under general anesthesia. Because all devices used were approved for endovascular treatment, the approval of the ethics committee was waived for this procedure. Written informed consent was obtained from all patients.

Case 1 A man in his 60 s had a history of medically treated acute type B aortic dissection 5 months ago (Fig. 2A). He also had a colon cancer that needed open surgery. Preoperative CT demonstrated an AAA (55 mm) and a right common iliac artery aneurysm (32 mm) with an extension of the dissection septum into the PN of AAA (Fig. 2B). As the dissection extended to the PN of AAA with three false lumen entry tears at the descending aorta (Fig. 2C), the right renal artery (Fig. 2D) and the PN (Fig. 2E). The right renal artery had a shared origin from both the true and the false lumens, and other visceral branches were originated from the true lumen. We planned endovascular neck stabilization by thoracic EVAR and aortic cuff placement (Excluder cuff, W.L. Gore & Associates, Inc., Flagstaff, Arizona) in the PN in order to achieve total FLT prior to EVAR (Fig. 2A) and open surgery for colon cancer after AAA repair.

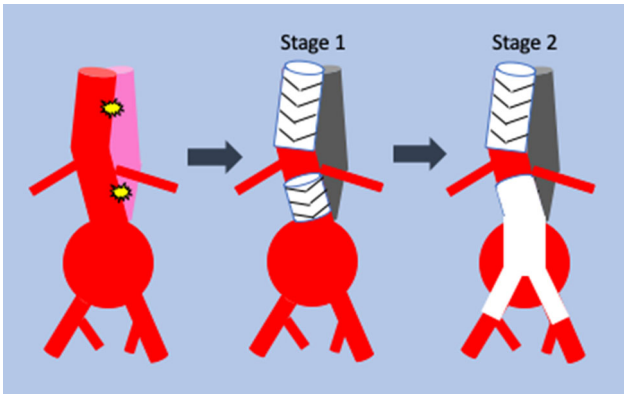

Fig. 1 Schematic of endovascular neck stabilization prior to infrarenal EVAR. To create a stable proximal neck suitable for infrarenal EVAR by closing all entries using aortic endografts, branch stenting and/or embolization, thereby resulting in total false lumen thrombosis (FLT) (stage 1). Standard EVAR is then performed after achieving total FLT (stage 2). The size of stent graft which is placed into the true lumen is nearly equal to flap length

A tapered 26–21 mm × 10 cm Gore C-TAG was deployed in the descending aorta via the right femoral artery followed by a 23-mm cuff in the PN of AAA. A 7 × 29 mm balloon-expandable stent (Omnilink, Abbott, Abbott Park, Illinois) was then placed in the right renal artery. Completion angiography showed mild flow into false lumen though the entry at the right renal artery (Fig. 2F). Operation time and radiation time were 2 h 30 min and 47 min, respectively. We achieved near-total FLT on follow-up CT 2 months later.

We then performed EVAR using AFX devices (25 × 75 mm aortic cuff and 25 × (80 + 40) × 16 mm, Endologix, Irvine, CA) at a second setting and performed an iliac extension with internal iliac artery embolization on the right side without endoleaks (Fig. 2G). Operation time and radiation time were 2 h and 36 min, respectively.

CT angiography after 14 months showed no type 1 or 3 endoleaks with total FLT (Fig. 2H–J).

Case 2 A woman in her 70 s had a history of a type A aortic dissection repair 12 years prior (Fig. 3A). She developed an AAA (50 mm) with CT demonstrating an extension of the residual dissection septum into the PN of AAA (Fig. 3B). There were four entries located at the descending aorta (Fig. 3C), level of the celiac trunk (Fig. 3D), superior mesenteric artery (SMA, Fig. 3E) and the PN of AAA (Fig. 3F). Celiac trunk perfusion originated from both the true and false lumens, and other visceral branches were originated from the true lumen.

Endovascular neck stabilization was planned prior to EVAR (Fig. 3A). Regarding the entry at the level of SMA, aortic cuffs were placed into the false lumen to cover the entry in order to maintain SMA flow. First, two pieces of 23-mm Ex-cuff were deployed in the false lumen at the level of SMA though the entry at the PN via the left femoral artery. Second, a 28 × 100 mm thoracic endograft (Valiant Captivia Medtronic, Santa Rosa, CA) was deployed just above the SMA with celiac trunk occlusion using a 16-mm Amplatzer Vascular Plug 2 (St. Jude Medical, St. Paul, Minnesota), followed by a 32 × 28 × 150 mm thoracic endograft (Valiant Captivia) deployment proximally into the true lumen. A 23-mm aortic cuff was then deployed in the PN of AAA. A 25 × 75 mm modified aortic cuff (AFX) was also placed between the thoracic graft and the aortic cuffs in the false lumen to prevent true lumen narrowing due to the aortic cuff in the false lumen.

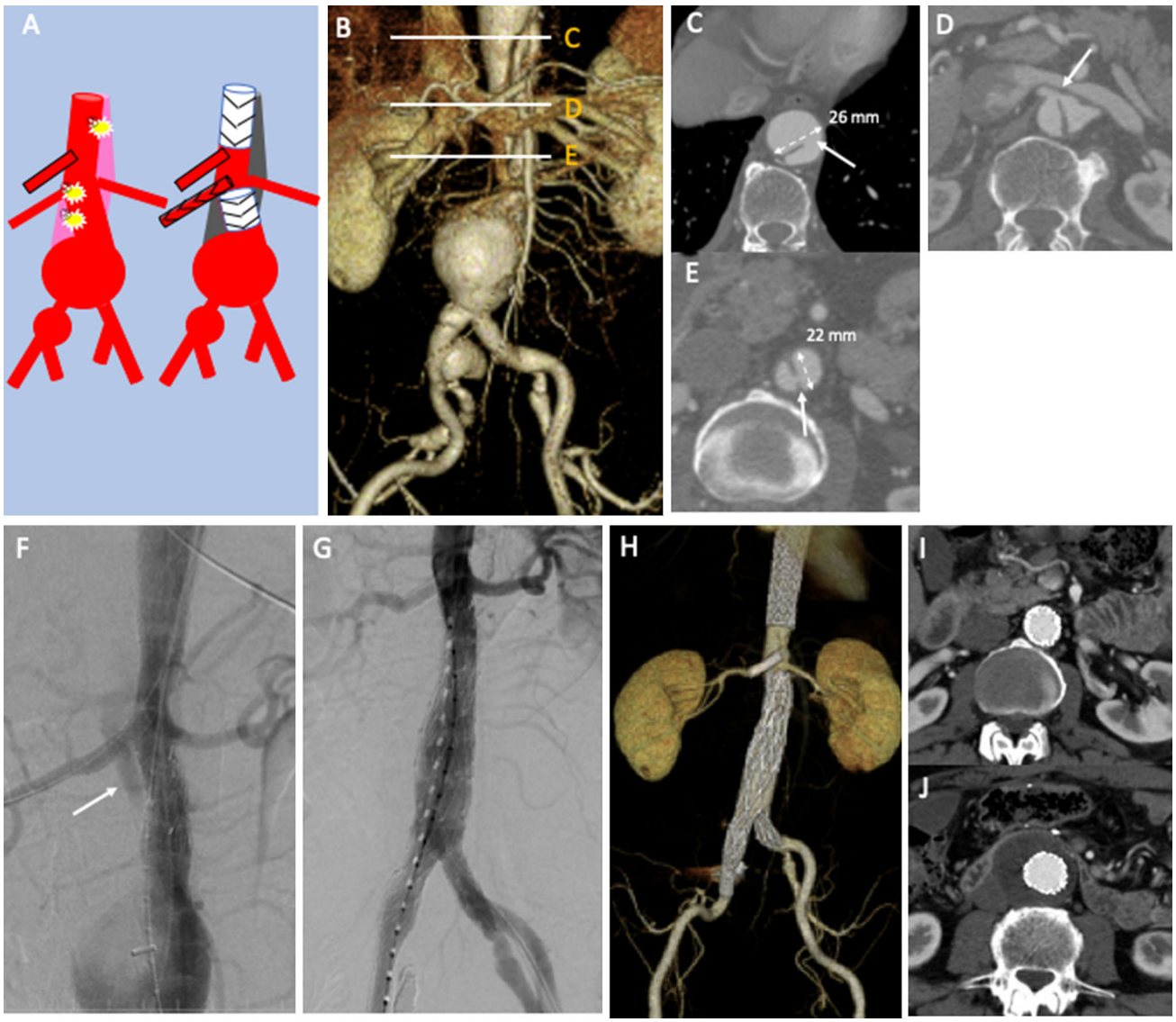

Fig. 2 Case 1: 60-year-old man with infrarenal AAA and right common iliac artery aneurysm due to type B aortic dissection. Schema of the planning of endovascular neck stabilization in this patient (**A**). There are three entry tears in the descending aorta, the right renal artery orifice and PN of the AAA. To close these entries, the thoracic stent graft is deployed in the descending aorta and aortic cuff in the PN. A bare stent is also placed in the right renal artery. Preoperative volume rendering shows the dissection flap extends to the PN of AAA (**B**). Contrast-enhanced CT axial images on early phase show entries at the descending aorta (**C**; arrow), the right renal artery orifice (**D**; arrow) and the PN (**E**; arrow). Completion angiography demonstrates mild residual flow into the false lumen through the entry at the right renal artery (**F**; arrow) which resolved on follow-up CT imaging. Standard EVAR using AFX device and Excluder iliac extension is performed without any complications after 2 months (**G**). CT angiography after 14 months shows well AAA exclusion without type 1 or 3 endoleaks (**H**–**J**)

Completion DSA showed no flow into the false lumen, and the procedure was completed without any complications (Fig. 3G). Operation time and radiation time were 4 h and 86 min, respectively.

A two-week postoperative CT revealed total FLT, and EVAR was performed one week later using a three-piece EVAR (C3 Excluder, Gore) (Fig. 3H). Operation time and radiation time were 2 h 25 min, and 34 min, respectively. CT angiography after 17 months showed no type 1 or 3 endoleaks with total FLT (Fig. 3I–K).

Discussion

These cases demonstrate that endovascular neck stabilization is a useful treatment option that facilitates standard EVAR for AAA in chronic aortic dissection.

This technique also would work for the situation in which the dissection extends in the aneurysmal sac or iliac artery if total FLT can be achieved using a combination of stent-graft placement, branch stenting and/or embolization.

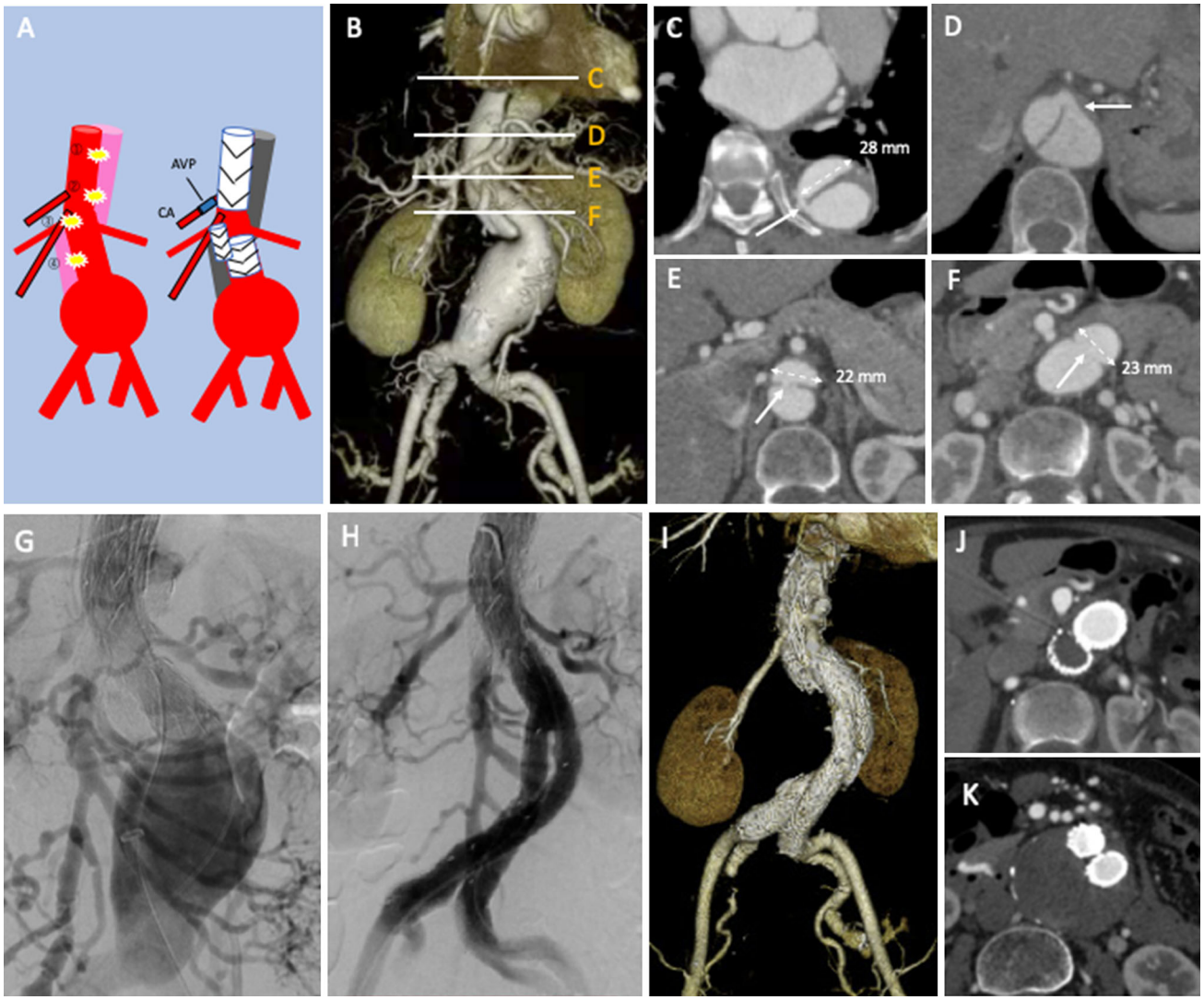

Fig. 3 Case 2: 70-year-old woman with infrarenal AAA after type A aortic dissection repair 12 years prior. Schema of the planning of endovascular neck stabilization in this patient (**A**). There are four entries at the descending aorta, abdominal aorta at the level of celiac trunk, SMA and PN of the AAA. To close these entries, the stent graft is deployed in the descending aorta with celiac trunk embolization and aortic cuffs in the PN and the false lumen at the level of SMA. Preoperative volume rendering shows the dissection flap extending to the PN of AAA (**B**). Contrast-enhanced CT axial images on early phase show entries at the descending aorta (**C**; arrow), at the level of celiac trunk (**D**; arrow), SMA (**E**; arrow) and the PN (**F**; arrow). Completion angiography demonstrates no flow into the false lumen (**G**). Standard EVAR is performed without any complications after 3 weeks (**H**). CT angiography after 14 months shows well AAA exclusion without type 1 or 3 endoleaks (**I**–**K**)

Standard EVAR for AAA with PN dissection is problematic as the dual lumen prevents adequate endograft fixation or potential risk of stent-graft-induced new entry [4, 5].

Percutaneous septectomy can create a suitable PN, and some studies [1–3] demonstrated the clinical utility of those techniques with successful well sealing and aneurysm exclusion, even in a patient with a contained aneurysm rupture [6]. However, the resultant lumens created by those techniques often have a large diameter because they are comprised of the combination of the true and false lumens. In fact, Gissler et al. [3] experienced total four patients who underwent percutaneous septectomy, and there were 35-mm Excluder devices in three patients and 45-mm C-TAG in one. Ullery et al. [2] also described a case with 35-mm Excluder device. Recently, several studies found that a large PN has an increased risk of secondary PN dilatation resulted in late type 1a endoleak [7–10]. A thin aortic wall also may affect the cause of neck dilation in a long term. Other possible concern of those techniques is visceral branch vessel occlusion by a segment of the divided flap that prolapses over a branch origin as Gissler et al. [3] described one patient with occlusion of the renal artery after the procedure. Fenestrated EVAR may also be

a treatment option. However, chronic aortic dissection often has narrowing true lumen in the abdomen that makes fenestrated EVAR difficult. Furthermore, fenestrated EVAR can close re-entries but leaves the primary entry that can cause false lumen growth.

This present technique may solve these issues, but it has several limitations.

First, this technique requires two procedures with high cost, whereas percutaneous septectomy allows treatment in a single stage.

One patient had bare stenting for closing the right renal ostium re-entry since any covered stents had not been approved in Japan at that time. Although it achieved total FLT in 1 month, we recommend the use of covered stent if available. We should not use this technique if it is technically difficult to close all entries.

When placing the stent graft in the false lumen such as case 2, a large bare stent should be positioned parallel in the true lumen in order to prevent true lumen narrowing.

Covered stent placement should be performed when major visceral branches arise from the false lumen because total FLT causes branch vessel obstruction. Furthermore, stent-graft-induced new entry is still a possibility even after total FLT. We decided that the size of the stent graft in the PN is nearly equal to flap length in order to prevent excessive oversizing, but issues regarding appropriate sizing needs to be studied further. Consequently, even though initial results have no obvious adverse events, the long-term durability of this technique is unknown.

Conclusion

The endovascular neck stabilization is a useful treatment option that facilitates standard EVAR for AAA in chronic aortic dissection.

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Compliance with Ethical Standards

Conflict of interest There are no conflicts of interest that could influence this study.

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