

CASE REPORT**PATHOLOGY/BIOLOGY**

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Occlusion of Left and Right Coronary Arteries and Coronary Sinus Following Blunt Chest Trauma

ABSTRACT: Blunt chest trauma from rapid automobile airbag deployment causing coronary artery occlusion and myocardial infarction is a rare but potentially fatal condition. We present the case of a 37-year-old man who developed extensive anterior and inferior myocardial infarction because of occlusion of both left anterior and right coronary arteries following blunt injury to the chest in a car accident. The patient was scheduled for emergency coronary angiography but left and right coronary ostia were not cannulated because of thrombus formation probably. The patient died, and the autopsy revealed external compression by epicardial hematomas involving separately left and right coronary arteries and the coronary sinus without signs of coronary and/or aortic dissection. To our knowledge, this is the first case presenting occlusion of both coronary arteries secondary to blunt chest trauma causing acute myocardial infarction in a young man without signs of prior coronary artery disease.

KEYWORDS: forensic science, myocardial infarction, blunt chest trauma, coronary occlusion, automobile airbag, coronary sinus occlusion

Nonpenetrating thoracic trauma has been associated with multiple cardiac injuries and with a mortality rate of up to 15% (1). The mechanisms for nonpenetrating cardiac injury include direct trauma, rapid deceleration, myocardial compression between the thoracic spine and the sternum, or sudden increase in the aortic pressure (2). Automobile airbags have been universally installed to save lives in motor vehicle accidents, but have also been linked with facial and thoracic burns and chest trauma during rapid deployment. Moreover, most patients presenting with blunt chest trauma complain of chest pain or dyspnea. Pneumothorax, cardiac tamponade, and acute aortic tear resulting in aortic dissection are considered in the differential diagnosis for these patients with trauma. Acute myocardial infarction (AMI) as a cause of chest pain is not generally considered in patients with blunt chest trauma unless AMI is thought to have preceded the traumatic incident. The electrocardiogram (ECG) seemed to be the most useful noninvasive test and while ECG abnormalities are present in about 63% of patients with blunt chest trauma (3), only 2% of patients demonstrate AMI patterns, including echocardiographic findings and laboratory tests (3). Nevertheless, all case reports presented in English literature describe single coronary vessel injuries caused by blunt chest trauma (3–8). We present a rare case of the occlusion of both left and right coronary arteries owing to airbag deployment during a car accident.

Case Report

A 37-year-old man, previously healthy, was admitted to the emergency room of a regional hospital following a car accident involving a collision with an oak tree while the patient was driving at a speed of 50 mph without seat belts fastened. The impact triggered the deployment of the driver-side airbag, resulting in a blunt injury to patient's chest. After a transient loss of consciousness, the patient complained of severe chest pain and dyspnea. On arrival to the emergency room, both pain and dyspnea persisted and vital signs were as follows: temperature = 36.5°C, blood pressure = 100/70 mmHg, heart rate = 110/min regular, and respiratory rate = 24/min. The physical examination showed precordial chest wall tenderness without pericardial rub, murmur, or neurological deficits. The 12-lead ECG demonstrated signs of complete left bundle block. The patient denied any prior history of cardiac disease and alcohol or intravenous drug abuse. Results of chest radiography and contrast-enhanced computed tomography (CT) showed multiple ribs and sternum fractures and minimal pericardial and bilateral pleural effusion. A transthoracic echocardiography ruled out cardiac tamponade and showed a markedly dilated right ventricle, akinesis of the inferior wall and the apex of left ventricle with reduction in ejection fraction at a value of 45%. Laboratory tests for myocardial ischemia showed elevated CK (579 U/L), MB fraction (>4% of CK), and troponin T (3.5 ng/mL). On the basis of high suspicion of AMI, the patient was transferred to the cardiology unit to perform a coronary angiography via right femoral artery using the Seldinger technique. Unfortunately, the angiographic wire did not pass both the coronary ostia because of a presumable coronary occlusion. In the meantime, the hemodynamics was getting worse with a systolic blood pressure <70 mmHg and heart rate =

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130/min, so an intra-aortic balloon catheter for counterpulsation was inserted via left femoral artery without any improvement. Thirty minutes after, an intractable ventricular fibrillation occurred and the patient died about 5 h after the initial impact. At the autopsy, the external analysis showed multiple hematomas as signs of airbag deployment. Moreover, complex ribs and sternum fractures were highlighted together with epicardial hematomas involving the left coronary artery (Fig. 1), the proximal right coronary artery (Fig. 2), and the coronary sinus. No signs of intracoronary thrombus, coronary atherosclerosis, and aortic and/or coronary dissection were revealed, and the analysis of the lumina of the affected coronary arteries showed an extensive epi-myocardial hematoma (Fig. 3). Finally, no signs of vasculitis and/or connective tissue disease were found at histology.

Discussion

Blunt chest trauma has been associated with myocardial contusion, aortic dissection or aortic isthmus rupture, and acute mitral (rare) or tricuspid valve insufficiency. Posttraumatic coronary artery occlusion causing AMI is a rare complication of blunt chest trauma and, as with any rare event, information about this process are difficult to obtain. Although there are multiple case reports documenting AMI in the setting of blunt trauma (3–8), many of these cases involve patients with cardiac risk factors, such as advanced age or preexisting heart disease, so the trauma does not represent per se the real cause of AMI. The coronary occlusion in this subset of subjects without preexisting atherosclerotic disease may result from vascular spasm, intimal tear with thrombus formation, or external compression by an epicardial hematoma related to the chest trauma. The vessel most commonly involved is the left anterior descending artery, although involvement of the right coronary artery, the left main coronary artery, and the diagonal branch has also been documented (4). Automobile airbags are designed to deploy instantaneously in the event of a collision and are controlled by electronic deceleration sensors and inflate at a rate of 6 L/msec. Consequently, intrathoracic injuries as aortic transection (9), aortic valve (10), and right atrial rupture (10,11) resulting from airbag deployment have been previously reported. Although myocardial infarction associated with other types of chest trauma has been described in the literature, to our knowledge, the involvement of both left and right coronary arteries together with coronary sinus has never been reported with blunt chest trauma from an airbag deployment. The diagnosis of coronary artery occlusion following blunt chest

trauma requires a strong clinical suspicion, and the criteria may be summarized as follows: (i) chest pain associated with ECG alterations as ST-segment changes or complete left bundle block, arrhythmias, hemodynamic instability, and ventricular wall motion abnormalities at echocardiography, (ii) CT scan to exclude aortic dissection or aortic isthmus transection or esophageal rupture, and (iii) laboratory-positive tests as CK-MB and above all, troponin I or T or both. The combination of these major criteria imposes prompt evaluation with coronary angiography, and a delayed action may limit the therapeutic benefit of surgical or percutaneous revascularization and result in the significant improvement of mortality and morbidity. In our rare case, unfortunately, the external epicardial forces attributed to a large hematoma avoided a correct diagnosis causing unsuccessful advance of the wire through the coronary ostia. In this manner, the correct diagnosis was performed only by the autopsy as any pharmacological and mechanical therapies were ineffective.

Another question of discussion is strictly related to the differential diagnosis between this specific case and the so-called “commotio cordis.” As reported in a recent article by Maron and Estes (12), “Ventricular fibrillation and sudden death triggered by a blunt, nonpenetrating, and often innocent appearing unintentional blow to the chest without damage to the ribs, sternum, or heart (and in the absence of underlying cardiovascular disease) constitute an event

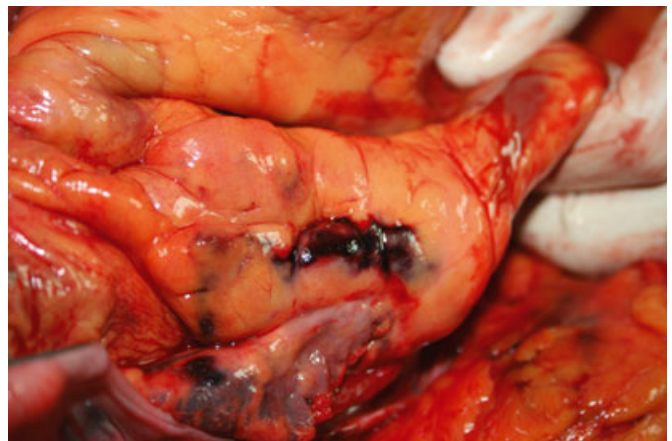


FIG. 2—Large epicardial hematoma involving the right coronary artery.

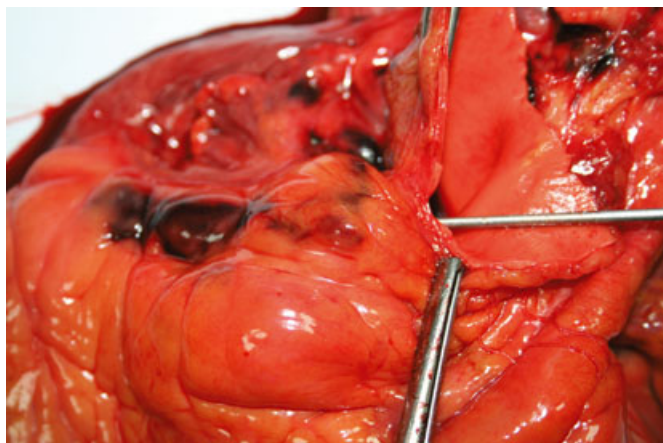


FIG. 1—Large epicardial hematoma involving the left anterior descending coronary artery.

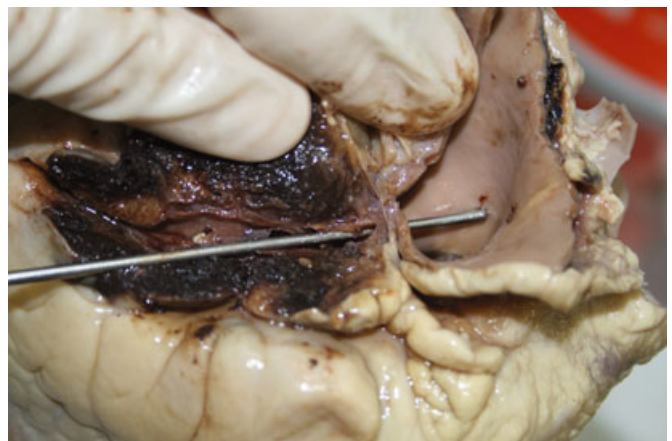


FIG. 3—Intraluminal analysis of left coronary artery showing no signs of thrombus or dissection. Presence of extensive epi-myocardial hematoma.

know as *commotio cordis*, which translates from the Latin as agitation of the heart” (p. 917). On this basis, “*commotio cordis*” is a primary arrhythmic event that occurs when the mechanical energy generated by a blow is confined to a small area of the precordium, altering the electrical stability of the myocardium. This event occurs more frequently in young people and is correlated with the practice of sports as baseball (highest incidence), softball, hockey, and football with sudden clinical presentation a short time after the initial chest trauma. In our case, clinical presentation was clearly progressive with signs of ribs and sternum fractures, and the intractable ventricular fibrillation must be considered as a consequence of AMI occurring about 5 h after the initial impact.

In conclusion, the association airbags—fasten seat belts—have been shown to decrease morbidity and mortality during motor vehicle accidents. However, airbag deployment has been implicated in several clinically significant injuries especially to the face and chest. The case presented herein underscores two main remarks: (i) the importance of considering acute coronary occlusion in the differential diagnosis of chest pain following blunt trauma related to airbag deployment, even in young patients, and (ii) the rare conjunction of occlusion of both left and right coronary arteries and coronary sinus by large epicardial hematomas causing massive and intractable anterior and inferior myocardial infarction.

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