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A 16-Year-Old Ukrainian Boy Shot at Close-Range to the Back of the Neck with a Handgun Who Required Surgical Removal of a 9×18-mm Bullet Shell from the Left Posterior Maxilla and Recovered Following Physical Therapy

Authors' Contribution:

Study Design A
Data Collection B
Statistical Analysis C
Data Interpretation D
Manuscript Preparation E
Literature Search F
Funds Collection G

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Patient: Male, 16-year-old
Final Diagnosis: Gunshot wound of the cervical spine with root damage at the level of C4-C7 • left upper monoparesis
Symptoms: Had facial asymmetry • left upper monoparesis • pain in the left shoulder • pain in the projection of the damage
Clinical Procedure: —
Specialty: Anesthesiology • Neurology • Pediatrics and Neonatology • Rehabilitation • Surgery
Objective: Rare disease
Background: The conflict in Ukraine during the past year has resulted in increased deaths and injuries to soldiers and civilians from military weapons and large and small caliber firearms. Unlike clinicians in some Western countries, until recently, clinicians working in Ukraine hospitals had little experience managing patients with gunshot wounds.
Case Report: A 16-year-old boy was admitted as an emergency following a gunshot wound to the back of the neck from a Makarov pistol. The gun was reported to have been fired at a distance of more than 15 cm. Imaging showed the 9-mm bullet hit the cervical spine, causing nerve root involvement at C4 to C7, traveled upwards, and lodged in the left posterior maxilla. On examination, the patient had facial asymmetry and paralysis of the left shoulder, arm, hand, and wrist and was in pain and shock. Intubation and emergency surgery were performed, with the removal of a 9×18-mm bullet shell from the pterygopalatine fossa, deep to the infratemporal fossa, and posterior to the maxilla. The patient underwent postoperative physical therapy and continues to improve his physical function.
Conclusions: This report has shown the importance of immediate evaluation of gunshot wounds so that surgery can be planned and performed rapidly, with a view to postoperative recovery and active physical therapy.
Keywords: Adult Children • Surgery Department, Hospital • Weapons • Wounds, Gunshot
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Background

The conflict in Ukraine during the past year has resulted in increased deaths and injuries to soldiers and civilians from military weapons and large and small caliber firearms. Unlike clinicians in some Western countries, until recently, clinicians working in Ukraine hospitals had little experience managing patients with gunshot wounds. Gunshot wounds are a global problem that are often examined by the forensic pathologist [1].

Gunshot injuries of the anatomical structures of the neck and head, as a result of a damaging mechanical effect on tissues and organs with a violation of their integrity with the formation of an infected wound, are not only a complex medical problem but also an important socially significant issue, owing to the high percentage of disability. Such injuries have certain differences in the principles of providing assistance, which consist of the peculiarities of evacuation, the terms of their hospitalization in specialized medical institutions, the level of diagnosis, and methods of providing timely surgical care [2-4]. In patients who survive the initial injury, the factors to consider are the type of firearm used, the manner of injury, the distance or range of the shot, and the trajectory of the bullet within the patient [1].

In a recent review by Baum et al of the effects of gunshot wounds and retained bullets and their management, the importance of identifying the type of gun, the caliber, and the trajectory within the body before planning surgical removal was highlighted [5-7].

This report is of a 16-year-old Ukrainian boy shot at close-range to the back of the neck with a Makarov pistol who required surgical removal of a 9×18-mm bullet shell from the left posterior maxilla and recovered following physical therapy.

Case Report

A 16-year-old Ukrainian boy was shot at close-range to the back of the neck with a handgun and was transported to and hospitalized in the Department of Anesthesiology and Intensive Care in the city of Vinnytsia.

The patient had a gunshot wound to the neck and left zygomatic area, with damage to the roots of the spinal cord. His condition was serious and he was conscious. His position in bed was maintained on the right side, with the chin brought to the front of the chest; immobilization was achieved with a tight Shantz collar. Locally, an entrance wound (skin defect up to 6 mm in diameter) with swollen edges was determined in the middle of the back of the neck on the left side of the midline. Hemorrhagic content was actively released directly from

the defect. When inspecting the area of the primary entrance hole, there were no signs of the limits of the mechanical action of the gas charge (irritant), which indicated that the shot was fired from a distance of more than 15 cm, which meant that the influence of some accompanying factors of the shot was excluded (**Figure 1A**).

Objectively, the patient had facial asymmetry due to moderate swelling of the neck and face on the left. Opening the mouth was limited due to sharp pain in the projection of the damage. In the area of the branch of the lower jaw on the left and the soft palate, significant swelling and tenderness were determined. The patient also had pain in the left shoulder and pronounced weakness in the left arm, with the inability to raise it.

A lateral X-ray of the head and neck showed the bullet trajectory and the location of the bullet lodged in the left pterygopalatine fossa, deep to the infratemporal fossa, and posterior to the maxilla (**Figure 1B**).

A neurologist's examination confirmed damage to the roots of the spinal cord at the level of C4 to C7 segments on the left, with plegia in the left hand. Movements in the fingers of the left hand were preserved. There was pronounced hypoesthesia at the level of C5 to C7 segments on the left. The neurological diagnosis was gunshot wound of the cervical spine with root damage at the level of C4 to C7 and left upper monoparesis.

The patient immediately underwent surgery under intubation anesthesia, according to urgent indications. After treatment of the operative field, an incision was made from the side of the oral cavity in the retromandibular area of the lower jaw on the left. During soft tissue dissection, we found a foreign body (the 9×18-mm bullet shell was removed) in the pterygoid fossa (**Figure 1C**).

After removing the foreign body, its bed was treated with an antiseptic solution and drained after the edges of the wound were closed and sutured. The primary entrance hole in the neck area on the left was drained with a rubber drain.

On the ninth day from the start of treatment, we discharged the patient in a satisfactory condition for outpatient treatment and rehabilitation at his place of residence.

During the follow-up examination after 1 month, we identified residual phenomena of plegia in the left hand, hypesthesia at the level of C5 to C7 segments on the left, in the area of the primary entrance hole, and a postoperative scar.

It was recommended that the patient continue the sanatorium-restorative treatment according to the individual rehabilitation plan.

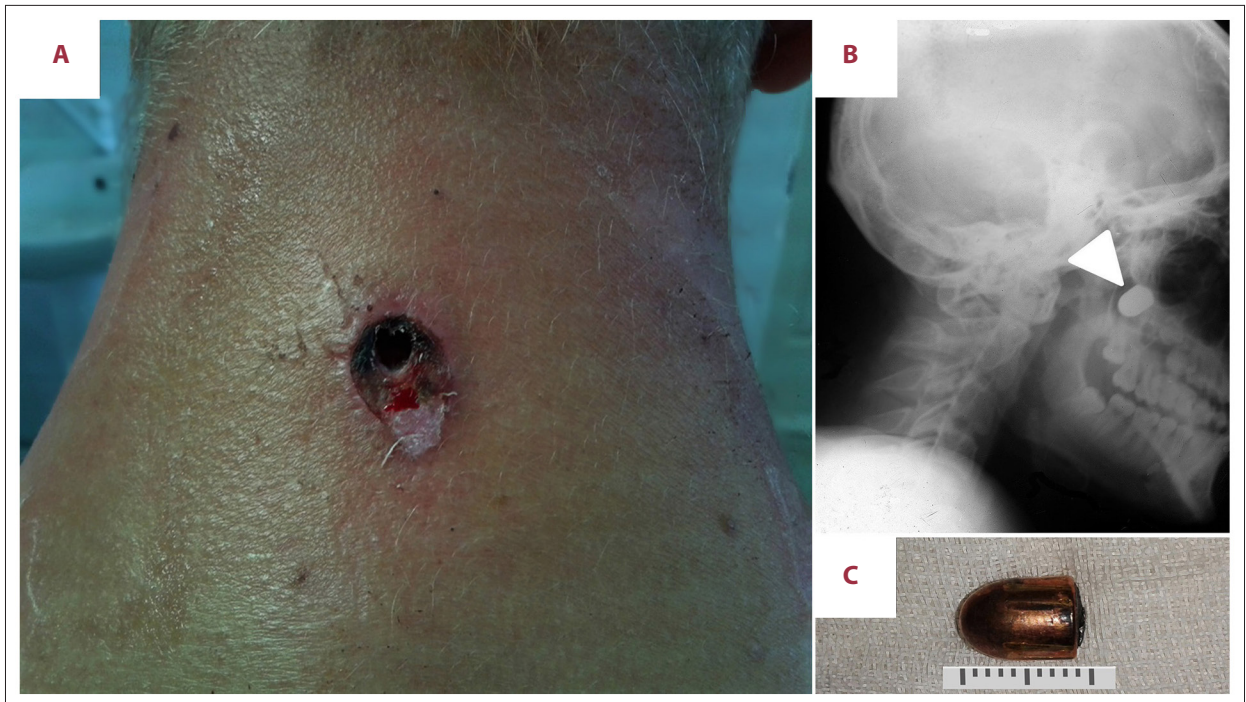


Figure 1. A 16-year-old Ukrainian boy shot at close-range to the back of the neck with a handgun. (A) The entrance wound at the back of the neck is from a Makarov pistol and shows some tissue damage and blood clot. (B) A lateral X-ray of the head and neck shows the bullet trajectory and the location of the bullet lodged in the left pterygopalatine fossa, deep to the infratemporal fossa, and posterior to the maxilla. (C) The 9×18-mm bullet shell was removed, intact, following surgery.

Discussion

A recent review by Baum et al [5] illustrates the effects of gunshot wounds and retained bullets and their management; the importance of identifying the type of gun, the caliber, and the trajectory within the body before planning surgical removal was highlighted [5-7]. Hollier et al, in a study based on 4 years of experience, mention that the severity of injury resulting from facial and neck gunshot wounds varies according to the caliber of the weapon used and to the distance from which the patient is shot [8].

Gunshot wounds are divided into bullet wounds (high-velocity and low-velocity), fragmentary (coarsely fragmented and shallowly fragmented), fragmentation and explosive, and explosive and other (fragments, shrapnel, balls), according to the nature of the injury: through, penetrating (blind), and tangential [9,10].

In our clinical case, it was a gunshot wound (Makarov pistol) with damage to the soft tissues of the neck and spinal canal, with damage to the roots of the spinal cord at the level of C4 to C7 segments. The 9×18-mm bullet was lodged in the skull in the pterygoid fossa and was successfully removed. The gun was reported to have been fired at a distance of more than 15 cm.

Godhi et al [6] stated that penetrating injuries of the head and neck present complex management problems because

of the major vascular, neural, aerodigestive, and ocular structures that are at risk. Mandatory exploration is very sensitive in identifying significant neck injuries and is associated with a low morbidity rate. However, up to 70% of patients explored in this way will have no injury to vital structures [6].

Treatment of patients with gunshot injuries to the cervical spine and head should consist of a pre-hospital and hospital stage. The pre-hospital stage involves the organization of emergency medical care by doctors, which includes: normalization of breathing (oxygen therapy), stabilization of hemodynamics (infusion therapy with crystalloids or colloids, plus vasopressor if necessary, plus anesthesia), and ensuring full access to the venous bed. If the victim is in shock, immediate anti-shock measures should be taken. At the same time, preliminary assessment of the site of gunshot damage and neurological symptoms is indicated. It is necessary to consider the fact that a spinal cord injury with possible damage to the spinal cord should be suspected in the case of a head injury, the presence of neurological spinal symptoms, and a traumatic impact that has a large kinetic energy, as happens with gunshot wounds. In such cases, patients must be transported in a cervical cage on a flat, hard surface to which the victim is fixed in order to prevent displacement of vertebrae or bone fragments. When carrying out all stages of transportation and diagnostics, it is necessary to strictly follow the rule: "head-neck-thorax: a

single unit". For this, it is advisable to use immobilization using a Kendrick splint, a bilateral plaster bandage, a Philadelphia collar, or similar structures with firm fixation.

At the hospital stage, a clinical diagnosis is made based on the anamnesis data and somatic and neurological examinations, for which an accurate topical diagnosis of the level and volume of gunshot injuries is conducted using ultrasound with Doppler, radiographic examination in at least 2 projections (if necessary and in functional positions), and if possible and necessary, computed tomography (CT or CAT) or magnetic resonance imaging of the affected department.

Operative intervention for penetrating wounds, after stopping the bleeding, begins with surgical treatment of the entrance hole, then treatment of the exit hole, and the operation is completed by draining the wound channel. In case of penetrating wounds, it is necessary to remove the damaging element as much as possible (bullet, ball, or fragments).

The volume and qualitative composition of infusion therapy depends on the general condition of the patient and the degree of impaired vital functions. Taking into account the fact that all gunshot wounds are considered conditionally infected, as well as that all patients are prescribed complex antibacterial therapy in the presence of tissue destruction during damage, anti-tetanus and anti-gangrenous serums are administered as indicated [11]. An important element of treatment at the hospital stage, in addition to adequate immobilization of the affected segment, is a full-fledged anesthesia program.

When creating programs for the treatment and rehabilitation of patients with neck injuries, the experience of wars and military conflicts should be considered. Also, the existing existence of certain periods of the wound process should be considered by allocating the periods as acute (2-3 days after injury), early (first 2-3 weeks), intermediate (up to 2-3 weeks), and late (from 3-4 months after injury to 2-3 years or more). The clinical picture of the acute and early periods is dominated by a general serious condition, hemodynamic disorders, respiratory disorders caused by injury and blood loss, and injuries to the

spinal cord that can manifest as phenomena of complete or partial disruption of its conduction, segmental type dysfunctions, and complex radicular syndromes. Important for the assessment of true neurological damage is the intermediate period, at the beginning of which (5-6 weeks after the damage), the phenomena of spinal shock disappear and a neurological deficit is revealed. In the late period, the functions of the spinal cord are restored, depending on the severity of its damage, and the appearance of new symptoms due to scar-malignant and inflammatory processes, previous symptoms, and disorders of blood circulation and liquid circulation should be considered as consequences and complications of the injury [12].

Conclusions

Gunshot wounds of the neck should be considered as a special group of infected mechanical injuries, in which early topical diagnosis using ultrasound, computed tomography, magnetic resonance imaging, and, if necessary, exploratory surgical intervention with appropriate hemostasis is indicated [1,2]. Diagnostic and therapeutic measures for patients with gunshot wounds to the neck should be active, complex, and as radical as possible, and the recovery and rehabilitation period should be long and continuous [3,13].

This report has shown the importance of immediate evaluation of gunshot wounds so that surgery can be planned and performed rapidly, with a view to postoperative recovery and active physical therapy.

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Declaration of Figures' Authenticity

All figures submitted have been created by the authors who confirm that the images are original with no duplication and have not been previously published in whole or in part.

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