

Proximal scalloped custom-made Relay[®] stent graft in chronic type B dissection: endovascular repair in a drug abuser patient

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Abstract: The best solution for enlarging chronic type B aortic dissection is not known. Hybrid surgical and endovascular procedures offer a reliable solution in such circumstances, but technically complex stent-graft designs are sometimes needed when the treatment segment of the aorta presents anatomical challenges. We report a case of a proximally scalloped custom-made stent-graft implantation following left subclavian artery transposition in a formerly cocaine-abuser patient. The one-month follow-up computed tomography angiography showed a proximal endoleak (type Ia) which was successfully solved by coil embolization. Proximally scalloped stent grafts offer a reliable solution in complex aortic dissections involving the supra-aortic branches.

Keywords: aortic arch, hybrid procedure, endovascular repair, drug abuse, new stent-graft device mesenteric cyst, abdominal pain, emergency, interventional radiology

Introduction

Among the different degenerative aortic pathologies, type B aortic dissection entails a challenging medical entity when surgery or endovascular treatments are proposed. Moreover, the treatment-associated risks are potentially even greater when the aortic arch and the ostia of supra-aortic branches (brachiocephalic trunk, left common carotid artery, and left subclavian artery) are anatomically connected to the lesion and included in the treatment segment of the aorta.

A detailed knowledge of the specific anatomical relationship between the supra-aortic trunks and the arch in each patient requires a careful preoperative case study based on diagnostic imaging techniques such as computed tomography angiography (CTA) and contrast magnetic resonance imaging evaluation (MRI). Three-dimensional (3D) segmentation of the images offers an

excellent starting point to determine the best choice when selecting the treatment modality, the design of the stent-graft, and the implant technique.

The combination of a nonregular tapered proximal landing zone with the anatomical curve of the aortic arch and the position of the supra-aortic branches generate a trilogy of unfavorable factors that require a precise solution.

Selected patients presenting with insufficient proximal landing zones can benefit from hybrid techniques by which a sufficient proximal aortic neck is created once the supra-aortic vessels have been surgically rerouted prior to stent-graft implantation [1].

We report a case in which a combination of surgical transposition of left subclavian artery to left common carotid artery together with endovascular delivery of one proximally scalloped custom-made Relay[®] was chosen as the preferred and safest option.

Case report

We present a case of a 42-year-old male patient admitted to our institution presenting with an asymptomatic chronic drug-abuse-related enlarging type B dissection that was successfully treated with a proximally scalloped custom-made Relay[®] stent graft [2].

Six years earlier, this patient was admitted to our Vascular Surgery Department after referring to severe six-day-long chest and back pain, numbness in both lower extremities, and therapy-resistant hypertension (220/125 mm Hg). His medical history was remarkable for regular abuse of drugs (cocaine) and surgically treated lumbar discopathy.

After visiting an orthopedic surgeon, who prescribed a lumbar MRI, the patient was referred to internal medicine for extreme hypertension (230/130 mm Hg). The patient had peripheral pulses on all extremities at admission and no blood pressure differences of the limbs with a stable cardio-respiratory condition. Chest

pain decreased, but his back complaints persisted. CTA showed an acute Stanford type B aortic dissection from the left subclavian artery to the aortic bifurcation with a significantly compressed true lumen at the level of the visceral arteries. Right renal artery had its origin from the true lumen, and perfusion of the kidneys was impaired. There was no suspicion of abdominal organ or lower limb ischemia or risk of aortic rupture. Therefore, conservative treatment was indicated and the pain diminished gradually. Nevertheless, the elevated blood pressure was resistant to combined high-dose intravenous antihypertensive drugs and the urine volume began to decrease so surgical intervention was decided.

TEVAR with a thoracic aorta stent-graft implantation was not an option at that time in our department; consequently, an open thoracoabdominal operation was performed with supraceliac clamping and surgical intimal flap resection of the visceral aorta. After the procedure, the patient's blood pressure quickly decreased to close

Table I | Timeline for the diagnosis and treatment evolution of the patient

<ul style="list-style-type: none"> • 35-years-old patient • Cocaine abuser • Type B dissection • Visceral aorta refenestration 	<ul style="list-style-type: none"> • Follow-up: Yearly CT angiography showed a growing of the aneurysm up to 66 mm in diameter 	<ul style="list-style-type: none"> • LSA to LCCA transposition • Proximal scalloped Relay implant • Type Ia endoleak at 1-month solved with coils • Discharge: Patient doing normal life 	
2008	From 2009	To 2014	2015

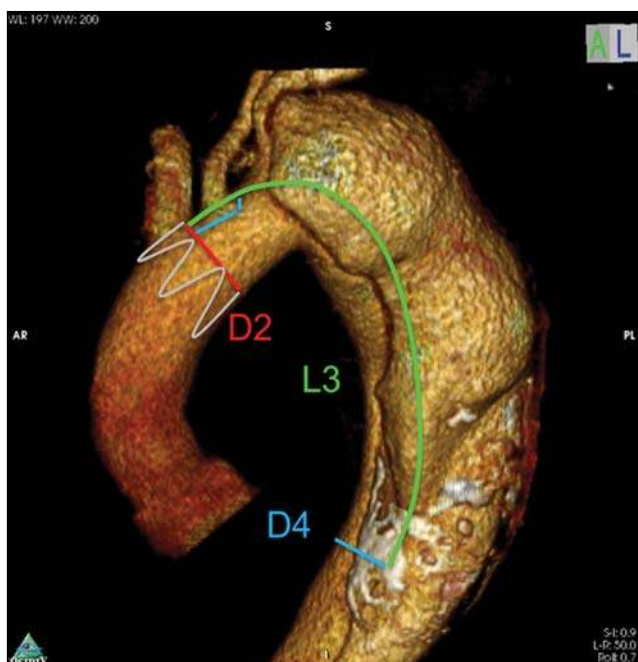


Fig. 1. Preoperative 3D aortic reconstruction including the representation of the proposed proximally scalloped Relay[®] stent graft. Proximal scallop was intended to keep the left common carotid artery patent

to normal level through administration of combined oral antihypertensive therapy. Postoperative recovery was uneventful, and the patient returned to his normal activity and stopped cocaine use.

The positive outcome was confirmed by resolution of symptoms, maintenance of antihypertensive therapy, and a yearly scheduled CTA exam program. At consecutive follow-up assessments, the CT images showed a post-dissection aneurysm on the descending aorta which was slowly but steadily growing. Six years after the primary procedure, the diameter of the descending aortic aneurysm increased to 66 mm (*Table I*).

A two-stage procedure with a left subclavian to carotid transposition, followed 1 month later by a thoracic stent-graft implantation, was indicated to prevent an eventual rupture of the aneurysm. The patient consented to the treatment plan (*Fig. 1*). Therefore, after the debranching procedure, a custom-made proximally scalloped and tapered Relay[®] stent graft (proximal diameter of 36 mm, distal diameter of 32 mm, and 200 mm in length) was implanted, extending from the left common carotid artery to the descending thoracic aorta to exclude the aneurysm. The size of the scallop (19 mm in width and 15 mm in length) was designed according to the ostial diameter. A slight lateral positioning of the

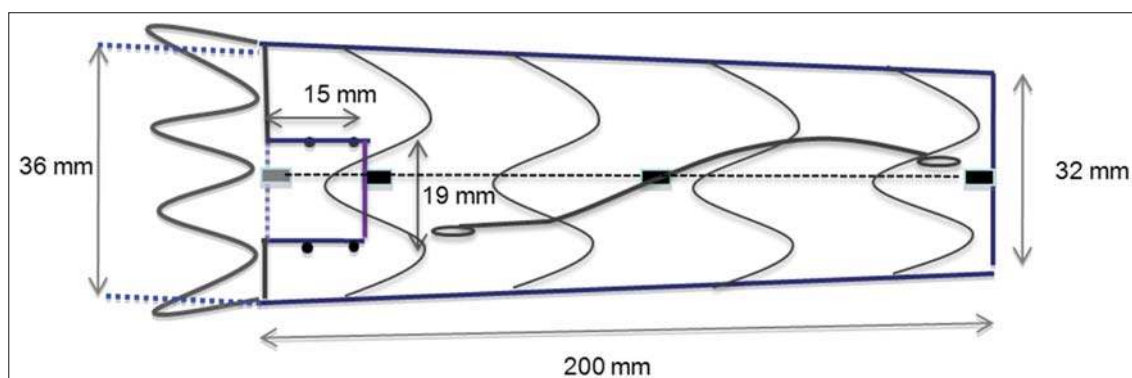


Fig. 2. Proximal scalloped Relay® drawing. Note the 10° anterior disposition of the scallop

scallop (10° anterior offset) was also recommended for optimal matching of the ostium (*Fig. 2*).

Technical procedural challenges included the advancement of the delivery system through the narrowed true lumen and the proper alignment of the scallop matching to the ostium of the left common carotid artery [3]. Both aspects were managed successfully due to

the flexibility and smoothness of the inner sheath in the delivery device and the auto-alignment capability and accurate positioning of the stent-graft due to its precurved internal design. One super-stiff guidewire (Lunderquist, CookMedical Inc., Bloomington, IN, USA) supported the advancement of the delivery device. Systolic blood pressure was decreased using the rapid pacing technique in order to prevent any longitudinal distal migration of the stent graft during its deployment. Transesophageal echography was used to identify the true and false aortic lumens.

End-of-surgery control angiography showed no endoleak and proper stent-graft position. The patient experienced a fast and uneventful recovery from the procedure; however, control CTA at 1 month showed growth of the aneurysmatic sac and a type Ia endoleak, which originated from the distal end of the proximal scallop. The endoleak was successfully embolized with coils (Nester, CookMedical Inc., Bloomington, IN, USA; TruFill, Cordis Corporation, Bridgewater, NJ, USA) via femoral access of the false lumen. The follow-up CTA at 1 month showed decreasing aneurysm sac and absence of any endoleak (*Fig. 3*). The patient remained asymptomatic and went back to his normal activities and work. The 6-month follow-up CTA revealed almost complete thrombosis of the false lumen, shrinkage of the dilated aorta, and no endoleak.



Fig. 3. Follow-up CT angiography after successful coil (red) embolization of type Ia endoleak

Discussion

Drug abuse can be a factor favoring the generation of aortic pathologies [4]. Moreover, due to the fact that many cocaine users are young or middle-age patients, degenerative diseases and chronic lesions can lead to illness for persons who still have a long life expectancy.

The conventional surgical procedures for treating dissections involving the aortic arch require cardiopulmonary bypass, deep hypothermia, or circulatory arrest. However, surgery under these conditions is not exempt from occasional serious complications that are associated with high mortality and morbidity rates: microemboli,

systemic inflammatory reactions, coagulopathy, renal and cardiac failure, respiratory distress syndrome, and other impairments subsequent to the treatment [5].

Proper landing zones are critical for effective anchorage and fixation of stent-graft devices and are even more critical when dealing with proximal landing zones (proximal necks). Careful, detailed analysis of the preoperative images is mandatory in such cases, and generation of 3D aortic reconstructions allowed us on this occasion to observe details that were helpful when designing the proximal scalloped device to be implanted [6]. Relay® plus stent-graft is a reliable platform for tailoring particular solutions when the permeability of upper trunks is at risk. Endografting is frequently based on visualization of the proximal and distal radiopaque markers delimiting the segment of the treated aorta. Placement of the C-arm in a left-oblique position covers the needs for good guidance when advancing and delivering the stent graft in the vessel in most cases. Nevertheless, aortic arch repair demands more visual references (e.g., left and right oblique orientation of C-arm) which can consume extra operational time (usually minutes) but offers better knowledge of the stent-to-aorta relationship and more confidence when correct position of the scallop is the ultimate target for successful treatment.

However, placement of these devices is not exempt from underlying procedure-related and/or device-related complications. In our case, a type Ia endoleak detected at the 1-month follow-up assessment was probably due to a suboptimal interaction between the distal scallop and the wall of the aortic and the stump of the previously transposed left subclavian artery [7]. This complication was successfully solved, and the endoleak was eliminated using coils.

Evidence of different uses of proximal scalloped devices already exists in the context of treating arch-related aortic lesions. Lack of prospective trials that include a more representative number of subjects is a reality, even though feasibility has been demonstrated in small series.

Conclusion

Endovascular treatment of aortic arch disease may require the use of a modified custom-made endograft in the event of a short healthy proximal aortic segment for proper fixation of the stent graft. Type B dissections typically only arise distally from the left subclavian artery and present a major communication (primary entry tear) between the true and the false lumens near the aortic arch which sometimes makes the use of standard stent-graft configurations impossible.

We reported the case of a young cocaine-abuser patient with an enlarging and long chronic type B dissection affecting the aortic arch and the origin of the left subclavian artery. Hybrid treatment consisted of a two-step procedure: the left subclavian artery was first transposed to the left common carotid artery, and a proximal scalloped custom-made stent graft was then successfully implanted not covering the left common carotid artery.

According to our experience, we believe that proximal scalloped custom-made Relay® stent grafts offer promising potential in the treatment of complicated aortic arch-related diseases including but not limited to type B aortic dissections.

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