

Delayed coronary air embolism post re-do mitral valve replacement: A case report

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Case Report

Abstract

BACKGROUND: Coronary air embolism (CAE) is a complication that can lead to catastrophic outcomes, including myocardial infarction, stroke, and death. It is reported to occur during cardiac catheterization, within a few hours after cardiac surgery, or as a result of chest trauma. This is a case report of delayed coronary air embolism following cardiac surgery.

CASE PRESENTATION: A 58-year-old female presented with New York Heart Association (NYHA) Class II symptoms resulting from severe, highly eccentric anterior mitral regurgitation from a bio-prosthetic valve. She had preserved ejection function and a total calcium score of zero. This patient underwent a re-do mechanical mitral valve replacement. Two days post-surgery, she was brought to the catheterization laboratory with signs and symptoms suggestive of an inferior myocardial infarction (MI) and complete heart block (CHB). Her symptoms and ST changes resolved immediately after the introduction of angiographic contrast. Angiography revealed no occlusion in the right coronary artery (RCA).

Keywords: Coronary Air Embolism, Mitral Valve Replacement, ST-elevation Myocardial Infarction (STEMI)

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Introduction

Coronary air embolism (CAE) is a non-atherosclerotic cause of myocardial infarction that can lead to death¹. It primarily occurs as an iatrogenic complication during cardiac catheterization in 0.1–0.3% of cases², interventional radiology procedures^{3,4}, and during cardiac and even non-cardiac surgeries⁵.

The incidence of iatrogenic air emboli, including CAE following cardiopulmonary bypass (CPB), ranges from 0.1% to 0.2%. It is largely under-diagnosed and under-reported, and has high morbidity (13–71%) and mortality (5–23%) rates⁶.

It is crucial to understand all the possible means of introducing air into the coronary arteries during cardiac surgery, not only for prevention but also for rapid detection and a confident management approach when air embolism occurs. In this report, we present a case of a patient who developed chest pain and inferior ST elevations two days after an uneventful re-do mitral valve surgery. She was

transferred to the cath lab and immediately after the injection of contrast medium, the pain and ST changes were resolved.

Case Presentation

This case involved a 58-year-old female who was electively admitted with New York Heart Association (NYHA) Class II symptoms from severe, highly eccentric anterior mitral regurgitation (MR) and normal biventricular function. She had a history of mitral valve annuloplasty three years prior to her operation for severe MR secondary to infective endocarditis. Moreover, she had a history of high-grade ductal carcinoma in situ (DCIS), three years prior to surgery, for which she underwent breast radiotherapy. A formal coronary angiogram four years earlier revealed no coronary artery disease, and preoperative CT coronary angiography (CTCA) showed a total calcium score of zero; no coronary artery disease was detected.

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She underwent an uneventful mitral valve replacement (MVR) with a 27/29 On-X valve with cardiopulmonary bypass (CPB) and a cross-clamp time of 80 minutes and 54 minutes, respectively. No dissection was performed to free the left side of the heart. Intraoperative transesophageal echocardiography (TOE) post valve replacement showed a peak/mean gradient of 9/4 mmHg, respectively, with no paravalvular leak and a well-seated valve away from the coronary sinuses. De-airing steps were taken at each stage during the surgery and before unclamping the aorta. A TOE confirmed adequate de-airing of the left ventricle and the patient was weaned from CPB in a standard fashion.

She had a sinus ECG (Figure 1) and a smooth one-day stay in the ICU. In the ward, two days after surgery, she developed a central squeezing chest pain associated with diaphoresis and a new inferior ST elevation with complete heart block and hypotension (Figure 2), which was suggestive of a right coronary artery (RCA) occlusion. Heparin infusion was commenced, as well as supportive care, including administration of 100% oxygen and intravenous fluids. Urgent coronary angiography was performed. The pain resolved and the ST segments settled at the beginning of the procedure and immediately after the introduction of the wire and contrast injection with the routine approach. No occlusion in the RCA was observed (Figure 3) and no other obstruction

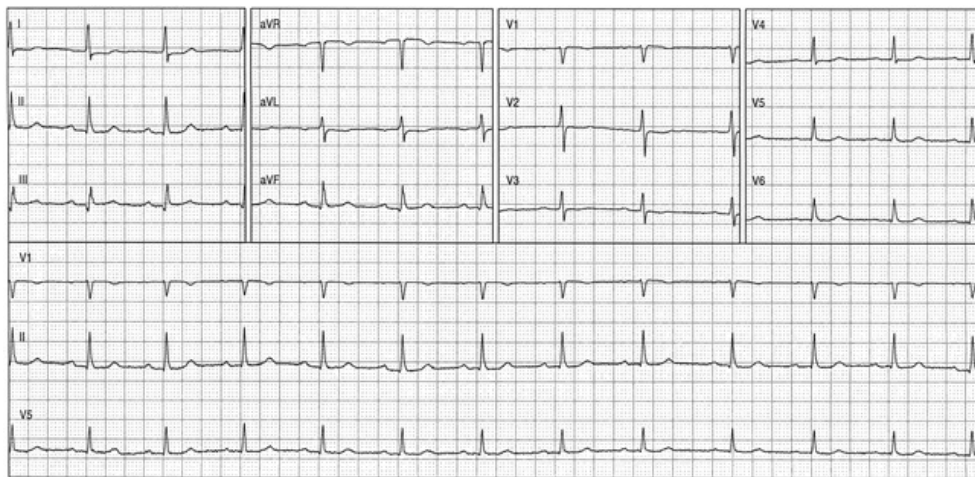


Figure 1. Sinus Electrocardiogram – Day one post-operation in ICU

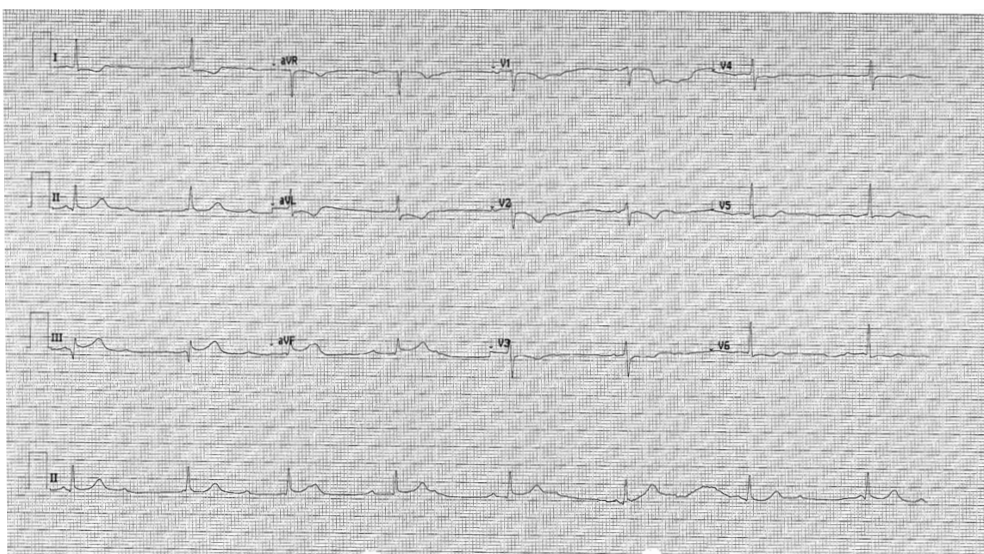


Figure 2. Electrocardiogram - Inferior ST Elevation with complete heart block

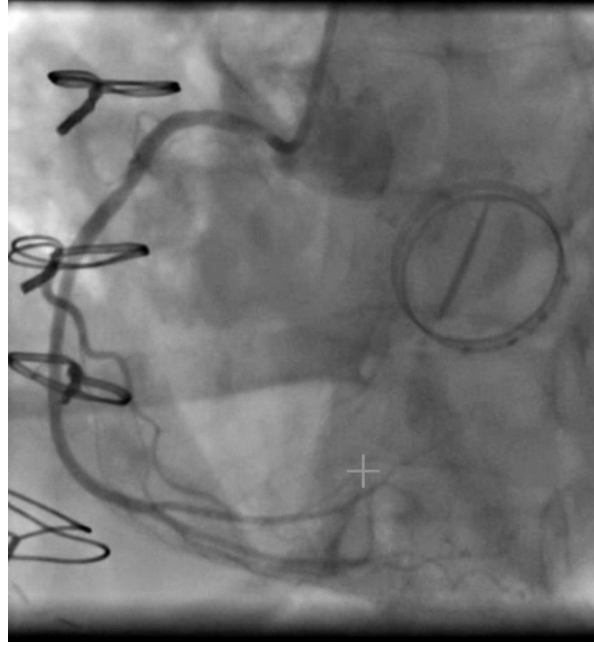


Figure 3. Coronary Angiogram - No occlusion in Right Coronary Artery

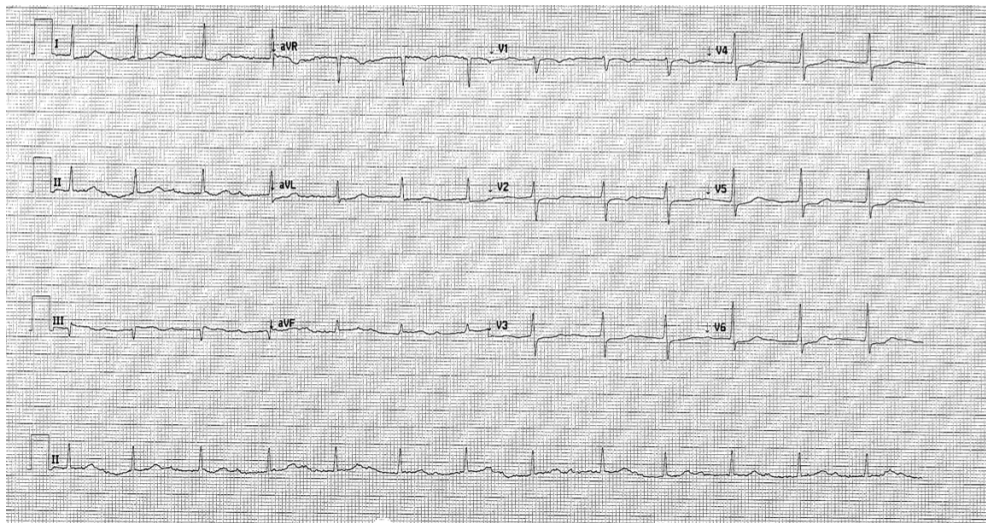


Figure 4. Rhythm strip during angiogram - sinus rhythm with 1st degree Atrioventricular (AV) block

in the coronary arteries was visible. Rhythm strips during angiography were sinus with 1st degree Atrioventricular (AV) block (Figure 4). The patient remained stable and was closely monitored in the coronary care unit. Heparin infusion continued until the INR was in the therapeutic range on day 4 and the patient was discharged on day 7 after surgery with sinus rhythm. She was clinically stable with a sinus ECG at the six-week post-operative review in our outpatient clinic.

Discussion

In the present case, CAE occurred two days after a re-do MVR. The patient developed inferior STEMI with a normal pre-operative CTCA and was brought to the cath lab with a high suspicion of a post-operative embolic event in the RCA, which resolved with the administration of contrast media, indicating a clinical picture of CAE. The signs and symptoms of CAE closely mimic the clinical picture of a typical acute coronary syndrome, which

includes chest pain, hypotension, arrhythmias, ECG changes, and even cardiac arrest^{2,7-10}. The severity of symptoms is greatly associated with the volume of air, the affected vessels, and the baseline myocardial dysfunction¹¹.

The extensive mediastinal scar tissue formed following the first operation and radiotherapy could account for a limited posture change of the heart – a de-airing maneuver – because of adhesions to surrounding structures, which could be the precipitating factor for the development of a delayed air embolism from air bubbles hidden intra-cardiac. Air bubbles are most likely to travel to the anterior coronary sinus, where the RCA begins.

CAE is a potential complication of any procedure requiring Cardiopulmonary Bypass (CPB)¹². De-airing is a crucial step in the reperfusion process, as large amounts of air can not only produce systemic embolism but also coronary embolism after aortic clamp removal. Other intraoperative measures to expel air from the coronary circulation include operating the extracorporeal circulation system properly to prevent the occurrence of an undesirable event. In case of an event, treatment with increased perfusion pressure and reperfusion is administered to push the air through the coronary circulation¹².

Moreover, de-airing involves mechanically removing air before releasing the cross clamp, aspirating through the cannulation vent, shaking the heart to dislodge air bubbles, placing the patient in the Trendelenburg position, and using the retrograde cardioplegia cannula (if in place) to de-air the coronary arteries, hot shot cardioplegia, and lung inflation¹³. Some of these steps are applicable in re-do situations.

Intraoperative Transesophageal Echocardiography (TOE) findings have revealed that it may not always be possible to remove all air from the heart, as small air bubbles can be missed and trapped air may be invisible^{11,14}. Most CAE incidents during cardiac surgery have been reported to occur between the release of the cross clamp and the termination of the Cardiopulmonary Bypass (CPB). However, there have been reports of events occurring up to 2 hours after surgery¹⁵. Yet, no report has shown a delay of CAE occurring 2 days post-operation.

When postoperative CAE is suspected, administering inhalational oxygen (100%) accelerates

the shrinkage and absorption of small to moderate air emboli, considering that the main gas in air is nitrogen¹⁶. When large amounts of air are involved, more aggressive modalities, including intracoronary administration of adrenaline and atropine, seem to be the best and readily available solution. This action increases coronary blood flow and causes division of the embolus through vasospasm. Forceful injection of saline and contrast medium has also been suggested^{2,17-19}. Other mechanical measures that have been described include air embolus aspiration using thrombectomy catheters or over-the-wire balloons²⁰. Finally, intracoronary administration of adenosine, calcium channel blockers, or nitrates may be useful after the patient's hemodynamic stabilization, as this can deal with the slow-flow phenomenon²¹.

In this case, the inhalation of 100% oxygen and simultaneous injection of contrast medium into the coronary arteries increased the local pressure, which immediately resulted in the shrinking and advancing of the air lock before coronary angiography pictures could capture the air emboli.

It is noteworthy that during Cardiopulmonary Bypass (CPB), cerebral air embolism is a feared complication. As 20% of cardiac output is supplied to the brain, a gas bubble is highly likely to travel to the brain and cause neurological symptoms, including seizure, mental deterioration, and paralysis post-CPB in cardiac surgery.

Conclusion

CAE post-cardiac surgery is rare and could be life-threatening and should be suspected as a differential diagnosis of ACS even 2 days post-cardiac surgery, particularly in patients with existing mediastinal scars from previous cardiac surgeries or radiotherapy, when adequate heart mobilisation is limited and trapped air bubbles cannot be properly visualised in TOE.

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Conflict of Interest

There is no conflict of interest with this paper.

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Author's Contributions

PN: Collection of data and drafting the manuscript and finalizing the manuscript. SY: Surgeon in charge of the operation and proof of the paper final version

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