Total aortic arch replacement for a huge aneurysm in a young woman

Remplacement de la crosse aortique pour un anévrysme chez une femme jeune

Hèla Ben Jmaà, Zied Ben Ayed, Hafedh Daly, Mohamed Seddik, Faten Dhouib, Imed Frikha.

Department of cardio-vascular surgery Habib Bourguiba Hospital Sfax Tunisia.

Summary

Dystrophic aneurysms are frequent in young patients.

A 28-year-old woman, complained from dyspnea. Echocardiography revealed aortic regurgitation, dilated left ventricle, and aneurysm of the aortic arch. CT scan revealed aneurysmal dilatation of the aortic arch.

She underwent emergent surgery.

We resected the aortic arch and the supra-aortic trunks, with circulatory arrest and antegrade cerebral perfusion. Distal anastomosis was done without clamping. Supra-aortic trunks were re-implanted in bloc.

Postoperative echocardiography revealed reduced ejection fraction, necessitating care support. She was discharged in 20 days postoperative in stable condition.

Keywords

arch aneurysm, surgery, cerebral protection, circulatory arrest, anterograde cerebral perfusion, total aortic arch replacement.

Résumé

Les anévrismes dystrophiques sont fréquents chez les patients jeunes. Une femme de 28 ans s'est plainte de dyspnée. L'échocardiographie a révélé une insuffisance aortique, une dilatation du ventricule gauche et un anévrisme de la crosse aortique. La tomodensitométrie a révélé une dilatation anévrismale de la crosse aortique. Elle a subi une intervention chirurgicale en urgence. Nous avons procédé à la résection de la crosse aortique et des troncs supra-aortiques, sous arrêt circulatoire et perfusion cérébrale antérograde. Les troncs supra-aortiques ont été réimplantés en bloc. L'échocardiographie postopératoire a révélé une diminution de la fraction d'éjection, nécessitant un support inotrope. Elle est sortie de l'hôpital 20 jours après l'intervention.

Mots-clés

Anévrisme de la crosse aortique, chirurgie, protection cérébrale, arrêt circulatoire, perfusion cérébrale antérograde, remplacement total de la crosse aortique.

Correspondance

Hèla Ben Jmaà

INTRODUCTION

Aortic arch aneurysms are complex and challenging. Open surgical replacement remains the gold standard for more proximal arch involvement in suitable candidates, although mortality rates and stroke risk remain significant [1].
The advancements in techniques and cerebral protection led to better outcomes of aortic arch aneurysms surgery.

CASE REPORT

A 28-year-old woman had no personal past-medical history and had familial past-medical history of sudden death at a young age of a first degree relative, and death by aortic rupture complicating an aortic aneurysm without genetic follow-up.

She complained from left side heart failure symptoms: dyspnea NYHA 3.

Echocardiography revealed severe aortic regurgitation with a coaptation defect, ddilated left ventricle with moderate dysfunction (Ejection fraction: 40%), aneurysm of the ascending aorta extending from the annulus to the origin of the left subclavian artery.

The aortic valve was tricuspid with thin, non-thickened leaflets. The sinus of Valsalva is dilated to 38 mm, the sino-tubular junction measures 49mm, and the ascending aorta measures 82 mm.

CT scan revealed cardiomegaly affecting the left cavities, and a significant aneurysmal dilatation of the aortic arch without signs of dissection.

The ascending segment measured 82 mm, and the horizontal segment was 73 mm, with a normal diameter at the isthmus. There was a second dilation at the descending aorta measuring 50 mm (figure 1).

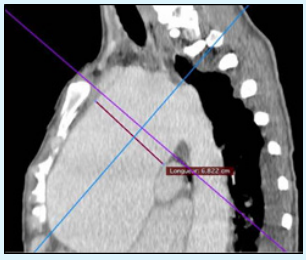

Figure 1. Pre-operative CT scan showing an important dilation of the ascending and the horizontal aorta.

The patient underwent an urgent open surgery for her aortic arch aneurysm, using a classic median sternotomy approach.

The innominate vein was clamped and sectioned for better exposure, and the dilated horizontal aortic arch and distal branches of the supra-aortic vessels were controlled (figure 2).

Figure 2. Intraoperative view showing a huge aneurysm of the ascending and the horizontal aorta.

Arterial cannulation was performed through the right axillary artery to maintain antegrade cerebral perfusion through the right carotid artery. Venous cannulation was performed through the atrio-caval approach.

We performed clamping of the supra-aortic trunks and the ascending aorta. After aortotomy, cardioplegia was initiated through the coronary ostia.

Then, we resected the horizontal thoracic aorta and in bloc of the supra-aortic trunks under moderate hypothermia (25°C), with circulatory arrest and cerebral flow at 10-20 ml/kg/min (300-700 ml).

The distal anastomosis between the descending aorta and a Dacron graft was done without aortic clamping. The supra-aortic trunks were re-implanted in bloc after aortic clamping (figure 3).

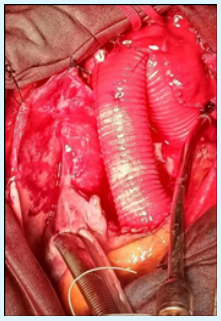

Figure 3. Intraoperative photography showing the replacement of the ascending and horizontal aorta and re-implantation of the supra-aortic vessels.

Then, the patient was rewarmed, and the proximal anastomosis was performed in the supra-coronary region with the Dacron graft after clamping of the tube.

After air removal and aortic declamping, the cardiopulmonary bypass was progressively weaned. It lasted 40 minutes.

In the immediate postoperative period, the patient required high doses of catecholamines.

A postoperative echocardiography revealed a reduced ejection fraction of 25%, necessitating intensive care support. The hemodynamic status improved by day 2 of hospitalization, with stabilization of blood pressure, and ejection fraction reassessed at 45%, allowing a reduction in vasopressor support.

He was extubated on day 3 of hospitalization. Neurologically, he was conscious and oriented, with no signs of focal deficits on clinical examination.

In the late postoperative course, the patient developed a pneumonia, requiring reintubation for 48 hours and broad-spectrum antibiotic therapy for 10 days.

Total stay in intensive care unit was 15 days. He was discharged from hospital in 20 days postoperative in stable condition.

The postoperative CT scan showed that the prosthesis and the great vessels are patent.

DISCUSSION

Acute type A dissections and aneurysms involving the transverse arch, are one of the technically most challenging interventions in modern aortic surgery.

The first successful replacement of the proximal aortic arch was reported by De Bakey and associates in 1957 [2]. It remains a complex surgical operation that necessitates specific neuro-protection strategies. These strategies include hypothermic circulatory arrest to reduce the cerebral oxygen consumption, retrograde cerebral perfusion, and antegrade selective cerebral perfusion [3].

Antegrade cerebral perfusion through a right axillary or innominate perfusion cannula, aiming for near-physiologic conditions to ensure optimal cerebral protection, requires target cerebral blood flow, arterial blood pressure and hemodilution, and intra-cranial pressure to be carefully monitored.

Distal perfusion via the femoral artery has also been successfully used in selective cases during total aortic arch replacement to sustain spinal cord and visceral integrity at moderate hypothermia [4].

Aortic arch surgery has traditionally been associated with high rates of morbidity and mortality [5]. The main complications are stroke, renal failure, and bleeding. Neurological complications are associated with increased mortality, longer hospitalization, healthcare resources' utilization and impaired quality of life [6].

Deep hypothermia with circulatory arrest is associated with reduced coagulopathy, which helps to decrease transfusion requirements and prevent the development of acute lung injury [7]. Open surgery provides satisfactory results regarding quality of life, but the long-term outcomes after thoracic endovascular repair still remain controversial [8]. Elderly patients experienced more operative death and post-operative complications.

Hybrid repair by debranching and thoracic endovascular aortic repair offers a less invasive therapeutic option for the treatment of aortic arch diseases in high-risk patients. It offers a less invasive therapeutic option for the treatment of aortic arch diseases in high-risk patients. should be selected in accordance with the risk for surgery and anatomical features of the aorta [9]. In the last decades, endoprostheses and stents have emerged as alternative options by fenestrated or branched arch endografts [10].

We opted for surgical management because of the non-availability of horizontal aortic endoprostheses in our department.

Endovascular and hybrid treatment options have demonstrated acceptable stroke and death rates. It provides a valuable tool for patients requiring complete repair of a and are considered attractive alternatives to conventional surgery [11].

Pecoraro et al [12] have also reported on the efficacy of hybrid endovascular repair using the debranching method in high-risk patients such as the elderly.

CONCLUSION

There are variety of approaches and surgical techniques used to reconstruct the aortic arch, protecting the vital organs, the extent of aortic replacement, and the options of reimplanting the supra-aortic arch vessels.

Outcomes of aortic arch surgery have improved the last decade due to the improvement of surgical techniques, and the more frequent use of moderate hypothermia and anterograde cerebral perfusion.

Though open surgery remains the « gold standard », in the last two decades, endoprostheses have emerged as alternate options. The high rate of surgical morbidity and mortality, especially in patients with several comorbidities, led to the development of alternative treatment options to conventional open surgery.

Nowadays, the leading choice is hybrid and endovascular aortic repair. The choice of the optimal and safest therapeutic option is essential to ensure good patient outcomes by a multi-disciplinary team.

REFERENCES

1. Chakos A, Jbara D, Yan TD, Tian DH. Long-term survival and related outcomes for hybrid versus traditional arch repair-A meta-analysis. Ann Cardiothorac Surg 2018; 7: 319-27.
2. De Bakey, M. E., Crawford, E. S., Cooley, D. A., and Morris, G. C., Jr.: Successful Resection of Fusiform Aneurysm of Aortic Arch With Replacement of Homograft, Surg, Gynecol. Obstet 1957 ; 105: 657.
3. Misfeld M, Mohr FW, Etz CD. Best strategy for cerebral protection in arch surgery – antegrade selective cerebral perfusion and adequate hypothermia. Ann Cardiothorac Surg 2013; 2(3): 331-338.
4. Della Corte A, Scardone M, Romano G, et al. Aortic arch surgery: thoracoabdominal perfusion during antegrade cerebral perfusion may reduce postoperative morbidity. Ann Thorac Surg 2006; 81: 1358-64.
5. Marina Ibrahim, Ali Hage, Ismail El-Hamamsy, Michael C. Moon, Bindu Bittira, Michael W.A. Chu, Louis-Mathieu Stevens, Francois Dagenais, Maral Ouzounian, Mark Peterson, Munir Boodhwani, Michael H. Yamashita, Darrin Payne, John Bozinovski, Rony Atoui, Kevin Lachapelle, and Jennifer C.-Y. Chung. Evolving Surgical Techniques and Improving Outcomes for Aortic Arch Surgery in Canada. CJC Open 3 (2021) 1117-1124.
6. Bassin L; Bell D. Temporary extracorporeal bypass modalities during aortic surgery. Best Pr. Res. Clin. Anaesthesiol 2016, 30, 341-357.
7. Matalanis G, Koirala RS, Shi WY, Hayward PA, McCall PR. Branchfirst aortic arch replacement with no circulatory arrest or deep hypothermia. J Thorac Cardiovasc Surg 2011; 142: 809-15.
8. Kurazumi H, Mikamo A, Kudo T, Suzuki R, Takahashi M, Shirasawa B, et al. Aortic arch surgery in octogenarians: Is it justified ? Eur J Cardiothorac Surg. 2014; 46: 672-7.
9. [9] Cronenwett JL. Endovascular aneurysm repair: important mid-term results. Lancet 2005; 365: 2156-8.
10. Idhrees M, Velayudhan B. Open aortic arch surgery—how we do it ? Indian Journal of Thoracic and Cardiovascular Surgery (December 2023) 39 (Suppl 2): S349-S352.
11. Seike Y, Matsuda H, Fukuda T, Inoue Y, Omura A, Uehara K, et al. Total arch replacement versus debranching thoracic endovascular aortic repair for aortic arch aneurysm: what indicates a high-risk patient for arch repair in octogenarians ? Gen Thorac Cardiovasc Surg 2018; 66: 263-9.
12. Pecoraro F, Lachat M, Hofmann M, Cayne NS, Chaykovska L, Rancic Z, et al. Mid-term results of zone 0 thoracic endovascular aneurysm repair after ascending aorta wrapping and supra-aortic debranching in high-risk patients. Interact Cardiovasc Thorac Surg 2017; 24: 882-9.