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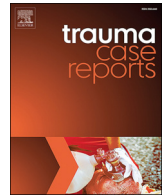
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Case Report

Minimally invasive surgical management of penetrating chest injury from kinetic impact bean bag projectile

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ABSTRACT

Bean bag guns are considered “non-lethal” weapons used by law enforcement. There are emerging reports in the medical literature on management of penetrating, intrathoracic injuries and none were found that involve potential cardiac complications. We present a case of a penetrating bean bag involving the pericardium. A young, adult man was shot in the left axillary region by law enforcement and presented hemodynamically stable. Computed Tomography (CT) demonstrated a bean bag anterolateral to the pericardium, associated with a small pulmonary contusion and hemothorax. He underwent a left tube thoracostomy and sub-xiphoid pericardial window with cardiopulmonary bypass on standby. The diagnostic pericardial window showed no pericardial effusion and the foreign body extraction was successfully performed through the subxiphoid incision via Video Assisted Thoracoscopic Surgery. There were no intra-operative or post-operative complications.

Introduction

In the past several decades, “less-lethal weapons” have been approved and used by law enforcement agencies in all 50 states to diffuse public upheaval and de-escalate distressed individuals [1,2]. The 12-gauge-bean bag round is the most commonly used Kinetic Impact Projectile. Although morbidity and mortality rates are substantially lower compared to the use of conventional bullets, shots to the chest and abdomen have caused internal organ damage requiring surgical intervention. Impact munitions were designed to be non-penetrating; however, there are cases reporting bean bags penetrating the chest resulting in pulmonary injury and even death [1–6]. Video Assisted Thoracoscopic Surgery (VATS) has become a successful, less-invasive method to assess intrathoracic injuries and remove foreign bodies in select patients that are hemodynamically stable [3,7], while a diagnostic pericardial window can be performed to assess cardiac injury. In this case, the foreign body traveled through the left thoracic cavity and lodged anterolateral to the heart. To our knowledge, there are no reports addressing management of patients with a retained bean bag abutting the pericardium. The aforementioned, minimally invasive procedures were performed to evaluate the injury and extract the foreign body.

Case report

Police officers escorted a young adult man, with an underlying psychiatric disorder, to the emergency room of an outside hospital.

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Fig. 1. Computed tomography showing position of bean bag anterior to pericardium.

While continuing to charge at police after being tazed twice, he was shot one time to the left, lateral chest with a bean bag gun from approximately 6 ft away. He was given Cefazolin and Fentanyl then transferred for cardiac evaluation and potential surgery. The patient's vitals upon arrival included: blood pressure 159/99, pulse 106, respiratory rate 22, and oxygen saturation of 100%. His Glasgow coma score was 14 for confused verbal response. Physical exam showed normal respiratory effort, a 2 cm wound to the anterior left axilla with crepitus in the chest wall, and bilateral breath sounds. CT of the chest with contrast (**Fig. 1**) showed a 3.6×1.4 cm foreign body abutting the pericardium, with a small left pulmonary contusion and a small left apical pneumothorax and hemothorax. The anterior proximity to the left ventricle raised concern of cardiac injury and potential complications with foreign body extraction during surgery.

In the operating room, a transesophageal echocardiogram showed normal cardiac wall motion with no evidence of effusion. With cardiopulmonary bypass on standby, the operation began by placing a 28-french chest tube via left thoracostomy in the seventh intercostal space; output approximated 100 mL of blood and a pleura vac was set to suction. A xyphoid incision was made and the pericardium opened which showed no evidence of hemorrhagic effusion. The pericardium was closed using a running vicryl suture. Through the xyphoid incision the left pleura was opened and a thoracoscope inserted to explore the left pleural cavity. The intact bean bag projectile was visualized in the anterolateral mediastinum, adjacent to the pericardium and removed without complications. A small pulmonary contusion was noted with no evidence of air leaks. There were no post-operative complications.

Discussion

Impact munitions have become popular among law enforcement agencies as means to deescalate violent confrontations since their introduction in the late 1900's. Since that time they have proved useful, as a large number of subjects in these encounters have impaired judgment due to underlying psychiatric illness and/or positive drug screens [1,2]. Although these munitions have been termed “non-lethal”, there have been a number of reports that implicate them in serious injuries and deaths. Contusions and abrasions are the most common injuries [1,2,8], while impact to areas other than the chest and abdomen are less likely to result in hospital admission [8]. All types of penetrating injuries have been reported, but total reported deaths in the US remains unclear. One report from 2004 includes an evaluation of 373 incidents from police reports; of those projectiles, there were 14 penetrating injuries, 8 reported deaths, and 4 deaths related to penetrating injuries, highlighting the rarity in bean bag gun fatality [1]. Complications among patients with bean bag injuries include hemothorax, pneumothorax, and pulmonary contusion, some requiring wedge resection due to significant pulmonary injury [3]. Since bean bags have a lower velocity compared to traditional bullets, they can be a significant source of infection, thus prophylactic antibiotics and immediate surgical removal is recommended [4,5]. Of the few case reports found in the medical literature, this is the first depicting a patient surviving impact and implantation of a bean bag on the heart.

Although bean bag guns are designed for blunt impact and have reduced morbidity and mortality compared to traditional bullets, there may be risk factors associated with penetrating injuries. The standard model is a 5×5 cm bean bag, filled with lead pellets, shot from a 12-gauge shot-gun with a velocity approximating 250–300 ft per second [1,2,4,8]. Though training programs encourage aiming at big muscle groups at least 30-ft away, there is more accuracy at shorter distances; cases that resulted in significant morbidity and mortality reported projectiles activated less than 30-ft away impacting the chest or abdomen [1]. It can be presumed

that greater injury results when projectiles are fired closer to the target, given the higher velocity and kinetic energy upon impact. The bean bag was designed to unravel upon exiting the shell, collapse upon impact, and distribute kinetic energy through the largest surface area [2,6]. However, there are reported incidents of bean bags that remained encased upon impact and resulted in fatal intrathoracic penetration [2]. Analysis has shown that this occurs when the square projectile impacts on edge. Newer “super-sock” projectiles have since been designed that improve distance accuracy, improve energy distribution, provide consistency, and prevent lacerations and penetrations [1]. More studies are needed, however, to evaluate the efficacy and outcomes of these munitions.

Though it may still be the standard practice, VATS spares the morbidity of an open thoracotomy and proves useful in foreign body extraction. One other case report described a successful VATS removal of a different model bean bag that had caused pulmonary injury requiring wedge resection [3]. Since our described patient was hemodynamically stable, a minimally invasive surgical approach was preferred. Our patient's pulmonary injury was less severe, but given the unique location of the bean bag, accessible cardiopulmonary bypass was deemed prudent in light of potential complications. In this case a diagnostic pericardial window ruled out cardiac injury and necessity of sternotomy. VATS was successful in determining the extent of pulmonary injury, and facilitating the precise intrathoracic location and subsequent extraction of the beanbag through a small subxiphoid incision.

Declaration of Competing Interest

None.

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