

## An Air Gun Pellet Retained in the Heart: A Case Report

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### ABSTRACT

We report the rare case of an air gun pellet retained within the myocardium. The pellet passed through the right ventricle and the interventricular septum and was retained in the posterior left ventricular wall. The patient presented with cardiac tamponade requiring urgent surgical treatment. The case report is followed by a review of the pertinent literature.

### INTRODUCTION

Nonpowder firearms represent a significant source of injury, especially in pediatric patients [Bratton 1997]. Most injuries are unintentional, and approximately 9% are deemed sufficiently serious to require admission to a hospital [Scribano 1997]. Air gun injuries can be life threatening, especially when the thoracic wall or abdomen is penetrated. We report a case of a penetrating cardiac injury due to an assault. The patient was referred to the hospital one day after the incident with signs of cardiac effusion and a pellet retained in the left ventricular wall.

### CASE REPORT

A 37-year-old man was shot in the left hemithorax with a spring-loaded air gun. The victim sought medical attention the next morning. On arrival in the emergency department, he complained of severe upper abdominal pain and nausea without vomiting but did not mention the air gun incident.

After the development of significant changes in the patient's electrocardiogram, a cardiac catheterization was performed. In the cardiac catheterization laboratory, the air gun pellet was visualized in the posterior wall of the left ventricle (Figure 1). A selective coronary angiographic evaluation ruled out traumatic coronary artery injury and chronic coronary artery disease. At that time, invasive monitoring revealed a decreased arterial blood pressure of 97/71 mm Hg. An echocardiogram showed signs of pericarditis and a 20-mm pericardial effusion. Cardiac tamponade was

suspected, and the patient was transferred urgently to our department for surgical treatment.

On arrival, the patient became hemodynamically unstable with a central venous pressure of 30 mm Hg. He was immediately taken to the operating room, where 500 mL of blood was evacuated from the pericardial space. Inspection of the anterior wall revealed the active bleeding site to be a 2-mm myocardial entry wound in the right ventricular wall 1 cm lateral to the left anterior descending artery. The entry wound was closed with a 5-0 polypropylene (Prolene) suture. No exit wound was found, but an inspection of the posterior wall of the heart revealed a localized bulging of the myocardium with hematoma next to the posterior interventricular artery, which confirmed the preoperatively suspected diagnosis of a retained pellet a few millimeters below the surface of the posterior wall of the heart. The pellet must have traveled within the interventricular septum without causing a ventricular septum defect. Because of poor biventricular function and the totally embedded missile, we decided not to remove the pellet. Later, the patient became extremely anxious about having a missile retained in his heart. After echocardiographic demonstration of an improved ventricular function 3 days later, the patient underwent operation with cardiopulmonary bypass. Palpation of the posterior wall of the heart revealed the missile to be within the left ventricular wall in close proximity to the posterior descending artery of the right coronary artery. A 1-cm incision was made. After careful removal of the pellet, the partial ventriculotomy was closed via an interrupted technique with 4-0 Prolene suture over autologous pericardium. The postoperative course was uneventful, and the patient was transferred to the primary hospital after 7 days. He was discharged home in good clinical condition.

### DISCUSSION

Nonpowder guns or air guns are often considered toys. In the United States, 2 to 2.5 million nonpowder guns are sold annually [Bratton 1997]. In the Chicago area, 6% of families have at least one 3-year-old child who owns an air gun [Senturia 1993]. The percentage increases to 11% in families with a boy between the ages of 10 and 14 years.

In 2000, the overall frequency of nonfatal injuries from ball bearing or pellet guns was 7.71 per 100,000 people, with an estimated 21,840 injuries caused by nonpowder guns treated in emergency departments in the United States. From 1990 to 2000, the Consumer Product Safety Commission reported 39 nonpowder gun-related deaths in the United States [Laraque 2004].

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Figure 1. An air gun pellet retained in the posterior left ventricular wall as visualized in the cardiac catheterization laboratory.

At first consideration, air guns may appear relatively harmless, but they are potentially lethal weapons. Today's air guns use a pneumatic spring, a pumping device, or a pressurized gas canister. The traditional spring-loaded devices generate a muzzle velocity of 250 to 350 ft/s. A gas-cartridge gun can produce a muzzle velocity of 350 to 450 ft/s. Depending on the number of times they are pumped, such guns can produce muzzle velocities ranging from 300 to 950 ft/s, and velocities of 1200 ft/s have been reported [Laraque 2004]. Thus, such guns have muzzle velocities in the same range as some lower-caliber pistols and revolvers (traditional firearm pistols have muzzle velocities of 750 to 1450 ft/s), but the pellets rapidly lose velocity because of their low mass. However, DiMaio et al [1982] concluded in a review of experimental studies and a discussion of their own tests that the critical velocity for an air gun pellet to penetrate human skin was between 58 and 75 m/s (191-245 ft/s) and that only a velocity >230 ft/s was required to penetrate soft tissue.

An investigation of traditional spring-loaded air guns demonstrated the penetration of skin and soft tissue in human cadavers at a missile velocity of 165 m/s. In all of the experiments, the pellet penetrated the chest wall, the lung, and the heart. Penetration depth, however, depends on the distance between the gun and the victim (14 cm at 1 m and 8 cm at 10 m). Thus, an air gun discharged from a distance of 10 m is still potentially lethal [Tausch 1976].

Most air gun injuries seen in the hospital are injuries to the head, with injuries to the eye predominating and a fatality rate of 30% for intracranial injuries. The frequency of serious air gun injuries of the chest ranged from <1% to 15% [Bratton 1997; Scribano 1997].

Thoracic injuries with air guns are associated with high morbidity and mortality when the chest wall is penetrated [Laraque 2004].

Several authors have warned that the wound itself may seem trivial—as was seen in the presented case; however, nonpowder gun injuries to the heart, chest, and abdomen may lead to catastrophic outcomes [Bond 1996; Bratton 1997] and should be urgently referred to a specialist.

In the presented case, a 37-year-old man experienced a penetrating thoracic injury due to an assault with a pellet gun. The pellet penetrated the skin and thoracic wall, entered the pericardium and penetrated the right ventricle. It passed through the septum and remained in the left ventricular wall. The pellet was completely embedded in the left ventricular wall. Patients with a foreign body completely embedded in the myocardium usually remain free of symptoms [Symbas 1990]. Although the management of missiles retained in the heart is still controversial, the management of completely embedded missiles is quite clear for asymptomatic patients. Several reviews [Symbas 1990] and case reports suggest that these foreign bodies can be left in place.

The first treatment for the patient was drainage of the pericardial fluid in addition to closure of the cardiac entry wound. The pellet was left in place, but the patient became extremely anxious about the presence of a foreign body in his heart. Anxiety itself is considered an indication for removal [Actis Dato 2003], especially because a retained missile has been described to lead to cardiac neurosis [Symbas 1990]. Hence, we surgically removed the pellet with the patient on cardiopulmonary bypass, after he had recovered from cardiac tamponade and cardiac function had been partially restored. The patient recovered well from the operation.

The presented case demonstrates that all air gun injuries should be taken seriously, because the damage often is more than meets the eye.

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