Case Reports

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A case of gunshot wound of the face, orbit and brain in a child: clinical presentation and consequences

S. A. Tronina, N. F. Bobrova

SI "The Filatov Institute of Eye Diseases and Tissue Therapy of the NAMS of Ukraine"

Odesa (Ukraine)

Non-combat gunshot wounds are uncommon injuries in the pediatric population of Ukraine. Here, we present a case of gunshot wound of the face, orbit and brain. Early and late features of damage to the eye resulting from a gunshot wound are reviewed.

Keywords:
gunshot wound, periorbital region, brain, children

Introduction

The prevalence of arms among the civilian population and ongoing combat actions in different regions contribute to increased incidence of gunshot wounds, e.g., those of the head and periorbital region. Not only adults but also children who inadvertently found themselves in areas of armed conflict can suffer from these conditions. So far, no unified national database of pediatric gunshot wounds to the head is available in Ukraine, likely due to the fact that these injuries were a rarity before the initiation of combat operations.

We present a case of gunshot wound of the head in a boy to review the mechanisms of damage from, and the clinical presentation, of this injury.

Case Description

An 11-year-old boy received a wound to his face from his father's air gun while he was playing with his elder brother, on January 28, 2023. He had dizziness and was transferred by an emergency ambulance to the district hospital. From there the child was referred to the Regional Pediatric Clinical Hospital (RPCH), where he was urgently admitted to the intensive care unit with a diagnosis of gunshot wound to the head. Additionally, the boy was diagnosed with foreign bodies in the right frontal and temporal lobes and right orbit; grade 2 cerebral contusion (or contusion of the right frontal lobe); pneumocranium; and hemosinus.

On day 3 after the traumatic event, after his systemic and neurological status was stabilized, the child was referred to the in-patient unit at the Department of Pediatric Eye Pathology, the Filatov institute. A single entry wound was visible over the right nasal wing.

Findings in the right ocular adnexa included a massive periorbital subcutaneous hemorrhage, a narrow orbital fissure, and a 3-mm direct exophthalmos.

The right eye exhibited massive subconjunctival hemorrhages, more prominent externally; chemosed outer bulbar conjunctiva in between the eyelids; and a conjunctival injury 4 mm from the limbus at the 9-o'clock position which we supposed to be another entrance wound (Fig. 1). In addition, the eye exhibited a clear cornea, moderately shallow anterior chamber, clear aqueous, round pupil, brisk pupillary reactions to light, clear lens, and partial vitreous hemorrhage, particularly prominent inferomedially. Moreover, ophthalmoscopic examination showed a pale optic disc with blurred margins due to edema of the optic disc; the macular reflex was blunted and there were massive epiretinal, intraretinal and subretinal hemorrhages centrally over the optic disc, inferior medial preretinal hemorrhage and massive retinal ischemia in the same sector (Fig. 2). The left eye showed no pathological changes. Vision was uncertain light perception in the right eye and 1.0 in the left.

A computed tomography (CT) head scan done prior to the referral to our institution, at the intensive care unit of the RPCH, disclosed foreign bodies in the right frontal and temporal lobes and the right orbit (Fig. 3).

Active hemostatic, anti-edematous and anti-inflammatory therapy was initiated. In addition, imaging modalities were used to localize foreign bodies. An X-ray examination of the skull in two planes demonstrated

numerous radioopaque foreign bodies. A 8×5×9 mm foreign body was localized posterior to the sphenoid sinus and below the sella turcica, whereas small radioopaque foreign bodies, in the soft tissues of the right orbit (Fig. 4). We believe that performing radiographs after CT scan would not be out of place, because, a halo surrounding a metallic foreign body can be seen on a CT scan (but not on a radiograph), which hampers accurate localization of the foreign body.

A right eye and orbit ultrasound found a vitreous hemorrhage associated with a 5.4×4.4-mm subretinal hemorrhage 6-7 mm from the optic disc at the 7-o'clock position. In addition, a 4.2×4.1×4.3 mm oval-shaped foreign body was seen in the retrobulbar space, at the optic nerve funnel, which created a funnel effect.

We have reviewed all the available data to reveal the tract of the pellet and understand better which structures of the orbit and brain had been affected. At first, we were not sure whether there a single shot or a pair had been fired to the head, since we noted not only a paranasal entrance wound, but also a wound of the outer conjunctiva which we supposed to be another entrance wound. The child, however, insisted that a single shot had been fired. In addition, we communicated to the doctors who had cared for the child at the RPCH, and they told us that a mild external hemorrhage from the eye was noted in the child at day 2 after he was admitted to the hospital. This caused us to change our mind regarding the conjunctival wound, and it was decided that the wound was a self-drainage site of an orbital hematoma.

With regard to the pellet track, we finally decided that the pellet traversed the soft tissues somewhat upwards, reached the edge of the orbit, and broke off a bony fragment from the edge which migrated deeper into the orbit to rest near the optic nerve. Then the pellet traversed the outer orbital wall near the orbital funnel, and broke off a smaller bony fragment from the orbital bony wall, with this fragment seen in the right frontal basal lobe. Thereafter the pellet came deeper into the brain to rest at the sphenoid sinus. Our assumption was confirmed by the fact that the two smaller foreign bodies, but not the largest foreign body, were not surrounded by "halos" typical of metallic foreign bodies, i.e., these were bony fragments.

An electrophysiological study showed that the threshold of the electric sensitivity of the optic nerve was significantly increased (as high as 164 mA) in the right eye and normal in the left eye.

On completion of the multicomponent drug treatment course, hemorrhages in the orbital soft tissues and periorbital region almost completely resolved, whereas vitreous hemorrhage partially resolved with partial transition to fibsosis. Vision was inaccurate light projection and pupillary responses were normal in the right eye.

At the follow-up three weeks later, there was an increase in the severity of post-traumatic degenerative processes in the optic nerve and retina (Fig. 5), leading to a decrease in visual acuity to zero. This deterioration was confirmed by deteriorated electric sensitivity of the optic nerve (as high as 460 mA). No subatrophy of the globe was, however, observed (axial length was 22.93 mm OD and 22.28 mm OS). At this phase of treatment, subtenon non-steroidal anti-inflammatory injections were used to preserve the eye.

Discussion

Gunshot injuries (particularly, gunshot injuries of the head) are a very dangerous, not infrequently lethal, but preventable condition. It is of note that the reviewed studies on the subject have been most commonly conducted in countries with social scuffles [1-3] or those with a high prevalence of legal firearms among the population [4-6]. In recent years, a tendency to a more careful analysis of the consequences of gunshot injuries has been observed due to the social value of the issue [7]. Unfortunately, there has been an increase in the incidence of gunshot wounds among children. The National Electronic Injury Surveillance System estimates that in 2013, 16,259 BB or pellet gun injuries (code 1237) occurred in the US. Of the 16,259 nonpowder gun injuries in 2013, approximately 63% (10,286) occurred in victims 18 years old and younger. In 2020, Flaherty and Klig [5] reported that firearm-related injuries lead to over 20,000 emergency department visits annually in children. Boys comprise 60-80% of all pediatric cases of gunshot injuries [1, 7-9]. Studies vary with regard to the reported median age of children or adolescents who have sustained gunshot injuries from 7 to 14 years [1, 8]. The circumstances of the injury also vary depending on the level of country development. The incidence of gunshot injuries due to violent clashes or criminal actions is substantially higher in the developing countries, whereas the total incidence of gunshot injuries and the incidence of unintentional gunshot injuries are higher in the developed countries.

Research on gun violence is leading to important national conversations on gun control and the role of physicians in the prevention of injury and advocacy for effective interventions and legislation [5, 7].

Conclusion

Due to the high energy of the projectile, gunshot wounds to the periorbital region can result in significant damage not only to the adjacent structures, but also to the eye itself, even in the absence of the penetrating wound. Non-combat gunshot injury prevention among the pediatric populations should be based primarily on improved rates of safe firearm storage and reduced firearm access among children.

References

1. Coughlan MD, Fieggen AG, Semple PL, Peter JC. Craniocerebral gunshot injuries in children. Childs Nerv Syst. 2003;19(5-6):348–352. doi: 10.1007/s00381-003-0736-y.

2. Omoke NI, Lasebikan OA. Firearm injury among children and adolescents in nigerian civilian trauma setting: prevalence, pattern, and implications for prevention. Yale J Biol Med. 2021 Mar; 94(1): 55–63.
3. Junior LSB, Neto OCF, Araruna Dias AJ, et al. Pediatric gunshot head injury: prevalence of prognostic factors in surgical patients: aninstitutional experience in ten years. Neurotrauma Rep. 2021; 2(1): 669–675. doi: 10.1089/neur.2021.0024.
4. Parikh K, Silver A, Patel SJ, Iqbal SF, Goyal M. Pediatric firearm-related injuries in the United States. Hosp Pediatr. 2017; 7: 303-312. doi. org/10.1542/hpeds.2016-0146.
5. Flaherty MR, Klig JE. Firearm-related injuries in children and adolescents: an emergency and critical care perspective. Curr Opin Pediatr. 2020 Jun;32(3):349-353. doi: 10.1097/MOP.0000000000000905.
6. Kamat PP, Santore MT, Hoops KEM, et al. Critical care resource use, cost, and mortality associated with firearm-related injuries in US children's hospitals. J Pediatr Surg. 2020; 55: 2475-2479. doi.org/10.1016/j.jpedsurg.2020.02.016.
7. Vatansever1 G, Yılmaz HL, TuğçeNalbant, et al. Clinical characteristics of firearm-related injuries in children in Turkey. Turk J Pediatr. 2022; 64: 971-984. doi: 10.24953/turkjped.2021.4564.
8. De Cuypère M, Muhlbauer MS, Frederick A, Klimo PJR. Pediatric intracranial gunshot wounds: the Memphis experience. J Neurosurg Pediatr. 2016 May;17(5):595-601. doi: 10.3171/2015.7.PEDS15285.
9. Sofer D. Gun violence and children. Am J Nurs. 2017 Sep;117(9):14. doi: 10.1097/01.NAJ.0000524529.50050.7b.

Disclosures

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Conflict of interest. *The authors declare that they have no real or potential conflict of interest that could influence their opinions on the subject matter or materials described and discussed in this manuscript.*

Disclaimer. *The opinions expressed in this article are those of the authors and do not reflect the official position of the institution.*

Ethical statement: *The written informed consent was obtained from the patient.*

Photos to the article «A case of gunshot wound of the face, orbit and brain in a child: clinical presentation and consequences» by Tronina S. A., Bobrova N. F.

Fig. 1. Photograph of the child taken during the admission to the inpatient care unit of the Department of Pediatric Eye Pathology. A single entry wound is visible over the right nasal wing.

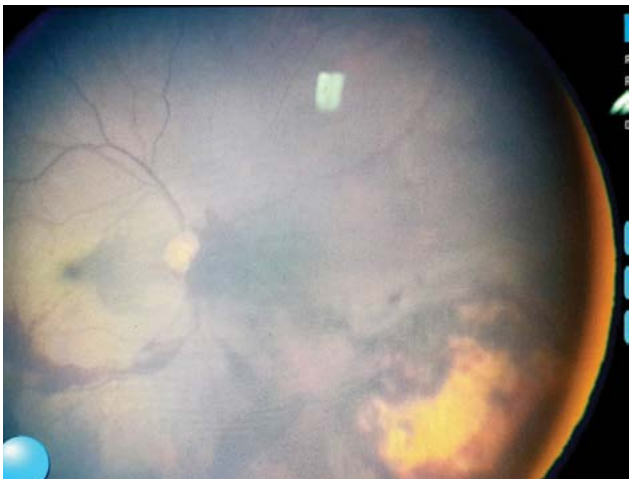
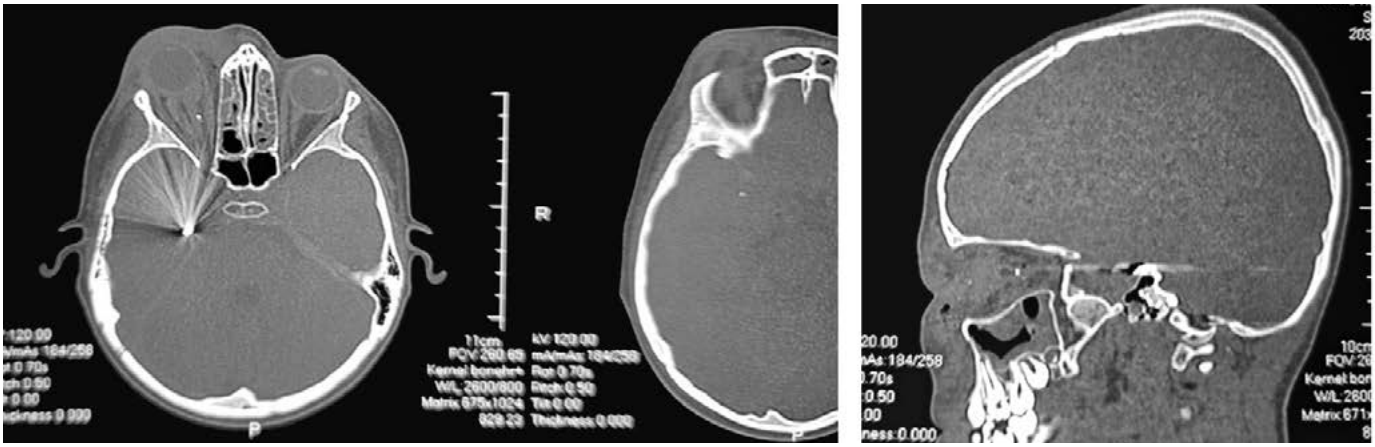


Fig. 2. Fundus picture of the right eye on day 3 after the traumatic event



a b

Fig. 3. Axial (a) and sagittal (b) head computed tomography. Note multiple foreign bodies in the right orbit, right frontal basal lobe, and right temporal basal lobes of the brain

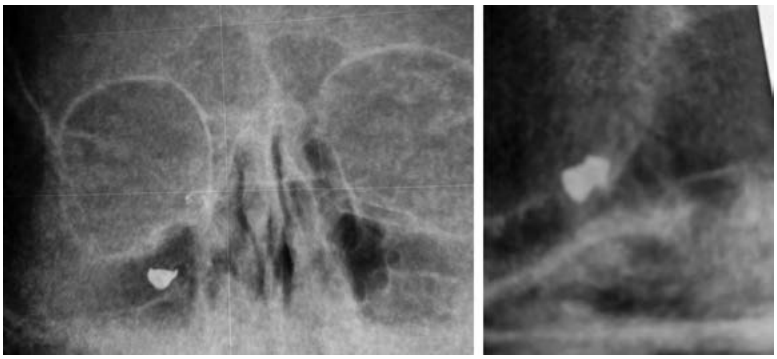


Fig. 4. Radiographs of the skull in the anteroposterior and lateral views

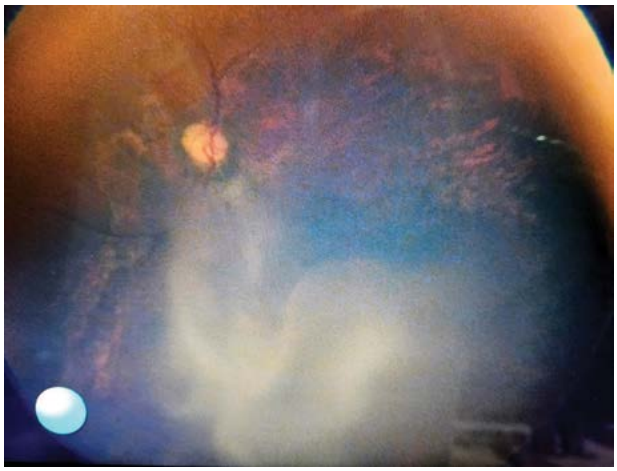


Fig. 5. Ophthalmoscopic picture of the right eye three weeks after the traumatic event. Note a pale optic disc with rather clear margins partially covered by vitreous opacities with massive fibrosis; remnants of epiretinal, intraretinal and subretinal hemorrhages at the periphery; marked retinal degeneration and pigment redistribution.