Right Coronary Artery Fistula and Occlusion Causing Myocardial Infarction after Blunt Chest Trauma

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Myocardial infarction (MI) secondary to coronary artery fistula and the subsequent occlusion of the distal right coronary artery (RCA) after blunt chest trauma is a rare entity. Here, we describe a case of coronary artery fistula and occlusion with an inferior MI that occurred following blunt chest trauma. At the initial visit to the emergency room after a car accident, this patient had been undiagnosed with acute myocardial infarction, readmitted five months after ischemic insult, and revealed to have experienced MI due to RCA-right atrial fistula and occlusion of the distal RCA. He underwent coronary surgery and recovered without complications.

Key words: 1. Blunt chest trauma  
2. Myocardial infarction  
3. Coronary artery fistula

CASE REPORT

A 47-year-old man, with no significant medical history, was admitted for the evaluation of abnormal electrocardiography (ECG). ECG showed sinus rhythm with pathologic Q waves in leads II, III, and aVF. He denied having recent chest pain but complained of general weakness and mild dyspnea on exertion since a motor vehicle collision 5 months ago.

Initially, he had been transported to the emergency room (ER) of Dongtan Sacred Heart Hospital and had been diagnosed with multiple facial bone fractures, cardiac contusion, and chest wall contusion without definite evidence of any bony thorax injury. Then, he was transferred to a local hospital near his residence. On review of his previous ER chart, the initial ECG at the ER (Fig. 1) showed ST elevation in leads II, III, and aVF and increased cardiac enzyme levels (serum creatinine kinase myocardial band fraction of 14.2 ng/mL and troponin-I of 2.64 ng/mL).

Transthoracic echocardiography on readmission revealed a dilated left ventricle (LV), akinesia of mid-to-basal inferior wall, and hypokinesia of the LV apex with an LV ejection fraction of 40%. The valvular functions were normal, and an abnormal flow via the fistula was identified between the right atrial (RA)-right ventricle groove and RA (Qp/Qs=1.3) by color flow Doppler.

Coronary angiography revealed an RCA-RA fistula and totally occluded distal RCA just beyond the fistula (Fig. 2A), while the other coronaries were normal (Fig. 2B). There was no abnormal collateral vessel around the fistula or along the RCA. Coronary computed tomography (CT) angiography showed similar findings to coronary angiography except a calcified plaque on the proximal left anterior descending (LAD) artery, and the size of the proximal RCA (4.5 mm)
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was not dilated compared with the left main coronary artery (4.9 mm) (Fig. 2C).

We concluded that the RCA injury by blunt chest trauma sustained 5 months previously induced RCA–RA fistula, distal RCA occlusion, and myocardial infarction (MI) consecutively or simultaneously. Their cause-and-effect relationship and time sequence were extrapolated retrospectively.

Surgery was planned for revascularization of the RCA and coronary artery fistula closure. Surgery was performed through standard median sternotomy with normothermic cardiopulmonary bypass. Before infusing a cardioplegic solution (Custodiol; Kohler Chemie GmbH, Alsbach-Hahnlein, Germany) via the aortic root, RCA around the fistula was dissected and clamped without any difficulty. After infusion of the cardioplegia, long arteriotomy was done from the distal RCA to bifurcation and a fistula opening (7×3 mm) to the RA was revealed. The distal RCA was occluded beyond the fistula opening up to the proximal posterolateral branch and filled mainly with fibrous tissue with loose myxoid stroma macroscopically and microscopically.

The fistula opening was closed with two horizontal mattress sutures of 5-0 prolene and excluded from the RCA, and a left radial artery graft was interposed between the RCA and the posterolateral branch. The posterior descending artery was sacrificed because the lumen of the proximal portion was very small (diameter <1.0 mm) and filled with fibrous tissue. Postoperative coronary angiography showed complete obliteration of the coronary artery fistula and good patency of the RCA and the interposed radial artery graft (Fig. 3). The postoperative course was uneventful, and the patient was discharged on postoperative day 7.

**DISCUSSION**

Although coronary artery injury is a rare complication after blunt chest trauma, it could lead to myocardial infarction and sudden death, and the diagnosis is frequently missed or delayed. The pathophysiologic mechanism that can result in myocardial infarction after blunt trauma includes intimal tear
Fig. 3. Postoperative coronary angiography showed complete obliteration of the coronary artery fistula and good patency of the interposed radial artery graft (arrows).

or dissection, submural hemorrhage, rupture of an existing plaque, vessel rupture or fistula formation, and external compression from epicardial hematoma [1,2].

Coronary artery rupture or coronary artery fistula from blunt thoracic trauma is very rare, and few cases associated with a traumatic ventricular septal defect have been described [2-4]. This is, to the best of our knowledge, the first reported case of coronary artery fistula (RCA to RA) and occlusion with an inferior MI that occurred following blunt chest trauma worldwide. In our case, initial coronary artery injury had not been recognized because of insufficient suspicion of cardiac injury. A plausible mechanism of myocardial ischemia and coronary artery-RA fistula in this patient might be a coronary artery rupture to RA followed by the RCA occlusion just distally to the fistula because of the compromised coronary blood flow. We were uncertain of whether this RCA-RA fistula was congenital, longstanding acquired, or recent trauma-related. The major determinants of the size of the shunt are the compliance of the recipient cardiac chamber and the cross-sectional area of the fistulous tract [5]. The coronary fistula-ending RA causes a large runoff into the low-pressure chamber and a steal of blood from the RCA and eventually from the left coronary arterial beds. It would appear that a coronary fistula involving a coronary artery may eventually result in a steal of the coronary blood flow from the uninvolved coronary as well, leading to global ischemia. This steal phenomenon enlarges the vessel diameter of the involved coronary artery proximal to the fistula and the uninvolved coronary artery over time and increases tortuosity, forming the typical Asian dragon shape [6]. In this 47-year-old patient, the chamber into which the RCA fistula drained was the RA, and the diameter of the fistula opening was 7×3 mm, approximately double the size of the RCA. The preoperative coronary CT angiography showed a similar size and contour of the RCA proximal to the fistula, compared with a normal left coronary artery. The postoperative right coronary arteriography also revealed a normal size and contour along the entire RCA, including an interposed radial artery graft. These findings support the belief that it would be inappropriate to consider that this patient had had congenital or longstanding acquired RCA-RA fistula in relation to his age of 47 years. Moreover, the volume overload caused by a longstanding fistula would have changed the right and left ventricular geometry and caused the valvular incompetency and atrial fibrillation. However, this patient did not show any remarkable echocardiographic findings.

The most commonly affected coronary artery after blunt trauma is the LAD. The probable explanation is the vulnerable anatomic position on the anterior part of the heart. The second most commonly affected artery is the RCA, and the involvement of the left main coronary artery and the left circumflex artery is infrequent [1]. In the traumatic coronary artery fistula, RCA has been reported more frequently than LAD. Presumably, LAD injury would be more fatal and cause early death.

Diagnosis of coronary artery injury following chest trauma requires clinical suspicion and systematic evaluation. In patients who present with chest pain or dyspnea after a blunt chest trauma, injury to the heart and coronary vessels should be considered. Diagnosis can be difficult because chest pain may be interpreted as being secondary to chest contusion or overshadowed by concomitant injuries [7]. Initially, our patient had complained of chest pain and presented abnormal ECG at the ER, but severe coronary artery injury had not been suspected because of the masking effect of the chest wall contusion, and this finally led to acute myocardial ischemia with LV dysfunction.
ECG and cardiac enzyme levels should be checked in every patient with thoracic trauma because clinical findings may be misleading or masked by combined injuries. Echocardiography is necessary in patients with hemodynamic compromise to rule out mechanical complications such as cardiac tamponade, ventricle rupture, or valve injury [3]. If the chest trauma patients have symptoms and ECG changes suggesting acute myocardial infarction, immediate coronary angiogram should be implemented and further management may depend on the angiographic findings [8].

In conclusion, coronary artery injury following blunt chest trauma is rare but can lead to severe myocardial dysfunction and sudden death. Clinical suspicion, early diagnosis of coronary artery injury, and appropriate intervention including prompt surgery can contribute to limiting disease progression and improving patient prognosis.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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