CASE REPORT

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Surgical Management of Ascending Aortic and Innominate Artery Pathology Following Previous Aortic Valve Replacement: A Redo Sternotomy Case Report

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Abstract

Background: Progressive dilation of the ascending aorta after aortic valve replacement (AVR) is increasingly recognized and may coexist with aneurysms of supra-aortic vessels such as the innominate artery. Concomitant pathology in the ascending aorta and innominate artery presents complex technical challenges, particularly in a redo sternotomy setting.

Case presentation: We describe a 30-year-old male with prior mechanical AVR who was incidentally found on routine imaging to have a dilated ascending aorta with a saccular aneurysm of the innominate artery. After multidisciplinary evaluation, he underwent elective redo median sternotomy with ascending aorta and hemiarch replacement and re-implantation/reconstruction of the innominate artery. Cerebral protection strategies and meticulous surgical technique were used. The postoperative course was uneventful; the patient was extubated on day 1, ambulated on day 2 and discharged in stable condition with preserved neurological function.

Conclusion: With careful preoperative planning, cerebral protection, and experienced surgical execution, redo sternotomy with hemiarch replacement and innominate artery reconstruction can be carried out safely in selected patients. Vigilant imaging surveillance after AVR permits elective intervention prior to emergent complications.

Keywords: Ascending aortic aneurysm, Innominate artery aneurysm, Redo sternotomy, Hemiarch replacement, Cerebral protection, Aortic valve replacement

Introduction

Ascending aortic aneurysm represents a significant cause of morbidity and mortality due to the risk of rupture, dissection, and thromboembolic complications. Progressive dilation of the ascending aorta following aortic valve replacement (AVR) is a well-documented phenomenon, particularly in younger patients with bicuspid aortic valve disease, connective tissue disorders, or longstanding systemic hypertension [1]. Altered hemodynamic flow patterns, intrinsic medial degeneration, and persistent aortopathy contribute to progressive aortic enlargement even after correction of valvular pathology [2]. Innominate artery aneurysms are rare and account for less than 3% of all supra-aortic trunk aneurysms [3]. These aneurysms are often asymptomatic and detected incidentally during imaging performed for unrelated indications. However, they carry substantial risks, including rupture, distal embolization, and compression of adjacent mediastinal structures [4]. When present in association with ascending aortic aneurysms, they significantly complicate surgical management.

Redo sternotomy for aortic and arch surgery is technically demanding and associated with increased operative risk due to dense mediastinal adhesions, distorted anatomy, and the potential for catastrophic hemorrhage during sternal re-entry [5]. Surgical strategies must therefore balance complete pathological correction with minimization of operative time, cerebral ischemia, and bleeding risk. Hemiarch replacement with selective re-implantation of supra-aortic vessels has emerged as an effective approach for localized arch pathology, allowing adequate disease control while avoiding the complexity of total arch replacement [6]. We present a detailed case of a young adult with post-AVR ascending aortic aneurysm and concomitant innominate artery aneurysm successfully managed with redo sternotomy, ascending aorta and hemiarch replacement, and innominate artery reconstruction.

Case presentation

A 30-year-old male presented for routine cardiology follow-up. He had a history of mechanical aortic valve replacement performed in 2011 for severe aortic valve disease. The postoperative course following AVR had been uneventful, and the patient was on long-term oral anticoagulation and antihypertensive therapy. He had a known history of systemic hypertension but no documented connective tissue disorder. There was no family history of aortic disease or sudden cardiac death.

At presentation, the patient was asymptomatic. He denied chest pain, dyspnea, palpitations, syncope, neurological deficits, or constitutional symptoms. Physical examination revealed a well-healed median sternotomy scar. Cardiovascular examination demonstrated normal prosthetic valve sounds with no murmurs. Peripheral pulses were palpable and symmetrical, and there were no signs of heart failure or neurological compromise. Routine transthoracic echocardiography revealed normal functioning of the mechanical aortic valve prosthesis with preserved left ventricular systolic function. However, significant dilation of the ascending aorta was noted. Given these findings, contrast-enhanced computed tomography angiography of the thorax was performed for further evaluation.

Computed tomography angiography demonstrated a markedly dilated ascending aorta extending up to the proximal aortic arch. In addition, a saccular aneurysm involving the innominate artery was identified. The aneurysm showed no evidence of rupture or thrombosis. The remaining supra-aortic vessels appeared normal. Based on imaging findings, a diagnosis of ascending aortic aneurysm with concomitant innominate artery aneurysm in a post – aortic valve replacement patient was established. Given the patient's young age, aneurysm morphology, and the risk of future complications, elective surgical intervention was planned. A multidisciplinary heart team discussion was conducted, and the patient was counseled regarding the risks and benefits of redoing aortic surgery. Written informed consent was obtained.

Surgical Management

The patient was brought to the operating room and placed under general anesthesia. Standard neuromonitoring, including near-infrared spectroscopy (NIRS) for cerebral oximetry, was instituted. Redo median sternotomy was performed with an oscillating saw and careful dissection of the mediastinum to minimize injury to adherent structures. Dense adhesions were taken down under direct vision. A central cannulation strategy was planned with readiness for peripheral cannulation if required to secure cardiopulmonary bypass (CPB) rapidly.

Cardiopulmonary bypass was established and systemic cooling to moderate hypothermia was performed per institutional protocol. After cross-clamping and cardioplegic arrest (to allow inspection of the valve prosthesis and ascending aorta), the ascending aorta was opened and the aneurysmal segment was resected. Hemiarch replacement (proximal arch prosthetic graft anastomosed to the healthy arch) was performed to address proximal arch involvement. Cerebral protection was achieved with selective antegrade cerebral

perfusion via cannulation of the right axillary/inominate/arch vessels based on intraoperative anatomy; NIRS monitoring helped tailor perfusion pressures and flow.

The innominate artery aneurysm was carefully dissected; a segmental resection of the aneurysmal innominate trunk was performed and the artery re-implanted into the neo-ascending aortic graft using end-to-side anastomosis with meticulous suturing. The mechanical aortic valve prosthesis was inspected and found to be functioning normally; the team elected to preserve it and avoid re-replacement. Hemostasis was achieved; the patient was rewarmed and weaned from cardiopulmonary bypass without difficulty.
The sternum was closed in standard fashion. Total CPB and selective cerebral perfusion times were recorded; estimated blood loss and transfusion requirements were within acceptable limits. The procedure proceeded electively without intraoperative complications.

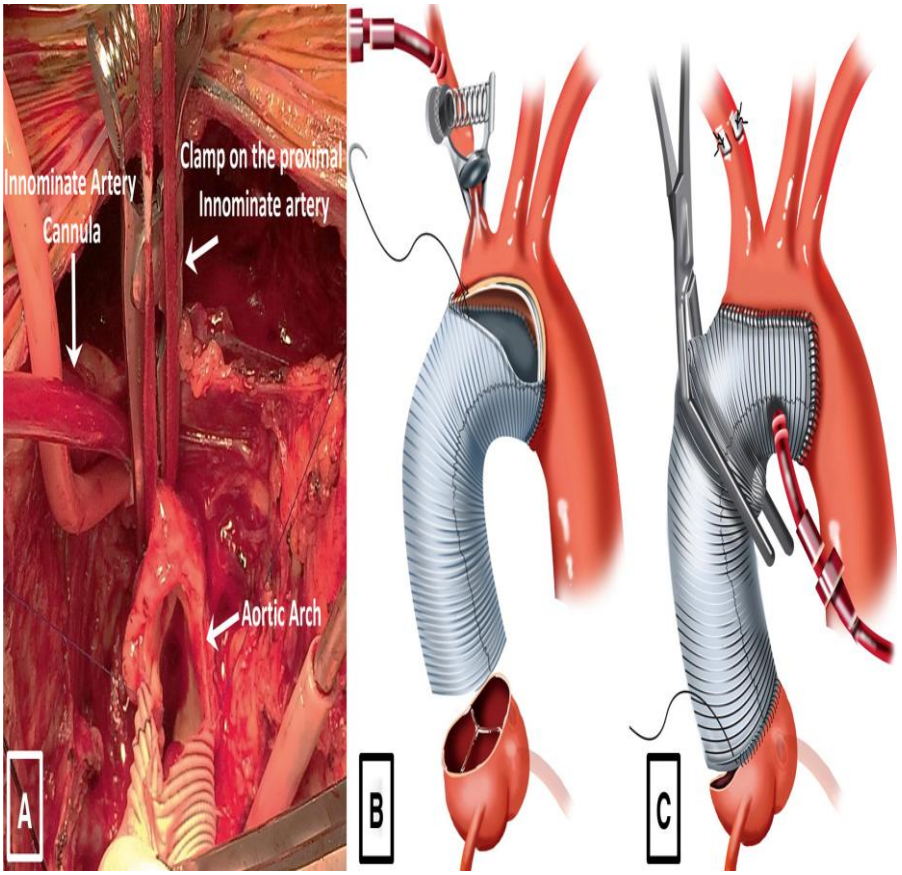

Figure 1: Hemiarch and Innominate Artery Reconstruction

Postoperative course and follow-up

The patient was transferred to the cardiac intensive care unit. He was extubated on postoperative day (POD) 1 with a normal neurologic exam and NIRS values. Early physiotherapy and mobilization were initiated on POD 2. Anticoagulation (warfarin) was resumed per standard protocol for mechanical valve protection after ensuring hemostasis. There were no postoperative strokes, spinal cord ischemia, re-explorations for bleeding, wound infections, or renal dysfunction. Renal function, liver function, and coagulation profiles remained within acceptable limits. CTA at postoperative follow-up (prior to discharge) demonstrated a patent ascending aortic graft with intact anastomoses and a patent reconstructed innominate artery without narrowing or leak. The patient was discharged on POD 7 in stable condition with instructions for routine surveillance imaging. At 3-month clinical and imaging follow-up, the patient remained asymptomatic, with stable graft appearance on CTA and no neurologic or cardiopulmonary abnormalities.

Discussion

This case highlights important contemporary considerations in the management of combined ascending aortic aneurysm and innominate artery aneurysm after prior aortic valve replacement, and demonstrates the feasibility of elective redo sternotomy with hemiarch replacement and innominate artery reconstruction in carefully selected patients.

Progressive dilatation of the ascending aorta following aortic valve replacement is increasingly recognized and is influenced by multiple factors, including intrinsic aortopathy, altered hemodynamic flow patterns, and systemic hypertension. Current guideline recommendations emphasize the importance of long-term imaging surveillance in patients following aortic valve replacement because of the persistent risk of aortic enlargement and late complications Isselbacher et al. [3]. Large ascending aortic aneurysms detected several years after valve surgery have been reported in contemporary series, underscoring the need for ongoing vigilance Dregoesc et al. [1]. Advances in postoperative imaging protocols now allow earlier identification of progressive aortic disease and timely elective intervention Ahmed et al. [2].

Innominate artery aneurysms are rare but clinically significant vascular lesions. They are often incidentally detected on cross-sectional imaging and may remain asymptomatic until complications such as rupture, thromboembolism, or compressive symptoms occur Jeon et al. [5]; Hong et al. [7]. Recent case series and single-center reports have documented diverse etiologies, including degenerative, inflammatory, and mycotic causes, with successful surgical or endovascular management depending on anatomical considerations and infective status Inam et al. [9]; Johari et al. [10]; Cinà et al. [21]. Contemporary surgical techniques for innominate artery reconstruction, including translocation and reimplantation, have demonstrated favorable outcomes when performed in specialized centers Phothikun et al. [11]. Although endovascular repair has been described in selected cases, open reconstruction remains the preferred approach for complex proximal arch involvement or when concomitant ascending aortic replacement is required Dang et al. [4]; Fridling et al. [20].

Redo sternotomy for aortic surgery is associated with increased operative risk due to mediastinal adhesions and potential injury to prior grafts or prosthetic valves. Contemporary analyses continue to highlight these challenges while demonstrating improved outcomes with careful patient selection and meticulous surgical planning Fudulu et al. [12]; Akintoye et al. [22]. Hemiarch replacement has emerged as a pragmatic surgical option for localized proximal arch pathology and is associated with acceptable in-hospital mortality and neurologic event rates in modern series Pearsall et al. [13]; Yamabe et al. [14]. Compared with more extensive arch reconstructions, limited arch replacement reduces cerebral ischemic time when disease extent permits, without compromising medium-term outcomes Yamabe et al. [14]; Krishnan et al. [16]. In the present case, the decision to perform hemiarch replacement with selective innominate artery reconstruction was guided by preoperative computed tomography morphology, absence of distal arch disease, and the presence of a well-functioning prosthetic aortic valve, enabling a focused and less invasive repair. Optimized cerebral protection is a cornerstone of contemporary aortic arch surgery. Recent reviews and meta-analyses have detailed the benefits of antegrade cerebral perfusion strategies, including unilateral and bilateral approaches, as well as the adjunctive role of neuromonitoring using near-infrared spectroscopy to tailor perfusion parameters Abjigitova et al. [17]; Werner [12]. In the present case, selective antegrade cerebral perfusion combined with near-infrared spectroscopy-guided monitoring was employed, consistent with current best practices to minimize neurologic complications during arch reconstruction.

Recent literature indicates that redo aortic procedures, when performed electively at experienced centers using modern techniques, can achieve acceptable morbidity and mortality rates Fudulu et al. [12]; Akintoye et al. [22]; Shrestha et al. [23]. Comparative studies evaluating limited versus extensive arch replacement

strategies have demonstrated that hemiarch replacement in appropriately selected patients is associated with shorter operative times and similar medium-term reintervention rates Krishnan et al. [16]; Yamabe et al. [14]. The uneventful postoperative recovery observed in our patient aligns with these findings and supports the role of targeted repair in young patients following aortic valve replacement. Reconstruction of the innominate artery during aortic surgery requires individualized planning based on aneurysm morphology, vessel length, and tissue quality. Contemporary reports describe various techniques, including translocation, reimplantation, and interposition grafting, with favorable outcomes in experienced hands Phothikun et al. [11].

Long-term surveillance following aortic valve replacement remains critical for early detection of progressive aortic pathology. Contemporary guideline updates reiterate the importance of structured imaging follow-up and clearly defined intervention thresholds, Isselbacher et al. [3]. Advanced imaging strategies have improved the ability to detect subtle changes in aortic dimensions and facilitate timely elective repair, thereby avoiding emergency surgery with its associated higher risk Ahmed et al. [25]; Borger et al. [15]. In the present case, routine follow-up imaging enabled elective surgical intervention at an optimal time, contributing to a favorable outcome. This report describes a single case, and the findings may not be generalizable to patients with extensive arch involvement, active infection, poor physiological reserve, or hostile mediastinal anatomy. Furthermore, outcomes may vary depending on institutional experience and the availability of multidisciplinary expertise. Referral to specialized aortic centers should be considered for complex redo arch procedures when feasible

Summary

This case report describes the successful management of a young adult with a prior history of aortic valve replacement who developed a combination of ascending aortic aneurysm and innominate artery aneurysm detected on routine surveillance imaging. The coexistence of these pathologies presents significant diagnostic and surgical challenges, particularly in the setting of redo sternotomy. A carefully planned elective redo median sternotomy with ascending aorta and hemiarch replacement, along with selective innominate artery reconstruction, was performed using contemporary cerebral protection and intraoperative monitoring strategies. The patient had an uneventful postoperative course with no neurological or surgical complications and demonstrated excellent early recovery. This case underscores the importance of long-term imaging surveillance after aortic valve replacement and highlights the feasibility of limited arch repair with supra-aortic vessel reconstruction in appropriately selected patients.

Conclusion

Progressive ascending aortic dilatation and associated supra-aortic vessel aneurysms can occur years after aortic valve replacement and may remain clinically silent until identified through routine surveillance. This case demonstrates that elective redo sternotomy with ascending aorta and hemiarch replacement combined with innominate artery reconstruction can be performed safely and effectively in selected patients when guided by meticulous preoperative planning, appropriate cerebral protection, and experienced multidisciplinary care. Early detection and timely intervention are critical in preventing life-threatening complications and achieving favorable surgical outcomes. Lifelong follow-up with structured imaging protocols should be considered an essential component of care in patients following aortic valve replacement.

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