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Favorable Aortic Remodeling Following Serial False Lumen Procedures in a Case of Chronic Type IIIb Dissection

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We report a case of acute type I aortic dissection in which an emergency graft replacement of the ascending aorta and innominate artery was performed. We performed false lumen thrombosis through hybrid thoracic endovascular aortic repair to seal the primary entry tear, followed by false lumen obliteration at the level of the descending thoracic aorta, abdominal aorta, and right common iliac artery. Over a period of 4.5 years, we used Amplatzer vascular plugs and coils based on our computed tomography angiography follow-up protocol.

Key words: 1. Aorta
2. Dissection
3. Vascular remodeling

Case report

Following graft replacement in cases of acute type I aortic dissection (AIAD), a pressurized false lumen (FL) is a risk factor for unfavorable remodeling of the aorta. Our treatment plan involved FL thrombosis to seal the primary entry tear, followed by FL obliteration at the level of the descending thoracic aorta (DTA), abdominal aorta, and right common iliac artery (RCIA) over 4.5 years, based on our computed tomography angiography (CTA) follow-up protocol.

A 56-year-old man presented with chest pain, which was diagnosed as AIAD on CTA. The patient underwent urgent graft replacement of the ascending aorta and aortic arch, including the innominate artery, with a 4-branch, 30-mm graft (InterGard Inc., La Ciotat, France). He underwent 5 serial CTA follow-ups over 5 months postoperatively, due to continuous back pain. Persistent aortic dissection involving the DTA and abdominal aorta was seen, extending into the RCIA, with a newly developed entry tear at the aortic arch and proximal DTA and an increase in the aortic arch diameter at the level of the left subclavian artery (LSCA) at 5 months (Fig. 1A).

Hybrid thoracic endovascular repair (TEVAR) was performed 6 months after the graft replacement. Debranching bypasses from the right common carotid artery to the left common carotid artery and LSCA with an 8-mm graft (Vascutek, Renfrewshire, Scotland) were performed, with LSCA embolization using a 12-mm Amplatzer vascular plug (AVP; AGA Medical, Golden Valley, MN, USA) (Fig. 1B) to achieve a proximal sealing zone and to cover the entry tear at the aortic arch. Zone 1 TEVAR was performed, with the

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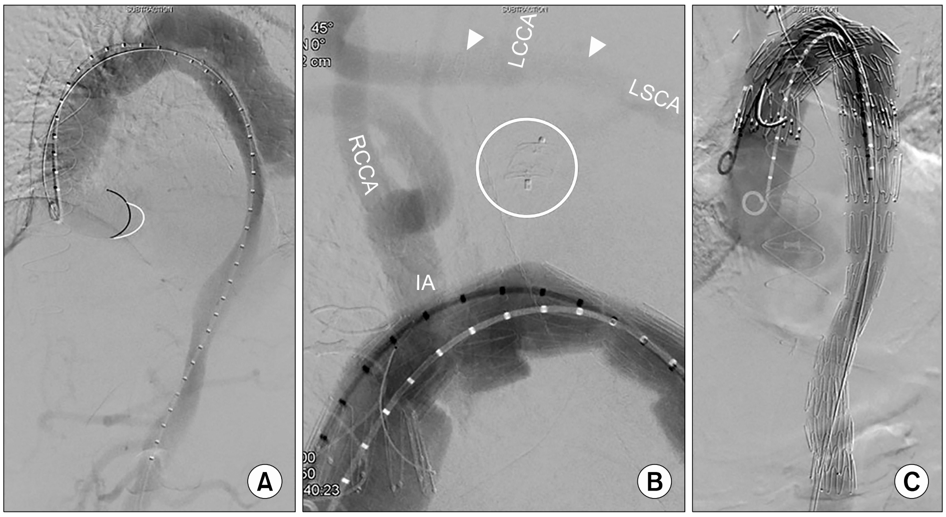

Fig. 1. Hybrid thoracic endovascular repair procedure. (A) An angiogram shows aneurysmal changes in the descending thoracic aorta. (B) Revascularization of the LCCA and LSCA from the RCCA through an 8-mm graft (white arrow head) with embolization using an Amplatzer vascular plug in the proximal region of the LSCA (white circle). (C) Zenith aortic device extending from origin of the IA to just above the origin of the celiac artery. LCCA, left common carotid artery; LSCA, left subclavian artery; RCCA, right common carotid artery; IA, innominate artery.

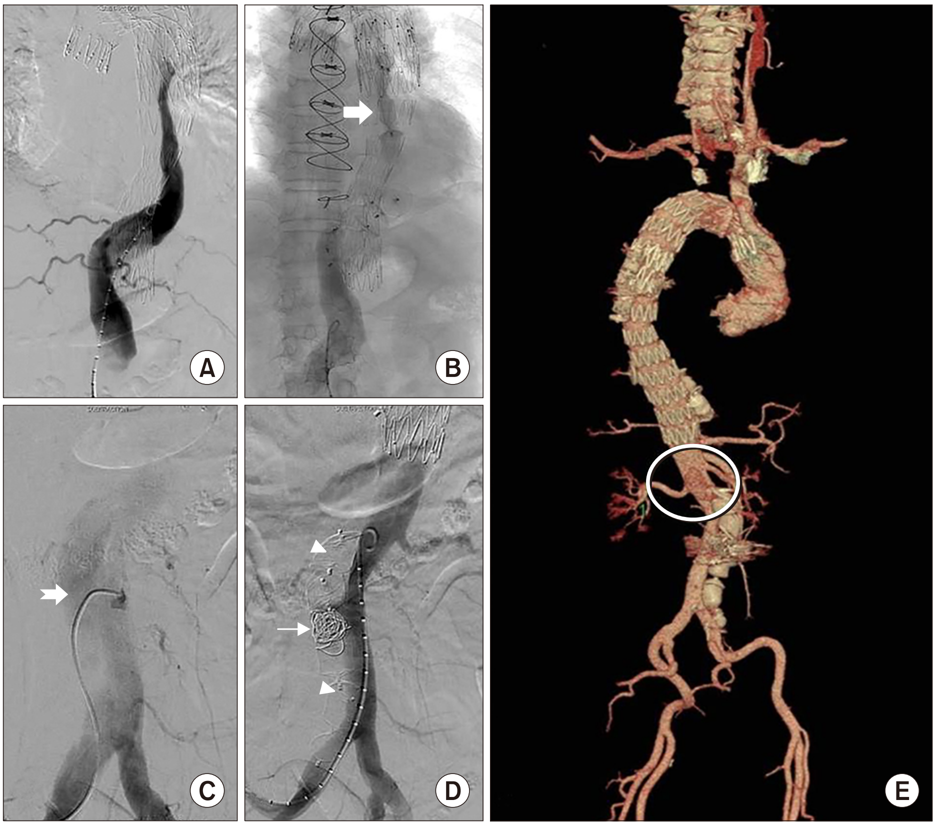

Fig. 2. FL procedure for the DTA and abdominal aorta FLs. (A) An angiogram shows a FL around the DTA. (B) Embolization of the FL using 6 AVPs (white arrow). (C) An angiogram shows communicating channels at the common iliac artery and left renal artery (the white arrow indicates the FL). (D) Embolization of the FL by AVPs (arrowhead) and coils (line arrow). (E) A 3-dimensional reconstruction of the aorta shows a remaining communicating channel that was missed at the level of the left renal artery (white circle). FL, false lumen; DTA, descending thoracic aorta; AVPs, Amplatzer vascular plugs.

distal landing zone just above the origin of the celiac artery, using Zenith TX2 with Proform (40-208 and 36-197; Cook Medical, Bloomington, IN, USA). The final aortogram showed no endoleak (Fig. 1C).

Our goal in performing TEVAR was to cover the newly developed entry tear, thereby initiating FL thrombosis and favorable aortic remodeling. However, in this case, the overall diameter of the DTA increased from 47 mm before TEVAR to 55 mm at 1 year after TEVAR, due to residual communicating channels at the abdominal aorta and a re-entry tear at the RCIA/external iliac artery junction. We were

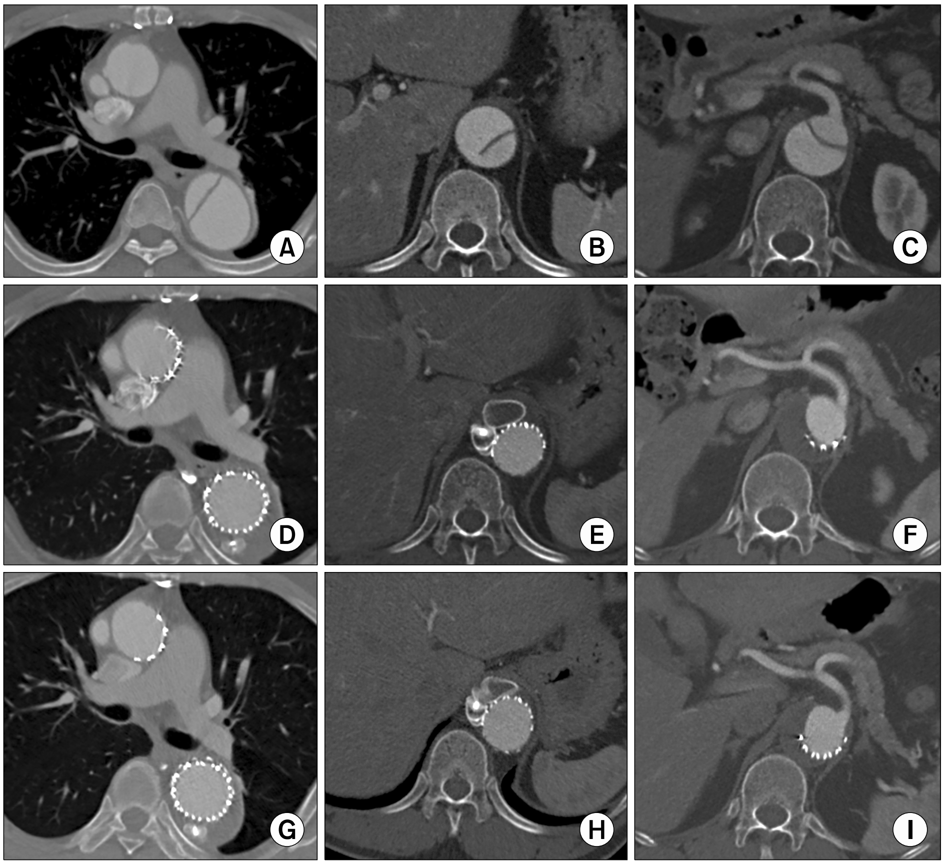

Fig. 3. The CT scan shows aorta at the level of PAB (A, D, and G), T11 (B, E and H) and CA (C, F and I) in postoperative periods of 4 months (A–C), 25 months (D–F) and 52 months (G–I), respectively. (A–C) The CT scan before the stent insertion. Aortic diameter at the level of PAB, T11, and CA was 51 mm, 37 mm, and 35 mm, respectively. True lumen diameter was 15 mm, 15 mm, and 14 mm, respectively. (D–F) Twenty-one months after the stent insertion. Aortic diameter at the level of PAB, T11, and CA was 52 mm, 49 mm, and 41 mm, respectively. True lumen diameter was 34 mm, 28 mm, and 23 mm, respectively. (G–I) Twenty-seven months after the stent insertion. Aortic diameter at the level of PAB, T11, and CA was 52 mm, 49 mm, and 43 mm, respectively. True lumen diameter was 37 mm, 33 mm, and 28 mm, respectively. CT, computed tomography; PAB, pulmonary artery bifurcation; T11, 11th thoracic vertebra; CA, celiac axis.

concerned about obliteration of the FL around the DTA due to a fear of rupture.

The DTA FL was embolized as follows. The right common femoral artery (CFA) was punctured with cannulation of the FL, an 8F shuttle was inserted, and the FL was embolized using 6 AVPs (1 measuring 14 mm, 3 measuring 16 mm, and 2 measuring 22 mm) (Fig. 2A, B). CTA after 1 year showed complete thrombosis in the entire DTA, but a dissecting aneurysm involving the abdominal aorta and the iliac tree persisted.

The abdominal aorta FL was embolized as follows. It was decided to make a right CFA puncture through the right external iliac artery proximal re-entry tear. FL aortography confirmed 2 communicating channels at the level of the infrarenal abdominal aorta (Fig. 2C). Through an 8F guiding sheath, embolization of the abdominal aortic and RCIA FL (the tract of major re-entry tear site) using four 22-mm AVPs was performed. True lumen aortography showed a non-obliterated communicating channel between the AVPs in the FL. Hence, a 5F Cobra catheter (Cook Medical) was inserted, and 7 coils of 20-mm, 0.0889-cm (Cook Medical) embolization into the FL of the abdominal aorta, where a large communicating channel was present, was also done (Fig. 2D). Six months later, CTA showed nearly complete thrombosis of the FL in the entire aorta; however, an additional embolization for a single residual communicating channel just below the left renal artery was necessary, so obliteration under local anesthesia was recommended (Fig. 2E). Finally, complete thrombo-exclusion of the entire FL of the aorta and favorable aortic remodeling was achieved (Fig. 3), roughly 4.5 years after the initial operation.

Discussion

AIAD remains one of the most challenging conditions for cardiovascular surgeons [1]. In our case, we identified the primary entry tear at the ascending aorta and performed graft replacement of the ascending aorta and aortic arch, including the innominate artery. Replacing the innominate artery makes it possible to perform hybrid TEVAR without re-entering the sternum. As the proximal part of the innominate artery was replaced, an extrathoracic debranching procedure was possible using the right common carotid artery as the inflow source.

The postoperative course of the patient after the initial operation was closely monitored through CTA, with an objective of ensuring future thrombosis of the FL in the arteries. However, there was an increase in the aneurysmal diameter of more than 5 mm in first 6 months after DTA; hence, we attempted to cover the proximal re-entry tear through a hybrid TEVAR procedure.

The role of TEVAR in chronic dissection aneurysms is controversial, because inconsistent remodeling and persistent FL perfusion result in treatment failure in 30% to 40% of patients with persistent aortic growth and the risk of rupture, despite extensive proximal and distal landing zone coverage using hybrid de-branching neck bypasses [2].

Our current practice adopts aggressive aortic coverage (i.e., we treat down to the celiac artery in patients with juxtaceliac fenestrations). In some cases, we covered the celiac trunk, when backflow from the superior mesenteric artery was expected [3]. Our policy for FL thrombosis is to compare arterial-phase and delayed-phase preoperative and postoperative CTA at 3, 6, and 12 months.

No paraplegia occurred despite coverage of the artery of Adamkiewicz, due to our strict protocol for cerebrospinal fluid drainage and LSCA debranching in all cases with extensive DTA coverage [3]. Although we achieved good proximal and distal sealing zones from the innominate artery down to its celiac origin, the diameter of the entire DTA increased to 5.5 mm in 1 year.

There are 4 main approaches for preventing FL backflow: (1) extension of aortic coverage by visceral debranching and hybrid repair; (2) extension of aortic coverage by fenestrated and branched stent grafts; (3) direct occlusion of the FL using coils, glues, AVPs, or visceral artery stent grafts for sealing reentry tears; and (4) fenestration techniques [4].

Visceral debranching, branched or fenestrated endografting, and fenestration techniques require an open approach or anatomic compatibility [2,4,5]. FL procedures in patients with a patent FL after TEVAR for chronic type IIIb dissection aneurysms are safe and effective, with a complete thrombosis rate of 80% [6].

There is no standard reporting system for these procedures, due to the lack of consensus regarding definitions of clinical success, aortic remodeling, and concerns about treatment failure. Most reports have focused on FL thrombosis and have relied on arterial-phase of CTA to determine the efficacy of treatment. However, FL can persist in the delayed phase. The absence of contrast in the delayed phase does not indicate thrombosis, but can denote a low-flow state. In our protocol, we used both the arterial phase and a 3-minute delayed phase as an indicator of complete FL thrombosis that favors aortic remodeling and subsequent clinical success, but with a strict surveillance protocol [3].

In conclusion, an adjunctive FL procedure can increase the number of patients with successful FL thrombosis and favorable aortic remodeling (Fig. 3).

Conflict of interest

No potential conflict of interest relevant to this article was reported.

References

1. Song SW, Chang BC, Cho BK, et al. *Effects of partial thrombosis on distal aorta after repair of acute DeBakey type I aortic dissection*. J Thorac Cardiovasc Surg 2010; 139:841-7.
2. Idrees J, Roselli EE, Shafii S, Reside J, Lytle BW. *Outcomes after false lumen embolization with covered stent devices in chronic dissection*. J Vasc Surg 2014;60:1507-13.
3. Song SW, Kim TH, Lim SH, Lee KH, Yoo KJ, Cho BK. *Prognostic factors for aorta remodeling after thoracic endovascular aortic repair of complicated chronic DeBakey IIIb aneurysms*. J Thorac Cardiovasc Surg 2014;148:925-33.
4. Rohlffs F, Tsilimparis N, Diener H, et al. *Chronic type B aortic dissection: indications and strategies for treatment*. J Cardiovasc Surg (Torino) 2015;56:231-8.
5. Verhoeven EL, Paraskevas KI, Oikonomou K, et al. *Fenestrated and branched stent-grafts to treat post-dissection chronic aortic aneurysms after initial treatment in the acute setting*. J Endovasc Ther 2012;19:343-9.
6. Kim TH, Song SW, Lee KH, Baek MY, Yoo KJ. *Effects of false lumen procedures on aorta remodeling of chronic DeBakey IIIb aneurysm*. Ann Thorac Surg 2016;102:1941-7.