EJVES Short Reports (2018) 38, 15—18

CASE REPORT

Multiple Re-entry Closures After TEVAR for Ruptured Chronic Post-dissection Thoraco-abdominal Aortic Aneurysm

R. Kinoshita [a], F. Ganaha [a,*], J. Ito [a], N. Ohyama [b], N. Abe [b], T. Yamazato [b], H. Munakata [b], K. Mabuni [b], T. Kugai [b]

[a] Department of Radiology, Okinawa Prefectural Nanbu Medical Centre, Okinawa, Japan
[b] Cardiovascular Surgery, Okinawa Prefectural Nanbu Medical Centre, Okinawa, Japan

Introduction: Although thoracic endovascular aortic repair (TEVAR) has become a promising treatment for complicated acute type B dissection, its role in treating chronic post-dissection thoraco-abdominal aortic aneurysm (TAA) is still limited owing to persistent retrograde flow into the false lumen (FL) through abdominal or iliac re-entry tears.

Report: A case of chronic post-dissection TAA treatment, in which a dilated descending FL ruptured into the left thorax, is described. The primary entry tear was closed by emergency TEVAR and multiple abdominal re-entries were closed by EVAR. In addition, major re-entries at the detached right renal artery and iliac bifurcation were closed using covered stents. To close re-entries as far as possible, EVAR was carried out using the chimney technique, and additional aortic extenders were placed above the coeliac artery. A few re-entries remained, but complete FL thrombosis of the rupture site was achieved. Follow-up computed tomography showed significant shrinkage of the FL.

Discussion: In treating post-dissection TAA, entry closure by TEVAR is sometimes insufficient, owing to persistent retrograde flow into the FL from abdominal or iliac re-entries. Adjunctive techniques are needed to close these distal re-entries to obtain complete FL exclusion, especially in rupture cases. Recently, encouraging results of complete coverage of the thoraco-abdominal aorta with fenestrated or branched endografts have been reported; however, the widespread employment of such techniques appears to be limited owing to technical difficulties. The present method with multiple re-entry closures using off the shelf and immediately available devices is an alternative for the endovascular treatment of post-dissection TAA, especially in the emergency setting.

Article history: Received 3 October 2017, Revised 9 January 2018, Accepted 17 January 2018,

Keywords: Aortic dissection, Ruptured aortic aneurysm, Post-dissection thoracoabdominal aortic aneurysm, Endovascular aortic repair, Reentry closure, Endovascular procedures

INTRODUCTION

Although thoracic endovascular aortic repair (TEVAR) has become a promising treatment for complicated acute type B dissection, its role in treating chronic post-dissection thoraco-abdominal aortic aneurysm (TAA) is still limited owing to persistent retrograde flow into the false lumen (FL) through distal re-entry tears, especially in ruptured cases.[1] A case of ruptured post-dissection TAA is described, in which endovascular re-entry closures were successfully performed with aortic endografts and covered stents in the right renal and iliac arteries, in addition to entry closure by TEVAR.

* Corresponding author. Department of Radiology, Okinawa Prefectural Nanbu Medical Centre, 118-1 Arakawa, Haebaru, Okinawa, 901-1193, Japan.

E-mail address: ganamaru@m2.gyao.ne.jp (F. Ganaha).

https://doi.org/10.1016/j.ejvssr.2018.01.002

Report

A 65 year old woman with haemoptysis was transferred to Okinawa Prefectural Nanbu Medical Centre, Okinawa, Japan. The patient's past medical history included chronic empyema but no aortic disease. Contrast enhanced computed tomography (CECT) showed aortic dissection extending from the distal aortic arch to the right external iliac artery (Fig. 1A). A thick dissection flap indicated chronicity. There was a haematoma around a dilated lower descending aorta, measuring 55 mm in diameter (Fig. 1B). The coeliac, superior and inferior mesenteric arteries, and the left renal artery (RA) originated from the true lumen (TL), whereas the right RA and right lumbar arteries originated from the FL. Entry was seen just below the left subclavian artery. Multiplanar reconstruction images showed multiple re-entries at the detached right RA (Fig. 1C) and right lumbar arteries (Fig. 1A), and the right iliac bifurcation (Fig. 1D). Diagnosis was rupture of post-dissection TAA with perforation into the left lung. Because intra-operative single lung ventilation was difficult owing to a large chronic

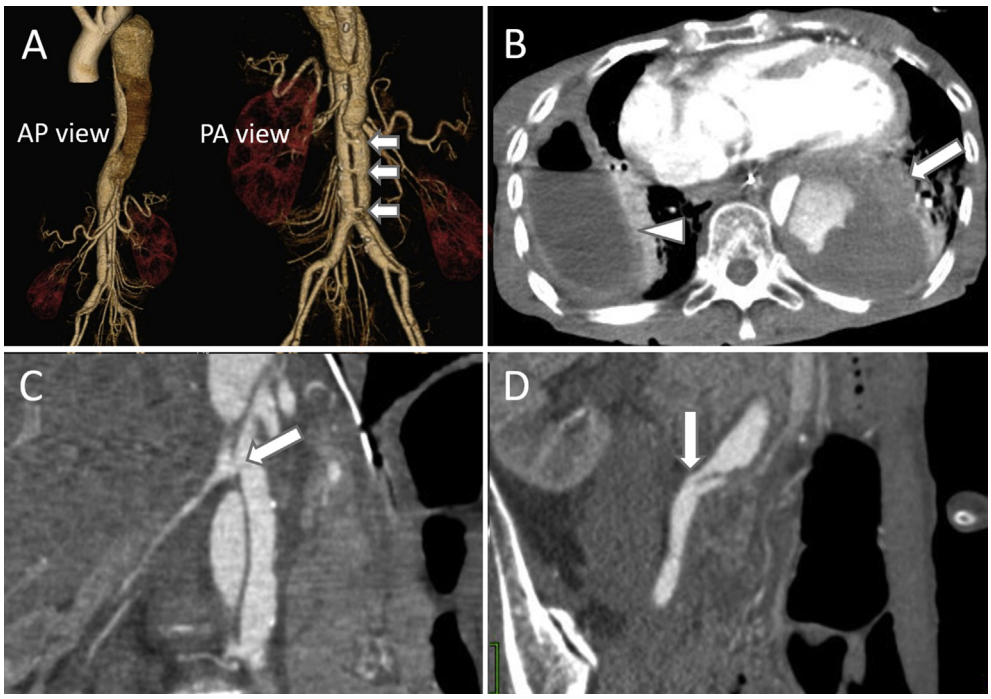

Figure 1. Pre-operative computed tomography. (A) Three dimensional images, in the antero—posterior (AP) and postero—anterior (PA) views, showed a post-dissection thoraco-abdominal aortic aneurysm. The arrows indicate re-entry tears at the detached right lumbar arteries in the PA view. (B) A haematoma around a dilated descending false lumen indicates rupture (arrow). In the right thorax, there was a large chronic empyema (arrowhead). (C) A multiplanar reconstruction image showed a large re-entry tear at the detached right renal artery ostium (arrow). (D) Another major re-entry tear at the right iliac bifurcation (arrow).

empyema in the right thorax, open surgery was not feasible, and it was decided to perform an endovascular repair.

At first, the entry site was closed by zone 2 TEVAR with a 28 mm × 15 cm conformable GORE TAG (W.L. Gore & Associates, Flagstaff, AZ, USA) via left femoral access. The left subclavian artery was covered without revascularisation. After TEVAR, abdominal TL aortography showed marked retrograde blood flow in the thoraco-abdominal FL (Fig. 2A). Decompression of the FL was necessary to control bleeding at the rupture site, and it was subsequently decided to close the re-entry sites.

Because all the right lumbar arteries were detached from the TL and there had been relevant re-entry at each ostium, it was decided to perform EVAR to close all of the re-entries simultaneously. Prior to EVAR, the right subclavian artery was exposed and accessed with a 9 F long sheath; an 8 mm × 6 cm covered stent (Fluency; Bard, Karlsruhe, Germany) was then placed from the TL to the right RA through its detached ostium to block a major path of re-entry flow. This RA stent protruded enough to perform the chimney technique. Endovascular aneurysm repair (EVAR) was performed using an Excluder (W. L. Gore & Associates) with a main body of 23 mm × 12 cm and a 12 mm × 10 cm contralateral leg; the proximal edge of the main body was placed just below the superior mesenteric artery (SMA) to close re-entries between the SMA and aortic bifurcation. Both RAs were spared using the chimney technique (Fig. 2B). Another major re-entry at the right iliac bifurcation was closed by adding a 7 cm iliac extender (Fig. 2C). Furthermore, two aortic extenders (26 mm × 3.3 cm and 23 mm × 3.3 cm, respectively) were placed to close the remaining re-entries above the coeliac artery (Fig. 2D). Although residual FL flow from the re-entry between coeliac and SMA level was still seen on angiography, it was significantly diminished compared with that seen on pre-procedural angiography (Fig. 2E).

During the operation, spinal cord function was assessed by monitoring motor evoked potentials (MEPs), and there was no decrease in MEPs. To avoid possible spinal hypoperfusion, a mean arterial pressure of ≥80 mmHg was meticulously maintained until several days after the operation.

The post-operative course was uneventful, and there was no spinal cord ischaemia (SCI). CECT 3 days after the operation showed that the thoracic FL, including the rupture site, was completely thrombosed (Fig. 3A, B). Although some FL flow remained, it was limited to coeliac level, and the FL had already shrunk (Fig. 3C). After 4 months, further FL shrinkage was observed (Fig. 3D).

DISCUSSION

In treating post-dissection TAA, entry closure by TEVAR is sometimes insufficient, owing to persistent retrograde flow into the FL from abdominal or iliac re-entries.[1] Methods to overcome this problem include complete endograft coverage of the thoraco-abdominal aorta and direct occlusion of the FL. The former approach can be achieved by the use of fenestrated or branched endografts that spare the visceral arteries, or hybrid repair that consists of tubular endograft coverage of the thoraco-abdominal aorta and visceral debranching. Although encouraging results of the

fenestrated or branched endografting strategy have been reported by a few pioneering centres,[2,3] actual endovascular techniques are often challenging because of limited working space with a narrowed TL and the existence of a dissection flap that obstructs branch vessel catheterisation.[1–3] The hybrid strategy appears to have a broader availability than fenestrated or branched endografting; however, a multicentre study showed a significant perioperative mortality of 34%.[4] Another obvious concern of extensive aortic coverage is the risk of SCI. The latter approach has been attempted using coils and/or liquid embolic agents,[5] and even a candy plug.[6] Alternatively a covered stent has been used to close re-entry.[7] Overall, most of these techniques have been applied in elective cases, and the experience with such techniques in rupture cases is limited.[6]

The present case was treated by multiple re-entry closures by EVAR following entry closure by TEVAR. In addition, major re-entries at the detached right RA and iliac bifurcation were closed using covered stents. To close re-entries as far as possible, EVAR was done using the chimney technique, and additional aortic extenders were placed as described. In most cases with post-dissection TAA, residual FL flow after TEVAR entry closure is mainly derived

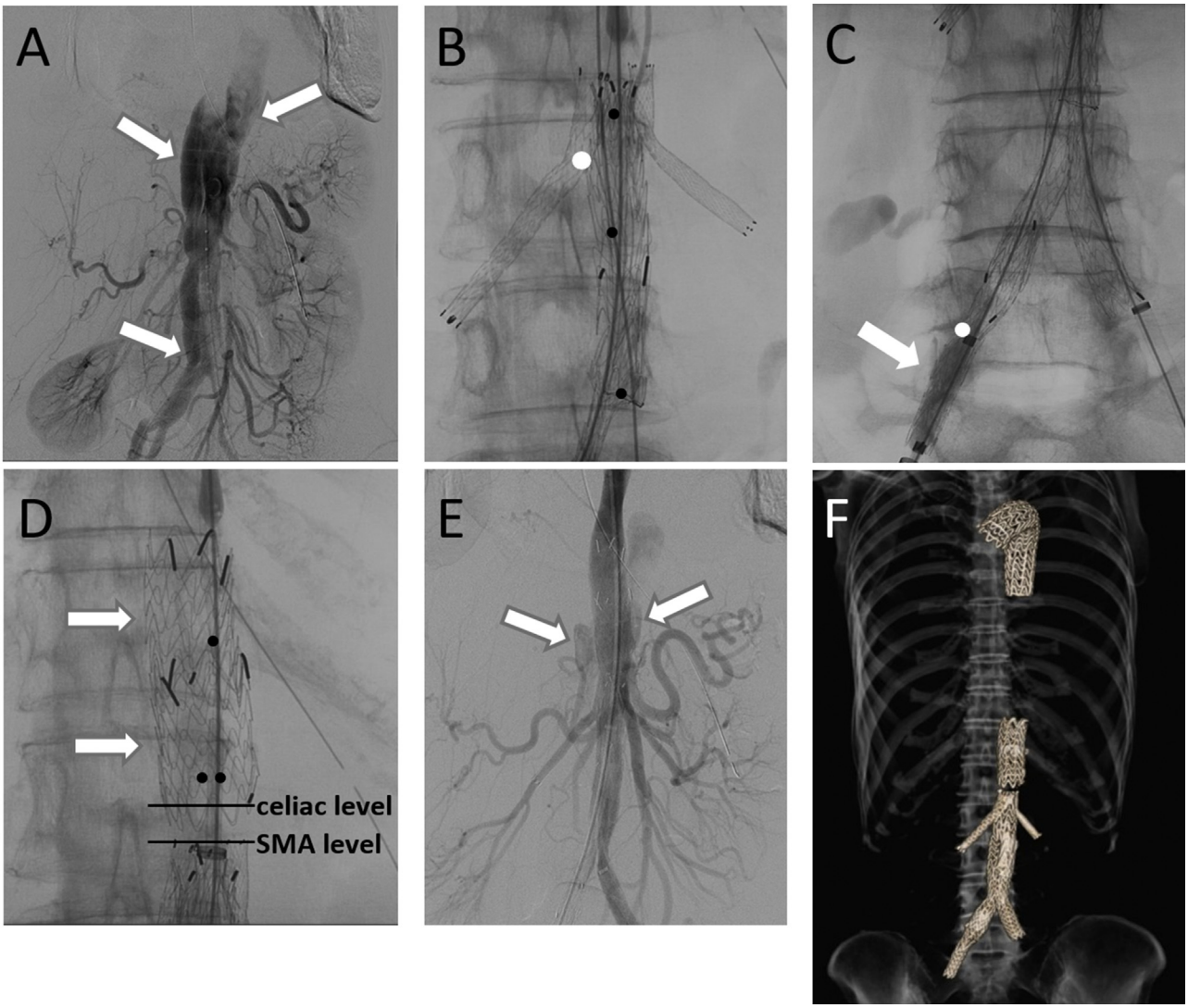

Figure 2. Multiple re-entry closures using aortic and branch endografts following TEVAR. Dots indicate the sites of re-entry tear. (A) After TEVAR, abdominal true lumen aortography showed marked ascending blood flow in the thoraco-abdominal false lumen (FL; arrows). (B) Re-entry at the detached right renal artery (RA) ostium (white dot) was closed using a covered stent. Re-entries at the detached right lumbar arteries (black dots) were closed by endovascular aneurysm repair, and both RAs were spared using the chimney technique. (C) Re-entry at the right iliac bifurcation (white dot) was closed by an iliac extender (arrow). (D) Two aortic extenders (arrows) were placed to close re-entries at the ostia of the detached bilateral inferior phrenic and left twelfth intercostal arteries (black dots) above the coeliac artery. (E) Completion aortography showed remaining FL retrograde flow from the re-entry at the ostium of the detached right first lumbar artery located between the coeliac and superior mesenteric artery (SMA), but it was significantly diminished (arrows). (F) Post-procedural three dimensional computed tomography (without contrast enhancement) shows all deployed endografts and the endovascular procedures that were performed.

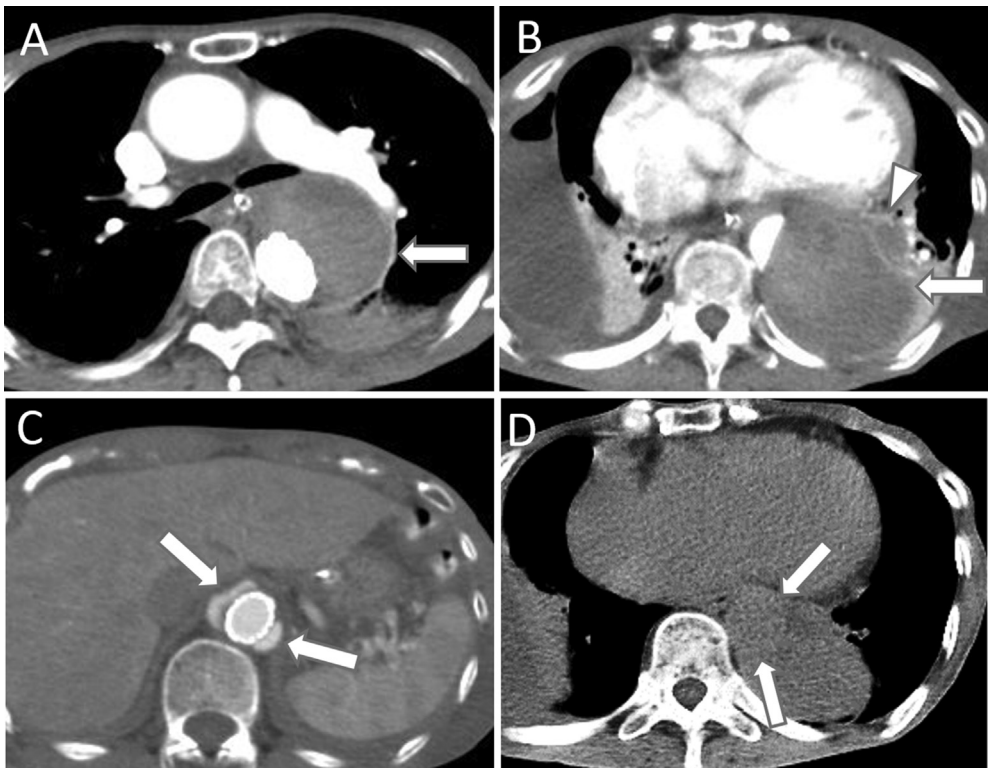

Figure 3. Computed tomography images (A—C) 3 days and (D) 4 months after thoraco-abdominal aortic aneurysm repair. (A, B) A patent thoracic false lumen (FL) was completely thrombosed (arrows), including the rupture site (arrowhead). (C) Coeliac level. Although the FL was not thrombosed (arrows), significant FL shrinkage was obtained. (D) After 4 months, further shrinkage of the thoracic FL was observed compared with the previous image at the same section B. The true lumen was fully expanded (arrows).

from abdominal and/or iliac re-entries; therefore, the present method, which consisted of EVAR and re-entry closure with a covered stent, can be applied in many cases with this aortic pathology. In addition, only off the shelf and immediately available devices were used in this case, and this might be another advantage, especially in the emergency setting. Some abdominal FL flow remained, but complete FL thrombosis of the rupture site was obtained. Follow-up CT showed significant shrinkage of the FL; therefore, the endovascular procedures were successful.

Endografts were not placed in the descending aorta, and this might be the main difference compared with the fenestrated or branched endografting strategy. There were two reasons for this. One was the risk of SCI, and the other was the lack of re-entry in the descending aorta in this particular case. As all intercostal arteries except for the left twelfth originated from the TL, they were not covered all together, considering the risk of SCI. However, there was no re-entry left in the descending aorta after closure of the left twelfth intercostal artery by aortic extenders; therefore, it was believed that further endograft coverage of the descending aorta was unnecessary. In general, however, there are cases that have relevant re-entry in the descending aorta. In such cases, extensive TEVAR down to the coeliac artery is needed, and revascularisation of the left subclavian artery would be mandatory.

REFERENCES

1 Kölbel T, Tsilimparis N, Wipper S, Larena-avellaneda A, Diener H, Carpenter SW, et al. TEVAR for chronic aortic dissection. Is covering the primary entry tear enough? *J Cardiovasc Surg* 2014;**55**:519—27.

2 Oikonomou K, Kopp R, Katsargyris A, Pfister K, Verhoeven EL, Kasprzak P. Outcomes of fenestrated/branced endografting in post-dissection thoracoabdominal aortic aneurysms. *Eur J Vasc Endovasc Surg* 2014;**48**:641—8.

3 Spear R, Sobocinski J, Settembre N, Tyrrell MR, Malikov S, Maurel B, et al. Early experience of endovascular repair of post-dissection aneurysms involving the thoraco-abdominal aorta and the arch. *Eur J Vasc Endovasc Surg* 2016;**51**:488—97.

4 Rosset E, Ben Ahmed S, Galvaing G, Favre JP, Sessa C, Lermusiaux P, et al. Editor's choice-hybrid treatment of thoracic, thoracoabdominal, and abdominal aortic aneurysms: a multi-center retrospective study. *Eur J Vasc Endovasc Surg* 2014;**47**: 470—8.

5 Hofferberth SC, Nixon IK, Mossop PJ. Aortic false lumen thrombosis induction by embolotherapy (AFTER) following endovascular repair of aortic dissection. *J Endovasc Ther* 2012;**19**:538—45.

6 Marone EM, Leopardi M, Bertoglio L, Mascia D, Chiesa R. Original off-label endovascular solution to occlude false lumen rupture in chronic type B aortic dissection. *Ann Vasc Surg* 2017;**40**:299.e1—5.

7 Bel A, Alsac JM, BaïssasV Julia P, Fabiani JN. Spot stenting of the tear in type B aortic dissection. *Ann Vasc Surg* 2013;**27**:671.e1—6.