

➤ **Case Report** ◀

# Stent-Graft Relining by Combined Aortic Cuff with Double-D Technique for Type IIIb or V Endoleak after Endovascular Aneurysm Repair: A Case Report

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We report the case of a 83-year-old man with aneurysmal sac enlargement after endovascular aneurysm repair for an abdominal aortic aneurysm, despite no overt endoleak (EL) detected on imaging. Occult type II EL was suspected, and treatment was performed. However, the aneurysm continued to enlarge. Thus, we diagnose with type V EL as exclusion diagnosis. We combined an aortic cuff and stent-graft leg to cover the initially inserted stent graft, as a diagnostic treatment for unrefined type IIIb EL. Subsequently, the aneurysm diameter decreased. This technique and concept may be effective for type V EL, which may include another type occult EL.

**Keywords:** type V endoleak, endotension, overhaul concept

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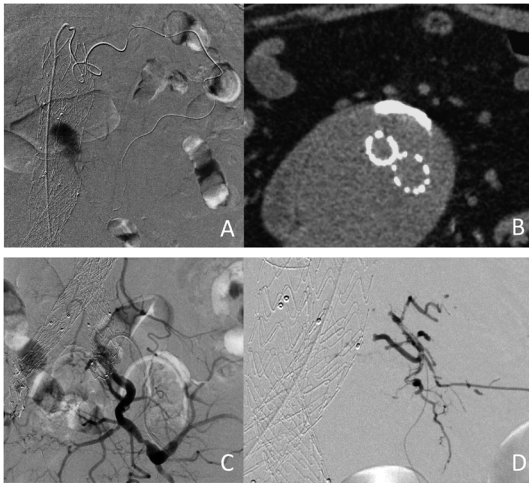
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## Introduction

Type V endoleak (EL), also referred to as endotension, is a type of EL that occurs after endovascular aneurysm repair (EVAR) for abdominal aortic aneurysm (AAA). It is defined as the aneurysm diameter enlargement by persistent pressure for an aneurysm sac despite no overt EL indicated on imaging. The rupture risk of type V EL is low compared with types I and III. However, type V EL is suspected to include occult type I/III EL, which is not able to be detected because of a slight leak, and type V EL is considered an exclusion diagnosis when other types of EL are denied. In type V EL, the proximal or peripheral side sealing zone decreasing as the aneurysm diameter enlarges can lead to type I/III EL. Thus, type V EL with observed aneurysm diameter enlargement is frequently indicated for treatment. Vascular prosthetic implantation performed by laparotomy or direct puncture aspiration of the aortic aneurysm sac is generally selected as the treatment for type V EL. However, because direct puncture exhibits a high relapse rate<sup>1)</sup> and laparotomy for EL exhibits a high mortality rate during the perioperative period (20%–30%),<sup>2)</sup> the number of cases wherein vascular prosthetic implantation is actually possible is limited. The present report describes a case which was treated by stent-graft relining for the aneurysm diameter enlargement despite EL not being detected by any imaging after EVAR.

## Case Report

The patient was an 83-year-old man with a surgical history of aortic valve replacement and coronary artery bypass surgery who had been taking anticoagulants (apixaban) and beta-blockers (bisoprolol) since said surgery. He was diagnosed with oropharyngeal cancer at another medical facility, and computed tomography (CT) was performed



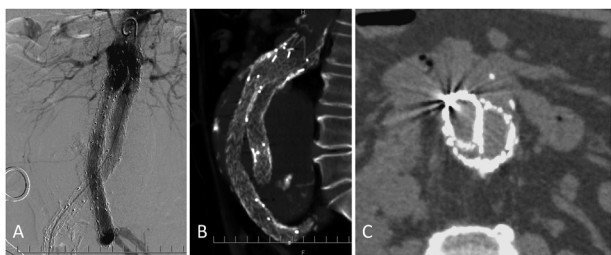
**Fig. 1** (A) Type II endoleak was suspected from the inferior mesenteric artery (IMA). Thus, cannulation was performed in the IMA via the superior mesenteric artery and embolization was conducted using a metal coil and n-butyl-2-cyanoacrylate (NBCA) diluted 4-fold with lipiodol. (B) Lipiodol deposition was observed along the arterial wall from the IMA on computed tomography after IMA embolization. (C) In addition, when contrast-enhanced imaging was performed on the left third lumbar artery via the lateral sacral artery from the left internal iliac artery, the vasa vasorum was depicted along the arterial wall. (D) Embolization was performed on the same site using NBCA diluted 4-fold with lipiodol.



**Fig. 2** Direct fine-needle aspiration was performed on the aneurysm from the back, with the body in the prone position, and 320 mL of a dark-red and serous liquid was aspirated. The aneurysm shrunk from 96 mm before the procedure to 76 mm immediately after.

for further generalized testing, which indicated an AAA (76 mm) and right internal iliac aneurysm (IIA); EVAR (Endurant II<sup>®</sup>, Medtronic Inc., Santa Rosa, CA, USA) and right IIA coil embolization were performed in the same year. The operation was completed with aortography showing no EL immediately after the procedure. On the follow-up CT, the aneurysm diameter enlarged, but no overt EL was indicated on repeat examination and testing with ultrasound, contrast-enhanced CT, and aortography.

Four years after EVAR, the aneurysm diameter enlarged to 100×94 mm. Type II EL was suspected, and treatment intervention was planned. Embolization was performed on the root of the inferior mesenteric artery via the superior mesenteric artery using a metal coil and n-butyl-2-cyanoacrylate (NBCA) diluted 4-fold with lipiodol. In addition, 4-fold-diluted NBCA was similarly used to perform embolization of the vasa vasorum, imaged from the lumbar artery via the lateral sacral artery (Fig. 1). However, the aneurysm diameter increased further after these treatments. Magnetic resonance imaging showed uniform high-signal intensity inside the aneurysm on both T1- and T2-weighted images. Thus, the contents of the aneurysm were judged to be hematoma, and direct fine-needle aspiration was performed 5 years after EVAR. A total of 320 mL of dark-red and serous liquid was aspirated from inside the aneurysm (Fig. 2); the main blood component of the aspirated liquid was red blood cells. In addition, a pigtail catheter was inserted inside the aneurysm, and contrast-enhanced imaging was performed. However, the blood vessels that branched from the aneurysm were not shown on the images. The aneurysm diameter decreased temporarily as a result of fine-needle aspiration, but 8 months later, it increased again to its previous size. The likelihood of type II EL was considered to be low, considering the course of treatment up to this time. Also, because the contents of the aneurysm were uniform blood components, perigraft seroma was ruled out. Type Ia or III EL was believed to be possible, a shepherd-hook-type catheter was hooked onto the top edge of the central side of the stent graft, and aortography was repeated around the entire area. However, the images showed no EL, and type Ia was ruled out. Next, contrast-enhanced imaging was performed on the joining part from inside the legs, but it also showed no EL, and type IIIa was ruled out. Without being able to completely rule out type IIIb, an aortic cuff and stent-graft leg (GORE<sup>®</sup> Excluder<sup>®</sup>, W. L. Gore & Associates, Flagstaff, AZ, USA) were combined as a diagnostic treatment, and the stent graft that was initially inserted was covered around its entire circumference (Fig. 3). In a subsequent follow-up, a slight decrease in the aneurysm diameter was found.



**Fig. 3** (A)(B) The GORE® Excluder® cuff (W. L. Gore & Associates, Flagstaff, AZ, USA) was placed in alignment with the center of the stent graft during the initial endovascular aneurysm repair (EVAR). Later, the Excluder® leg (16×20 mm/13.5 cm) was inverted, and the legs were expanded in parallel inside the aortic cuff to align with the top edge of the stent graft. This made it possible to cover the entire circumference of the stent graft that was placed during the initial EVAR. (C) The right and left legs inside the aortic cuff were aligned in a back-to-back D shape, referred to as a double-D technique.

## Discussion

In the present case, therapeutic intervention for type II EL was ineffective, and overt EL was not indicated on imaging. Therefore, this case's EL was believed to be type V. However, the fact that stent-graft relining was successful suggests the presence of occult type IIIb EL that was intermittent or of a trace amount so small that it could not be seen on imaging. Type III EL is classified into IIIa (EL from the joining part of the stent graft) and IIIb (EL due to damage to the stent-graft fabric). Type IIIb EL is normally undetectable on CT angiography or aortography and first becomes diagnosable by contrast-enhanced imaging with a direct microcatheter inserted into the fabric tear. Therefore, the diagnosis itself is difficult. The most common type of EL accompanied by aneurysm diameter enlargement is considered to be type II, comprising 10% to 44%.<sup>3)</sup> However, because type II EL is not involved in aneurysm diameter enlargement or vital prognosis, some reports state that therapeutic intervention is not required.<sup>4)</sup> Behind this debate is the fact that, in many cases, including ours, EL is diagnosed by contrast-enhanced CT. Therefore, branches from the aneurysm, such as the depicted inferior mesenteric artery or lumbar artery, might be overestimated to be type II.

At our facility, when diagnosing post-EVAR EL accompanied by aneurysm diameter enlargement, we thoroughly reassess imaging findings from immediately after the initial EVAR and from follow-up examinations, and we focus on sites that changed even slightly as well as sites where new findings appeared. Occult type I/III EL that is undetectable on contrast-enhanced CT or plain aortography can be diagnosed by inserting a catheter at the sites with those findings (e.g., the top edge of the stent graft

or the joining part) and proactively looking for EL. We propose this as an “overhaul concept,” the basic concept in determining EL diagnosis and treatment strategy. In the present case, type II EL was our first treatment target, but the aneurysm diameter continued to enlarge even after treatment. Therefore, based on the overhaul concept, a catheter was inserted into the gap between the top edge of the stent graft, and a microcatheter was used for searching. Thus, the possibility of type I/III was thoroughly reassessed. Despite finding no fabric tear (a cause of type IIIb EL), delayed occurrence of type IIIb EL has been reported in the leg branch region of the main body<sup>5,6)</sup> of branching stent grafts, such as the Endurant II® and Zenith Flex® (Cook Inc., Indianapolis, IN, USA), which we used in the initial EVAR in our case. Therefore, the possibility of occult type IIIb could not be ruled out.

An effective treatment for type IIIb EL is to reinsert a stent graft and cover the entire circumference of the initial stent graft.<sup>7)</sup> The Nellix<sup>8)</sup> and Altura,<sup>9)</sup> frequently used in other countries, are unable for use in Japan. If the stent graft used in the initial EVAR were something other than the unibody stent graft, it would not be anatomically compatible with the company-made branching stent graft presently usable in Japan. Therefore, we proposed a double-D technique (DDT) in which an aortic cuff is placed on the central side and the stent-graft leg is expanded in parallel so that the right and left legs form a back-to-back D-shape on the inside.<sup>10)</sup> The DDT can be used to cover the full circumference of the preexisting stent graft, even if it is anatomically incompatible with the company-made branching stent grafts usable in Japan.

## Conclusion

Type V EL includes perigraft seroma and occult type I to III EL, in which EL exists intermittently or at a very trace amount. Therefore, when contemplating treatment strategies for type V EL, considering the limits of imaging (such as contrast-enhanced CT) in EL diagnosis and reassessing the diagnosis based on the “overhaul concept” is necessary. Relining of a stent graft to cover the entire circumference of the preexisting stent graft, as we did in our case, is suggested to likely be an effective option for type V EL treatment. If that is the case, the DDT is useful in Japan.

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## Disclosure Statement

All authors declare that they have no conflicts of interest.

## Author Contributions

Study conception: HN, TM

Writing of the manuscript: TM

Critical review and revision: all authors

Final approval of the manuscript: all authors

Accountability for all aspects of the work: all authors

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