Surgical Management of an Isolated Huge Innominate Artery Aneurysm Causing Tracheal Compression: A Case Report

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ARTICLE INFO
Received February 7, 2022
Revised April 28, 2022
Accepted June 24, 2022

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The innominate artery is an uncommon site for an aneurysm, and tracheal compression caused by an innominate artery aneurysm is a very rare occurrence. An innominate artery aneurysm can cause catastrophic complications, such as rupture or thromboembolism. The most common surgical approach for open repair is median sternotomy with cardiopulmonary bypass, but cerebral ischemic injury and thromboembolism can occur during surgery. We present the case of a male patient who had an isolated giant innominate artery aneurysm causing tracheal compression, which was successfully managed by surgical repair.

Keywords: Brachiocephalic trunk, Aneurysm, Operative surgical procedures, Case report

Case report

A 53-year-old male patient made an outpatient visit to the Department of Pulmonology with a chief complaint of a mass-like lesion in the right upper lobe of the lung, which was detected during a medical examination (Fig. 1A). He complained of voice changes and exertional dyspnea in the last 8 months. He had difficulty swallowing solid foods. He also experienced paresthesia in the fourth and fifth fingers of the right hand that had lasted for 2 months. His past medical history showed only well-controlled hypertension. A chest computed tomography (CT) scan revealed a giant innominate artery aneurysm causing compression of the trachea, esophagus, and ipsilateral recurrent laryngeal nerve (Figs. 1B, 2A). Transthoracic echocardiography showed a normal left ventricular ejection fraction of 73% and no other abnormalities. CT angiography showed an approximately 73×54-mm isolated saccular innominate artery aneurysm. There was no evidence of definite stenosis or occlusion of both carotid arteries from the proximal portion to the intracranial portion. No stenosis or occlusion of the vertebral artery was observed, and slight left vertebral artery dominance was noted (Fig. 3A). The decision was made to perform surgical repair.

Fig. 1. Preoperative chest X-ray and chest computed tomography (CT). (A) Chest X-ray shows a large round radiopaque mass in the right upper medial thorax. (B) An approximately 73×54-mm saccular aneurysm of the innominate artery causing compression of the trachea and adjacent structures is noted on preoperative chest CT (axial view). L-PA, left posterior-anterior; IA, innominate artery; T, trachea; E, esophagus; RRLN, right recurrent laryngeal nerve.
Under general anesthesia with cerebral somatic oximetry (INVOS 5100C; Covidien, Minneapolis, MN, USA), a median sternotomy incision was made to expose the arch vessels, including the right proximal common carotid artery. Tight adhesion was noted between the sternal manubrium and innominate artery, and there was no free space beneath the sternal manubrium for a safe median sternotomy. Right common femoral arterial and venous cannulations were performed to initiate partial cardiopulmonary bypass for accidental rupture of the innominate artery aneurysm during median sternotomy. Cardiopulmonary bypass was initiated following systemic heparinization. After lowering the body temperature to the target temperature (18°C), median sternotomy was successfully performed without rupture of the arch vessels, but ventricular fibrillation occurred and the left ventricle was slightly dilated. The right atrial auricle was cannulated for additional venous drainage, and a venting catheter was inserted via the right superior pulmonary vein for left ventricular decompression. Delivery of cardioplegic solution for myocardial protection was not needed. Median sternotomy extending up to the right side of the neck was performed. The aneurysm was located at the supra-aortic level, and the posterosuperior wall of the aneurysm was adherent to the right superior mediastinum. The proximal end of the aneurysm was 1 cm away from the origin of the innominate artery. The aneurysmal dilatation involved the proximal end of the right common carotid artery (Fig. 2B). A Y-graft was prepared with 8-mm and 6-mm woven double velour collagen-impregnated polyester grafts (Hemashield Platinum; Maquet, Rastatt, Germany) by side-to-end anastomosis. The proximal innominate artery and right proximal carotid artery were clamped, and the aneurysm was resected. The distal end of the 8-mm graft was anastomosed to the right proximal carotid artery. Right carotid arterial perfusion was reestablished by the distal end of the 6-mm graft, and the proximal end of the 8-mm graft was anastomosed to the partially clamped ascending aorta. Finally, the distal end of the 6-mm graft was anastomosed to the right proximal subclavian artery. The origin of the innominate artery was occluded with a vascular stapler and reinforced with felt strips. Aortic cross-clamping or circulatory arrest was not used. The time of cessation of right carotid blood flow during surgery was only 14 minutes. The patient regained consciousness 6 hours after surgery and could be weaned from mechanical ventilation on postoperative day 1 (POD #1). The postoperative course was uneventful, except for paroxysmal supraventricular tachycardia, which was converted to sinus rhythm after adenosine injection on POD #7. The patient was discharged without any cognitive dysfunction on POD #10. Postoperative CT carotid angiography showed complete exclusion of the aneurysm with well-restored right subclavian and carotid artery flow (Fig. 3B). The patient provided written informed consent for publishing his clinical details and photographs in the article.
Discussion

Innominate artery aneurysms are very rare, accounting for only 3% of all arterial aneurysms [1]. The etiology of innominate artery aneurysms is multifactorial, and it includes atherosclerosis, syphilis, Takayasu disease, trauma, chronic dissection, bacterial infection, collagen disorders, and autoimmune diseases [2-4].

Innominate artery aneurysms can be asymptomatic or can present with severe symptoms. The most common signs and symptoms include a pulsatile mass in the neck and chest pain. Compression of other structures results in clinical manifestations, such as dysphagia, dysphonia, brachial plexus dysfunction, and superior vena cava syndrome. The patient presented in this case report had symptoms, including dyspnea, dysphagia, dysphonia, and paresthesia in the right hand, as a result of compression of structures adjacent to the innominate artery. These aneurysms can lead to fatal complications, such as rupture or cerebral ischemia, ocular deficits, or vertebrobasilar insufficiency due to thromboembolism [3,4]. An innominate artery aneurysm without connective tissue disorder or coexisting aneurysm at another site causing tracheal compression is an extremely rare occurrence.

However, an increasing number of cases have been found incidentally on routine chest radiographs without any symptoms. A definitive diagnosis could be made through CT angiography of the thoracic aorta [5].

Surgical treatment is necessary in symptomatic patients. Even in asymptomatic cases, surgery should be considered when the transverse diameter of the aneurysm is more than 3 cm or the aneurysm is saccular [3]. The treatment of choice is open surgery using median sternotomy, including cardiopulmonary bypass. If the aneurysm does not include the origin of the innominate artery and it is small enough to handle, surgery without cardiopulmonary bypass is possible. Otherwise, it is safe to perform repair with cardiopulmonary bypass.

If the aneurysm is large or it includes the subclavian or carotid artery, as in our case, it is difficult to clamp the distal right subclavian or carotid artery. In such a case, proceeding without cardiopulmonary bypass can be very dangerous because unexpected events can occur upon opening the aneurysmal sac. The use of cardiopulmonary bypass reduces the possibility of excessive bleeding. After anastomosis of the distal right carotid artery, the side branch of the graft is used to maintain right carotid perfusion while the proximal part is anastomosed, so that surgery can be safely performed with very short cessation of right carotid artery perfusion under cardiopulmonary bypass [6]. Sternotomy for exposure of the aneurysm may not be possible after rupture or in complicated cases, such as a syphilitic aneurysm with the erosion of the sternum. After installation of a femorofemoral cardiopulmonary bypass, reduction of the core temperature, and induction of deep hypothermic circulatory arrest before opening the chest, the sternum can be opened without exsanguination [7]. Cardiopulmonary bypass with profound hypothermia has some adverse effects, such as postoperative coagulopathy and arrhythmia, and prolonged ventilatory support may be needed in cases of circulatory arrest [8]. In an elective setting, the mortality rate of open repair was found to be 4.3%, but it was as high as 70% in critically ill patients who experienced rupture or embolization.

Endovascular approaches are also feasible if the patient is not a suitable candidate for open surgery. More recently, endovascular techniques have been associated with fewer short-term morbidities, shorter hospital stays, and graft patency comparable to that of open repair. However, despite these clinical benefits, endovascular treatment can be challenging in cases where other structures are compressed, and if the aneurysmal neck is inadequate for the landing of the stent-graft or when the distal innominate artery is involved. Therefore, further clinical data on their safety and efficacy are required [9].

This case demonstrates the safe application of a median sternotomy with cardiopulmonary bypass to perform open repair of a large, complex aneurysm of the innominate artery without postoperative cerebral dysfunction. Further studies are necessary to assess the long-term patency and mortality associated with open repair.

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Conflict of interest

No potential conflict of interest relevant to this article was reported.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

References

1. Schumacher PD, Wright CB. Management of an arteriosclerotic aneurysm of the innominate artery. Surgery 1979;85:489-95.
2. De Maria E, Olaru A, Cappelli S. Isolated innominate artery aneurysm: a very rare finding. Austin J Clin Case Rep 2014;1:3.
3. Kieffer E, Chiche L, Koskas F, Bahnini A. Aneurysms of the innominate artery: surgical treatment of 27 patients. J Vasc Surg 2001;34:222-8. https://doi.org/10.1067/mva.2001.115807
4. Brewster DC, Moncure AC, Darling RC, Ambrosino JJ, Abbott WM. Innominate artery lesions: problems encountered and lessons learned. J Vasc Surg 1985;2:99-112. https://doi.org/10.1067/mva.1985.avs0020099
5. Villegas-Cabello O, Cooley DA. Aneurysm of the innominate artery with aberrant origin of the left carotid artery: case report. Tex Heart Inst J 1996;23:298-300.
6. Regina G, Greco L, Fullone M, Testini M, Caruso G, Rizzi R. The emergency treatment of aneurysms of the supra-aortic trunks and of the internal carotid. Ann Ital Chir 2000;71:469-73.
7. Bower TC, Païrolero PC, Hallett JW Jr, Toomey BJ, Głowiczki P, Cherry KJ Jr. Brachiocephalic aneurysm: the case for early recognition and repair. Ann Vasc Surg 1991;5:125-32. https://doi.org/10.1007/BF02016744
8. Jeon BH, Lee CH, Bae CH, Jang JS, Cho JW. Surgical treatment of an innominate artery aneurysm using near-infrared spectroscopy for cerebral monitoring: a case report. J Chest Surg 2021;54:517-20. https://doi.org/10.5090/jcs.21.028
9. Soylu E, Harling L, Ashrafian H, et al. Surgical treatment of innominate artery and aortic aneurysm: a case report and review of the literature. J Cardiothorac Surg 2013;8:141. https://doi.org/10.1186/1749-8090-8-141