Bullet embolization to the heart: A rare and confounding penetrating cardiac injury case report

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1. Introduction

Gunshot wounds (GSWs) to the cardiac region usually result in devastating injuries with a high mortality rate [1]. Survival from cardiac injury may be predicted from the presence of cardiac tamponade, physiologic status on presentation, injury to one or more cardiac chambers, and the need for resuscitative thoracotomy [2]. In rare cases, bullets may penetrate the pericardium but not directly damage the heart [3,4]. Even less commonly, bullets may travel with the blood into the heart and injure the endocardium [5–9]. The management of a hemodynamically unstable patient with cardiac GSW is universally operative [10]. However, management of a hemodynamically stable patient after a GSW to the cardiac area with no clear signs of penetrating cardiac injury, may proceed without initial operation [11].

We present the case of a hemodynamically stable young male who suffered a GSW to the right chest. Computed Tomography (CT) scan performed because of his stability, demonstrated a bullet in close proximity to the heart. Sternotomy revealed bullet embolization through the superior vena cava (SVC) to the right ventricle that then embedded in the apical endocardium, obviating safe retrieval. We discuss the literature on bullet embolization to the heart and options of observation, endovascular and open surgical management.

2. Presentation of case

A 37-year-old male with no significant medical history presented to a level 1 trauma center as a level 1 trauma activation after suffering a single GSW to the right anterior chest just lateral to the midclavicular line at approximately the level of the fourth thoracic vertebra (Fig. 1). On presentation, his only complaint was pain localized to the GSW. All vital signs were stable. A chest x-ray and focused abdominal sonogram for trauma were emergently...
performed. Imaging revealed no pneumothorax, hemothorax, pericardial effusion, or intra-abdominal free fluid. The patient was taken for a CT scan which showed a focused area of parenchymal lung injury in the right anterior upper lobe with an adjacent first rib fracture.

The bullet was noted to be anterior to the apex of the heart in the pericardial fat (Fig. 2). Laboratory values were within the normal limits, including a hemoglobin of 14.7 g/dL, base deficit of 1 mEq/L and troponins <0.1 ng/mL. An electrocardiogram demonstrated normal sinus rhythm with heart rate of 79 beats per minute.

A transthoracic echocardiogram was unable to clarify whether the bullet was outside or within the pericardial sac, and a three-dimensional reconstruction of the initial CT scan was performed. Interpretation by a dedicated thoracic radiologist was that the bullet was not within the pericardium. The presence of an upper mediastinal hematoma raised moderate suspicion that the bullet had migrated inside the pericardial sac from its entry site in the anterior mediastinum. Due to concern for future cardiac irritation and endocardial erosion, the decision was made for exploration performed by thoracic and cardiac surgeons.

A subxiphoid pericardial window did not reveal a bloody pericardial effusion or the presence of a bullet. This was converted to a sternotomy because of a high index of suspicion, and this also did not reveal the bullet in the pericardial sac or in either pleural space. There were no outward signs of myocardial injury. We identified a moderately-sized hematoma in the right hilum, surrounding the SVC, without active bleeding. Fluoroscopy confirmed the location of the bullet to be midline and in the region of the heart. We lifted the apex of the heart, and the bullet was palpated in the right ventricular myocardium just lateral to the septum. A simple ventriculotomy failed to allow access to the bullet. The bullet had embedded through the endocardium into the deep myocardium, and retrieval would have likely necessitated cardiopulmonary bypass with extensive cardiac dissection.

The decision was made to leave the bullet in place, and the ventriculotomy was repaired and the chest closed. The patient had an uneventful recovery. At 3-month follow up, the bullet had not changed position on chest x-ray.

3. Discussion

We present the case of a healthy, hemodynamically stable young male, who suffered bullet embolization through the SVC into the endocardium of the right ventricle. (Fig. 3). The rarity of his case combined with benign presentation and inconclusive imaging created challenges with regard to choice of treatment modality. Few cases of bullets or bullet fragments embolizing to the right heart exist in the literature, and most are isolated case reports or case series [5–9]. Thus, definitive guidelines for evaluation and management have yet to be developed.

In 2018, Yoon et al. performed a systematic review of 54 articles, reporting 62 patients with thoracic bullet emboli [11]. The authors found that 64.7% of bullet emboli that enter the venous system migrate into the right heart with most such emboli being caught in the chordopapillary apparatus or ventricular trabeculae.
with our case, Yoon et al. found that nearly 90% of such cases are asymptomatic on initial presentation [11].

The workup of patients with GSWs to the chest begins with Advanced Trauma Life Support protocols and guidelines. Patients who remain stable may undergo adjunct imaging to help determine the specific location of the bullet as a guide for management.

Suspicion for bullet emboli should occur in the setting of radiographic evidence of a missile and ongoing hemodynamic stability. Imaging options include X-ray, Computed Tomography, and transthoracic and/or transesophageal echocardiography. Hashimi et al. found transesophageal echocardiography superior to transthoracic echocardiography for the localization and characterization of intracardiac bullet fragments [12]. Indeed, localization is essential for the surgeon contemplating observation versus operative intervention [13].

In addition to observation and open operative retrieval, endovascular extraction of intracardiac missiles has emerged as a viable option. In Yoon et al.’s review, endovascular retrieval was successful in 53% of attempts. Of the endovascular attempts that failed, 28.6% were successfully observed, and 71.4% underwent open retrieval [11]. Thus, despite clinical earnest to retrieve intracardiac bullets, observation in the asymptomatic patient may be a satisfactory approach particularly if the bullet appears to be small caliber or firmly lodged and immobile [11,13]. To leave the bullet and observe or to remove the bullet invasively is not an easy decision, and discussion should occur between the patient and treatment team. Embolization of intracardiac bullets into the distal pulmonary artery branches is unlikely to have a significant impact based on available literature on fractured IVC filter fragments leading to benign pulmonary artery embolization [14].

This case report has been reported in line with the SCARE 2018 criteria [15].

4. Conclusion

Our review of the literature and current experience suggests that the initial management of hemodynamically stable patients with suspected intracardiac bullet emboli can be non-operative. Non-operative management should include intensive care observation along with transesophageal echocardiography to better-localize the bullet. Considering endovascular approaches with preparation for possible open operative intervention is a valid alternative that carries a higher risk of morbidity and mortality, in comparison to non-operative management [12,13]. Intracardiac bullets can be left in place, with no significant impact.

Declaration of Competing Interest

None.

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Ethical approval

This is a case report, thus exempted from IRB approval.

Consent

Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

Author contribution

Dospoina Daskalaki: Writing original draft.
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Adam Stright: Review and editing.
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Evan R. Mair: Reviewing.
D’Andrea K. Joseph: Supervision, review and editing.
Gerard A. Baltazar: Writing original draft, supervision, review and editing.

Registration of research studies

Case report does not need to be registered.

Guarantor

D’Andrea K. Joseph.
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