Review with Illustrative Case

Giant Coronary Artery Aneurysms:

Review and Update

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Giant coronary artery aneurysms are rare, with a reported prevalence of 0.02% to 0.2%. Causative factors include atherosclerosis, Takayasu arteritis, congenital disorders, Kawasaki disease, and percutaneous coronary intervention. Most giant coronary artery aneurysms are asymptomatic, but some patients present with angina pectoris, sudden death, fistula formation, pericardial tamponade, compression of surrounding structures, or congestive heart failure. Clinical sequelae include thrombus formation, embolization, fistula formation, and rupture. Surgical correction is generally accepted as the preferred treatment for giant coronary artery aneurysms. We present an illustrative case of a giant 70 × 40-mm coronary artery aneurysm in a 56-year-old man who declined surgery and died one month later. In addition, we provide a review of the medical literature on giant coronary artery aneurysms. ***(Tex Heart Inst J 2014;41(6):603-8)***

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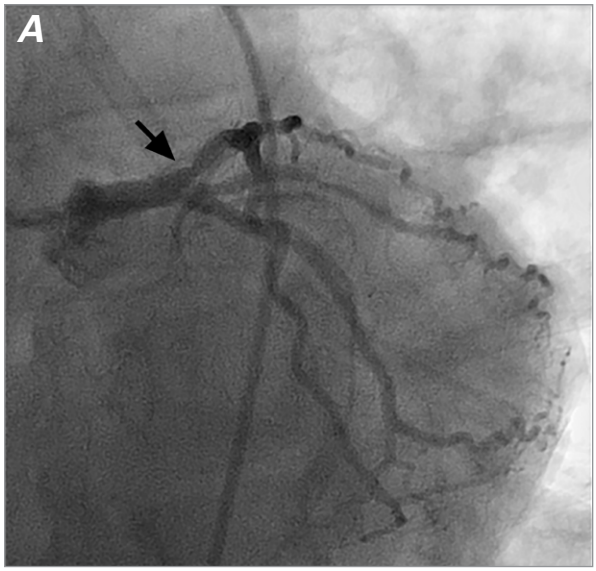
Aneurysmal coronary artery disease is seen in 0.3% to 5% of patients undergoing coronary angiography[1-16] and is defined as a localized luminal dilation measuring at least 1.3 to 2 times the diameter of a normal, adjacent reference segment.[1,5-7,9,12,13,17-27] Rarely, coronary artery aneurysms (CAAs) are large enough to be called giant CAAs. A universally accepted definition of a giant CAA does not exist: diameters of greater than 20 mm, 40 mm, 50 mm, and quadruple the reference-vessel diameter have all been proposed as definitive in the medical literature.[7,17,21,25,28] Published data on giant CAAs report a prevalence of 0.02% to 0.2% (the prevalence of giant CAAs ≥50 mm in diameter is 0.02%).[28-30]

Case Report

A 56-year-old man with a history of end-stage renal disease and type 2 diabetes mellitus presented at another institution's emergency department for the evaluation and management of angina pectoris, which had progressively worsened over the past several months. A myocardial perfusion study yielded normal findings; however, because of his persistent symptoms, he also underwent coronary angiography. This showed a 50%-to-60% stenosis of the ostium of the left anterior descending coronary artery (LAD) (Fig. 1) and nonobstructive lesions elsewhere. The patient was treated medically.

Three months later, the patient presented at our institution with recurrent angina of increased severity. A chest radiograph showed pulmonary vascular congestion, cardiomegaly, and a left perihilar density (Fig. 2). His electrocardiogram showed no repolarization abnormalities, and his initial troponin level was 0.08 (normal, ≤0.8). To further evaluate the radiographic findings, we ordered a computed tomogram with intravenous contrast medium. This showed a 55 × 55-mm contrast-enhanced mass arising from the left main or proximal LAD. The densely calcified proximal LAD appeared to be fractured (Fig. 3). An echocardiogram looked normal, except for moderate tricuspid regurgitation with evidence of mildly elevated right ventricular systolic pressure.

Because of the patient's ongoing angina and the suggestion of an aneurysm on the computed tomogram, we emergently performed coronary angiography. An aneurysm 70 × 40 mm in size was seen bulging from the distal left main coronary artery. Contrast medium flowed freely into this aneurysm, but there was evidence of decreased flow (Thrombolysis in Myocardial Infarction II) in the LAD distal to the aneurysm (Fig. 4).



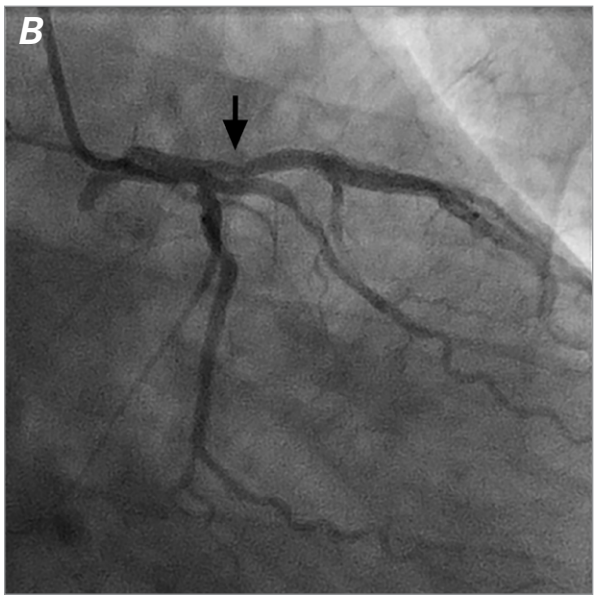


Fig. 1 *Coronary angiograms in **A**) posteroanterior and **B**) caudal right anterior oblique views show a 50%–60% stenosis at the proximal left anterior descending coronary artery (arrows).*

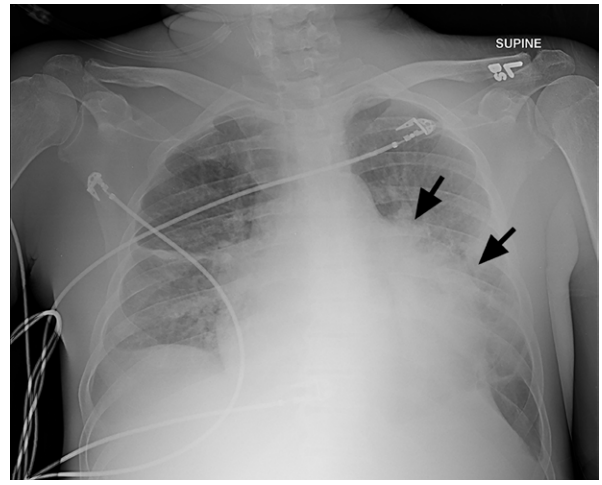


Fig. 2 *Chest radiograph shows pulmonary vascular congestion, pleural effusions, cardiomegaly, and a left perihilar density (arrows).*

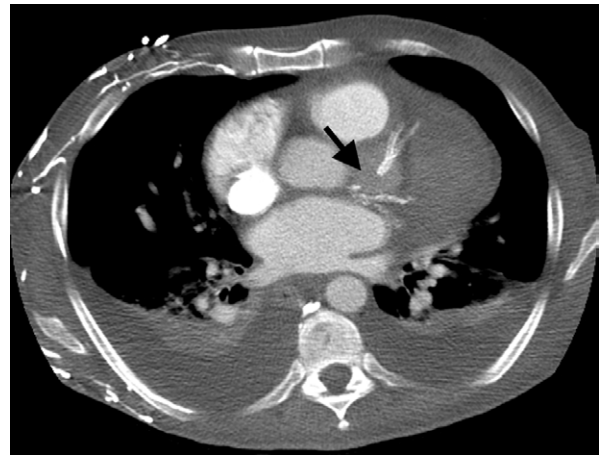


Fig. 3 *Computed tomogram with intravenous contrast medium reveals a contrast-enhanced mass arising from the left main or proximal left anterior descending coronary artery (arrow).*

The patient was evaluated by our cardiothoracic surgery department, which recommended surgical repair of the aneurysm. However, the patient refused further intervention because his father had died during open-heart surgery. After receiving a dialysis treatment, he was discharged from the hospital on warfarin and could not be contacted for a follow-up appointment. Subsequently, a death certificate indicated that the patient had died one month after his hospital discharge.

Discussion

The histologic features of an atherosclerotic aneurysm include hyalinization, lipid deposition, disruption of intima and media, focal calcification and fibrosis, cholesterol crystals, intramural hemorrhage, and foreign-body giant-cell reaction to the atherosclerotic process.[1,13,15,16,19,22,25,31,32] If the process extends into the media of the vessel, extensive destruction of the musculoelastic elements can be noted.[1,13,15,16,19,22,25,31,32] The pathologic mechanism of CAAs remains controversial. An inherent defect of the vessel wall can predispose atherosclerotic vessels to aneurysm formation. In areas of marked atherosclerosis, the media of the vessel wall is weakened, and there is a decrease in elasticity. The intraluminal pressure against the weakened wall decreases the stress tolerance and subsequently enables dilation of the vessel. The chronic transmural inflammation seen in atherosclerotic vessels aggravates this process.[6,13,15,19,22,25,30-32]

The most frequent cause of CAAs is atherosclerosis,[1,2,4-7,9-14,16-28,30-38] but other causes include congenital heart disease, trauma, Ehlers-Danlos syndrome, Kawasaki disease, Marfan syndrome, Takayasu arteritis, polyarteritis nodosa, syphilitic aortitis, scleroderma, systemic lupus erythematosus, Behçet disease, and fibromuscular dysplasia.[2,4-6,9,10,12-14,16-19,21,23-25,27,28,30,32,34-37,39,40] Similarly, the usual cause of giant CAAs is atherosclerosis, but other causes have been described. Keyser and colleagues[30] presented a compilation of 28 cases of giant CAA (exceeding 50 mm in size) reported over a period of 49 years. Of these, one was secondary to Takayasu arteritis and another was described as congenital. In yet another case,[14] a giant circumflex artery aneurysm was associated with cystic medial necrosis in a non-Marfan patient. Our patient had no history of connective-tissue disease, vasculitis, trauma, or infectious processes; therefore, atherosclerotic disease was considered to be most likely.

More recently, CAAs have been reported as a result of percutaneous interventions, including coronary artery angioplasty, atherectomy, and stenting.[4,16,17,19,21,24,25,27,32,33,38,41-43] Causative factors include residual nonhealing dissection, arterial barotrauma secondary to high-pressure balloon inflation, and the use of oversized balloons or stents, atherectomy techniques, and laser angioplasty.[17,19,43] Authors of case series have reported an aneurysm occurrence rate of 3.9% after percutaneous coronary angioplasty, 10% after direct atherectomy, and 3.5% to 5% after stenting.[42] Antiproliferative drug-eluting stents can suppress restenosis by dramatically inhibiting neointimal growth; however, they can cause CAAs by other mechanisms, such as delayed re-endothelialization, inflammatory changes of the medial wall, and hypersensitivity reactions.[5,41]

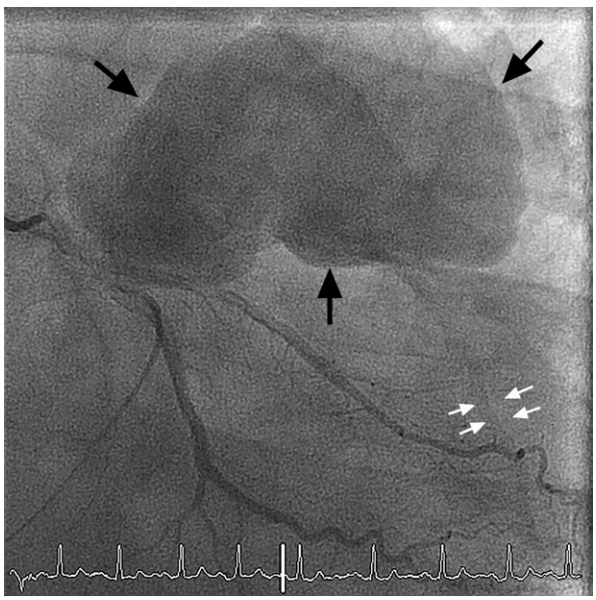


Fig. 4 *Coronary angiogram shows a 70 × 40-mm aneurysm bulging from the distal left main coronary artery (black arrows). Faint opacification of the distal left anterior descending coronary artery is seen (white arrows).*

Giant coronary aneurysms have been identified throughout the coronary arterial circulation, with the right coronary artery more frequently affected than the left.[15,21,40] Out of the 28 cases of giant CAA compiled by Keyser and colleagues,[30] the vast majority (89%) occurred in the right coronary artery (85.7% were found in the proximal portion thereof). One giant CAA involved both the left and right coronary artery systems. Giant aneurysms from the proximal LAD are exceedingly rare, although one 7-cm giant CAA from a septal branch was reported.[44]

True Aneurysms vs Pseudoaneurysms. Pathologically, true aneurysms have an intact vessel wall: intima, media, and adventitia are all involved in the aneurysmal structure. Pseudoaneurysms are dissections or perforations: there is loss of vessel-wall integrity, with damage to the adventitia, perivascular tissue, or both.[8,12,18,19,24,32,34] Pseudoaneurysms often occur after catheter-based interventions, as a result of traumatic dissection or perforation of the coronary artery, and they rarely occur spontaneously.[8,12,17,24,32,34,43]

Our illustrative case is unusual because the aneurysm occurred in the left system and was markedly large, at 70 × 40 mm. The rapid development of the aneurysm (in the space of 3 months after the previous coronary angiogram) was also unusual. A possible explanation for this rapid time course is that the patient actually had developed a pseudoaneurysm rather than a true aneurysm. This dissection could have been caused by trauma related to instrumentation during the procedure 3 months earlier. However, a careful review of the catheterization films and report confirmed that no intervention had been performed at that time, and hyperengagement of the catheter could not be seen on any of the films. A pseudoaneurysm could also have been caused by spontaneous rupture of an atherosclerotic plaque. This plaque would have ruptured transmurally rather than simply endocardially. Such epicardial ruptures are very rare but have been reported.[34]

Presentation

Most CAAs are asymptomatic, but some patients present with angina pectoris, myocardial infarction, sudden death, fistula formation, hemopericardium, tamponade, compression of surrounding structures, or congestive heart failure.[2,3,5,7,9,18,20,21,32,40,41] Patients with giant CAAs can also present with superior vena cava syndrome or with a mediastinal mass that can be misdiagnosed as a cardiac tumor or thymoma.[21] In one case report, a giant CAA was the source of a mid-diastolic murmur that was localized to the 3rd left intercostal space.[38] In another, a patient who presented with congestive heart failure was found to have a giant CAA originating from

the LAD, with a fistulous connection to the pulmonary artery.[28] Our patient presented with unstable angina and a mass on chest radiography.

Imaging

A variety of imaging techniques have been used to view giant CAAs. Noninvasive tools—including echocardiography, computed tomography, and magnetic resonance imaging—can detect some CAAs,[4,7,12,19,21,32,33,40] and large aneurysms have even been seen on chest radiographs.[40] Coronary angiography remains the gold standard, for it provides important information about the size, shape, location, and number of aneurysms, as well as the degree of coronary artery atherosclerosis.[4,7,12,17,19,21,22,32,41] However, it is difficult to determine by coronary angiography whether an aneurysm is true or false.[8,17,24,34] The coronary angiogram is a "luminogram" that does not define the 3 layers of vessel wall that differentiate true aneurysms from pseudoaneurysms.[17,24,34] The information obtained via coronary angiography can be refined by intravascular ultrasound, which can provide additional information to differentiate a true aneurysm from a false aneurysm.[7,12,17,19,24,32-34,41] Intravascular ultrasonography provides transmural images of the coronary arteries that include information on the composition of the lumen and the arterial wall structure.[17,24,33] Intravascular ultrasonography was not performed on our patient, so we could not definitively identify the layers involved in the aneurysmal segment. Our patient did not undergo any known instrumentation procedures in the vessel; therefore, this giant CAA was most likely either a true aneurysm or a pseudoaneurysm caused by spontaneous arterial rupture.

Prognosis

Clinical sequelae of giant CAAs include thrombus formation, distal embolization of those thrombi, fistula formation, and rupture.[2,4,5,7,9,12,19,21,23,28,29,32,36,40,41] A frequent finding is the presence of thrombus within the aneurysm.[1,4,7,11,13,14,16,23,30] The slow flow of the blood and the irregular internal surface of the aneurysmal wall predispose the lesion to this development.[1,6,13,15,31,33] Distal embolization or extension of the thrombus can of course result in myocardial ischemia or infarction. Several investigators have reported a greater incidence of myocardial infarction in patients with aneurysmal disease.[1,10,13,26,39] In a review of case reports published in 2011, Morita and colleagues[28] found that 25% of patients with a giant CAA had an associated fistula. Ipek and associates[29] reported a case of a giant right coronary artery aneurysm with a coronary–cameral fistula.

Management

Surgical correction is generally accepted as the preferred treatment for giant CAAs.[7,12,15,16,21,25,32,40] In the compilation by Keyser and colleagues,[30] 19 of 28 patients underwent surgical correction. One was treated by means of percutaneous intervention, with detachable latex balloons and coil embolization to the aneurysm; 5 were treated conservatively with antiplatelet or anticoagulant medication. Only one of the 5 patients treated conservatively had an uneventful course. The 3 patients who received no therapy died.[30] Surgical tactics include aneurysm ligation with distal bypass grafting, isolated coronary artery bypass grafting, aneurysm plication, and saphenous vein patch repair of the aneurysm.[5,19,21,27,32,42] These procedures are often performed as part of a multivessel bypass operation.[19] However, surgical intervention necessitates median sternotomy, cardiopulmonary bypass, and myocardial revascularization. Therefore, certain patients will not be candidates for such an invasive procedure.[12,21,34,40]

In the absence of surgical correction, some authors support the use of antiplatelet or antithrombotic treatment (or both) for all large aneurysms, in order to reduce the risk of in situ thrombus or distal embolization.[1,2,5,6,12,16,18,22,23,25,30,32,36] This treatment is inferred from the beneficial effects seen in patients with Kawasaki disease and its associated giant aneurysms.[1,19] There is little published information, however, regarding the incidence of distal embolization from thrombus.[2,4,10,18] The cases of anticoagulation and antiplatelet therapy in selected patients that have been reported to date have resulted in varying degrees of success.[15,19,30,32,40] Banerjee and colleagues presented a case of a giant right CAA partially filled with thrombus that was treated conservatively and successfully with warfarin.[18] Despite the lack of substantial evidence-based results, warfarin seems to be a reasonable option in treating selected patients whose symptoms are otherwise controlled with medical therapy.

It is now possible to treat selected patients with percutaneous techniques that are less invasive; however, long-term outcomes are still unknown.[16] Percutaneous options include stent placement with or without coil embolization.[7,25,32] Polytetrafluoroethylene (PTFE)-covered stents were introduced in the late 1990s and have been used for treatment of CAAs with some success.[7,9,16] In one case, a PTFE-covered stent was used in a patient with a 16 × 22-mm giant CAA in the LAD just distal to a focal stenosis. The stent excluded the aneurysm and eliminated the corresponding stenosis. A follow-up angiogram continued to show exclusion of the aneurysm.[7] Bhindi and colleagues[3] presented a case of progressive dilation of an LAD aneurysm that was successfully treated with a single covered stent. Szalat and associates[27] reported successful treatment of a giant right CAA with a PTFE-coated stent and presented a review of patients who had surgical treatment of their CAAs, compared with those treated with covered stents. In this comparison, stent patients who had aneurysms larger than 10 mm had a higher restenosis rate than did those with a CAA smaller than 10 mm.[27] Therefore, the less invasive

percutaneous approach to CAA exclusion seems reasonable for aneurysms greater than 5 mm but less than 10 mm. Further experience with covered stents, together with technologic advances in stents, delivery systems, and covering material, might lead to increased success in the percutaneous elimination of giant CAAs.

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