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FATAL GUNSHOT WOUND TO THE TEMPLE AREA FROM AN AIR GUN – CASE REPORT

Summary
The authors present the case of a 45-year-old man fatally shot with an air gun. As a result of suicidal gunfire from an airgun, the deceased suffered damage to his right temporal bone and subarachnoid hemorrhage. The authors discuss possible complications after air gun shots and their consequences, relating their own experience to reports by other authors.

Keywords: gunshot, air gun, head injury, subarachnoid hemorrhage, death

Introduction
Air guns use the energy of compressed atmospheric air or another gas (such as carbon dioxide) as the driving force of the projectile. A shot from a long distance above 90 meters is usually harmless. Shots from a shorter

distance can lead to serious injury[1]. Serious injuries, however, are rare. Usually, these are accidental events, and a small percentage are suicide attempts[2]. Cases of fatal air gun shootings have already been reported in the Polish scientific literature[3]. Suicide among men in Poland ranks fourth as a cause of death[4]. Data from the Police Headquarters shows that in 2021, 5201 people, including 4413 men, committed suicide in Poland. Death by shooting in our country in 2021 was suffered by 66 people, accounting for about 1.27% of all suicides in the Polish population. In the 45-49 age group, which includes the case we describe, 465 people committed suicide. Among the causes of suicide in the Polish population, mental disorders rank first[5]. Data provided by the World Health Organization shows that Polish men commit suicide seven times more often than women[6].

Case description

A 45-year-old man was found in the apartment with a gunshot wound to the right temporal region. He was transported to the hospital but was pronounced dead on the fourth day of hospitalization. A male corpse was delivered to the Department of Forensic Medicine. An autopsy performed at the Department of Forensic Medicine found a gunshot wound to the skin in the right temporal region. The diameter of the wound was 4.5 mm (Fig. 1). In addition, no other external injuries were visible on the body of the deceased.

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1 M. Kędzierski, E. Meissner, J. Berent, *Śmiertelny postrzał z broni pneumatycznej*, "Archives of Forensic Medicine and Criminology" 2010, vol. 60(no. 2–3), pp. 132–136.

2 I. Tsranchev, P. Timonov, A. Alexandrov, *Penetrating brain trauma due to air gun shot – a case report*, "Folia Medica" (Plovdiv) 2021, vol. 63(6), pp. 977–980. doi: 10.3897/folmed.63.e59428.

3 M. Kędzierski, E. Meissner, J. Berent, op. cit.; K. Woźniak, J. Pohl, *Samobójcze postrzały z broni śrutowej po wprowadzeniu lufy do ust a ryzyko błędnej oceny na miejscu ujawnienia zwłok*, "Archives of Forensic Medicine and Criminology" 2003, vol. 53(4), pp. 347–355.

4 World Health Organization, *Global Health Estimates 2016: Deaths by cause, age, sex, by country and by region, 2000–2016*, World Health Organization, Geneva 2018.

5 https://statystyka.policja.pl/st/wybrane-statystyki/zamachy-samobojcze/63803,Zamachy-samobojcze-od-2017-roku.html (accessed September 28, 2023).

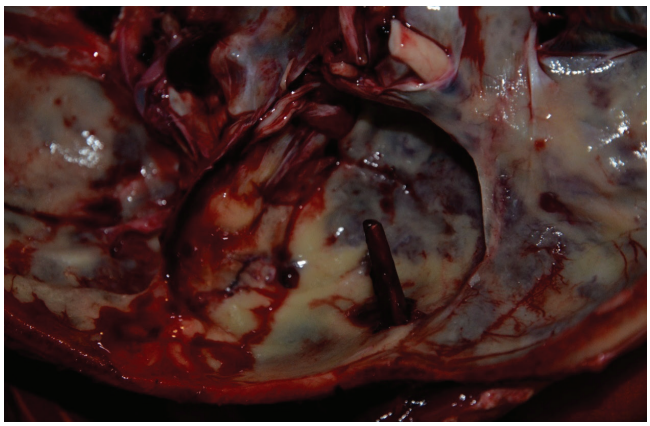
6 World Health Organization, op. cit.

Fig. 1. Visible inlet of a 4.5 mm diameter gunshot wound in the right temporal region

Source: own research.

After the cranial cavity was opened, fairly extensive bleeding sub-abscesses, 65 mm in diameter, were visualized on the cranial shell on the inner side in the projection of the gunshot wound described earlier. In addition, a subluxation of the left temporalis muscle of about 75 mm in size was visible. A gunshot hole 4.5 mm in diameter was found within the right temporal bone (Fig. 2). At the height of the gunshot injury, the thickness of the temporal bone was 2 mm.

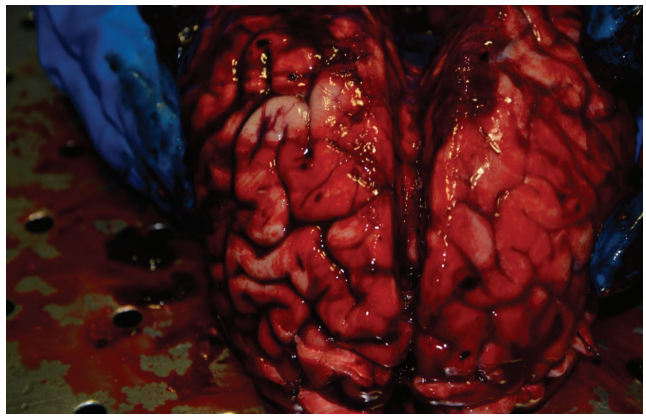
Fig. 2. Inlet canal in the right temporal bone. The bullet hole was indicated with a marker.



Source: own research.

No damage to the skull base was found in the deceased. A gunshot injury to the dura was also found at the height of the injury described in the temporal bone. Features of subarachnoid hemorrhage were evident in the soft meninges of the brain. Visual inspection of the brain revealed features of profuse subarachnoid hemorrhage (Fig. 3).

Fig. 3. Subarachnoid hemorrhage



Source: own research.

A gunshot canal was revealed within the right cerebral hemisphere. It ran obliquely backward through the right hemisphere, piercing the brain's ventricular system. The ventricles of the brain showed abundant blood and clots (Fig. 4).

Fig. 4. Blood and clots in the ventricles of the brain

Source: own research.

Further, the gunshot canal was lost within the left cerebral hemisphere. In the posterior part at the border of the arachnoid meninges within the left cerebral hemisphere, the end of the gunshot canal was found.

A distorted lead bullet was visualized at the end of the gunshot channel. Macroscopically, this bullet corresponded to "diabolo" type air ammunition. In the deceased, no damage to the cerebellum or extended medulla was visualized.

Discussion

Airgun wounds to the central nervous system can lead to serious brain injuries or even death. However, these injuries are extremely rare. In the literature, they are described mainly in children and adolescents[7].Air gun injury cases with head injuries are often confused with firearm accidents because air guns are seriously underestimated devices[8]. In the UK, for example, there is one fatal accident every year due to the use of air weapons[9]. In contrast, in a 5-year study in the US, there were a total of 33 deaths resulting from the use of such weapons[10]. BB gunshots most often result in minor, non-life-threatening injuries, but in extreme cases can lead to death, as in the situation described here[11].

A mushroom-shaped lead ("diabolo") shot is used as ammunition in the airgun; its presence was found in the section described here. In the case in question, a 4.5 mm caliber long-barreled airgun was used in the shooting, which corresponds to the injuries found in the deceased at autopsy. The initial energy of a projectile fired from an air gun does not exceed 17 J. According to current Polish law, pneumatic propelling devices with projectile energy of less than 17 J do not require a permit for their possession or registration. The bullet's initial velocity ranges from 260 m/s to 290 m/s and depends on the weight and shape of the shot. The maximum range of the shotgun reaches up to 300 m[12].

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7 A. Amirjamshidi, K. Abbassioun, H. Roosbeh, *Air-gun pellet injuries to the head and neck*, "Surgical Neurology" 1997, vol. 47(4), pp. 331–338. doi: 10.1016/s0090-3019(96)00357-6; B .Dumenčić, J. Rajc, D. Pavoković, et al, *Fatal injury by air gun: A case report*, "Egyptian Journal of Forensic Sciences" 2020, vol. 10(7), https://doi.org/10.1186/s41935-020-00182-7.

8 I. Tsranchev, P. Timonov, A. Alexandrov, op. cit.

9 A. Amirjamshidi, K. Abbassioun, H. Roosbeh, op. cit.

10 C.M. Milroy, J.C. Clark, N. Carter, G. Rutty, N. Rooney *Air weapon fatalities*, "Journal of Clinical Pathology" 1998, vol. 51, pp. 525–529.

11 M. Kędzierski, E. Meissner, J. Berent, op. cit.

12 V.J. Di Maio, *Gunshot Wounds. Practical Aspects of Firearms, Ballistics, and Forensic Techniques*, ed. 2, CRC Press, Boca Raton 1999.

A shot from a distance of more than 90 meters is harmless to humans. However, the energy of the shot from a short distance is high enough to penetrate soft tissues to a depth of up to 5–6 cm[13]. Experimental studies on cadavers and using gelatin blocks have shown that a bullet shot with an energy of about 1.7 J from a distance of about 1 m can damage the pleura and liver, and a lead shot with an energy of 9.4 J from a distance of up to 10 m can damage: pleura, lung, pericardium, and heart. The same shot fired with an energy of 14.2 J from a distance of 20 m can damage the pleura, pericardium, thoracic aorta, liver, spleen, kidneys, abdominal aorta, and femoral artery[14].

Another author conducted similar experimental studies. They consisted of taking a series of shots at animal tissue (pig – ribs with bacon measuring about 60 × 30 cm, about 10 cm thick). Weapons of three calibers were used in the experiment. Accordingly, they were: 4.5 mm caliber with an average initial projectile energy of 14 J; 5.5 mm caliber with an average initial projectile energy of 12.3 J, and 4.5 mm caliber with an average initial projectile energy of 7.5 J. In the study, shots were also fired from a distance of 10 and 20 meters. The study showed that shots fired from a distance of 10 m can pierce animal tissue through or remain in it. In contrast, in shots taken from a distance of 20 meters, only one bullet lodged in the animal tissue, while the rest pierced the tissue under examination through and through. These studies have shown that a BB gunshot can penetrate soft tissue to a depth of 10 cm[15]. The cited experiments unanimously confirm that a gunshot from a sports device (which is not a weapon under current Polish law) can cause serious life-and-death injuries to a person. In addition, the authors of one

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13 M. Kędzierski, E. Meissner, J. Berent, op. cit.; A. Smędra-Kaźmirska, M. Barzdo, M. Kędzierski, S. Szram, J. Berent, *Głębokość penetracji pocisków, wystrzelonych z urządzenia pneumatycznego o energii kinetycznej poniżej 17 J, w 20% blokach żelatynowych w korelacji ze stwierdzonymi sekcyjnie obrażeniami ciała 9-letniego chłopca*, "Archives of Forensic Medicine and Criminology" 2011, vol. 61(2), pp. 102–106.

14 A. Smędra-Kaźmirska, M. Barzdo, M. Kędzierski, S. Szram, J. Berent, *Głębokość penetracji...*, op. cit.; A. Smędra-Kaźmirska, M. Barzdo, M. Kędzierski, Ł. Antoszczyk, S. Szram, J. Berent, *Experimental effect of shots caused by projectiles fired from air guns with kinetic energy below 17 J*, "Journal of Forensic Sciences" 2013, vol. 58(5), pp. 1200–1209. doi: 10.1111/1556-4029.12251. 12 A. Smędra-Kaźmirska, M. Barzdo, M. Kędzierski, S. Szram, J. Berent, *Doświadczalny efekt postrzału pociskami kalibru 4,5 mm wystrzeliwanymi z karabinka pneumatycznego Norica Dragon i pistoletu pneumatycznego Walther PPK/S*, "Archives of Forensic Medicine and Criminology" 2010, vol. 60(2–3), pp. 77–82.

15 D. Mankowski, *Nie przekracza 17 dżuli. Następstwa użycia urządzeń pneumatycznych – perspektywa kryminalistyczna*, in: V. Kwiatkowska-Wójcikiewicz, L. Stępka (eds.), *Broń. Problematyka prawna i kryminalistyczna*, Scientific Publishing House of the Nicolaus Copernicus University, Toruń 2013, p. 90.

of the cited papers state that a bullet fired from an airgun can penetrate the bones of the skull only in the temporal bone or orbital region[16]. The penetration depth of a bullet fired from an air gun depends on its kinetic energy and initial velocity[17].

The Polish literature has already described a case of a fatal suicide shot from an air gun, which led to the fragmentation of the skull bones[18]. On the other hand, in a review of the English-language literature, the most common result of an air gunshot, when the bullet penetrates the brain, is subarachnoid hemorrhage[19], which also shows our case.

It is noteworthy that although suicides from air guns are rare, those committed with firearms are much more common. In a study conducted by the authors of the cited paper[20], in which 87 cases of gunshots were analyzed, it was proven that the site of a suicide shot is most often the head (temple), followed by the chest. Of the 87 cases analyzed, only 14 deaths occurred by accident. In contrast, suicide involved 21 cases (including only four women). The remaining deaths were due to homicide. The cited study also shows that suicide by gunshot is most often committed by young men (21–30) who live in the city. The study also proved that most of the men were in a state of alcoholic intoxication at the time of the suicide. As the case presented here – and described by other cited authors – indicates, an air gunshot can lead to death, so these weapons should be treated the same as firearms.

Applications

1. A shot from a short distance with an air gun can penetrate the brain.
2. The most common result of a bullet entering the brain is subarachnoid hemorrhage.
3. A gunshot from an air weapon can lead to death.

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16 https://statystyka.policja.pl/st/wybrane-statystyki/zamachy-samobojcze/63803,Zamachy-samobojcze-od-2017-roku.html (accessed: 27.09.2023).

17 A. Smędra-Kaźmirska, M. Barzdo, M. Kędzierski, S. Szram, J. Berent, *Depth of penetration*..., op. cit.

18 K. Woźniak, J. Pohl, op. cit.

19 A. Amirjamshidi, K. Abbassioun, H. Roosbeh, op. cit.

20 I. Ptaszyńska-Sarosiek et al., *Analiza śmiertelnych obrażeń postrzałowych w materiale Zakładu Medycyny Sądowej w Białymstoku w latach 1964–2015*, "Archives of Forensic Medicine and Criminology" 2016, vol. 66(4), pp. 211–219.

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