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MINI-FOCUS ISSUE: CHEST WOUNDS

INTERMEDIATE

CASE REPORT: CLINICAL CASE

Collateral Damage

Gun Violence-Induced STEMI

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ABSTRACT

A young man who presented with chest trauma from multiple gunshot wounds was found to have regional ST-segment elevations perioperatively. This case describes the rapid evaluation and clinical management by a multidisciplinary consultative team pursued for this unusual presentation of cardiac injury. (**Level of Difficulty: Intermediate.**)
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A 29-year-old man with no previous medical history presented as a victim of multiple gunshot wounds. Initial survey revealed ballistic wounds to the left upper extremity, right upper chest, left lower chest, and bilateral thighs, with ongoing hemorrhage from his left thigh and progressive respiratory distress. On arrival, he was rapidly intubated and underwent bilateral thoracostomies with chest tube placement because of hemothorax (**Figures 1 and 2**).

LEARNING OBJECTIVES

- To recognize and evaluate causes of myocardial ischemia in penetrating thoracic trauma.
- To anticipate and manage cardiovascular complications of penetrating thoracic trauma.
- To provide rapid and accurate cardiovascular consultative assessment in the setting of multidisciplinary surgical management of trauma.

He was taken on an emergency basis to the operating room for exploratory laparotomy and control of hemorrhage from his extremity gunshot wounds. He was found to have transection of the left superficial femoral artery and vein, injury to the left brachial artery and median nerve, injury to the right iliac vein, bilateral femur fractures, a distal left humerus fracture with a retained bullet, and fracture of the left radial head, all of which were repaired. Computed tomography of the chest identified a bullet fragment just to the right of the eighth and ninth levels of the thoracic spine in the posterobasal right lower lobe. Laparotomy revealed no intra-abdominal injury. Perioperatively, he was found to have ST-segment elevations on the cardiac monitor. An electrocardiogram (ECG) was obtained (**Figure 3**).

PAST MEDICAL HISTORY

The patient had no past medical history.

DIFFERENTIAL DIAGNOSIS

This young patient with no past medical history and presenting with penetrating chest trauma had an

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ST-segment elevation myocardial infarction (STEMI) despite a very low risk for acute coronary syndrome. These findings raised concern for the following: direct coronary, myocardial, or epicardial trauma; cardiac contusion; or stress cardiomyopathy, rather than plaque rupture from coronary atherosclerosis. His chest imaging on arrival also elevated concern for direct cardiac injury.

INVESTIGATIONS

Immediately post-operatively, he was hemodynamically stable while receiving minimal pressor agents with adequate perfusion, and the remainder of his cardiovascular examination was limited by mechanical ventilator and chest tube sounds. Although the initial investigation of STEMI would have included cardiac catheterization to evaluate coronary anatomy, this was deferred because of the active management of his hemorrhagic vascular wounds. An immediate echocardiogram was performed, revealing a small, hazy-appearing circumferential pericardial effusion and an abnormal appearance of the right ventricular free wall without regional wall motion abnormalities or evidence of hemodynamic compromise (Figure 4).

On the basis of these findings, the trauma surgery, cardiothoracic surgery, and cardiology teams jointly decided to pursue supportive and expectant management with a follow-up echocardiogram. Unfortunately, he developed progressively worsening hypotension and tachycardia over the course of the next few hours. A follow-up echocardiogram (6 h after the initial echocardiogram) revealed an enlarging circumferential pericardial effusion with echocardiographic evidence of tamponade, coinciding with escalating pressor requirements (Figure 5).

MANAGEMENT

In the setting of tamponade concerning for traumatic hemopericardium, repeat multidisciplinary consultation resulted in the decision to pursue an emergency exploratory thoracotomy with a pericardial window. On incision of the pericardium and evacuation of pericardial blood, the patient's systolic blood pressure increased by approximately 50 mm Hg, a finding supporting a diagnosis of tamponade. Direct inspection revealed a bleeding epicardial laceration over the right ventricle adjacent to the left anterior descending coronary artery (LAD) approximately 5 cm from the left ventricular apex, as well as thrombosis of the distal LAD with preserved apical motion by visual inspection. No bullet was visualized intraoperatively. The laceration was repaired with topical adhesive agents, and the patient returned to the intensive care unit for supportive management with no further hemodynamic compromise.

ABBREVIATIONS AND ACRONYMS

ECG = electrocardiogram

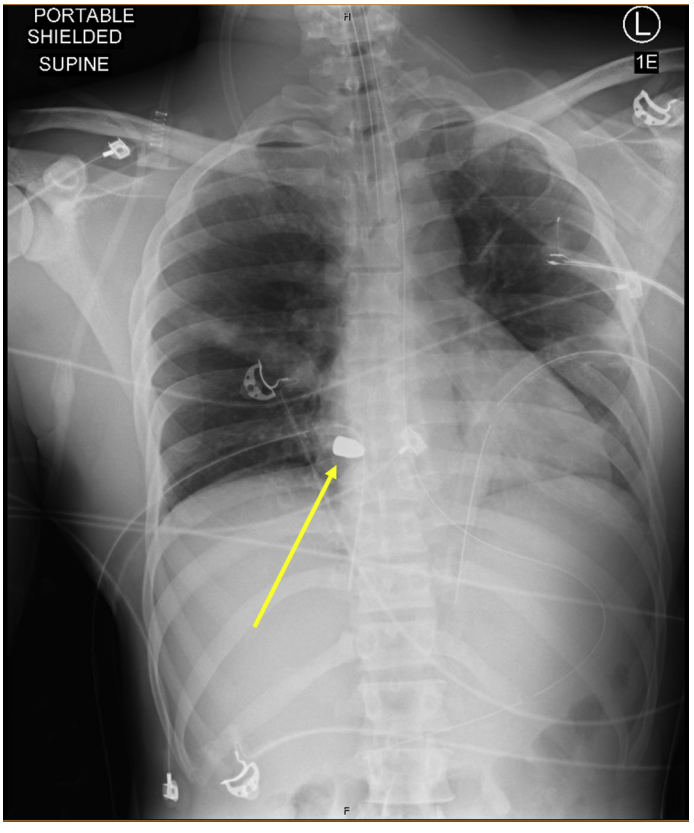
LAD = left anterior descending coronary artery

STEMI = ST-segment elevation myocardial infarction

DISCUSSION

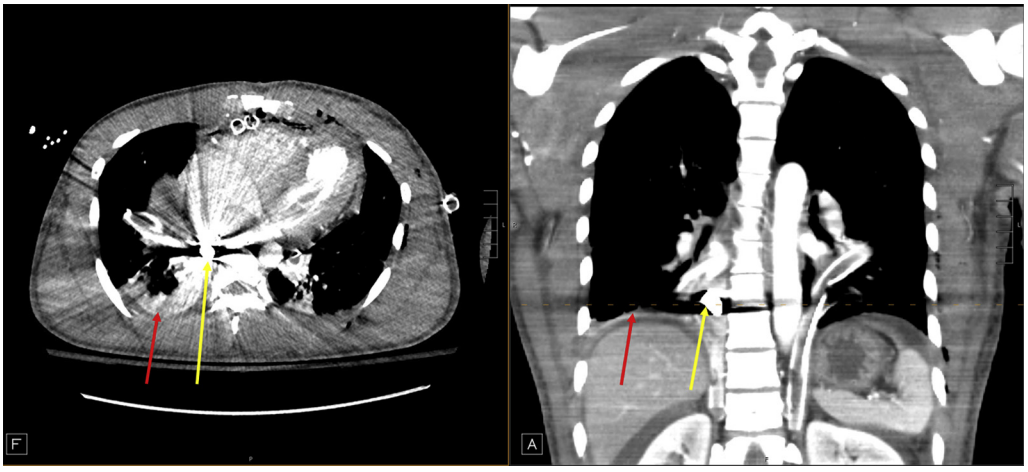
Although myocardial ischemia from blunt thoracic trauma is rare yet well recognized, penetrating thoracic trauma associated with myocardial ischemia without coronary artery disease or coronary artery injury is a rarely reported and underrecognized

FIGURE 1 Post-Thoracostomy Chest Radiograph



Radiograph on presentation after emergency bilateral thoracostomies revealed bilateral chest tubes and an intrathoracic retained bullet **(yellow arrow).** L = left.

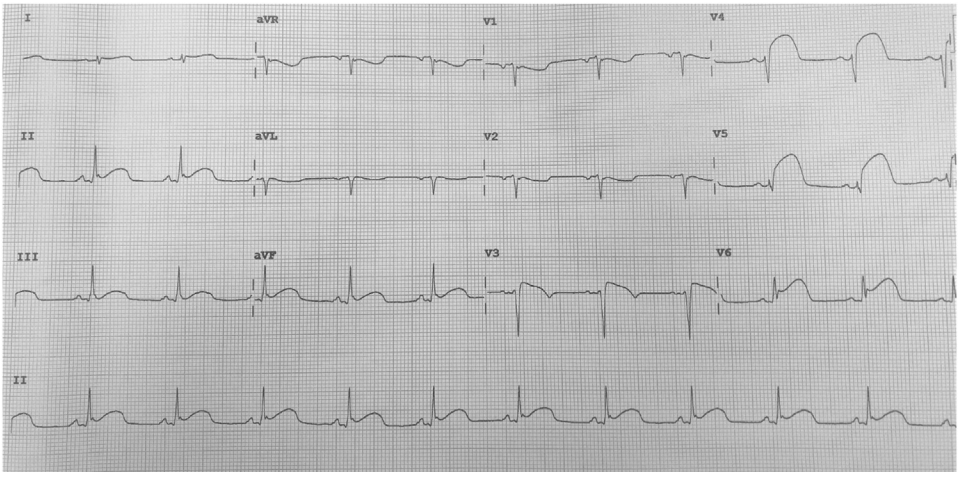
FIGURE 2 Post-Thoracostomy Computed Tomography of the Chest



Emergency post-thoracostomy chest computed tomography demonstrated a retained intrathoracic bullet **(yellow arrow)** posterior and inferior to the right side of the heart, as well as hemothorax **(red arrow). Left** = axial CT image; **right** = coronal CT image.

phenomenon. Faryar et al. (1) described a 42-year-old man with a self-inflected gunshot wound and inferior STEMI who underwent delayed catheterization revealing no coronary plaque or obstructing pellets. The patient was medically managed with dual antiplatelet therapy and did not have tamponade. However, in addition to direct coronary injury, penetrating thoracic injury may also be complicated by laceration of the pericardium, free wall, intracardiac structures, or conduction system. As such, it is imperative to assess patients for life-threatening tamponade, which may be exacerbated by positive pressure ventilation. Additionally, in patients with hemothorax, although exploration may be

FIGURE 3 Perioperative ECG



Immediately following surgical resolution of hemorrhaging extremity wounds, an electrocardiogram (ECG) demonstrated large ST-segment elevations in leads II, III, aVF, and V_3 to V_6.

undertaken by thoracotomy for presumed noncardiac injury, the possibility of cardiac injury should be considered, and this may require a median sternotomy (2).

With the foregoing differential diagnosis in mind, immediate multidisciplinary collaboration between the cardiology and surgical teams facilitated emergency assessment and management without cardiac catheterization. Readily available bedside echocardiography excluded intracardiac or intracoronary foreign objects and raised ongoing attention to the development of tamponade. Recognition of tamponade led to the immediate suspicion of pericardial or epicardial injury, thus prompting immediate surgical pericardial drainage and exploration revealing an epicardial laceration and LAD thrombosis without a nearby foreign object. As other investigators have noted, the decision to treat with antiplatelet agents or cardiac catheterization in the setting of trauma should be undertaken with consideration of competing risk factors (1). Here, antiplatelet agents and anticoagulant agents were contraindicated.

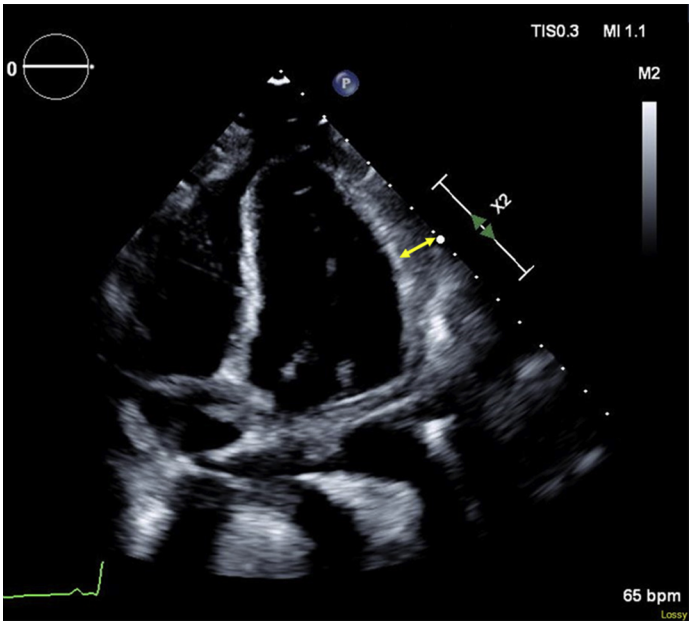
FOLLOW-UP

An ECG obtained 1 day post-operatively continued to show signs of an anterolateral STEMI (**Figure 6**). A repeat transthoracic echocardiogram obtained 1 day post-operatively demonstrated akinesis of the apical segments, mild diastolic dysfunction, a left ventricular ejection fraction of 42%, and resolution of the pericardial effusion. The patient was discharged after 22 days to inpatient rehabilitation, and he returned home after 29 days of rehabilitation. He has since recovered his functional ability, but he continues to have post-traumatic stress. He was lost to follow-up for nearly 10 months; however, on returning to care, his follow-up ECG (**Figure 7**) and transthoracic echocardiogram were consistent with an apical aneurysm, as well as with an improved left ventricular ejection fraction of 57%. No medications have since been started.

CONCLUSIONS

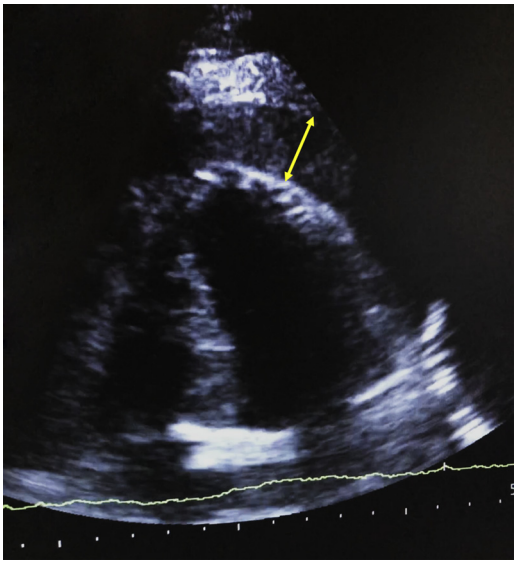
In the unusual case of penetrating thoracic injury associated with myocardial ischemia, emergency evaluation with ECG, echocardiography, and multidisciplinary consultation is necessary. Cardiovascular consultants should still consider the possibility of epicardial injury and tamponade even in the absence of a visualized intracardiac foreign body or suspicion of coronary artery disease.

FIGURE 4 Initial Echocardiogram



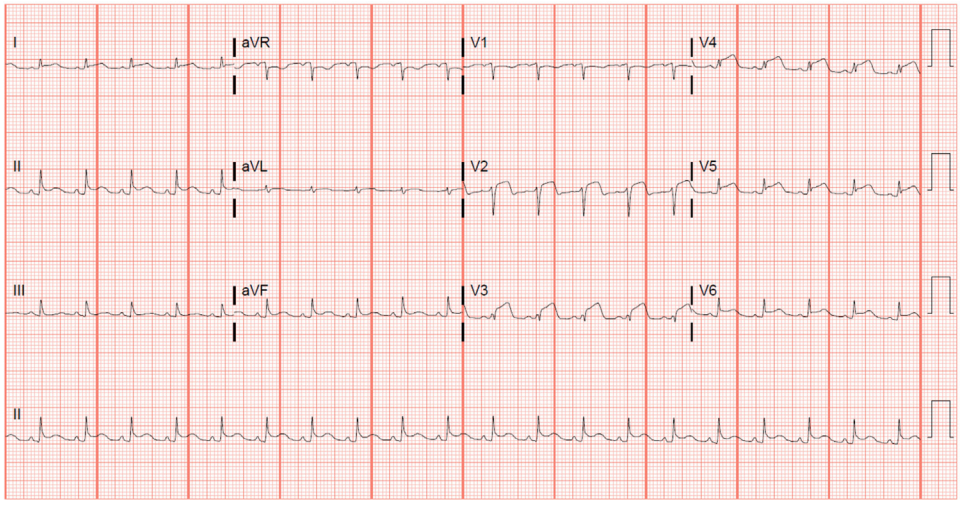
An initial echocardiogram obtained immediately after surgical resolution of hemorrhaging wounds demonstrated a hazy-appearing, small, circumferential pericardial effusion without signs of hemodynamic compromise **(yellow arrow).** A foreshortened apical 4-chamber view in end-diastole is presented.

FIGURE 5 Subsequent Echocardiogram



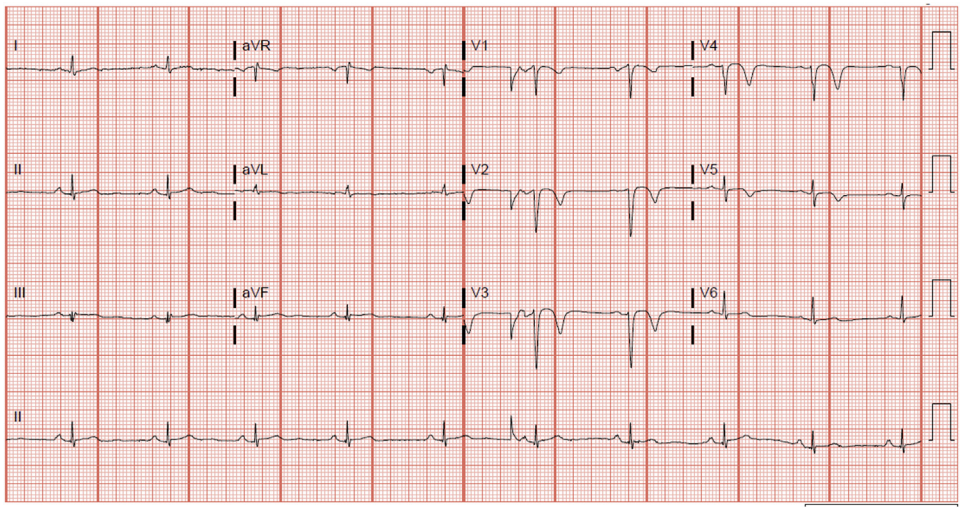
A follow up echocardiogram 6 h following the initial echocardiogram demonstrated enlargement of the pericardial effusion **(yellow arrow)** with clinical and echocardiographic evidence of tamponade. A foreshortened apical 4-chamber view in end-diastole is presented.

FIGURE 6 Post-Operative Electrocardiogram



An electrocardiogram obtained 1 day after surgical pericardial evacuation and observation of left anterior descending coronary artery thrombus revealed persistence of ST-segment elevation in leads II, III, aVF, and V_2 to V_6.

FIGURE 7 Follow-Up Electrocardiogram



An electrocardiogram obtained 10 months after the initial electrocardiogram demonstrated typical features of left ventricular aneurysm, including pathological precordial Q waves and T-wave inversion.

AUTHOR DISCLOSURES

The authors have reported that they have no relationships relevant to the contents of this paper to disclose.

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