CASE REPORTS

A TIMELINE FROM INDEX PROCEDURE TO COMPLEX REINTERVENTIONS FOR THORACOABDOMINAL AORTIC DISSECTION

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Abstract

Introduction: *The optimal management of acute type A aortic dissection (ATAAD) remains a controversial subject. While some surgeons opt for a hemiarch approach to minimize bypass and cross-clamping time, others prefer partial or total arch replacement to prevent the need for additional operations. The advent of hybrid approaches offers a variety of options to the aortic surgeon in treating ATAAD. Herein, we present a complex case of ATAAD requiring multistage reconstruction of the aortic arch and its branch vessels utilizing hybrid techniques. A 67-year-old man presented with chest pain and hypertension, leading to diagnosis of ATAAD. He initially underwent hemiarch replacement, which required multiple further interventions secondary to progressive thoracic aorta aneurysmal dilation, innominate artery dissection, and subclavian steal syndrome. A hybrid approach of open and endovascular techniques was utilized to treat the patient's pathology. ATAAD represents a challenging clinical entity in its acute, subacute, and long-term management. Currently, no consensus exists on ideal initial management of this disease. Nonetheless, new techniques such as fenestration of thoracic endografts can be utilized for the subsequent operations. Individualized care tailored to each case is the most effective management of this intricate disease.*

Keywords: *type A aortic dissection, hemiarch replacement, total arch replacement, aortic reconstruction, hybrid technique*

INTRODUCTION

The immediate management of acute type A aortic dissection (ATAAD) aims to prevent malperfusion of the coronary arteries or pericardial tamponade secondary to retrograde proximal dissection[1]. Accordingly, excision of the entry tear in the ascending aorta and arch is the minimum required initial treatment. The distal extent of aortic replacement at the index operation is a topic of debate, with two primary options available: limited hemiarch replacement versus partial/total arch replacement with up-front supra-aortic trunk (SAT) vessel debranching[2-5].

Utilizing the hemiarch approach can effectively reduce bypass and aortic cross-clamp time by avoiding immediate debranching of the SAT vessels[6, 7]. The residual dissection flap may then be addressed in the subacute period with thoracic endovascular aortic repair (TEVAR) and SAT reconstruction as needed. Depending on specific flap morphology, these reconstructions can become increasingly complex and extensive[8]. A partial arch replacement with debranching of the innominate artery or total arch replacement (TAR) with debranching of all SAT vessels, both include performance of an elephant trunk (ET) or frozen elephant trunk (FET) procedure[9]. Although the aim of these initially aggressive approaches is to limit the number and complexity of future aortic interventions, controversy exists whether they provide a real clinical benefit[10, 11].

Alternative approaches to complete endovascular repair of the aortic arch in patients with prohibitive risk for open repair are being investigated. Nevertheless, these approaches carry their own set of risks, including TEVAR-associated retrograde dissection[12] and perioperative stroke, which may arise due to manipulation of SAT vessels[13]. While fenestrated or branched endovascular devices add to the arsenal of treatment options for ATAAD, open repair of the SAT vessels remains a crucial adjunct to hemiarch replacement and TEVAR due to the low morbidity and high patency rate[1]. Herein, we describe a

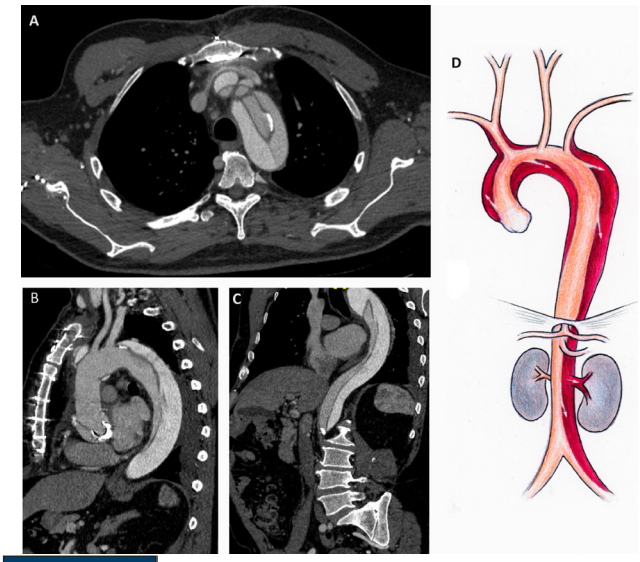

Figure 1

1 Type II A aortic dissection extending from the ascending arch distal to the coronary sinuses (A, B) down to the aortic bifurcation (C, D)

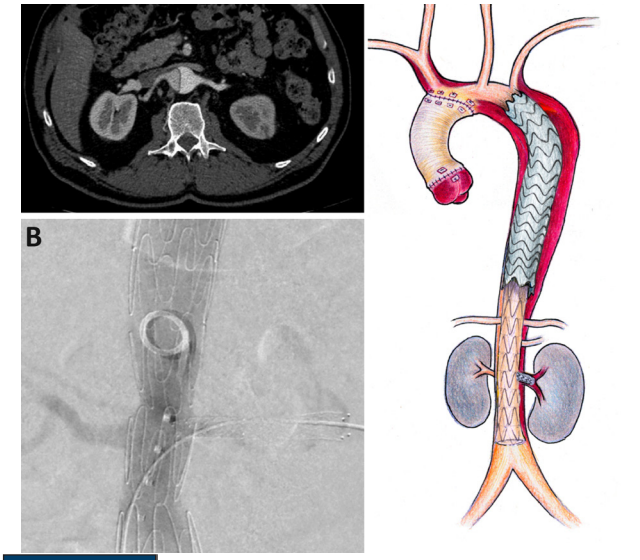

Figure 2

Dissection flap at the level of the renal arteries (A, B). A bare metal stent was placed in the renal artery to permit perfusion via the false lumen (C).

case of an extensive ATAAD from the ascending arch down to the aortic bifurcation that required multistage reconstruction and replacement of the entire thoracic aorta and its branch vessels, utilizing a range of hybrid techniques to sequentially address sequelae of malperfusion and arch dilation.

METHODS

The electronic medical records of a patient with ATAAD extending to aortic bifurcation were reviewed. Data were collected regarding patient's baseline lesion, procedural characteristics, and outcomes during follow up. Informed consent was obtained from the patients for treatment and publication of these case reports and accompanying images. No Protected Health Information was disclosed. No institutional review board (IRB) approval was required.

CASE REPORT

Presentation

A 67-year-old man presented with acute onset severe chest pain and hypertension with systolic pressures reaching 190 mmHg. Subsequent computed tomography (CT) angiography demonstrated a complex type A aortic dissection extending from the ascending aorta, distal to the coronary sinuses, down to the aortic bifurcation (Figure 1). Despite the arch dissection involving the major SAT vessels, the patient demonstrated no neurologic deficits, upper extremity ischemia, or any other evidence of distal malperfusion.

Hemiarch repair

The patient was taken to the operating room and placed on cardiopulmonary bypass. An on-table trans-esophageal echocardiogram was suggestive of severe aortic valve incompetence and opening of the aorta confirmed poor alignment of the aortic valve leaflets due to the proximal extent of the dissection. Aortic valve replacement with a 25 mm Edwards © tissue valve was performed. The ascending arch was excised and replaced with a 28 mm Gelweave © Dacron graft. A distal hemiarch approach via oblique aortic transection was utilized due to entry tear in the inferoanterior portion of the mid-aortic arch. The patient recovered well from the initial procedure and was eventually discharged home.

TEVAR and left renal artery stenting

On 3-month postoperative surveillance scan, he was noted to have dilation of his thoracic aorta to 4.5 cm. He subsequently underwent TEVAR in an attempt to stabilize the dissection flap and prevent further dilation. Intravascular ultrasound (IVUS) was utilized to identify the true lumen. Three Cook © endografts were deployed, with proximal stent landed in Ishimaru zone 3, flush with the origin of the left subclavian artery. The second graft was landed 4 cm proximal to the celiac artery origin. A bare metal stent graft was then deployed with landing zone 5 mm above the aortic bifurcation. The STABILISE technique was selectively utilized in the infrarenal segment with a semi-compliant balloon and the false lumen was obliterated distally. Ballooning was not performed proximally in the visceral segments, as multiple visceral vessels were involved with the dissection and partially perfused by the false lumen. Of note, the left renal artery received perfusion from both the true and false lumens, with insufficient perfusion noted on angiography after stent deployment. Due to dynamic compression, a bare metal stent was placed in the renal artery to permit perfusion via the false lumen (Figure 2). Our patient again recovered well and received surveillance scans over the ensuing year.

Hybrid approach: TEVAR revision with laser fenestration & open debranching

During postoperative surveillance, imaging revealed further dissection into the innominate artery and continued aneurysmal dilation of the thoracic aorta. He was scheduled for a hybrid procedure involving laser fenestration, left subclavian artery revascularization, and open debranching/reconstruction of the innominate and left carotid arteries to extend the existing TEVAR.

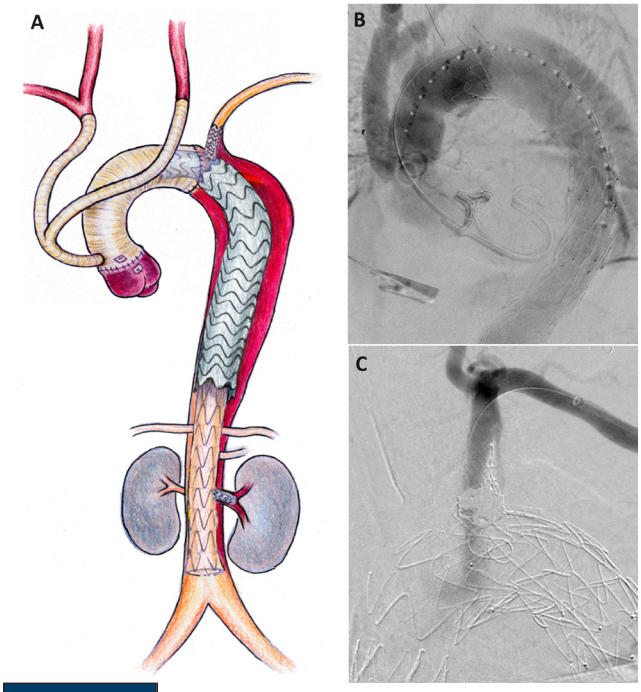

Figure 3

The branched Dacron graft used for repair of the proximal dissection that was anastomosed to the TEVAR stent graft distal and via a laser fenestration a balloon expandable covered stent was placed in the left subclavian artery.

A median sternotomy was performed to debranch the arch. The ascending aortic graft was controlled with a side-biting clamp. A 14 x 10 x 10 mm branched Dacron graft was modified and placed, with the left subclavian branch stapled off. This was then anastomosed to the proximal aortic graft in an end-to-side fashion. The innominate and left carotid were controlled and stapled, with end-to-end anastomoses performed to the graft. This incorporated both the true and false lumen of the innominate artery. The graft anastomosis was marked, and a Cook© ZTA 36 x 161 mm stent graft was placed antegrade with proximal end landed 5mm distal. The chest was closed, and attention turned to revascularization of the left subclavian artery.

A left brachial cutdown was performed and via retrograde access the stent graft was engaged and fenestrated using an .035 Baylis© PowerWire. The fenestration was then pre-ballooned to 7mm to accommodate the planned 7 x 29 mm Gore© VBX stent. Separately, the false lumen of the left subclavian artery was accessed and coil embolized to minimize risk of Type III endoleak around the subclavian stent. The stent was then deployed in the left subclavian artery (Figure 3). Completion angiography demonstrated flow through the aortic arch vessels and the subclavian stent with no evidence of antegrade flow into the false lumen.

The thoracic aortic sac was subsequently stabilized in size following this procedure. Despite an intact seal at the proximal TEVAR site, there was persistent retrograde filling of the false lumen within the descending thoracic and abdominal portions of the dissection. The patient continued to receive standard surveillance scans to watch for signs of thrombosis and remodeling of the false lumen.

Left carotid to right subclavian artery bypass

Approximately 18 months postoperatively, he began experiencing pre-syncopal episodes with right upper extremity exertion. Duplex ultrasound confirmed right subclavian artery stenosis with associated flow reversal in the right vertebral ar-

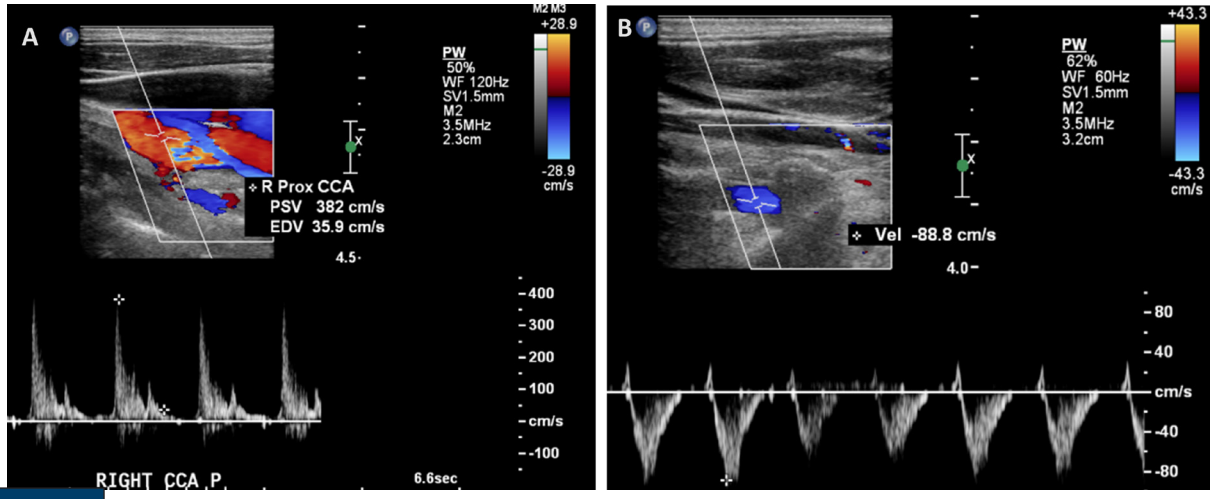

Figure 4

The right common carotid was involved in the dissection of the innominate artery from index procedure (A). Duplex ultrasound showing right subclavian artery stenosis with associated flow reversal in the right vertebral artery (B).

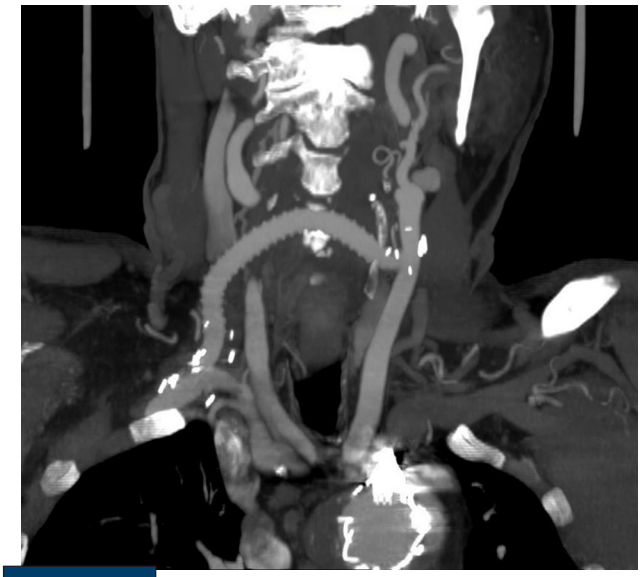

Figure 5 *The retropharyngeal left carotid to right subclavian artery bypass*

tery (Figure 4). The right common carotid was involved in the dissection of the innominate artery, making it unsuitable for subclavian revascularization. Endovascular approach was not possible due to the debranched aortic arch as well as the difficulty in excluding the carotid artery if the subclavian artery was stented proximal to the take-off of the vertebral artery. After discussing with the patient, a left carotid to right subclavian bypass was performed using an 8 mm ringed PTFE graft through a retropharyngeal tunnel (Figure 5). Following this procedure, the patient recovered well with resolution of his symptoms.

He has been under regular follow-up (every 6 months) in the vascular outpatient clinic and is currently well and asymptomatic from the arterial point of view 24 months from his last procedure, 4 years from initial presentation.

DISCUSSION

The decision between hemiarch and extensive arch reconstruction at the initial procedure remains the subject of debate. Some reports suggest that early arch reconstruction carries increased risk of morbidity and mortality[14-16]. A review of the International Registry of Acute Aortic Dissection (IRAD) database indicates that since 1996, the proportion of surgeons utilizing a hemiarch repair has significantly increased, perhaps due to the perception of increased mortality rate of partial/total arch repairs[17]. Numerous studies have demonstrated that initial extensive arch reconstruction is more technically demanding, with increased cardiopulmonary bypass and aortic cross-clamp time[3, 13, 14, 16]. While the current literature does not demonstrate a clear long-term benefit with TAR, future operations may be performed more easily or even prevented entirely in a hybrid setting, given the availability of endovascular options[3, 10, 13, 15, 18, 19].

In some specific circumstances, such as patients with connective tissue disease (e.g., Marfan syndrome) or greater than 5 cm dilation of the distal thoracic aorta, TAR has a statistically significant decrease in future reoperation rate[13]. FET and ET are considered the most aggressive reconstructions and, therefore, are most likely to provide long-term benefit. Nevertheless, these procedures carry an overall small but not negligible risk of paraplegia that is rarely seen in hemiarch repair cases[9, 18, 19]. Although extensive reconstruction may be appropriate in carefully selected patients in dedicated aortic centers to decrease future procedures, a hemiarch approach is safe and likely sufficient in the short term to address acute type A aortic dissections and ensure operative survival[20-22].

TEVAR has recently become an adjunct to open repair in type A aortic dissections, with a favorable morbidity/mortality profile compared to open repair of the descending thoracic aorta[23-26]. While the STABILISE technique shows promise in complex and extensive dissection, it necessitates cautious implementation to steer clear of potential complications like aortic rupture. If intricate dissections are present involving visceral vessel branches, stenting the true lumen can result in malperfusion—especially if there is a sizeable flow into dissected vessels from a patent false lumen. Our case serves as a demonstration of this phenomenon. Careful attention should be paid to perfusion of visceral branches upon completion, as further stent placements may be required to avoid or treat malperfusion. To mitigate these risks, the balloon should be appropriately undersized to perform intimal flap disruption and false lumen depressurization rather than full aortic wall re-apposition[25].

Laser fenestration is a useful tool in both elective and emergent aortic repairs as a flexible adjunct to endovascular stent-grafting, allowing for lengthening of the proximal seal zone without requiring preplanned custom endovascular grafts[27, 28]. Burning graft material and potentially tearing the graft during ballooning risks type III endoleak, damage to the integrity of the graft, and embolization of fenestrated graft debris. Ex vivo studies have demonstrated that laser fenestration can achieve consistent fenestration dimensions with negligible low-risk embolic debris, particularly when using smaller 6- or 8-mm balloons for dilation of the initial fenestration[29]. PTFE grafts are fenestrated with better shape and margin compared to woven polyester graft materials but have a theoretical risk of chemical toxicity from the cauterized material[29, 30]. Evans et al. demonstrated that using the larger 2.3 mm laser systems compared to 0.9 mm systems produced more consistent fenestrations with reduced fabric tearing during dilation[27]. In this case, the false lumen was coil embolized and the entry point of the stent into the fenestration was flared to decrease type III endoleak. This has been shown to be more common when grafting for dissection pathology but can be effectively prevented using the above technique[27, 28].

When aortic pathology extends into the branch vessels, revascularization and bypass of the vessels may be necessary. Revascularization options for the left subclavian artery include both open and endovascular approaches. The two main open

approaches are carotid-subclavian bypass (CSB) and subclavian-carotid transposition (SCT). The SCT is considered a feasible, effective, and safe technique for subclavian artery revascularization and is associated with optimal mid-term patency along with low risk of neurological events and mortality[31]. However, due to the delicate subclavian artery and the dissection in the ipsilateral carotid artery in our patient, the R CCA was not a suitable donor vessel. Thus, we opted to perform CSB. Several studies indicated that CSB offers a lower but still acceptable 5-year patency rate (84-92%) with very low risk of death, stroke, or nerve palsy[32, 33]. Retropharyngeal tunneling to facilitate contralateral bypass offers a theoretical advantage in patency over subcutaneous tunneling due to the shorter path to the contralateral neck and has been demonstrated to have long-term safety and efficacy[34].

ATAAD is a devastating disease with a high mortality rate. Even in those patients who survive the initial insult, hospital course can be prolonged and long-term health permanently affected. The care of these patients is long-term, requiring lifelong follow-up as aortic expansion may develop as late as a decade postoperatively[35]. Reoperation rates can range from 5-10% over the next decade[36-38]. Accordingly, patients and their families should be actively engaged in their care. A study of patients who survived ATAAD and subsequent operations demonstrated significantly decreased quality of life in seven of eight different fields, including physical/social functioning, pain, overall health, and vitality[39]. It has been well-documented that patients surviving ATAAD are at higher risk for development of post-traumatic stress disorder (PTSD) and other mental health disorders[40, 41] Support groups may prove beneficial in assisting patients and families as they cope with these changes. Survivors of ATAAD have been demonstrated to have lower resiliency scores, but those with increased social support tend to have better overall resilience[42]. The increasing prevalence of social media and digital connectivity could allow these patients greater access to social resources and support.

CONCLUSION

ATAAD continues to present a therapeutic challenge in the acute, subacute, and long-term periods to aortic surgeons as the handling and timing of managing aortic arch branch vessels remains a topic of discussion. The growing armamentarium of open, endovascular, and hybrid approaches offers several treatment options. However, more research is still required to improve mortality and reintervention rates. Given the variety in dissection morphology and symptomatology, we strongly believe that patients are best served with an individualized approach. Our case demonstrates an example of this personalized care, using a hybrid approach for staged complete reconstruction of the aorta and the SAT vessels.

REFERENCES

1. Gudbjartsson T, Ahlsson A, Geirsson A, et al. Acute type A aortic dissection - a review. Scand Cardiovasc J. 2020;54(1):1-13.
2. Norton EL, Wu X, Kim KM, et al. Is hemiarch replacement adequate in acute type A aortic dissection repair in patients with arch branch vessel dissection without cerebral malperfusion? J Thorac Cardiovasc Surg. 2021;161(3):873-84.e2.
3. Larsen M, Trimarchi S, Patel HJ, et al. Extended versus limited arch replacement in acute Type A aortic dissection. Eur J Cardiothorac Surg. 2017;52(6):1104-10.
4. Ma L, Chai T, Yang X, et al. Outcomes of hemi- vs. total arch replacement in acute type A aortic dissection: A systematic review and meta-analysis. Front Cardiovasc Med. 2022;9:988619.
5. Poon SS, Theologou T, Harrington D, et al. Hemiarch versus total aortic arch replacement in acute type A dissection: a systematic review and meta-analysis. Ann Cardiothorac Surg. 2016;5(3):156-73.
6. Saw LJ, Lim-Cooke MS, Woodward B, et al. The surgical management of acute type A aortic dissection: Current options and future trends. J Card Surg. 2020;35(9):2286-96.
7. Abjigitova D, Mokhles MM, Papageorgiou G, et al. Outcomes of different aortic arch replacement techniques. J Card Surg. 2020;35(2):367-74.
8. Malaisrie SC, Duncan BF, Mehta CK, et al. The addition of hemiarch replacement to aortic root surgery does not affect safety. J Thorac Cardiovasc Surg. 2015;150(1):118-24.e2.
9. Di Bartolomeo R, Murana G, Di Marco L, et al. Frozen versus conventional elephant trunk technique: application in clinical practice. Eur J Cardiothorac Surg. 2017;51(suppl 1):i20-i8.
10. Jassar AS, Sundt TM, 3rd. How should we manage type A aortic dissection? Gen Thorac Cardiovasc Surg. 2019;67(1):137-45.
11. Pan E, Gudbjartsson T, Ahlsson A, et al. Low rate of reoperations after acute type A aortic dissection repair from The Nordic Consortium Registry. J Thorac Cardiovasc Surg. 2018;156(3):939-48.
12. Chen Y, Zhang S, Liu L, et al. Retrograde Type A Aortic Dissection After Thoracic Endovascular Aortic Repair: A Systematic Review and Meta-Analysis. J Am Heart Assoc. 2017;6(9).
13. Omura A, Miyahara S, Yamanaka K, et al. Early and late outcomes of repaired acute DeBakey type I aortic dissection after graft replacement. J Thorac Cardiovasc Surg. 2016;151(2):341-8.
14. Kim JB, Chung CH, Moon DH, et al. Total arch repair versus hemiarch repair in the management of acute DeBakey type I aortic dissection. Eur J Cardiothorac Surg. 2011;40(4):881-7.
15. Ehrlich MP, Ergin MA, McCullough JN, et al. Results of immediate surgical treatment of all acute type A dissections. Circulation. 2000;102(19 Suppl 3):Iii248-52.
16. Shi E, Gu T, Yu Y, et al. Early and midterm outcomes of hemiarch replacement combined with stented elephant trunk in the management of acute DeBakey type I aortic dissection: comparison with total arch replacement. J Thorac Cardiovasc Surg. 2014;148(5):2125-31.
17. Parikh N, Trimarchi S, Gleason TG, et al. Changes in operative

strategy for patients enrolled in the International Registry of Acute Aortic Dissection interventional cohort program. J Thorac Cardiovasc Surg. 2017;153(4):S74-s9.
18. Matalanis G, Ip S. Total aortic repair for acute type A aortic dissection: a new paradigm. J Vis Surg. 2018;4:79.
19. Andersen ND, Williams JB, Hanna JM, et al. Results with an algorithmic approach to hybrid repair of the aortic arch. J Vasc Surg. 2013;57(3):655-67; discussion 66-7.
20. Frankel WC, Green SY, Orozco-Sevilla V, et al. Contemporary Surgical Strategies for Acute Type A Aortic Dissection. Semin Thorac Cardiovasc Surg. 2020;32(4):617-29.
21. Li B, Ma WG, Liu YM, et al. Is extended arch replacement justified for acute type A aortic dissection? Interact Cardiovasc Thorac Surg. 2015;20(1):120-6.
22. Elbatarny M, Stevens LM, Dagenais F, et al. Hemiarch versus extended arch repair for acute type A dissection: Results from a multicenter national registry. J Thorac Cardiovasc Surg. 2023.
23. Matalanis G, Ip S. A new paradigm in the management of acute type A aortic dissection: Total aortic repair. J Thorac Cardiovasc Surg. 2019;157(1):3-11.
24. Nienaber CA, Kische S, Zeller T, et al. Provisional extension to induce complete attachment after stent-graft placement in type B aortic dissection: the PETTICOAT concept. J Endovasc Ther. 2006;13(6):738-46.
25. Hofferberth SC, Nixon IK, Boston RC, et al. Stent-assisted balloon-induced intimal disruption and relamination in aortic dissection repair: the STABILISE concept. J Thorac Cardiovasc Surg. 2014;147(4):1240-5.
26. Nienaber CA, Kische S, Rousseau H, et al. Endovascular repair of type B aortic dissection: long-term results of the randomized investigation of stent grafts in aortic dissection trial. Circ Cardiovasc Interv. 2013;6(4):407-16.
27. Evans E, Veeraswamy R, Zeigler S, et al. Laser in situ Fenestration in Thoracic Endovascular Aortic Repair: A Single-Center Analysis. Ann Vasc Surg. 2021;76:159-67.
28. Zhao Z, Qin J, Yin M, et al. In Situ Laser Stent Graft Fenestration of the Left Subclavian Artery during Thoracic Endovascular Repair of Type B Aortic Dissection with Limited Proximal Landing Zones: 5-Year Outcomes. J Vasc Interv Radiol. 2020;31(8):1321-7.
29. Lin J, Rodriguez LE, Nutley M, et al. Optimal In Situ Fenestration Technique With Laser Perforation and Balloon Dilation for Aortic Stent-Grafts. J Endovasc Ther. 2021;28(2):300-8.
30. Zeng Q, Zhou X, He Y, et al. Experimental Analysis of In Situ Fenestration of Endovascular Stent-Grafts: Comparison between Needle and Laser Puncture. Ann Vasc Surg. 2021;77:280-7.
31. Stilo F, Catanese V, Montelione N, et al. Subclavian artery revascularization with subclavian-carotid transposition for TEVAR and non-TEVAR patients. J Cardiovasc Surg (Torino). 2023.
32. Rylski B, Matzdorf M, Kondov S, et al. Outcome of Revascularizing the Left Subclavian Artery via Carotid-Subclavian Bypass. Thorac Cardiovasc Surg. 2023.
33. Cinà CS, Safar HA, Laganà A, et al. Subclavian carotid transposition and bypass grafting: consecutive cohort study and systematic review. J Vasc Surg. 2002;35(3):422-9.
34. Egaña JM, Sánchez J, Rodríguez V, et al. A technical improvement in retropharyngeal carotid reconstruction. J Vasc Surg. 2012;56(2):542-4.
35. Zierer A, Voeller RK, Hill KE, Kouchoukos NT, Damiano RJ Jr, Moon MR. Aortic enlargement and late reoperation after repair of acute type A aortic dissection. Ann Thorac Surg. 2007 Aug;84(2):479-86
36. Xue Y, Pan J, Cao H, Fan F, Luo X, Ge M, et al. Different aortic arch surgery methods for type A aortic dissection: clinical outcomes and follow-up results. Interact Cardiovasc Thorac Surg. 2020 Aug 1;31(2):254-262.
37. Hsieh WC, Kan CD, Yu HC, Aboud A, Lindner J, Henry BM, et al. Ascending aorta replacement vs. total aortic arch replacement in the treatment of acute type A dissection: a meta-analysis. Eur Rev Med Pharmacol Sci. 2019 Nov 1;23(21).
38. Kimura N, Tanaka M, Kawahito K, Yamaguchi A, Ino T, Adachi H. Influence of patent false lumen on long-term outcome after surgery of acute type A aortic dissection. J Thorac Cardiovasc Surg. 2008 Nov; 136(5):1160-1166.
39. St Pierre EC, Orelaru F, Naeem A, Farhat L, Wu X, Yang B. Quality of life worsens after surgical repair of acute type A aortic dissection. Semin Thorac Cardiovasc Surg. 2022 Summer;34(2):399-407.
40. Adam U, Habazettl H, Graefe K, Kuppe H, Wundram M, Kurz SD. Health-related quality of life of patients after surgery for acute Type A aortic dissection. Interact Cardiovasc Thorac Surg. 2018 Jul 1;27(1):48-53.
41. Chaddha A, Kline-Rogers E, Braverman AC, Erickson SR, Jackson EA, Franklin BA, et al. Survivors of aortic dissection: Activity, mental health, and sexual function. Clin Cardiol. 2015 Nov;38(11):652-659.
42. Hong M, Zhang R, Zhu J, Tan W. Social support and self-efficacy multiply mediate the relationship between medical coping style and resilience in patients with type A aortic dissection. Front Psychiatry. 2023 May 31;14:1174038.