

Endovascular repair of a thoraco-abdominal aneurysm using the sandwich technique

Petroula Nana¹, Georgios Kouvelos¹, Konstantinos Spanos¹, Aikaterini Bouzia², Konstantinos Batzalexis¹, Eleni Arnaoutoglou², Athanasios Giannoukas¹, Miltiadis Matsagkas¹

¹Department of Vascular Surgery, Faculty of Medicine, School of Health Sciences, University of Thessaly, Larissa, Greece

²Department of Anesthesiology, Faculty of Medicine, School of Health Sciences, University of Thessaly, Larissa, Greece

Abstract:

Endovascular repair of thoraco-abdominal aneurysms has gained popularity due to custom-made devices such as fenestrated and branched ones. However, these devices may not be applicable in the emergent setting and/or in specific anatomical conditions. Sandwich technique using parallel grafts, may be a valid alternative in some of these cases. We report a case of a 73-year-old male patient, who was considered unfit for open repair and unsuitable for fenestrated/branched devices, presenting with a large type II thoraco-abdominal aneurysm. The patient has been treated in two stages using the sandwich technique.

INTRODUCTION

Endovascular repair of thoraco-abdominal aneurysms has gained popularity during the last decade, lowering the mortality and morbidity rates in comparison with open surgery.¹ Fenestrated and branched endografts have substantially improved the operative outcomes in these patients.² However, these devices are not applicable in urgent cases or/and may not be suitable in tortuous aortic anatomy.³ In this setting, “off-the-shelf” techniques, as chimney and sandwich, sustain as a valid alternative.^{2,3} The sandwich technique for the treatment of thoraco-abdominal aneurysms (TAAAs) consists of four steps: A. A thoracic endograft is deployed to treat the thoracic part of the aneurysm. Its distal end is left above the celiac axis, B. Cannulation of the visceral arteries, usually from above and deployment of covered self-expandable stents in the visceral arteries, C. Treatment of the remaining segment of the aneurysm, using a thoracic or bifurcated endograft, depending on aneurysm type, demonstrating the final sandwich technique.⁴ Herein, we report a case of a 73-year-old male, presenting a type II TAAA, treated with the sandwich technique. This report has been approved by the Ethics Committee of the Hospital.

CASE REPORT

Author for correspondence:

Miltiadis Matsagkas, MD, PhD, FEBVS

Professor of Vascular Surgery, Department of Vascular Surgery, Medical School, University of Thessaly, Mezourlo, Larissa, Greece

Tel: +30 2413501739

E-mail: milmat@gmail.com

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A 73-year old male, with a history of EVAR with a bifurcated endoprosthesis (Talent, Medtronic, Minnesota, USA) 12 years ago, presented after a 7-year absence of follow-up. His medical history was significant for tobacco use, hypertension, dyslipidemia, coronary arterial disease and chronic obstructive pulmonary disease. Computed tomography angiography (CTA) revealed a graft migration associated with the development of a type II TAAA with a maximum diameter at 75mm and a 30mm left common iliac artery aneurysm (Figure 1A). A chronic coeliac trunk occlusion was also identified. Extreme angulations of the para-visceral aorta precluded any treatment with conventional complex endovascular techniques (Figure 1B). Considering this complex anatomy, a sandwich technique repair was decided. A two-stage approach with an interval of 12 weeks was initially decided, in order to decrease the possibility of spinal cord ischemia.

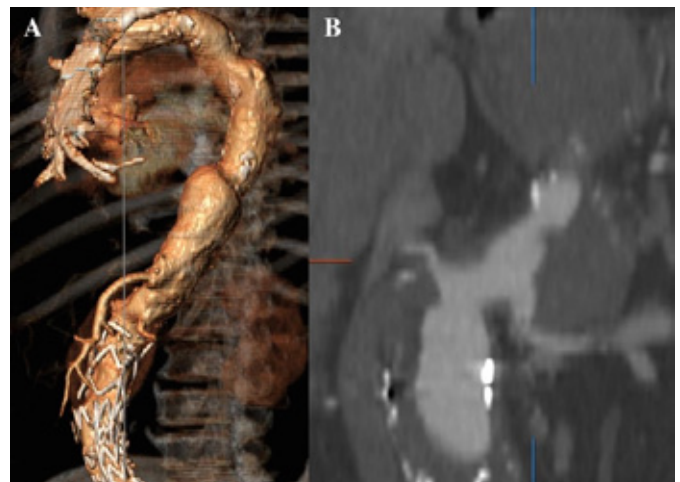


Figure 1. (A) A type II thoraco-abdominal aneurysm was developed after a failed previous EVAR. (B) Extreme angulations of the para-visceral aorta precluded any treatment with fenestrated or branched devices.



Figure 2. Pre-operative planning of the sandwich technique. A periscope was decided to be used to re-vascularize the right renal artery. Two custom-made endografts were deployed to achieve sealing.

Two custom-made thoracic endografts and 3 visceral stent grafts were used during the first procedure. A thoracic endograft (Relay 42x34x135mm, Bolton Medical, Sunrise, Florida, USA) (Figure 2) was implanted initially at the distal descending aorta. Parallel covered stents were deployed in the renal (RA) and superior mesenteric (SMA) arteries to achieve vascularization. The SMA and left RA were catheterized antegrade from the axillary arteries while the right RA was able to be catheterized via the left common femoral artery, creating a periscope. Covered self-expanding stents, with 100mm of length, were deployed in all arteries (Viabahn, W. L. Gore & Associates, Newark, Delaware, USA). Relining, using self-expanding bare metal stents, was applied in all vessels in order to achieve a better configuration and more stability (E-Luminex, Bard, Covington, USA). A second thoracic graft (Relay, 40x38x150mm, Bolton Medical, Sunrise, Florida) (Figure 2) was deployed down to the bifurcation of the previous endograft. An additional limb, extending to the external iliac artery, was used to seal the iliac aneurysm (Excluder, 16x14.5x120mm, W. L. Gore & Associates, Newark, Delaware, USA). The procedure was completed after kissing-balloon technique at the level of thoracic grafts' overlapping and visceral artery stents.

The completion angiography showed no endoleak and all visceral stents were patent (Figure 3). The operation duration was 300 min, contrast use was 250ml and dose area product was 735mGy/cm² (113 min). Pre-discharge CTA confirmed no complication in terms of endoleaks and graft patency. The patient was discharged the 6th post-operative day with a mild renal impairment (GFR 44ml/min/1.73m²). A close surveillance with clinical re-evaluations and laboratory exams confirm the good general status of the patient and the restoration of the renal function.

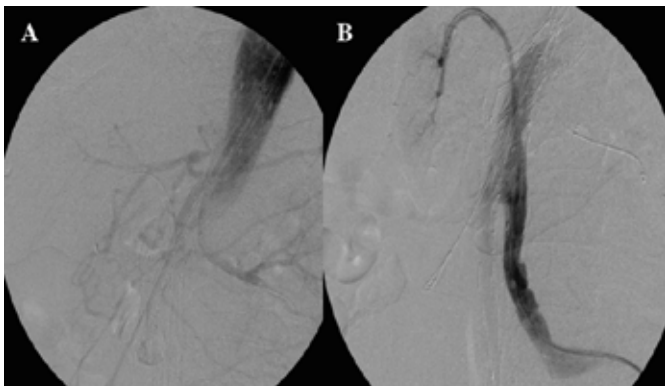


Figure 3. Completion angiography revealed no endoleak while all visceral stents were patent. Self-expanding stents, relined with bare metal stents, were used as parallel grafts.

A month later, the patient presented at the emergency department referring an atypical thoracic pain. An emergent CTA revealed a proximal descending aorta expansion from 69mm to 90mm (Figure 4). An additional thoracic endograft (Relay, 38x38x145mm, Bolton Medical, Sunrise, Florida) was successfully deployed below the left subclavian artery to the previous proximal thoracic graft, using a right femoral and left brachial access. The patient had an uncomplicated post-operative in-hospital stay. A pre-discharge CTA confirmed the complete exclusion of the aneurysm sac and no endoleak was revealed. The patient was discharged the 4th post-operative day in a good general condition.

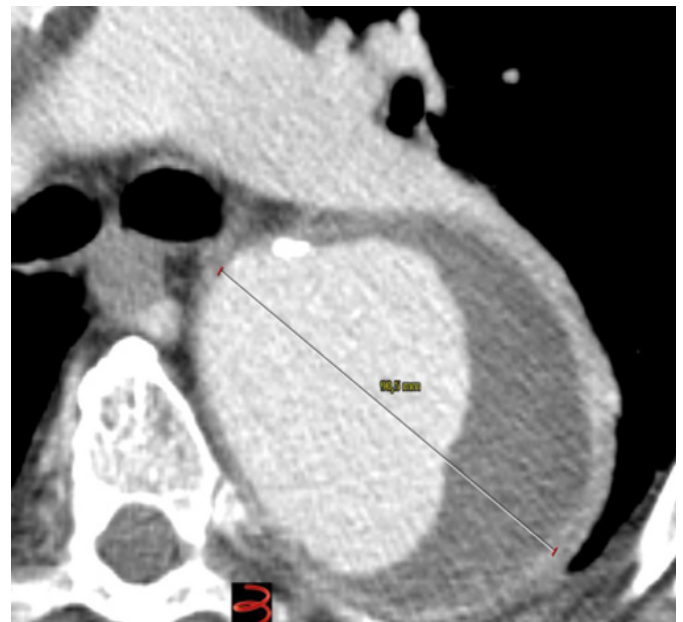


Figure 4. A thoracic aneurysm sac expansion was detected in an emergent CTA

Follow-up at 6 and 12 months revealed no complication, with a complete sac exclusion and patent visceral stents (Figure 5A, B and C), while the patient remains in good clinical condition.

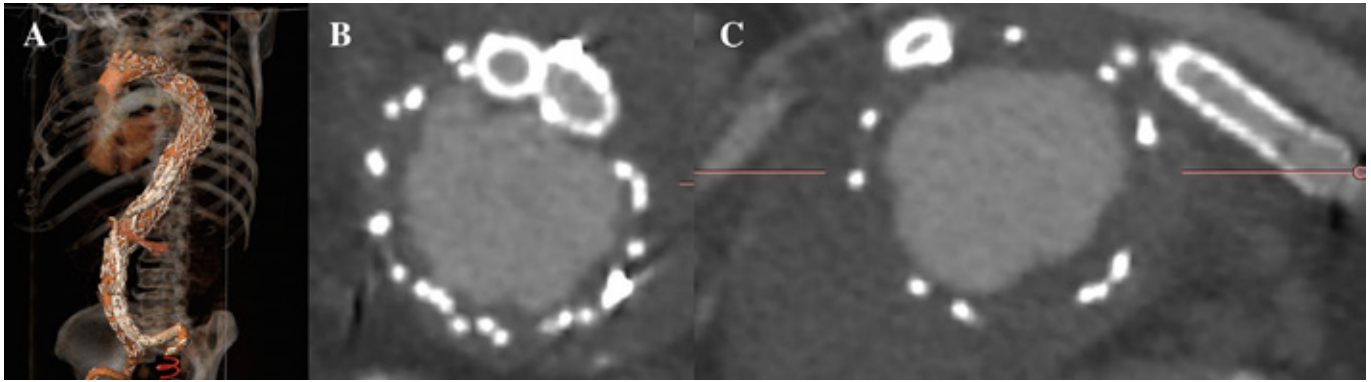


Figure 5. CTA at 6 (A, B) and 12 (C) months of follow-up revealed no endoleak. All stents remained patent.

DISCUSSION

TAAA repair is associated with 6.6% mortality rate in elective cases and up to 47% in the emergent setting.⁴ Fenestrated and branched devices offer a safe and durable option when aneurysm anatomy is suitable for these techniques.⁵ Hybrid procedures and other complex endovascular techniques have been used with conflicting outcomes.⁴ The sandwich technique, which was initially presented by Lobato *et al*, may be a valid alternative in patients with unsuitable anatomy or in emergent/urgent cases, due to its intra-operative management flexibility, which characterizes the “off-the-shelf” techniques.^{2,4,6,7,8} In these series, 15 patients, considered high-risk for open surgical repair, have been treated with the sandwich technique. Technical success rate was achieved in 92.3% of them and the total 30-day mortality rate was 20%.⁴

Visceral graft occlusions are a rare complication in patients treated with the sandwich technique.⁹ They appear to occur generally during the early follow-up (mean 3.5 months) with an expected rate up to 4.5%.⁹ In most cases, renal artery endograft occlusion may have mild or moderate consequences while SMA occlusion can be associated with life-threatening events.⁹ Current literature records a high primary patency rate for the visceral grafts in the sandwich setting, while different management strategies may be applied in case of stenosis/occlusion, including open conversion, endovascular re-vascularization or conservative treatment.^{9,10,11} In any case during the long-term follow-up, the cumulative primary patency rate may achieve 90%.¹¹ As reported in this case, the use of longer covered stents is usually necessary in the sandwich setting as a 5cm overlapping between the main endografts is usually demanded. This makes inadequate the use of balloon expandable stents in many cases, as most of them come with lengths shorter than 60mm.¹⁰ However, a novel one comes in 79mm of length and it may offer a valid option in some cases.³ Thus, in many cases, self-expanding covered stents have to be used to facilitate the extended length needed. It should be mentioned that such long parallel grafts are more prone to kink, suppression, stenosis and eventually, thrombosis. Thus, in our opinion, relining with an extra self-expanding bare metal stent should be a standard approach, in order to avoid kinking and suppression.

Endoleak remains one of the most important disadvantages of the technique with a reported total intra-operative endoleak rate up to 35%.^{3,9,10,12} Type I endoleaks may be treated with endovascular means while type III and IV may be treated conservatively as spontaneous sealing may be expected during the first month.^{5,10} Gutter endoleak formation may be inevitable in parallel graft techniques. The low flow characteristics and their benign evolution separates them from high-flow type Ia endoleaks, formed by an inadequate sealing between the endograft and the aortic wall.¹³ Endoleaks may be detected during the mid-term follow-up (3-6months) due to graft migration. An endovascular re-approach may be a solution in these cases, even if a re-catheterization of the visceral grafts may be extremely challenging.¹⁰ No late or recurrent endoleaks may be expected in the long-term follow-up according to the current literature.^{10,11,12}

In this high-risk group of patients, sandwich technique seems to be associated with acceptable mortality and morbidity rates. In previous case series, all-cause mortality was up to 11% in 30-day follow-up while aneurysm-related death rate remained low.^{12,14,15} During mid-term follow-up, aneurysm sac stability or shrinkage confirms the early durability of the technique.¹⁴ Renal failure is usually seen in cases with stent thrombosis.⁹ However, severe consequences are rarely reported.⁹ In the current case, mild post-operative renal insufficiency was treated with aggressive hydration. No further measures were used. Spinal cord ischemia with associated paraplegia has already been recorded in such cases, as an important aortic length is needed to be covered during the endovascular repair of TAAAs.¹⁵ In this case, a two-stage approach was decided during the pre-operative planning. Despite the emergent 2nd procedure, the patient revealed no neurological deficit.

Sandwich technique seems to be a safe and feasible “off-the-shelf” alternative for the treatment of TAAAs.⁹ The flexibility of the technique permits its application in aneurysms with challenging anatomy, where fenestrated or branched devices are not applicable, or available.⁸ In emergent cases, “off-the-shelf” parallel graft techniques may be the only existing solution.⁷ In any case, this technique is rather complex and requires endovascular expertise as well as the availability of several materials and adequate imaging. Low aneurysm-relat-

ed mortality indicates that the sandwich technique may be a promising endovascular method for the treatment of TAAAs in certain conditions.^{12,15}

CONCLUSION

Parallel-graft techniques may be a valid option for the treatment of complex cases of TAAAs. The sandwich technique seems to be a safe and durable intervention at least during the mid-term follow-up.

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Conflict of interest: None

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