CASE REPORT

Air gun injury to the pericardium in a 9-year-old boy

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ABSTRACT

The authors present the case of a 9-year-old boy who sustained a gunshot injury to the pericardium by an air gun. The penetrative wound to the pericardium was, according to the performed pre-operative diagnostic methods, initially believed to be a penetrative wound into the cardiophrenic angle of the left pleural cavity. The stabilized patient was indicated for an extraction of the projectile through a left anterior minithoracotomy, during which the projectile was found and successfully removed from the pericardium. The limits of pre-operative assessment, optimal treatment procedures, and surgical approaches in pediatric patients with gunshot injuries to the chest and heart are discussed.

Keywords: Air gun; computed tomography; echocardiography; penetrative injury; pericardiotomy.

INTRODUCTION

Gunshots to the chest are considered a lethal injury. In those cases where emergency thoracotomy is required, the mortality rate is between 69% and 98% depending on the circumstances.[1,2] Gunshot wounds to the heart and great vessels are burdened by the worst prognosis; the reported mortality rate is already up to 93% in the pre-hospital setting.[3] An air gun injury is a specific type of gunshot injury. They are considered less dangerous. However, in certain cases, such as injury to the chest within the Murdock zone and bordered by the midclavicular lines and epigastrium, they can be potentially fatal. In the following case report, the authors present the unusual case of a young boy with a penetrative wound to the pericardium caused by an air gun pellet.

CASE REPORT

On September 19, 2020 at around 1.30 p.m., during a game, a 9-year-old boy was shot by an air gun in the chest from a distance of approximately 2–3 m. At the place of the incident, the boy remained conscious, with stable circulation and respiration. He was taken care of by the emergency medical services and transported 15 km to a trauma center at the University Hospital in Plzeň, where he arrived at 2 p.m.

When admitted to the trauma center, the arterial pressure was repeatedly 110/80 mmHg, heart rate 80/min, SpO_2 stable at around 98%, with spontaneous breathing, Glasgow coma scale 15, normal laboratory results, and no alterations to his condition. There was a non-bleeding wound approximately 3×3 mm in size to the chest at the level of the manubrio-corporal junction (Fig. 1). The chest and neck were symmetrical, without edema, no evidence of subcutaneous emphysema on palpation, the neck vein filling was adequate, clear, resonant percussion sounds, vesicular breathing without any pathological phenomena by auscultation, and the findings on the abdomen were physiological. The bedside ultrasonography

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Figure 1. Entrance of the penetrative gunshot wound on the anterior surface of the chest, in the area of the manubrio-corporal junction of the sternum.

(USG) of the pleural cavity, pericardium, and abdominal cavity found no free fluid. With regard to the ongoing hemodynamic and respiratory stability of the patient, a computed tomography (CT) examination was indicated to refine the diagnosis. The CT assessment was hindered by the remains of the projectile. However, both the radiologist and surgeon agreed that the projectile was located in the cardiophrenic angle of the left pleural space (Fig. 2). The patient also underwent a transthoracic echocardiograph (TTE), which did not show any injury to the heart, the presence of fluid, or the projectile in the pericardium, nor injury thereof.

After the diagnostic assessment, the boy was referred for exploratory surgery under general anesthesia and endotracheal intubation. An anterior minithoracotomy in the fifth left intercostal space was selected as the optimal and least burdening approach based on the findings from the imaging methods. After entering the left pleural cavity, both the cardiophrenic recess and the accessible portion of the pleural space were explored visually and by palpation; however, the pellet was not found. It was hypothesized that the projectile may have travelled to another part of the pleural cavity during manipulation of the patient. The subsequently performed intraoperative radiograph (C-arm) showed that the projectile was surprisingly in the right portion of the chest, next to the fifth thoracic vertebra. This pointed to the possibility of the projectile being in the pericardium, which is the only structure in the chest that would allow the projectile to travel to both sides from the midline. The summoned cardiac surgeon performed a pericardiotomy, evacuated a minimal amount of blood from the pericardium and then took out the projectile, which was embedded in one of the pericardial recesses. Thorough and repeated exploration, including that of the wound tract, did not show any trauma to the heart and great vessels, or signs of continued bleeding, and therefore with regard to the continuing hemodynamic and respiratory stability of the boy and the type of removed projectile, the decision to expand the surgical approach to a complete sternotomy was dropped. A Redon drain was placed in the pericardium, which was sutured. The left pleural space was provided with a drain and the minithoracotomy was closed using standard methods, in anatomical layers. The boy was extubated immediately after the procedure and further hospitalized in the pediatric intensive care unit. The post-operative phase was entirely without complications; ultrasonography follow-ups of the pericardium and pleural space were conducted daily. From the very beginning, the Redon drain only drained away a minimal amount of serosanguineous liquid. The drain was removed on the 1st post-operative day. The chest drain was subsequently removed on the 4th post-operative day. The lung radiograph after the removal of the chest drain was normal, as was the follow-up TTE. On the 4th post-operative day, the boy was referred to the Department of Pediatric Surgery for further treatment. On the 10th post-operative day, the stitches were removed and the boy was discharged into home

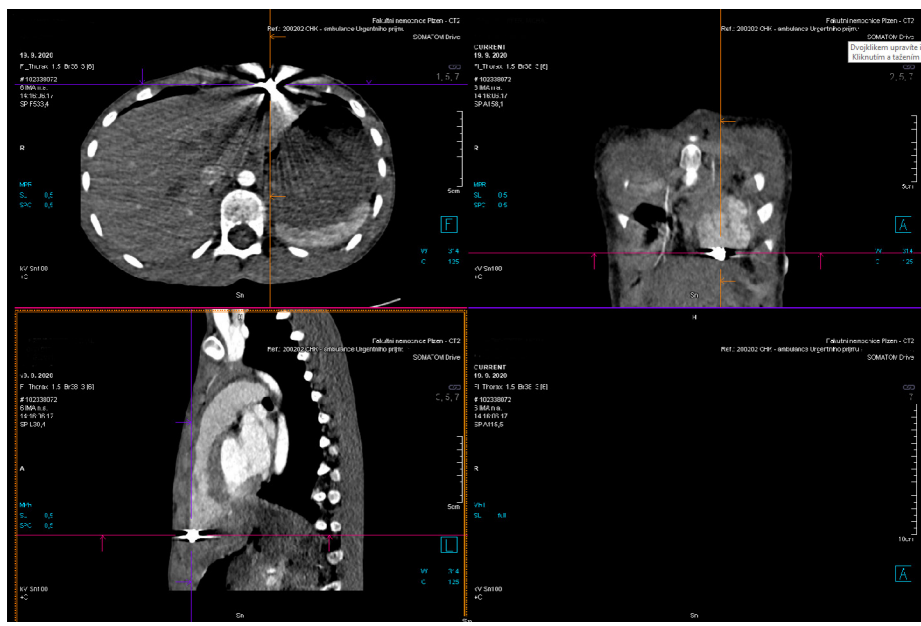

Figure 2. Computed tomography images of the projectile in the left portion of the chest.

care. There were no issues during his subsequent follow-ups, even fully burdened. The follow-up clinical and imaging findings were normal.

DISCUSSION

Air gun injuries are a specific group of gunshot wound. They typically occur in males around 10–15 years old.[4,5] Although it is considered to be a low energy trauma, the muzzle velocity of modern air guns can reach around 300 m/s. The projectiles of these guns may, therefore, exceed the limit for penetration of the skin, muscle, and bones, which is stated as 36–106 m/s.[5] On the other hand, these are small-caliber guns and the projectiles very quickly lose their kinetic energy, so the distance from which the projectile was shot is determinant. This precisely corresponds to the manner and character of the injury of the boy in the case presented. He was shot from a very short distance, with the projectile still having sufficient speed to penetrate the sternum. This led to the loss of the majority of its kinetic energy, and on entering the thin pericardial wall, did not cause any other injury.

All patients with a gunshot wound to the chest, especially children, should be approached with extreme caution. It is essential to stabilize vital functions and quickly transport the patient to a trauma center, where the patient can be managed and bedside diagnostics (USG, or chest radiograph) undertaken. Emergency surgery is necessary in patients with hemodynamic instability. If the situation and condition of the patient permits, a precise diagnostic process must follow. This should include CT, with the administration of an intravenous contrast agent, TTE, and so on, based on the character of the injury. When a bullet enters the cardiovascular system, it is necessary to consider the possibility of the embolization of the projectile. In the case of penetrative gunshot wounds, it is important to localize the projectile in the body of the patient, which despite using adequate diagnostic methods (CT and TTE), and as the subsequent exploratory surgery showed, was not very accurate in this particular case. Since the penetrative gunshot wound was at the level of angulus Ludovici, slightly left from the midline, we assumed that the projectile would more likely go into the left pleural space, especially when combined with the findings from CT and TTE, which did not show any signs of injury to the heart or mediastinum. At the same time, we did not expect that the upper border of the pericardium would be as high in the mediastinum as the level of the gunshot wound.

In unstable patients, the anterolateral thoracotomy, clamshell thoracotomy, or sternotomy are the surgical approaches of choice based on the character of the injury. The least invasive approach is recommended for pediatric patients who are hemodynamically stable – minithoracotomy; exploration of the pericardium is also possible under the subxiphoid approach.[5,6] In published literature, in cases similar to ours, the totally conservative approach of watch and wait, whereby the diagnosis of a stable patient confirms a simple penetrative wound without complications, is also discussed.[6,7] However, we do not have experience with the conservative approach in such cases. We, therefore, gave preference to the early and uncomplicated surgical exploration in an acute stable patient, rather than having to perform a later emergency procedure in a worsened patient who had only been watched until that time and would then understandably have a worse prognosis.[1] The watch and wait strategy should also be evaluated cautiously due to varying legal procedures.

Conclusion

The deciding factors for surviving a gunshot wound to the chest, which may involve the heart, are quick transport to a specialized facility, early diagnosis, and adequate therapeutic intervention. In penetrative gunshot wounds caused by small-caliber projectiles, we cannot absolutely rely on pre-operative localization diagnostics, which has its limits. Therefore, it can be recommended to use C-arm for the final localization of the projectile before the skin incision. The operating surgeon must be prepared to face the unexpected situation of a different perioperative finding. Such patients should therefore be mainly directed to specialized centers that have experience with this type of injury. For pediatric patients with a penetrative gunshot wound, especially small-caliber, exploratory surgery using a limited approach is, in our opinion, the optimal procedure.

Informed Consent: Written informed consent was obtained from the patient family for the publication of the case report and the accompanying images.

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Conflict of Interest: None declared.

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OLGU SUNUMU - *ÖZ*

Dokuz yaşındaki bir çocukta perikardda hava tabancası yaralanması

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Bu yazıda, hava tabancası ile perikarda kurşun isabet eden dokuz yaşındaki bir erkek çocuğu olgusu sunuldu. Perikarddaki penetran yaralanmanın, ameliyat öncesi uygulanan tanı yöntemlerine göre, başlangıçta sol plevral boşluğun kardiyofrenik açısına nüfuz eden bir yaralanma olduğuna inanılıyordu. Stabilize edilen hastada, sol anterior minitorakotomi yoluyla mermi bulunarak perikarddan başarıyla çıkarılmıştır. Burada, göğüs ve kalpte ateşli silah yaralanması olan pediatrik hastalarda ameliyat öncesi değerlendirmenin sınırları, optimal tedavi prosedürleri ve cerrahi yaklaşımlar tartışılmıştır.

Anahtar sözcükler: Bilgisayarlı tomografi; ekokardiyografi; hava tabancası; penetran yaralanma; perikardiyotomi.

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