The diagnostic and treatment challenge of type IIIb endoleaks

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Type IIIb endoleak is a rare complication of endovascular aortic repair caused by endoprosthesis deterioration, leading to aneurysm pressurization and potential rupture. Because of its rarity, few cases are published. We report six cases of type IIIb endoleak in a 15-year period. Appropriate preoperative diagnosis was achieved in five cases; duplex ultrasonography, computed tomography angiography, and contrast-enhanced ultrasonography were useful diagnostic tools in one case, and angiography led to the correct diagnosis in four cases. In the remaining case, only surgical exploration identified the type IIIb endoleak. Successful treatment was achieved by endovascular relining in five cases and by surgical conversion in one case. (J Vasc Surg Cases 2015;1:249-53.)

Late type IIIb endoleaks are due to structural failure of the endoprosthesis after endovascular aortic aneurysm repair (EVAR).[1] Although they are exceedingly rare, their identification is crucial because of aneurysm growth and the risk of rupture determined by direct sac pressurization.[2] In a literature search, only 15 cases have been identified so far; therefore, there is no standardized approach for diagnosis and treatment.[3] Type IIIb endoleak can also be associated with other types of endoleaks, leading to further difficulties in diagnosis and treatment choice.

The aim of our work was to report a case series of type IIIb endoleaks identified and treated in the same institution. Each patient has consented to the publication of his data.

CASE REPORT

Patient 1. A 70-year-old man was treated (in another institution) with Vanguard (Boston Scientific, Oakland, NJ) in 1998. During follow-up, he maintained a stable aneurysm sac (60 mm); after 8 years, a new endoleak was identified by duplex ultrasound (DUS) at annual control, with a sac increase of 8 mm. The endoleak was detected between the endoprosthesis and the sac wall, with no communication with the proximal or distal landing zone. Computed tomography angiography (CTA) and contrast-enhanced ultrasonography (CEUS) were also performed, but a secure endoleak diagnosis was not achieved. Diagnosis was made by digital subtraction angiography (DSA), identifying double type IIIb endoleaks from both iliac legs. A relining procedure was performed with two Anaconda (Vascutek, Glasgow, United Kingdom) iliac legs. The procedure was completed without complication, and exclusion of the endoleaks was confirmed at intraoperative DSA and at postoperative and 1-year CTA (Fig 1).

Patient 2. A 70-year-old man was treated with Vanguard (Boston Scientific) in 1999. During follow-up, the aneurysm sac shrunk from 65 mm to 38 mm. The DUS control after 9 years identified a new high-flow endoleak and a sac expansion of 9 mm. The endoleak type was not categorized by CTA and CEUS; only DSA revealed a type IIIb endoleak from the left iliac leg. Subsequently, one Anaconda (Vascutek) iliac leg was implanted. The procedure was completed without complication, and exclusion of the endoleaks was confirmed at intraoperative DSA and at postoperative and 1-year CTA.

Patient 3. A 71-year-old man was treated with Anaconda (Vascutek) in 2005 for a 60-mm abdominal aortic aneurysm (AAA). The AAA remained stable in diameter with no endoleaks for 8 years; after that, a new high-flow endoleak was detected at DUS annual control with a sac growth of 11 mm. The endoleak type was not categorized by CTA and CEUS; only DSA revealed a type IIIb endoleak from the main body (Fig 1, *C* and *D*). Subsequently, a Cook (Cook Medical, Bloomington, Ind) proximal cuff was implanted. The procedure was completed without complication, and exclusion of the endoleaks was confirmed at intraoperative DSA and at postoperative and 1-year CTA (Fig 1).

Patient 4. A 67-year-old man was treated for an AAA of 55 mm with an Anaconda (Vascutek) stent graft in 2007. After 7 years of DUS follow-up, he presented with a new endoleak in the distal portion of the right iliac limb with an increase in diameter of both common iliac arteries from 20 mm to 40 mm. A type Ib endoleak from the right iliac limb was suspected after CTA. To resolve the type Ib endoleak and to cover the left common iliac artery more (considering the growth of the iliac aneurysm), an extension in both the iliac arteries was planned with two Gore Excluder (W. L. Gore & Associates, Flagstaff, Ariz) limbs. During the procedure, retrograde DSA from the right femoral access failed to identify a type Ib endoleak, showing instead a type IIIb endoleak from the right iliac limb. The procedure was performed as planned, however, with deployment of the two iliac limbs and resolution of the endoleak, as confirmed by DUS and CTA postoperative control.

Patient 5. A 79-year-old man who was treated (in another institution) in 2009 for an AAA of 55 mm with a Talent

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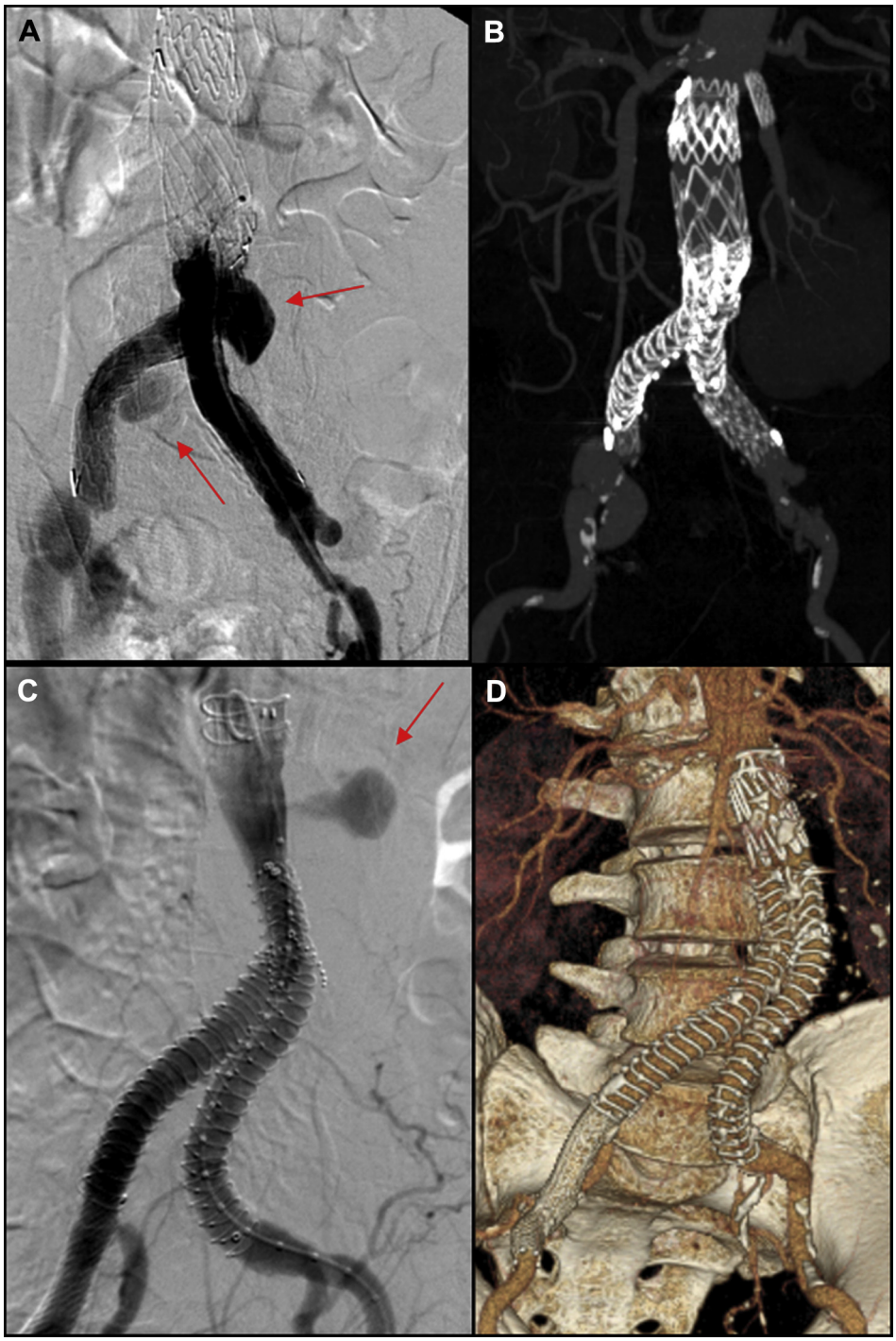

Fig 1. Patient 1 **(A** and **B)** and patient 3 **(C** and **D)**. **A,** Preoperative digital subtraction angiography (DSA) of a type IIIb endoleak from both iliac limbs (*arrows*). **B,** Postoperative computed tomography angiography (CTA) reconstruction after treatment with two iliac limbs. **C,** Preoperative DSA of a type IIIb endoleak from the main body (*arrow*). **D,** Postoperative CTA reconstruction after treatment with a proximal cuff.

(Medtronic, Minneapolis, Minn) endoprosthesis and embolization of the left hypogastric artery, landing the left iliac limb in the external iliac artery, was discharged with a type II endoleak. The aneurysm sac slowly grew in the first 3 years after the procedure from 55 mm to 62 mm in diameter. At 4-year follow-up, the diameter increased to 70 mm, and CTA and DUS were performed. The type II endoleak was confirmed, and a possible type Ib endoleak from the right iliac limb was suspected. During

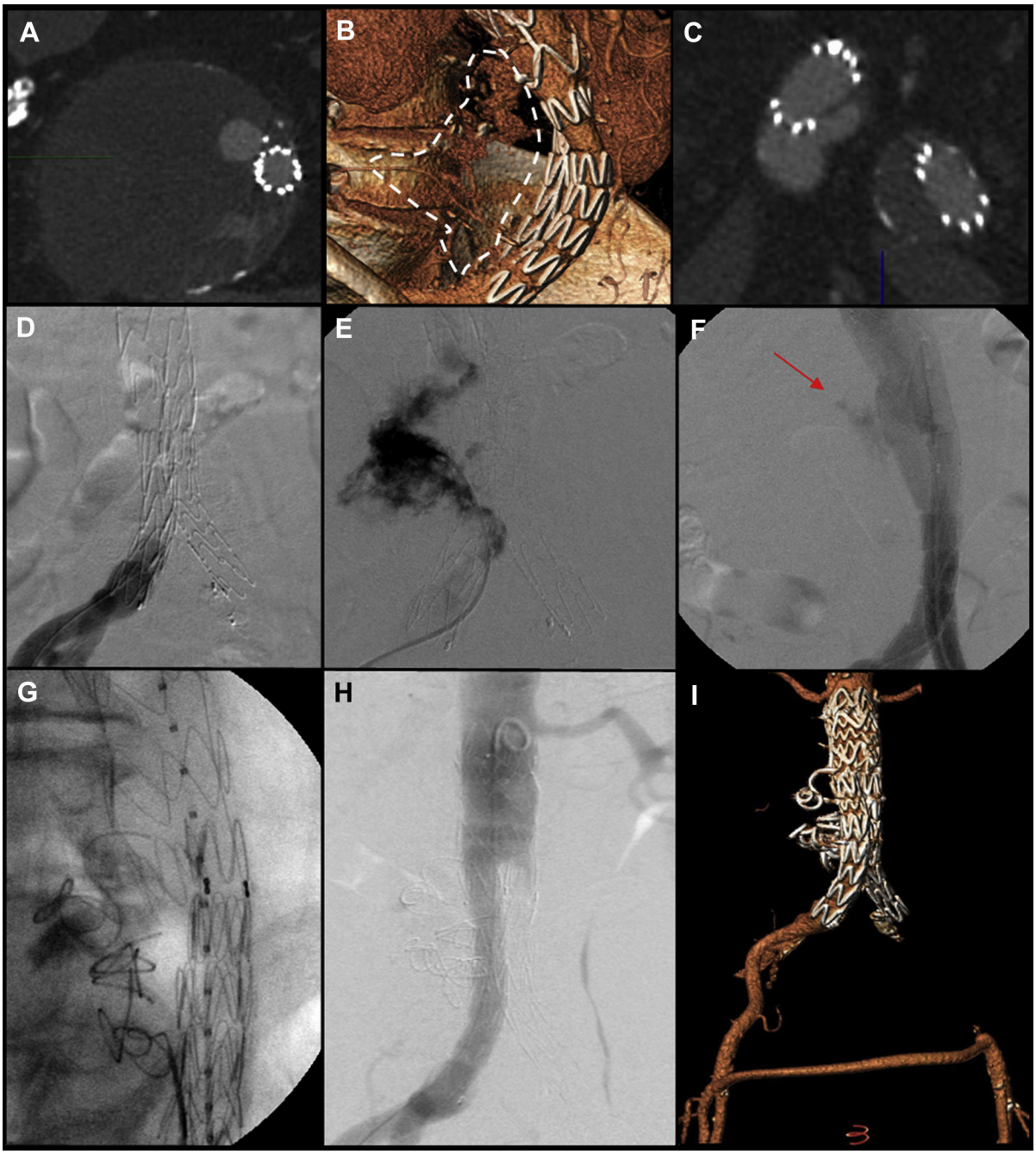

Fig 2. Patient 5. Preoperative computed tomography **(A)** and volume rendering reconstruction of the endoleak (**B,** *dotted line*) with the identification of type II endoleak. The incomplete sealing of the right iliac limb led to an incorrect diagnosis of type Ib endoleak **(C)**. **D**-**F,** Intraoperative angiography with exclusion of the type Ib endoleak from the right iliac limb **(D)**, angiography of the "nidus" through cross-limb catheterization **(E)**, and identification of the type IIIb endoleak (**F,** *arrow*). **G** and **H,** Intraoperative angiography of trans-limb sac embolization **(G)** and deployment of aortouni-iliac endoprosthesis with the exclusion of the type IIIb endoleak. **I,** Postoperative volume rendering reconstruction of the aortouni-iliac endoprosthesis and femoral-femoral crossover showing the resolution of the endoleaks.

intraoperative DSA, the presence of type Ib endoleak was excluded, and a type IIIb endoleak from the endograft body was identified. The aortic sac was therefore embolized with a trans-right-limb approach (five MReye-Cook coils, Cook Medical) to treat the type II endoleak, and an aortouni-iliac endoprosthesis (Medtronic Endurant) was placed to exclude the type IIIb endoleak. The procedure was completed with femoral-femoral crossover and occlusion of the left external iliac artery. Intraoperative

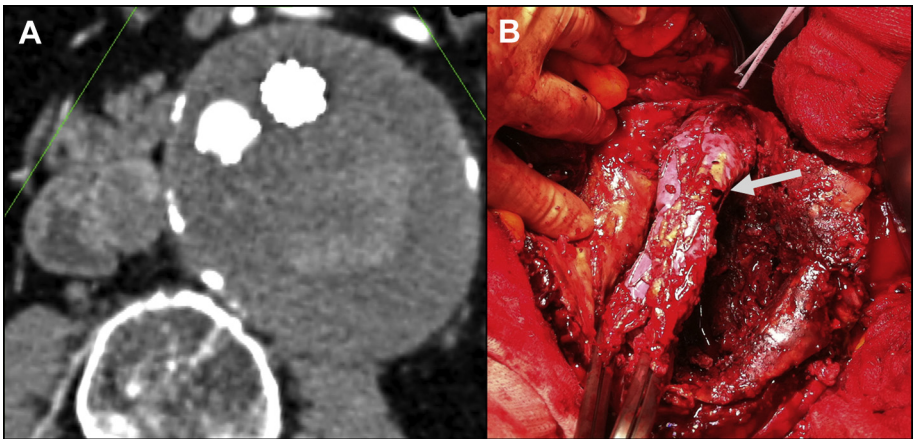

Fig 3. Patient 6. **A,** Preoperative computed tomography angiography (CTA) with possible type II endoleak. **B,** Intraoperative identification of an endograft tear (*arrow*).

DSA and postoperative CTA and CEUS confirmed the resolution of the endoleaks (Fig 2).

Patient 6. A 77-year-old man was treated in 2006 for a 60-mm infrarenal AAA with a Talent (Medtronic) endoprosthesis. The aneurysm sac remained stable for 5 years. In 2011, DUS examination identified a 5-mm increase in the aneurysm sac, with possible late type II endoleak. After 6 months (in 2012), CTA and CEUS showed further 10-mm-diameter increase, with maximum diameter now reaching 75 mm. The patient was scheduled for sacculotomy and surgical lumbar artery ligation; however, a contained rupture occurred in the preoperative period. The patient underwent emergency surgical treatment, and a tear in the endoprosthesis was detected intraoperatively, with subsequent bifurcated aortoiliac grafting. The patient was discharged without complications after 10 days (Fig 3).

DISCUSSION

The six patients in this series were treated during a 16-year period from the original procedure; since that time, 958 standard EVAR procedures were performed in our high-volume center. Type IIIb endoleak occurrence should be considered an extremely rare complication (only four cases were treated initially in our hospital), developing 4 to 9 years after EVAR; moreover, no predictive elements were identified in the first CTA after the procedures. All the cases presented herein belong to first-generation endografts; in particular, Vanguard (Boston Scientific) and Talent (Medtronic) devices are reported in the literature with a high rate of structural damage.[4,5] Although the new-generation devices might be more durable in follow-up, no data are currently available in this regard. The high volume of EVAR procedures performed worldwide may lead to significant numbers of type IIIb endoleak, with subsequent necessity of careful follow-up and treatment. Type IIIb endoleak is a severe complication, leading to sac pressurization and potential rupture of the aneurysm, similar to type I endoleak.[6] Moreover, the diagnosis is particularly difficult, as shown by our series. In five of six cases, the diagnosis was achieved by DSA, either preoperatively or during the relining procedure. CTA, DUS, and CEUS are helpful in endoleak analysis and follow-up; however, in our experience, DSA was the only tool able to confirm the presence of the type IIIb endoleak. The use of different, expensive, and invasive diagnostic methods led us to consider type IIIb endoleak a "difficult diagnosis." Other case reports underline the difficulties of a correct type IIIb endoleak diagnosis.[7,8] Candell et al,[8] in a retrospective analysis of 1700 EVAR procedures, reported a similar experience with an incorrect diagnosis of type I endoleak, with the identification of a structural tear only during the surgical conversion.

CONCLUSIONS

Similar to other experiences, a relining procedure was the preferred approach in our series. The structural characteristics of the endoprosthesis, in particular, the main body length, are important elements to consider during the relining procedure. Even if in our series (patient 3) no complications occurred, certainly endoprostheses with a long main body are associated with easy relining procedures. Other authors reported surgical correction of type IIIb endoleak with partial endograft substitution with glue or pledged surgical repair of the tear, with satisfactory results.[3]

Although structural deterioration of the fabric is a rare complication, Ueda et al[9] identified a high percentage (18%) of metal ring fractures in AneuRx (Medtronic) endoprostheses at 5-year follow-up with three-dimensional CTA, with a significant type IIIb endoleak development. The long-term durability of the new devices is therefore exceedingly important to keep the occurrence of type IIIb endoleak at a minimum, particularly considering the increasing number of EVAR procedures.

REFERENCES

1. Cao P, De Rango P, Verzini F, Parlani G. Endoleak after endovascular aortic repair: classification, diagnosis and management following

endovascular thoracic and abdominal aortic repair. J Cardiovasc Surg (Torino) 2010;51:53-69.
2. Zhou W, Blay E Jr, Varu V, Ali S, Jin MQ, Sun L, et al. Outcome and clinical significance of delayed endoleaks after endovascular aneurysm repair. J Vasc Surg 2014;59:915-20.
3. Jones SM, Vallabhaneni SR, McWilliams RG, Naik J, Nicholas T, Fisher RK. Type IIIb endoleak is an important cause of failure following endovascular aneurysm repair. J Endovasc Ther 2014;21:723-7.
4. Espinosa G, Ribeiro Alves M, Ferreira Caramalho M, Dzieciuchowicz L, Santos SR. A 10-year single-center prospective study of endovascular abdominal aortic aneurysm repair with the talent stent-graft. J Endovasc Ther 2009;16:125-35.
5. Chakfé N, Dieval F, Riepe G, Mathieu D, Zbali I, Thaveau F, et al. Influence of the textile structure on the degradation of explanted aortic endoprostheses. Eur J Vasc Endovasc Surg 2004;27:33-41.
6. Lawrence-Brown MM, Sun Z, Semmens JB, Liffman K, Sutalo ID, Hartley DB. Type II endoleaks: when is intervention indicated and what is the index of suspicion for types I or III? J Endovasc Ther 2009;16(Suppl 1):I106-18.
7. Yoshitake A, Hachiya T, Itoh T, Kitahara H, Kasai M, Kawaguchi S, et al. Nonvisualized type III endoleak masquerading as endotension: a case report. Ann Vasc Surg 2015;29:595.e15-7.
8. Candell L, Tucker LY, Goodney P, Walker J, Okuhn S, Hill B, et al. Early and delayed rupture after endovascular abdominal aortic aneurysm repair in a 10-year multicenter registry. J Vasc Surg 2014;60:1146-52.
9. Ueda T, Takaoka H, Petrovitch I, Rubin GD. Detection of broken sutures and metal-ring fractures in AneuRx stent-grafts by using three-dimensional CT angiography after endovascular abdominal aortic aneurysm repair: association with late endoleak development and device migration. Radiology 2014;272:275-83.

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