

Iatrogenic coronary artery dissection: A surgical perspective

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Abstract:

Iatrogenic aortocoronary dissection is a rare but potentially fatal complication of coronary catheterizations. Although the incidence is comparatively low, dissection often leads to procedure failure with increased risk of myocardial infarction and death. Iatrogenic aortocoronary dissection is principally caused by disruption of intima at the ostia of the right or left coronary artery during interventional procedures and appears as luminal filling defects, the persistence of contrast or intimal tear outside the coronary lumen.

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Introduction

Iatrogenic Aortocoronary Dissection (IACD) is a fatal complication occurring in 0.02% to 0.04% cases (1) of coronary catheterization that requires early recognition and emergent surgical treatment. Aortic dissection may lead to serious complications like myocardial infarction or sudden cardiac death. Most described cases occurred during catheterization and angioplasty of the Right Coronary Artery (RCA).

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Various options have been tried by many in the past including Coronary Artery Bypass Grafting (CABG) with aortic dissection repair, stenting the coronary artery, monitoring the aortic dissection using Transesophageal Echocardiography (TEE), implanting coronary stents to maintain coronary blood flow before surgery and repairing aortic dissection surgically. Thus, it is important to recognize and manage IACD promptly to prevent dissection propagation and improve outcomes. The purpose of this review is to describe the causes and characteristics of IACD, and to propose potential strategies for the identification and management of this lethal complication (Figure 1).

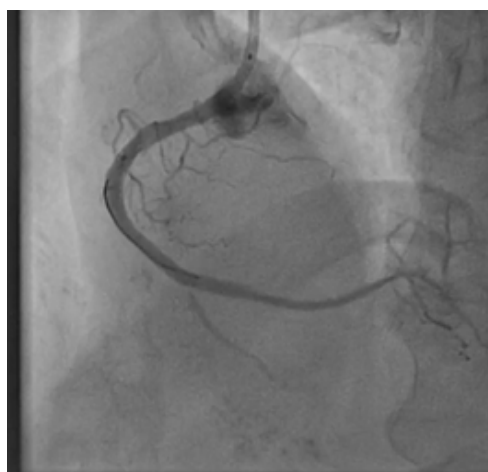


Figure 1: Iatrogenic Aorto coronarony dissection in a patient while hooking the RCA.

Our Experience

We usually perform around 4500 cases of diagnostic and therapeutic catheterizations annually. We found a significantly higher total incidence of iatrogenic aortic dissection in the setting of Acute Myocardial Infarction compared to elective procedures. The reason for this higher incidence is unclear. Aortic dissections are thought to occur when a hematoma develops within the aortic media and in most cases, is the result of a tear or break in the intima. Vulnerability to the development of intimal tears and propagation of the hematoma may be related to an underlying structural weakness of the media. Extensive atherosclerosis may also be a risk factor for dissection. Although Amplatz catheters used in our institute provide better support, there may be an associated risk of dissection and increased caution should be exercised, particularly in the acute setting. All cases involved experienced high volume operators. The smaller RCA more frequently develops proximal dissection that may evolve into aortic dissection as the hemodynamic force vector is directed to the right-side convexity of the ascending aorta (Figure 2).

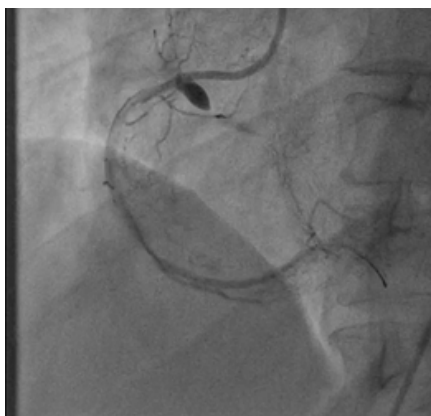


Figure 2: Iatrogenic Aortocoronary dissection in another patient while hooking the RCA.

We recently operated on a 63 years of age lady who presented to us in the Emergency Department following diagnostic coronary catheterization at a local center done for evaluation of breathlessness and chest pain. Coronary catheterization demonstrated significant disease in LAD (70% stenosis in the proximal part) and a tight RCA ostial disease. Also, on engaging the RCA, dye spillage was seen from the ascending aorta which was suggestive of aortic dissection. This was later confirmed by a CT Thoracic Aortogram and the patient was then referred to our institute. The patient was operated under general anesthesia using standard anesthetic protocols with neurological monitoring using Near Infrared Spectroscopy (NIRS). The patient underwent central aortic cannulation using 18 Fr Femoral arterial cannula. The patient underwent an aortic interposition tube graft (30 mm Intergard woven Dacron tube

graft, Maquet) with CABG (RSVG to distal-RCA and mid-LAD). The patient was hemodynamically stable in the postoperative period and was discharged on postoperative day-8. The patient is doing well in the follow-up clinic. A CT-Angiogram done 6 weeks post-surgery as per institutional protocol showed normal contrast opacification of aortic graft and arch of aorta along with the arch vessels.

Discussion

Dunning et al. [1] analyzed data from 43,143 cardiac catheterizations and found nine aortocoronary dissections for an incidence of 0.02% In a single-center experience of 42,345 cardiac catheterizations, 30 cases (0.071%) died within 24 hours, 20 (67%) of which were caused by LM dissections during diagnostic coronary angiography [2]. Recent studies showed the incidence of iatrogenic LM dissection was about 0.07% [3,4].

The RCA is more easily dissected in the retrograde direction into the coronary sinus than the Left Main Coronary Artery (LMCA) because of the presence of more smooth muscle cells and a dense matrix of collagen type I fibers in the periostial wall and sinotubular junction of the LMCA [5]. Its mechanism involves disruption of the coronary intima by mechanical trauma caused by aggressive manipulation of rigid or hydrophilic guide wires, followed by vigorous contrast injection, which, in turn, contributes to the subsequent retrograde extension of the dissection. Over 40% of the cases usually spread rapidly to the ascending aorta if the entry-door is not sealed rapidly, a “wait and see” approach may be too risky. Coronary dissection may be partly associated with extensive atherosclerosis. Catheter-induced plaque ulceration may also serve as an entry point for the pulsatile flow of blood [6]. The rapid propagation of aortocoronary dissection may become immediately life-threatening via several sequelae, including hemorrhage into the pericardium resulting in cardiac tamponade, occlusion of the contralateral coronary ostium or propagation of the dissection into the descending aorta [7].

Dissection could disseminate anterogradely and lead to subtotal or total lumen occlusion and is associated with complaints of severe chest distress, chest pain, nausea or vomiting, as well as hemodynamic compromise including slowing down of heart rate and blood pressure. Electrocardiogram often presents with ST-segment elevation in culprit vessel-related leads or severe arrhythmia. It is to be noted that some IACD patients may have no symptoms or changes in hemodynamics, and are prone to be ignored. Various investigations like multi-slice Computed Tomography (CT), magnetic resonance imaging, transthoracic echocardiography and transesophageal echocardiography can also be used to evaluate the progression of IACD.

Various classifications have been used to classify iatrogenic aortocoronary dissections with no one classification scheme being accepted universally. All these schemes have their own merits and demerits. National Heart Lung and Blood Institute (NHLBI)

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[6,8], classifies dissections into six types—Type A-F which could predict the risk of acute coronary occlusion. However, the NHLBI classification is limited by unavailability to entirely show coronary ostia and aortic dissections in patients with IACD. Dunning et al. [1] categorized aortocoronary dissection according to the level of aortic involvement in class I, II, and III. As a class I and II patients with limited involvement of the aorta can benefit from stenting of the coronary dissection entry point, it was found that urgent surgery is the treatment of choice for class III patients with extensive dissection. Thus, this classification could help to predict prognosis and guide therapeutic strategy, but it did not take into account the antegrade extension of dissection into the coronary tree. Eshtehardi [3], put forward a classification to further classify left main ostial dissections into Type-I-III. However, this classification involves both antegrade and retrograde extension of dissection. However, it was only applicable to LM ostial dissection, and could not precisely reflect the extension of the dissection flap.

Aortic dissection when localized may be followed up with electrocardiogram and CT scan if coronary blood flow has been corrected by stenting. However, if the above procedure fails or cannot be attempted without a high risk of further compromising of the coronary circulation, surgery is the only option. Surgery is a preferred option in cases of the extensive aortic dissection and coexistent coronary artery disease which have to be managed surgically by bypass grafting. Immediate bail-out stenting and emergency Coronary Artery Bypass Grafting (CABG) are two initial strategies available for the management of IACD [9]. Central cannulation of the true lumen of the ascending aorta in acute type A aortic dissection was introduced in the early 2000's as done in our case [10]. An advantage of this cannulation strategy is that it is relatively quick and it saves a lot of time, resources and manpower. Locating an adequate site for cannulation is of paramount of importance since the sequence of false lumen cannulation can be catastrophic. The major concerns in relation to the use of this technique are the rupture of the cannulation site and false lumen perfusion [11,12]. Once coronary dissection was identified, the key point is to maintain blood flow in the true lumen. Successful treatment of dissection relies on prompt sealing of the entry site to terminate the progression of dissection or even abrupt occlusion due to intramural coronary hematoma. When taking full anticoagulation and antiplatelet setting into consideration, as well as the unstable hemodynamic condition, the risk of surgery is higher but it provides a definitive solution to this problem. To date, the optimal treatment of this rare entity has not been well established. Management depends on the status of the distal coronary circulation and the extent of aortic dissection.

Conclusion

IACD is extremely dangerous and a life-threatening situation requiring emergency surgery; therefore, it is critically important to prevent a catheter-induced aortic dissection during any interventions. Thus, we suggest that surgical management is the preferred modality for this condition. The standard institutional

protocols may vary across all institutions but comparable results can be achieved across the globe. In this time of the pandemic where the entire world is still coming to terms with its onslaught, percutaneous interventions should only be performed in institutions with a cardiac surgical backup. Percutaneous interventions should only be performed in patients with a dire need of undergoing these investigations.

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Competing Interests

The authors declare no competing interests.

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