Acute cardiac tamponade secondary to nonpenetrating injury from gunshot with beanbag round: A case report and literature review

Grant Schalet a,*, Brooke Davis a, Mario Gomez b, Timothy Dickhudt b, Ivan Puente b

a Department of Surgery, Broward Health Medical Center, Fort Lauderdale, FL 33316, United States of America
b Division of Trauma and Surgical Critical Care, Department of Surgery, Broward Health Medical Center, Fort Lauderdale, FL 33316, United States of America

ABSTRACT

Over the past twenty years, “less-lethal” munitions have caused a variety of significant, life-threatening injuries. However, evidence of blunt cardiac injury due to these weapons is sparse. A healthy 44-year old man presented with hemodynamic instability due to cardiac tamponade after he was shot with a beanbag, ultimately requiring operative intervention. This case report describes a unique clinical presentation of blunt cardiac injury and the diagnostic and therapeutic steps that the trauma surgery team took to appropriately manage this rare injury.

Introduction

Cardiac trauma accounts for less than 10 % of all trauma admissions but is associated with much higher mortality than other organ system injuries [1]. Blunt cardiac trauma presents as a spectrum from stable patients with clinically silent, transient arrhythmias to critical patients with cardiac rupture. Given the high associated mortality of cardiac trauma, early recognition and intervention is paramount in achieving optimal outcomes [1]. Over the past two decades, law enforcement agencies have increasingly used alternative forms of impact munitions to subdue individuals with the goal being to uphold public safety in the face of an acute threat without causing lethal harm. However, there is evidence that these weapons can still cause significant injuries [3]. The purpose of this report is to present a case of a patient who suffered acute cardiac tamponade secondary to a nonpenetrating injury from a beanbag weapon.

Case presentation

A 44-year-old male presented as a level 1 trauma alert after sustaining a gunshot wound with a beanbag to his left chest. On presentation, he was agitated with a Glasgow Coma Scale (GCS) score of 11, and he was subsequently intubated. He had an enlarging left chest hematoma with surrounding ecchymoses. An ultrasound demonstrated a pericardial effusion and chest x-ray showed subcutaneous emphysema suggesting a lung parenchymal injury (Fig. 1). He was hemodynamically unstable with a heart rate of 131 beats per minute and a blood pressure of 60/50. A left anterolateral thoracotomy was performed with significant evacuation of a pericardial hematoma. He responded well after pericardiotomy and was taken to the operating room for definitive treatment.
The heart was inspected and found to have a 15 mm disruption of epicardium posterior to the left anterior descending coronary artery (Fig. 2A-D). At the site of injury, there was minimal bleeding and no obvious disruption to the myocardium. A hemostatic agent (Surgicel® Fibrillar™) was placed over the disrupted epicardium and hemostasis was achieved. Evaluation of the left lung revealed a blast type injury and laceration at the inferior surface of the inferior lingula with defunctionalized lung (Fig. 2C-D). An inferior lingular segmentectomy was completed using a linear cutting stapler with reinforced black loads.

The pericardiotomy was closed in a running fashion with 4-0 prolene suture. Two pericardial fenestrations were created to facilitate pericardial drainage and prevent potential late tamponade with drainage into the left hemithorax. The thoracic cavity was irrigated. Inspection of the chest wall revealed multiple fractures of the fourth rib which was then resected. The chest wall was reapproximated with green braided polyester (Ethibond) interrupted figure of-eight sutures and then the overlying intercostal musculature was reapproximated with absorbable polyglactin (Vicryl) sutures in simple interrupted fashion. Two 32 French thoracostomy tubes were placed. The subcutaneous tissue and skin edges were reapproximated. The patient was taken to the intensive care unit (ICU) in hemodynamically stable condition.

The patient recovered well from surgery and was extubated on postoperative day two. The anterior thoracostomy tube was removed on postoperative day three and the posterior thoracostomy tube was removed on postoperative day seven. On postoperative day six, the patient had an episode of atrial fibrillation with rapid ventricular response that resolved with administration of diltiazem metoprolol. He remained in sinus rhythm and was discharged home on postoperative day 10.

Discussion

Blunt cardiac trauma presents as a spectrum from stable patients with clinically silent, transient arrhythmias that can be admitted for observation and monitored with noninvasive diagnostic testing to critical patients with deadly cardiac rupture requiring emergent operative intervention. Most blunt cardiac injuries occur due to motor vehicle collisions, followed by pedestrians being struck by motor vehicles, motorcycle collisions, and falls from a significant height [1].

Fig. 1. Chest X-ray obtained on patient’s presentation, demonstrating a left-sided chest wall defect with subcutaneous emphysema and parenchymal changes in the left middle and lower lung.
Beanbag munitions are used by law enforcement officers to stop an individual from harmful activity or flight from a crime scene. These are considered “less-lethal” munitions, in that they have less of a penetrative effect versus the standard bullet. While penetrating beanbag-induced thoracic injuries are well cited, blunt cardiac injury is much less common [2]. A total of eight articles addressing beanbag injuries were identified (Table 1). Of those, only one article described a blunt cardiac injury sustained from a gunshot with a beanbag [7]. Amongst all injuries inflicted by less lethal weapons, the beanbag is the most common culprit, causing 65% of these injuries [2].

There have been several ‘non-lethal’ weapons developed in an attempt to avoid the serious injuries sustained from conventional

Fig. 2. Intra-operative imaging, demonstrating the disrupted epicardium (below the star in panels A-D) along with evidence of blast injury to the inferior lingula of the lung, causing defunctionalization (white arrow in panels C-D).
## Table 1
Current literature on beanbag round injuries, including articles caused by both beanbag rounds and other less-lethal munitions.

| Reference                      | Type of munition      | Injuries                                                                 | Management                                                                 |
|--------------------------------|-----------------------|--------------------------------------------------------------------------|---------------------------------------------------------------------------|
| Olson et al., 2020 [6]         | Beanbag               | • Intracranial hemorrhage • Skull fracture • Soft tissue laceration • Facial fracture • Mandibular fracture • Facial nerve palsy • Open extremity fracture • Close extremity fracture • Soft tissue contusion | • Craniectomy with cranioplasty • Tracheostomy • Foreign-body removal • Bifrontal craniotomy with cranioplasty • Complex wound closure • Closed reduction, washout, debridement • Sling-Splinting • Washout and laceration repair • Observation with same-day discharge |
| Schenck et al., 2021 [5]       | Beanbag               | • Superior pubic ramus osteomyelitis • Pelvic abscess with cutaneous fistula | • Washout and removal of foreign body                                        |
| Thakur et al., 2013 [7]        | Beanbag               | • Hemopneumothorax                                                      | • Tube thoracostomy • Thoracotomy • Removal of foreign body               |
| Gonzalez et al., 2021 [8]      | Beanbag               | • Facial fracture • Ocular proptosis • Intracerebral hemorrhage          | • Lateral canthotomy • Foreign-body removal • Open reduction and internal fixation of facial fracture • Foreign body removal |
| Grange et al., 2002 [9]        | Beanbag               | • Soft tissue laceration, multiple • Anterior chest wall contusions     | • Achilles tendon repair • Washout and laceration repair • Observation with same-day discharge |
| Suyama et al., 2003 [4]        | Rubber bullet, Beanbag | • Soft tissue contusion • Facial laceration • Pulmonary contusion • Chest wall contusion • Liver laceration • Rectus sheath hematoma • Extremity laceration | • Thoracotomy and washout • Removal of foreign body |
| Wawro and Randolph, 2001 [10] | Beanbag               | • Cardiac contusion                                                      | • Median sternotomy • Pericardial window • Ligation of internal mammary artery and vein • Thoracotomy and washout • Removal of foreign body |
| Manhas et al., 2021 [2]        | Conducted energy devices (i.e., Taser), Tear gas, Flash Ball, Beanbag | • Cerebrovascular accident • Myocardial infarction • Digit penetration • Vertebral compression fracture • Hypersensitivity reaction • Soft tissue contusion • Cardiac contusion • Pulmonary contusion • Scrotal hemorrhage • Subcapsular liver injury • Penetrating ocular injury • Embedded foreign body • Cranial fracture • Pneumocephalus • Hemopneumothorax | • Foreign body removal • Ocular enucleation • Splenectomy • Upper extremity fasciotomy • Testicular removal |
| de Brito et al., 2001 [3]      | Beanbag               | • Soft tissue contusions/ hematomas/abrasions • Soft tissue lacerations • Extremity fractures, closed • Embedded foreign body • Wound infection • Osteomyelitis • Thumb amputation • Rhabdomyolysis • Renal hematoma | • Foreign body removal • Ocular enucleation • Splenectomy • Upper extremity fasciotomy • Testicular removal |

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firearms. These include ‘plastic bullets’, ‘rubber bullets’, and ‘beanbag rounds’. Due to the broad range of injuries and the potential for mortality, these weapons have been re-classified as ‘less-lethal’ rather than “non-lethal”. The beanbag bullet is a synthetic bag filled with 40 g of lead pellets [4]. It is designed to collapse on contact and distribute kinetic energy over the surface of impact reaching speeds of around 90 m per second. This weapon can cause both blunt and penetrating injuries with significant mortality and morbidity (see Table 1). Further research on the long-term effects of less-lethal munitions is warranted. Various severe injuries have been cited in the literature secondary to this form of ammunition, including ocular trauma (e.g. blindness), limb amputation, perforated viscus, and pelvic abscess [5].

Law enforcement officers have adopted the use of non-lethal weapons to mitigate civilian casualties incurred by firearm use over recent years. Nonetheless, severe injuries and even deaths can occur with the use of these weapons. This case report provides a rare, yet informative example of a case in which a less lethal form of munition caused a major blunt cardiac injury. This significant injury presents in a clinically inconspicuous fashion without obvious findings on physical examination. As a result, expedient utilization of imaging was key to prompting operative intervention. This patient’s unique presentation highlights not only the dangerous power of these modernized weapons but also the need for a high degree of suspicion for major organ damage when a patient presents after suffering this mechanism of injury.

Conclusion

Blunt cardiac injury from nonlethal police methods is a rare occurrence. While most blunt cardiac injuries can be managed non-operatively, complications such as acute cardiac tamponade require urgent surgical intervention to prevent morbidity and mortality. Prompt recognition and surgical intervention are key to promoting favorable outcomes. Despite their publicized advantage, the “less-lethal” title for these weapons is somewhat misleading. The trauma team should be on high alert whenever a patient presents with this mechanism of injury, ready to initiate rapid evaluation with appropriate imaging and operative intervention if necessary.

Funding

None declared.

Declaration of competing interest

None declared.

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