International Journal of Cardiovascular and Thoracic Surgery
2024, Vol. 10, No. 4, pp. 56-61
https://doi.org/10.11648/j.ijcts.20241004.12

Case Report

Exclusion of a Giant Right Coronary Artery Aneurysm with Concomitant Bypass Grafting

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Abstract

Coronary artery aneurysms (CAAs) are defined as a dilation of 1.5 times the diameter of a normal adjacent coronary artery, and CAAs larger than 20 cm are classified as giant. CAAs are typically asymptomatic, but complications can be fatal. There is currently no consensus on treatment, although medical, percutaneous, and surgical options have all been previously described in the literature. Additionally, there is little published video footage of the surgical exclusion of giant coronary artery aneurysms. This report describes the case of a 53-year-old man with a persistent globus sensation who was found to have a 4.5 cm right coronary artery aneurysm with diffuse calcification of the right coronary artery. He underwent exclusion of the aneurysm and coronary artery bypass grafting (radial artery to the right coronary artery and left internal mammary artery to the left anterior descending artery). Due to heavy calcification in the vessel wall, the right coronary artery both proximal and distal to the aneurysm was ligated with a pericardial buttress. The patient had no major adverse events and was discharged six days after surgery. This report includes detailed video footage of the giant coronary artery aneurysm exclusion technique. This case and accompanying video footage will help prepare surgeons to manage adult patients with CAAs and diffuse coronary atherosclerosis.

Keywords

Giant Coronary Artery Aneurysm, Right Coronary Artery, Bypass Grafting, Arterial Grafts

1. Background

Coronary artery aneurysms (CAAs) are defined as a dilation of 1.5 times the luminal diameter of contiguous segments of the coronary artery [1, 2]. Various studies have suggested surgical intervention is warranted in CAAs larger than 8 mm [3, 4]. When a CAA is larger than 2 cm, it is classified as a giant coronary artery aneurysm [1, 5]. CAAs are often discovered incidentally during coronary angiography or computed tomography (CT) scans [1]. There is no consensus on treatment, but available options include percutaneous, medical, and surgical management [3]. If left untreated, CAAs can result in rupture, compression of surrounding structures, or thrombus formation with embolization and subsequent myocardial infarction.

Human subject research exemption was approved by IRB protocol (ID #75619) on the 13th of May 2024, and the patient provided informed, written consent for the publication of this report. This report details the case of a 53-year-old man who presented to the emergency department with persistent globus

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Received: 27 October 2024; **Accepted:** 11 November 2024; **Published:** 28 November 2024

sensation who was found to have a 4.5 cm right coronary artery (RCA) aneurysm. He was found to have heavy calcification in the wall of the RCA. He underwent exclusion of the aneurysm and coronary artery bypass grafting. This report includes detailed video footage of the RCA aneurysm exclusion technique in a patient with diffuse atherosclerosis (Supplemental Video 1).

2. Case Presentation

A 53-year-old man with a prior history of percutaneous coronary intervention (placement of a drug-eluting stent to the left anterior descending artery (LAD) almost a decade ago) presented to the emergency department (ED) with a one-day history of globus pharyngeus. He also reported non-radiating chest discomfort earlier in the morning that had resolved by the time he arrived at the ED. He was noted to be tachycardic with an elevated D-dimer and underwent a chest computed tomography angiography (CTA) scan to rule out a pulmonary embolism. The CTA revealed a "4.5 cm mass in the atrioventricular groove off the epicardium possibly arising off the right coronary artery, suspicious for partially to nearly completely thrombosed coronary artery aneurysm," (Figure 1A, Supplemental Video 2). He underwent cardiac catheterization (Figure 1B, Supplemental Video 3) and echocardiography (Supplemental Video 4), which demonstrated 50% in-stent re-stenosis of the proximal LAD stent and 50-60% stenosis of the mid-LAD. The aneurysm was found to fill with contrast during the cardiac catheterization (Supplemental Video 3). The risks and benefits of surgery were discussed with the patient, and he wished to proceed with surgery.

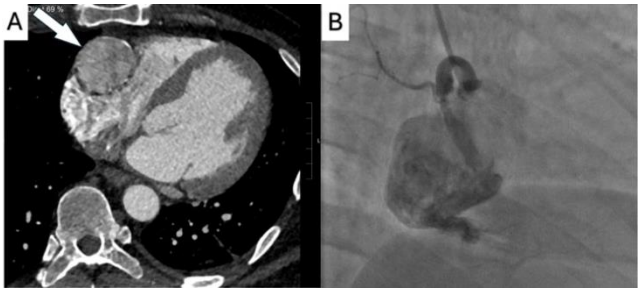

Figure 1. *Pre-Operative Imaging of a Giant Right Coronary Artery Aneurysm. A) 4.5 cm right coronary artery aneurysm (white arrow) seen on chest computed tomography. B) Giant right coronary artery aneurysm noted on cardiac catheterization.*

Detailed intraoperative video footage is presented in Supplemental Video 1. The patient was taken to the operating room and a midline sternotomy was made. The left internal mammary artery (LIMA) was harvested in a pedicled fashion. The aortic cannula, dual-stage venous cannula, and aortic vent were placed. Cardiopulmonary bypass was initiated. The left side of the pericardium was divided in an anteroposterior dimension to allow passage of the LIMA without tension or kinking. The ascending aorta was cross-clamped and cardioplegia quickly achieved diastolic arrest.

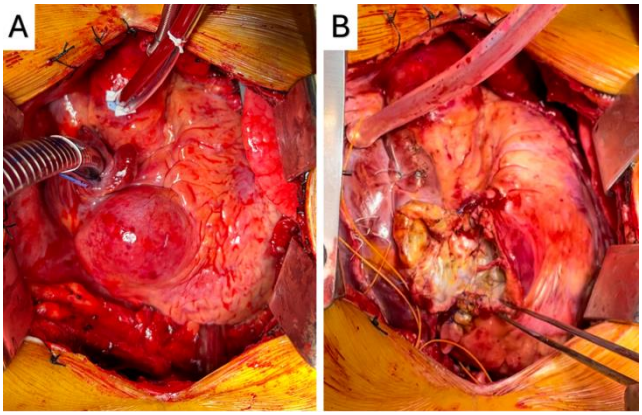

Figure 2. *Giant Right Coronary Artery Aneurysm with Coronary Artery Bypass Grafting. A) Intraoperative photograph of the giant right coronary artery aneurysm at the start of the case. B) Intraoperative photograph after exclusion and bypass grafting.*

The giant aneurysm sac (Figure 2A) was opened longitudinally, and the normal proximal and distal RCA were dissected (Figure 3). The decision was made to ligate the proximal and distal RCA due to heavy calcification in the vessel wall. The distal RCA was ligated with a pericardial buttress. We dissected the distal RCA and found an appropriate site to perform the distal anastomosis. An arteriotomy was made in the distal RCA, then an end-to-side anastomosis was performed between the left radial artery graft and the right coronary artery using 7-0 polypropylene suture. Heparinized saline was injected down the graft to confirm good flow and adequate hemostasis. The proximal RCA was then ligated with a pericardial buttress (Figure 2B). The radial artery graft was sized, and the anastomosis between the graft and aorta was performed in an end-to-side fashion. Then, the LIMA to LAD anastomosis was performed. Once adequate hemostasis was achieved, the patient was weaned off cardiopulmonary bypass.

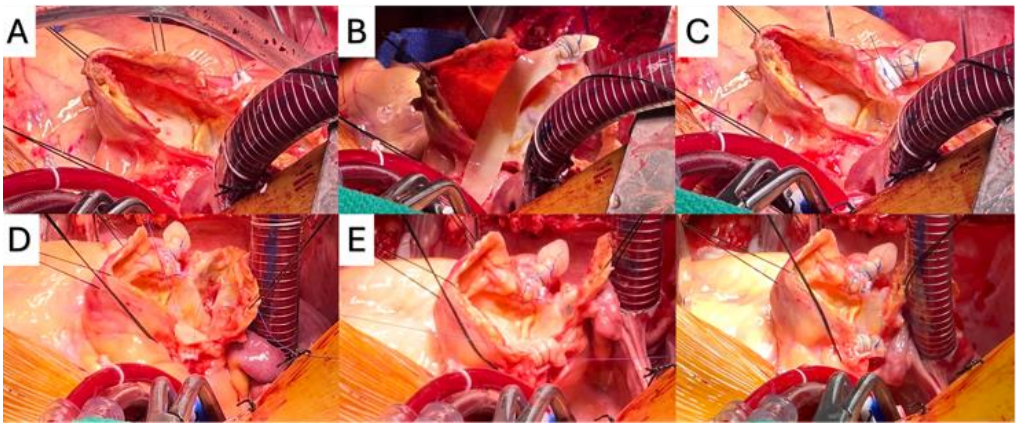

Figure 3. *Intraoperative Photographs of the Giant Coronary Artery Aneurysm Exclusion. A) The aneurysm sac was opened longitudinally. B) Pledgets and pericardium were used to ligate the distal right coronary artery (RCA). C) The distal RCA was ligated with a pericardial buttress. D) An arteriotomy was made distal to the ligated RCA, and an end-to-side anastomosis was performed between the radial artery graft and the RCA. E) Pledgets and pericardium were used to ligate the proximal RCA. F) Intraoperative photograph of the aneurysm at the end of the case.*

The cardiopulmonary bypass time was 138 minutes, and the cross-clamp time was 93 minutes. The patient spent four days in the intensive care unit and two days on the stepdown unit before being discharged home. On post-operative day five, CTA demonstrated patent bypass grafts with no acute postoperative complications (Supplemental Video 5). As of six months after surgery, the patient had not experienced any major adverse cardiac events nor re-hospitalizations.

3. Discussion and Conclusions

Giant coronary artery aneurysms are very rare, with an overall prevalence of 0.02% [6, 7]. The most common causes in adults and children are atherosclerosis and Kawasaki disease, respectively [8, 9]. Less common causes include autoimmune disease and connective tissue disorders, [10, 11] and there is also an increasing number of reports suggesting CAAs can be a potential complication of drug-eluting stents [12]. For patients with atherosclerosis, aneurysm formation is proposed to be attributed to inflammation from the tunica intima spreading into the tunica media, promoting proteolysis of extracellular matrix protein [13]. The RCA is more commonly involved (40-61%) than the left anterior descending (15-32%) and left circumflex artery (15-23%) [14]. Symptoms of CAAs can include chest pain, shortness of breath, and palpitations, although many CAAs are asymptomatic and are discovered incidentally [15]. CAAs are incidentally found in up to 5% of patients undergoing angiography [3]. There has been an increase in the detection of CAAs due to the increased utilization of chest CTA, coronary angiography, and cardiac magnetic imaging [16].

The treatment for coronary artery aneurysms typically include either medical therapy, surgical repair, or percutaneous intervention (PCI) [16]. Medical therapy typically involves treatment with an antiplatelet agent, with aspirin typically being first-line, and a second antiplatelet agent is considered unless medically contraindicated [17]. There are multiple small retrospective studies reporting patients with CAAs treated with either anti-platelet therapy or anticoagulation, with mixed results [8, 18]. Recent reports from Lee et al and Veenu et al both present cases of symptomatic found to have coronary aneurysms involving all three major coronary arteries [19, 20]. Lee et al describe a 65-year-old male with chest pain found to have aneurysms of all three major coronary arteries who was initially treated with dual antiplatelet therapy. He was then switched to long-term oral anticoagulation after he was found to have occlusion of a branch of the left anterior descending which was previously dilated. This report does not detail why the patient did not undergo surgery or percutaneous intervention, but presumably there was most likely a lack of good targets for bypass or stenting. Veenu et al described a similar case of a symptomatic 63-year-old male who opted for conservative treatment and was managed with dual antiplatelets, high dose statins, beta blockers, and ACE inhibitors.

Percutaneous intervention is most often used to treat symptomatic CAAs when there is single-vessel or focal multivessel disease, no left main coronary artery involvement, and suitable anatomy amenable to PCI [7]. The use of both stents and coil embolization have been described [7, 21, 22]. However, most studies describe the use of PCI in patients with symptomatic CAAs, so it is unclear whether PCI is a viable option for asymptomatic patients [7].

There is little consensus on how to surgically manage patients with CAAs. An alternative to ligation followed by bypass grafting is the use of an interposition graft [1]. In our patient's case, the decision was made to ligate the proximal and distal RCA due to the heavy calcification in the wall of the vessel. After an appropriate target was identified, an arteriotomy was made and bypass grafting was performed (radial artery from the aorta to distal RCA). Only a few case reports have described the use of bypass surgery to treat a giant right CAA in adults with atherosclerosis [23-29]. A recent case

report by Altarabsheh et al describes a patient with similar presentation and treatment to what we have described [30]. However, a saphenous vein graft was used to bypass the RCA aneurysm. The radial artery was chosen as an appropriate conduit for our patient because due to his relatively young age and patency of the palmar arch in his non-dominant hand, and we encourage the use of arterial grafts when feasible and clinically indicated [31, 32].

Exclusion of a giant coronary artery aneurysm can be safely performed in adults with extensive atherosclerosis. This report provides detailed video footage of the repair of a giant right coronary artery aneurysm. Giant atherosclerotic coronary artery aneurysms are rare but can occur in adults with coronary artery disease. As treatments continue to evolve, patients with atherosclerosis are living longer than ever before. Additionally, the increased utilization of chest CTA, coronary angiography, and cardiac magnetic resonance imaging will result in an increased detection of coronary artery aneurysms. More published data, such as detailed case reports and video footage, will be an important step to prepare surgeons to manage patients with coronary artery aneurysms.

Abbreviations

CAA	Coronary Artery Aneurysm
CT	Computed Tomography
CTA	Computed Tomography Angiography
ED	Emergency Department
LAD	Left Anterior Descending Artery
LIMA	Left Internal Mammary Artery
PCI	Percutaneous Coronary Intervention
RCA	Right Coronary Artery

Supplementary Material

Supplemental Videos 1-5 can be found at https://doi.org/10.11648/j.ijcts.20241004.12

Author Contributions

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Lilian Tsai: Data Curation, Investigation, Supervision, Writing – Review & Editing

John Ward MacArthur: Project Administration, Funding Acquisition, Supervision, Writing – Review & Editing

Funding

This work is not supported by any external funding.

Data Availability Statement

The data is available from the corresponding author upon reasonable request.

Conflicts of Interest

The authors declare no conflicts of interest.

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Biography

Danielle Mullis is a medical student at Stanford University. She completed her undergraduate studies at the University of Michigan, where she majored in Biomolecular Sciences and Spanish. She worked for two years as an Emergency Medical Technician and MCAT teacher, while also doing inorganic chemistry research in the Szymczak Lab. At Stanford University, she is a Cardiovascular Interest Group Leader, CVI Early Career Committee member, and Cardinal Free Clinic volunteer. She is part of the Physician Scientist Training Program, where she dedicated an additional year to research in the Dr. Joseph Woo Lab during medical school. She is passionate about cardiac surgery and research.