Targeting fenestrations in an aortic aneurysm secondary to chronic type A or B dissections: a case series

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ABSTRACT

Using entry and re-entry analysis we report a simple technique designed to solely manage the fenestrations in an aortic aneurysm caused by chronic type A or B dissections. With meticulous computed tomography mapping of each fenestration, endovascular management can be customized to those areas only. Several cases are presented using this selective approach resulting in durable thrombosis of the false lumen. Targeted coverage of fenestrations in a chronic type B dissecting aneurysm is a feasible and effective management option resulting in reliable false lumen occlusion whilst maintaining visceral perfusion. (J Vasc Surg Cases Innov Tech 2021;7:386-9.)

Keywords: Dissecting thoracoabdominal aortic aneurysm; Endovascular repair; TEVAR; Fenestration

Aortic aneurysms caused by chronic type B dissections are selectively managed by thoracic endovascular aortic repair as an alternative to demanding traditional open surgery.[1,2] Endovascular therapy aims to obliterate the false lumen (FL), but is only suitable for post-dissection aneurysms limited to the thoracic aorta.[3,4] The favored technique lining the complete true lumen (TL) with fenestrated and branched endografts is effective and durable over a medium-term follow-up.[5] We describe a small series where total endovascular management of a dissecting aneurysm was achieved by solely attending to the entry/re-entry fenestrations within the intimal flap, obtaining occlusion of the FL with less coverage of the aortic surface area. The patients each consented to publication of their case and associated images.

CASE REPORT 1

A 71-year-old man had undergone Dacron graft replacement of his ascending aorta and arch 5 years before for a type A aortic dissection. Follow-up computed tomography angiography (CTA) (using a GE medical system revolution CT scanner, images obtained were of 1 mm thickness) documented propagation of the dissection toward the right iliac artery (B3,10 Society for Vascular Surgery/Society of Thoracic Surgeons [SVS/STS] reporting standards) with both TL and FL supplying the left renal artery. The FL became a large aneurysmal sac (78 mm) within the chest and the abdomen (90 mm) with several fenestrations (Fig 1) including the descending thoracic aorta, left renal artery, the aortic bifurcation, and a termination at the right external iliac artery. The celiac axis, the superior mesenteric artery, and the right renal artery were all supplied by the TL with the patient deemed unfit for open repair. The left renal artery was catheterized via the left brachial artery covering the fenestration with 59 mm × 6 mm and 29 mm × 7 mm stent grafts (Bentley, Hechingen, Germany). The left renal stent graft extended approximately 3 cm into the TL establishing left renal perfusion. A left femoral guidewire was passed into the TL covering the proximal fenestration with a 36 mm × 26 mm × 100 mm Valiant Captivia (Medtronic, Dublin, Ireland) stent graft. A pigtail catheter was connected to the arterial pressure monitor, with measurement on completion of a 50% decrease in systolic pressure in the thoracic FL. Though not necessary, this was an assurance for efficient seal of the thoracal fenestration. An aorto-uni-iliac 28 mm × 14 mm × 102 mm Medtronic stent graft was deployed beneath the right renal artery and the orifice of the left renal stent graft, ending in the left common iliac artery and covering the aortic bifurcation fenestration. The right common iliac artery was occluded with a 26 mm Medtronic Talent occluder and a 6 mm × 100 mm stent graft (Viabahn; Gore, Flagstaff, Ariz) was passed from the right external iliac artery to the internal iliac artery preserving pelvic perfusion with a completion femorofemoral cross-over bypass graft (8 mm ringed polytetrafluoroethylene). We used the cross-fem bypass because the right common iliac artery was entirely supplied by the FL and had to be occluded. Aortography demonstrated flow via the TL with bilateral renal perfusion. The patient was discharged on the seventh day after an uneventful course with confirmation of FL exclusion at 1 month on follow-up CT with arterial and delayed venous phase to ensure the absence of flow in the FL.

CASE REPORT 2

A 58-year-old man underwent surgical replacement of his ascending aorta and arch with a Dacron graft in 2005 for an acute type A aortic dissection. A dissecting flap was noted extending through the aorta and terminating at the left common iliac artery (B3,10 SVS/STS reporting standards) with poor perfusion of the left kidney from the FL with the patient lost to

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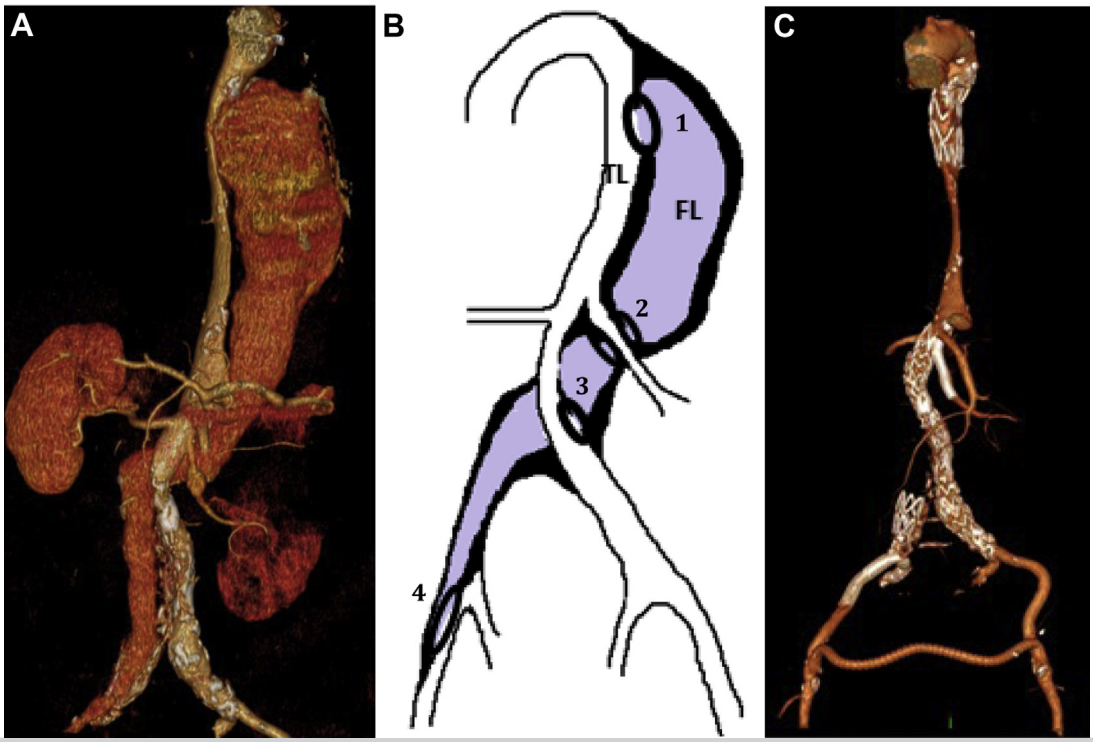

Fig 1. A, CTA confirms a type B dissection with the two lumens. **B,** Schematic representation of the anatomy of the entry and re-entry fenestrations. These include a tear at the descending thoracic aorta, entry at the left renal artery, the aortic bifurcation, and at the right external iliac artery (termination of the dissection). The celiac axis, superior mesenteric artery, and the right renal artery were supplied by the true lumen (*TL*). **C**, Postoperative computed tomography angiography (CTA) with no contrast in the false lumen (*FL*) and the aneurysmal sacs, during the arterial phase.

follow-up. The patient re-presented at 70 years of age with acute onset lower abdominal and left flank pain where a CTA showed a contained rupture of an FL aneurysm below the renal arteries, with several fenestrations including an intimal tear 3 cm proximal to the celiac trunk, a connection between the two lumens at the atrophic left renal artery, and a terminal left common iliac artery fenestration. The thoracic aortic TL was accessed to cover the supraceliac fenestration via the right external iliac artery deploying a 28 × 28 limb extension stent graft (Endurant; Medtronic). A second left femoral guidewire was passed into the FL cannulating the left renal artery and deploying a 5 × 59 Bentley stent graft. This stent was deployed in the TL, not for the preservation of the kidney, but for sealing the luminal connections inside the renal artery itself. The left iliac fenestration was covered by two 59 mm × 8 mm stent grafts (Atrium Maquet, Gothenburg, Sweden), and a pigtail catheter was left in situ in the FL for 10 cc thrombin injection (RECOTHROM Baxter, 5000 U as 1000 U/mL N saline dilution). Completion CTA (and repeat at 1 month) confirmed that flow only through the TL (Fig 2).

CASE REPORT 3

A 68-year-old man with end-stage renal failure on hemodialysis was known since 2010 to have a type B dissecting aneurysm. He was admitted with chest pain but had declined treatment or follow-up. Dissection distal to the left subclavian artery terminated at the aortic bifurcation (B3,9 SVS/STS reporting standards) with all visceral arteries (except the inferior mesenteric) originating from the TL. The patient was readmitted in 2018 with chest pain and negative CT coronary angiography but a widening through its course of the false aortic lumen alone. The thoracic fenestration was sealed with a 40 mm × 40 mm × 150 mm stent graft (Valiant Captivia; Medtronic), and the FL was filled with detachable coils (Concerto; Medtronic). Because of the narrow working space, tears in the abdominal aorta were covered with two parallel stent grafts embraced with a tube stent graft (Medtronic) designed to create an aortic neo-bifurcation. Completion aortography showed good visceral perfusion in the TL with resolution of the chest pain. Before discharge repeat CTA showed minute flow via the FL with exclusion of the aneurysmal sacs at 3 and 12 postoperative months (Fig 3).

DISCUSSION

Management of aortic aneurysms caused by chronic type A or B dissections remains challenging. Currently, the favored option to seal the chronic FL aneurysm is to line the entire TL with fenestrated and branched endografts[5] although it is appreciated that occlusion of the FL with aortic remodeling is only achieved in half of these cases.[6] The "cork in the bottleneck" technique[7] uses caval filters, detachable balloons, thrombin, and Talent occluders to obliterate the FL. Kölbel[8] has reported that

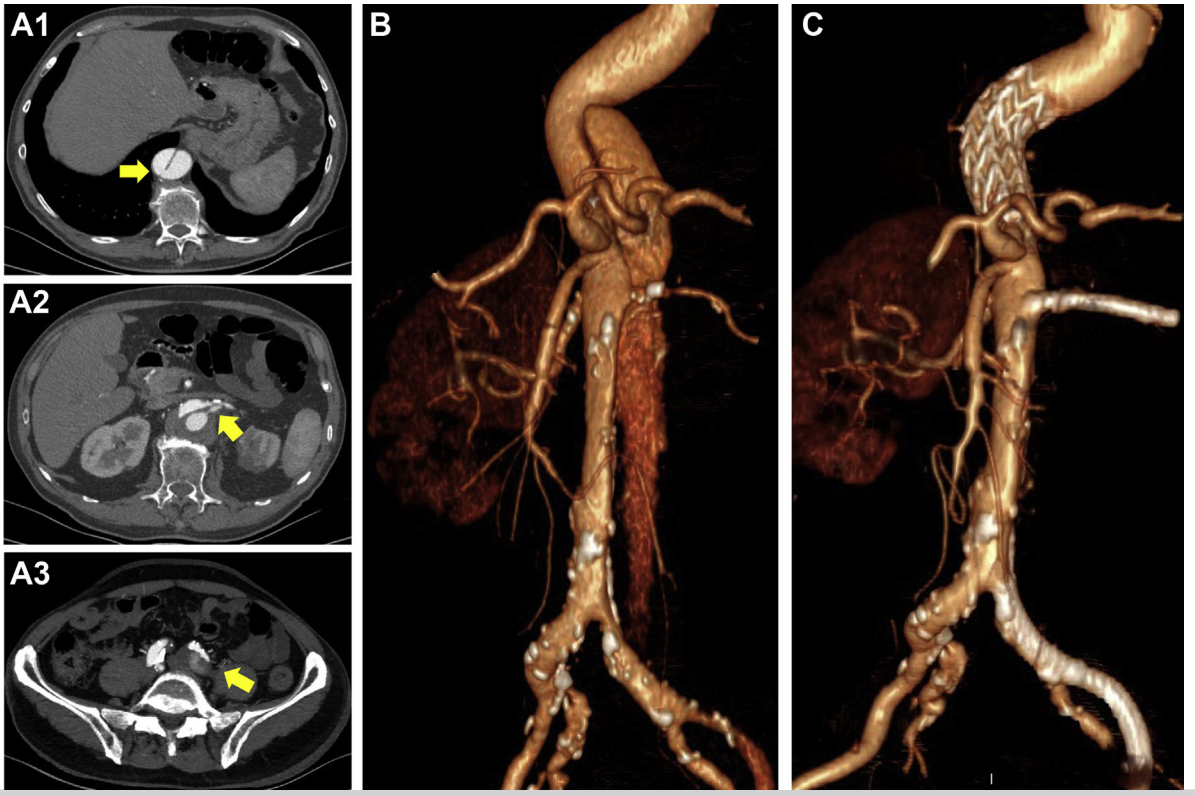

Fig 2. A, Computed tomography angiography (CTA) confirms a type B dissection with two lumens. There is an intimal tear proximal to the celiac trunk, a connection between the two lumens at the takeoff point of the atrophic left renal artery and a fenestration at the left common iliac artery. **B,** 3D CTA reconstruction. **C,** Post-operative CTA with no contrast in the false lumen (FL) and the aneurysmal sacs, during the arterial phase.

a traditional thoracic endovascular aortic repair strategy in aortic dissection is unable to interrupt flow in the FL leaving a back door that can still fill the aneurysm with an ongoing high-pressure distal inflow but with restricted outflow. This group devised two methods to prevent retrograde flow: the candy-plug and the knickerbocker techniques.[9,10] The candy-plug method is useful when there is restricted access to the proximal entry tear, sealing off the distal FL with a customized graft. The knickerbocker method relines the TL with an oversized graft, which after a controlled mid-section rupture of the dissection membrane occludes the FL. Recently, Carta et al[11] deployed the candy-plug occluder after coverage of the proximal tear with a delayed-stage fenestrated device to induce spinal cord preconditioning.[12] Thrombin injection into the FL can aid in its exclusion, though it can be of risk to emboli to lumbar and intercostal vessels and cause spinal cord ischemia. Pellenc et al[13] demonstrated the feasibility of this technique, with a low morbidity rate.

We suggest that simple, efficient sealing of all entry/re-entry fenestrations should thrombose the FL and obviate the risk of enlargement and rupture. This overcomes some of the disadvantages of other techniques and may be indicated where there is restricted access for deployment of a stent graft. A candy-plug is not suitable for every intimal fenestration where narrowing of the TL could potentially lead to branch vessel thrombosis. The knickerbocker method risks rupture and can fail to prevent visceral and infrarenal perfusion from the distal FL.[10] Another issue is that viscerorenal stents that extend into the aorta can make future fenestrated repair more challenging. An additional drawback of this technique is the need for occlusion of an entire artery when it is derived from FL alone, and thus can lead to bypass. In the present study, only one patient required this type of bypass as adequate seal of the aneurysm required an aorto uni device. We used the cross-fem bypass because the right common iliac artery was entirely supplied by the FL and had to be occluded. Because of these drawbacks, we believe that although it is a feasible procedure, it should probably be considered in these cases where custom made device (fevar or bevar devices) cannot be used.

CONCLUSIONS

Targeted coverage of fenestrations in type B dissecting thoracic aortic aneurysms is feasible effectively ensuring FL occlusion whilst maintaining visceral perfusion.

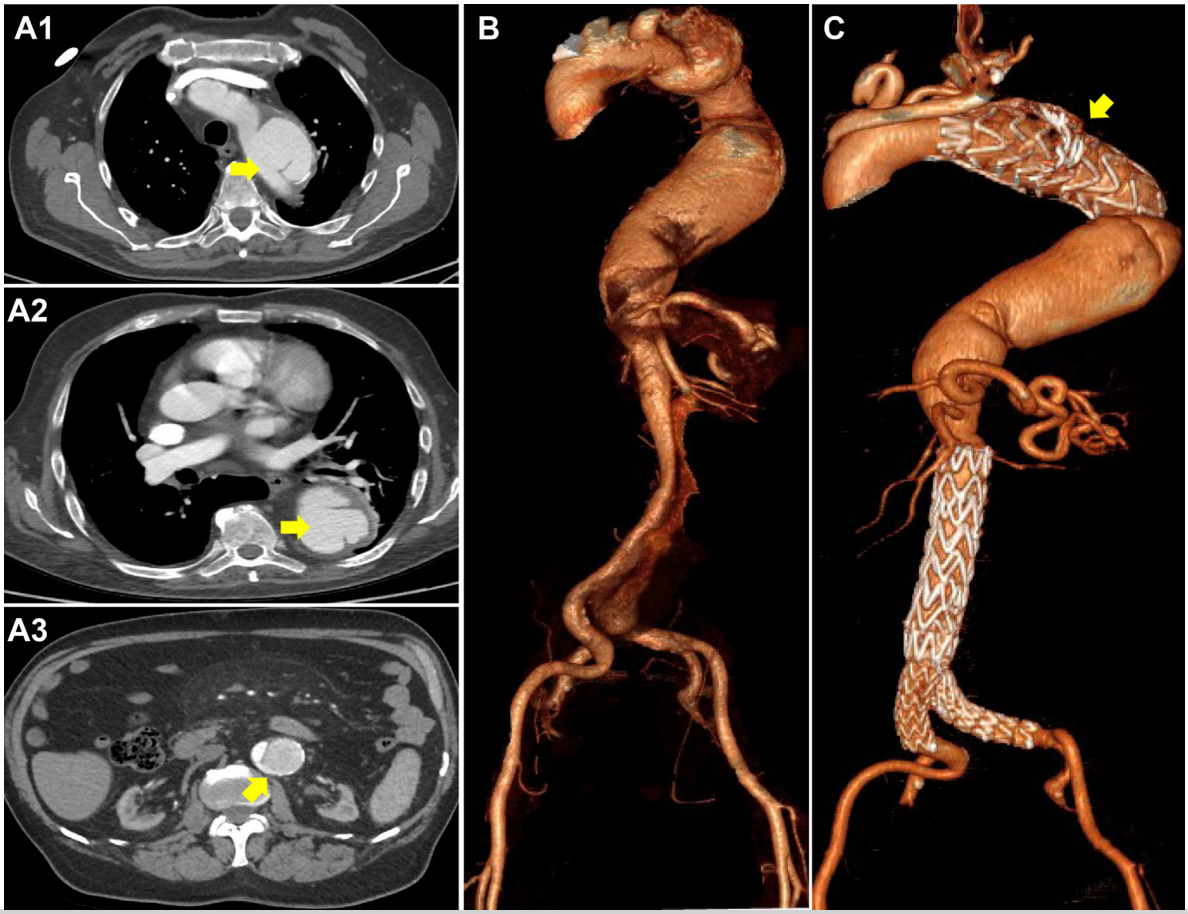

Fig 3. A, Computed tomography angiography (CTA) confirms a type B dissection with two lumens and extensive intimal tears. In this case, the concentrations of contrast in the true (TL) and false lumens (FL) in the thoracic aorta are virtually identical. **B,** Preoperative 3D CTA reconstruction. **C,** Reconstructed CTA at one postoperative year. The *arrow* shows the coils deployed into the FL.

Reduced aortic coverage minimizes risk of spinal cord ischemia and the need for fenestrated grafts.

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