



Penetrating Brain Trauma due to Air Gun Shot – a Case Report

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Abstract

Cases of severe injuries caused by air guns are really uncommon, but they can lead to a fatal outcome. Usually, these injuries occur in children due to their not fully developed skull bones or in adults through less resistant and thin regions of the cranium. Most of them are accidental events, followed by low percentage of suicidal attempts.

In this paper, we present the case of a 68-year-old man suffering from severe depression, with self-inflicted air gun injury to the head. The patient was admitted to the hospital in a coma with a Glasgow Coma Scale (GCS) score of 8, with severe penetrating head injury manifested with brain contusion and intraventricular bleeding seen at the CT examination. Metal particles from the projectile were seen inside the brain. The entry wound had inverted margins, abraded collar and skin defect. The additional neurological examination of the patient showed symptoms of increased intracranial pressure. The treatment started with the air gun wound care. Craniotomy surgery was also done and bone fragments around the entry wound were successfully extracted with subsequent debridement and duraplasty. The patient was treated with new-generation combined antibiotics for preventing inflammatory complications. On the nineteenth day, the patient was discharged with mild hemiparesis on the left side and with GCS score of 15.

Air-gun traumatic cases with head injury or with injury to other parts of the body are often mistaken for firearm accidents, because air guns are seriously underestimated devices. Nevertheless, they could lead to severe health consequences and severe disability. This case highlights the necessity of strict monitoring of air guns by the responsible government institutions which should apply the same regulations in controlling these weapons as they implement in controlling the firearm guns. Presence of severe depression, mental illnesses, and neoplasms are risk factors for committing suicide with this type of weapons and the control over the air weapons in this group of people should be stricter.

Keywords

air gun injury, penetrating brain trauma, suicide

INTRODUCTION

Air guns are arms that utilize compressed air to propel a projectile. Cases of severe injuries caused by air guns are really uncommon, but they can lead to a fatal outcome.^{1,2} Most of them are accidental events, followed by low percentage of suicidal attempts.³ Cases of severe brain trauma

due to this type of weapons are very rare occurring usually in children due to their incomplete skull development or in adults through the less resistant and thin regions of the cranium.⁴

CASE REPORT

In this paper we present the case of a 68-year-old man with severe depression, with self-inflicted air gun injury with air-gun rifle to the head in the frontal area near the midline on the right. At the crime scene, a suicide note was found and an air-gun rifle nearby (**Fig. 1**). The patient was admitted in a coma to the Emergency Department of St George University

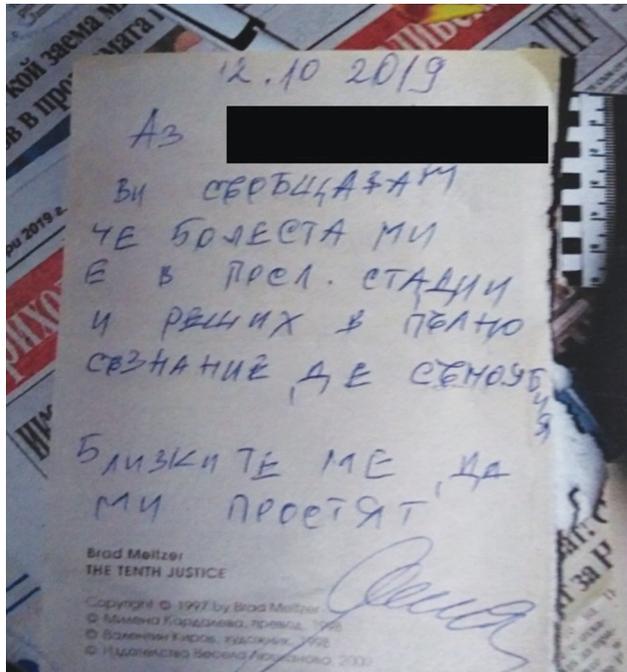


Figure 1. The suicide note found on the crime scene (on the left). (translation in English: "I want to say that my illness is in the final stage and I took a decision to commit a suicide. I hope that my relatives will forgive me.")

Hospital in Plovdiv, Bulgaria with GCS score of 8, with a severe penetrating injury manifested with brain contusion seen on CT examination from the frontal to the occipital region of the brain with intraventricular bleeding in the direction of the wound track. A round defect 1 cm in diameter was found on the frontal bone with well-defined margins on CT examination, with metal particles from the projectile located inside the brain tissue in the occipital region of the head (**Figs 2, 3**). The entry wound was seen on the right frontal area of the head near the midline with inverted margins, abraded collar and skin defect 0.5 cm in diameter. At the physical examination, the patient presented with a heart rate of 76 beats per minute, and blood pressure of 130/80 mm Hg.

The additional neurological examination of the patient showed symptoms of increased intracranial pressure. Due to vital indications, the patient was transferred and treated in the Neurosurgical Department of the same hospital. The treatment started with the air gun wound care at the entry site. Craniotomy surgery was also performed and bone fragments around the entry wound were successful-

ly extracted from the right frontal region with subsequent debridement of the damaged tissue and duraplasty. The patient was treated with new generation combined antibiotics used to prevent inflammatory complications.

The patient was discharged at 19 days with mild hemiparesis of the upper and lower limbs on the left side and with GCS score of 15.



Figure 2. 3D CT reconstruction of the entry bone defect over the skull (on the right).



Figure 3. Lateral CT image showing the metal projectile in the occipital region of the brain.

DISCUSSION

Air guns or non-powder guns are devices that propel a projectile by the kinetic energy derived from compressed air or from carbon dioxide. Projectiles of these guns can be

made of different materials such as plastic or steel and they may vary in calibres. Basically, air guns propel projectiles at low velocity and are not considered able to cause severe injuries, but recent compressed-gas technologies have seriously increased the muzzle velocity of non-powder guns.⁵ The harming potential of these weapons is strongly related to the kinetic energy imparted on the tissues. The kinetic energy is related to the mass of the projectile and the square of the high velocity at impact.⁶ Such high velocity of the projectile can cause serious trauma to the head and brain structures. An air gun causes brain damage directly by the action of the projectile in its direction. Usually, air gun pellets directly crush the tissues when they penetrate and create a permanent cavity. This cavity can cause significant injury if it passes along the main brain structures or vascular structures inside the cranium.⁷ This direct mechanism of action can even lead to complications such as brain death.² Another possible but less common mechanism of the trauma is due to the formation of a temporary cavity near the wound track with destruction of the brain tissue.⁸ According to the small mass of the bullet and its dimensions, temporary cavitation as a phenomenon is not a significant cause of morbidity in present brain injury. Important point in the present case is the differential diagnosis with inflicted firearm injury to the head. Air gun traumatic cases with head injury or with injury to other parts of the body are often mistaken for firearm accidents. The entry wound inflicted by an air gun pellet usually appears as a round hole with an abrasion collar and the lack of additional factors, typical in contact or near range, such as smoke, flame, unburnt gun powder particles, around the entry wound or in depth of the wound track is evidence for the type of the injury. The treatment of inflicted non-powder gun injury to the head focuses on several main steps which are included in every emergency protocol that should be followed in such cases. First, the entry wound and underlying tissues must be treated with antiseptic medications and disinfectants. The projectile is fired with an air gun, and the flame and the heat are not seen as additional factors at the time of impact of the bullet with the biological structures. The wound in this case is not disinfected by the high temperature as seen in firearms⁹ and can lead to life-threatening infection to the brain. There are several reports in the literature describing such cases of abscess formation inside the brain following penetrating brain injury due to the presence of non-sterile metal or other foreign body inside.¹⁰⁻¹² It is not absolutely necessary that the projectile be removed in all of the cases. The bullet should be removed only when it has superficial localization and when it is easily accessible, or if extraction is part of another larger surgery in the area of the head. Some researchers report that there are no short- or long-term complications related to leaving the bullet in place.¹³ Others report that leaving the lead bullet inside the body is a risk factor for lead toxicity in the organism and also that it can act as carcinogen to the cells and tissues.¹⁴ In all cases of air gun penetrating head injury, it is recommended that the patient receive protective

treatment with new-generation combined antibiotics as well as protect the organism from inflammatory changes and life-threatening harm.¹⁵ As in other penetrating injuries to the head operative decision must be applied based on factors such as leakage of cerebrospinal fluids, displaced fracture, or intracerebral bleeding.¹⁶

CONCLUSIONS

Air gun injuries to the head may have fatal outcome due to brain contusion and brain destruction following penetration in thin areas of the skull with damage to the cerebrum, cerebral vessels or brain stem by direct or indirect mechanism. Air guns are seriously underestimated devices but they could lead to severe health consequences and severe disability. This case makes it more than necessary that air guns should be strictly monitored by the responsible government institutions and these institutions must apply the same regulations to control as they do for firearm guns. Severe depression or mental illnesses are risk factors for committing suicide¹⁷ and the control over the air weapons in this group of people should be stricter.

REFERENCES

1. Stankov A, Jakovski Z, Pavlovski G, et al. Air gun injury with deadly aftermath – case report. *Legal Medicine* 2013; 15(1):35–7.
2. Simon G, Heckmann V, Tóth D, et al. Brain death of an infant caused by a penetrating air gun injury. *Legal Medicine* 2019; 39:41–4.
3. Campbell-Hewson G, Egleston CV, Busuttill A. The use of air weapons in attempted suicide. *Injury* 1997; 28(2):153–8.
4. Dalgiç A, Okay O, Ergüngör FM, et al. Brain injury due to air gun shot: report of three adult cases. *Ulus Travma Acil Cerrahi Derg* 2010; 16(5):473–6.
5. Kumar R, Kumar R, Mallory GW, et al. Penetrating head injuries in children due to BB and pellet guns: a poorly recognized public health risk. *J Neurosurg Pediatr* 2016; 17(2):215–21.
6. DiGiulio G, Kulick R, Garcia V. Penetrating abdominal air gun injuries: pitfalls in recognition and management. *Ann Emerg Med* 1995; 26(2):224–8.
7. Wightman G, Beard J, Allison R. An investigation into the behaviour of air rifle pellets in ballistic gel and their interaction with bone. *Forensic Sci Int* 2010; 200(1-3):41–9.
8. Hollerman JJ. Wound ballistics is a model of the pathophysiology of all blunt and penetrating trauma. *Emerg Radiol* 1998; 5:279–88.
9. Pfeifle C, Moche M, Heyde CE. Extraction of an air gun projectile under angiologic safety procedure. A case report. *Interdiscip Neurosurg* 2020; 20:100673.
10. Amirjamshidi A, Abbassioun K, Roosbeh H. Air-gun pellet injuries to the head and neck. *Surgical Neurology* 1997; 47(4):331–8.
11. Zycik S, Toshkezi G, Krishnamurthy S, et al. Treatment of penetrating nonmissile traumatic brain injury. Case series and review of the literature. *World Neurosurg* 2016; 91:297–307.
12. Drosos E, Giakoumettis D, Blionas A, et al. Pediatric nonmissile penetrating head injury: case series and literature review. *World Neuro-*

- surg 2018; 110:193–205.
13. Hyak J, Todd H, Rubalcava D, et al. Barely benign: the dangers of BB and other nonpowder guns. *J Pediatr Surg* 2020; 55(8):1604–9.
 14. Kühnel TV, Tudor C, Neukam FW, et al. Air gun pellet remaining in the maxillary sinus for 50 years: a relevant risk factor for the patient? *Int J Oral Maxillofac Surg* 2010; 39(4):407–11.
 15. Darmadipura S, Kasan U, Hafid A, et al. Air rifle injury to the head. *J Clin Neurosci* 1994; 1(3):188–92.
 16. Awori J, Wilkinson A, Gemmete J, et al. Penetrating head injury by a nail gun: case report, review of the literature, and management considerations. *J Stroke Cerebrovasc Dis* 2017; 26(8):e143–e9.
 17. Ernst M, Kallenbach-Kaminski L, Kaufhold J, et al. Suicide attempts in chronically depressed individuals: What are the risk factors? *Psychiatry Research* 2020; 287:112481.

Проникающая травма мозга в результате выстрела из пневматической винтовки – клинический случай

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Резюме

Случаи получения тяжелых травм из пневматического оружия действительно редки, но могут привести к летальному исходу. Эти травмы обычно возникают у детей из-за недоразвитых костей черепа или у взрослых в менее устойчивых и тонких областях черепа. Большинство из них - случайные события, за которыми следует низкий уровень самоубийств.

В этой статье мы представляем случай 68-летнего мужчины, страдающего тяжелой депрессией, получившего травму головы в результате самострела из пневматической винтовки. Пациент был доставлен в больницу в коме с оценкой по шкале комы Глазго (GCS) 8, с тяжелой проникающей травмой головы, представленной черепно-мозговой травмой и внутрижелудочковым кровоизлиянием, обнаруженным на компьютерной томографии. В мозгу наблюдались металлические осколки от пули. Входная рана имела обращенные внутрь края, уширенное контузионное кольцо и кожный дефект. Дополнительное неврологическое обследование пациента выявило симптомы повышения внутричерепного давления. Лечение началось с обработки ранения от пневматической винтовки. Была выполнена трепанация черепа, и костные фрагменты вокруг входной раны были успешно удалены с последующей обработкой раны и пластикой твердой мозговой оболочки. Для профилактики воспалительных осложнений пациенту назначили комбинированные антибиотики нового поколения. На 19-е сутки пациент был выписан с легким гемипарезом слева и оценкой по шкале GCS 15.

Ранения из пневматической винтовкой, с травмой головы или других частей тела, часто путают с инцидентами с огнестрельным оружием, потому что пневматические винтовки - это оружие, которое сильно недооценивают. Однако они могут привести к серьезным последствиям для здоровья и к серьезному ущербу. Этот случай подчеркивает необходимость строгого контроля за пневматическим оружием ответственными государственными учреждениями, которые должны применять те же правила для контроля этого оружия, что и для контроля над огнестрельным оружием. Наличие тяжелой депрессии, психических заболеваний и новообразований являются факторами риска самоубийства с использованием этого вида оружия, и контроль над пневматическим оружием среди этой группы людей должен быть более строгим.

Ключевые слова

ранение из пневматической винтовки, проникающая травма головного мозга, суицид
