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Transorbital Penetrating Injury of the Skull and Brain

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Abstract: Penetrating skull and brain injuries are considered severe trauma, often resulting in permanent disability and death. In this article, we describe a case of successful surgical treatment of a rare penetrating transorbital injury to the cerebral hemisphere caused by a metallic foreign body in a 20-year-old patient with no neurological deficit.

Key words: penetrating wounds of the skull and brain, metallic foreign bodies, transorbital wounds.

Skull and brain injuries are prevalent among individuals aged 20-49, i.e., the most active segment of the population [1,4]. The high frequency and mortality associated with head injuries in the active population underscores the socio-medical significance of traumatic brain injuries.

One of the pressing challenges in modern neurotraumatology is the treatment of victims with penetrating craniocerebral wounds. Penetrating skull and brain injuries caused by complex metallic foreign bodies are rare. The literature lacks recommendations regarding the diagnosis and surgical and conservative treatment strategies for this group of patients. Unlike gunshot craniocerebral wounds, injuring metallic foreign bodies do not possess high kinetic energy and, penetrating the cranial cavity, primarily cause damage to the craniofacial and craniobasal regions [3]. These patients are typically hospitalized in multidisciplinary hospitals, where treatment strategies are jointly determined by neurosurgeons, maxillofacial surgeons, ophthalmologists, and otolaryngologists [2].

Patient T.Kh., 20 years old (case history No. 22169/1631), was transported by a passing vehicle on November 3, 2018, at 5:05 PM to the neurotraumatology emergency department to see a neurosurgeon with a metallic foreign body in his right eye. The patient complained of headache, dizziness, nausea, vomiting, and a wound in the upper eyelid of his right eye.

History: While performing construction work, he fell from a height of 2 meters onto rebar. He was taken to the hospital by a passing vehicle. Given the severity of his condition, he was admitted to the neurological intensive care unit.

Physical examination: the patient's general condition is moderate. The skin and visible mucous membranes are pale pink. Breathing is regular and spontaneous. Respiratory rate is 20 times per minute. Heart sounds are muffled. Pulse is 110 beats per minute. Blood pressure is 100/60 mmHg. The tongue is clean and moist. The abdomen is soft and painless.

Neurological status: The degree of impairment of consciousness is profound obtundation. The patient answers questions reluctantly, using monosyllables. The neurological score is 12 points. The left pupil is of normal size, photoreaction is preserved, but due to the inability to raise the upper eyelid, the right pupil could not be examined. The face is symmetrical. Facial expressions are preserved. Active movements in the limbs are preserved. Muscle strength in the limbs = 4 points. Tendon reflexes BR , TR , PR , ARD = S are evoked. The pathological Babinski reflex is positive on both sides. There are no meningeal signs.

Locally: a foreign metal object (rebar), approximately 1/4" long, is present 1 метра, penetrating the upper eyelid on the right side toward the cranial cavity. A soft tissue swelling measuring 4.0 x 1/4" is present in the frontal region 3,0 см, under which the distal end of the foreign body is palpated.

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Ophthalmologist: OD – a penetrating wound of the upper eyelid. Enophthalmos. (Is there really no bleeding, such as a hematoma of the iris?)

Neurologist: Severe open head injury. Moderate brain contusion.

X-ray of the skull in two projections reveals the presence of a penetrating metallic foreign body in the cranial cavity. Signs of increased intracranial pressure.

Preliminary diagnosis: Catatrauma. Severe penetrating craniocerebral injury. Severe contusion and crushing of the brain. Perforated fracture of the upper wall of the right orbit and frontal bone with the presence of a metallic foreign body (reinforcement). Destruction of the right eyeball. Post-traumatic shock, stage II .

Blood test: Hemoglobin – 90 g/l, Erythrocytes 3.5 x 1012 g/l, Leukocytes – 7.0 x 109, Hematocrit – 31%, ESR – 3 mm/hour.

Urine analysis: Color – straw-yellow, transparency – complete, Protein – abs , Bilirubin – negative, Epithelium (flat) – 1 – 2, Leukocytes – 4 – 5, salts – abs .

ECG – Sinus rhythm, heart rate – 84 beats/min, vertical electrical axis of the heart.

Blood biochemistry: Glucose-9.0 mmol/l, total protein-78 g/l, Urea 5.6 mmol/l, total bilirubin. 8.1 μmol/l, direct- abs . Siydik takh. Rangisarik. Tinikligitulik. Protein – abs . Leukocytes-4-5. Epithelial-1-2.

An hour after admission, on November 3, 2018, a "Post-surgical wound debridement and radiographic examination of the right frontal region" was performed. Inspection of the wound channel, removal of a foreign body, brain debris, and intracerebral hematoma of the right cerebral hemisphere under microscopic assistance.

Surgical protocol: under general anesthesia, after appropriate skin preparation, a horseshoe-shaped incision was made in the projection of the exit hole of the foreign body in the right frontal-parietal region of the head, up to 16 см. The soft tissues were edematous, imbibed with blood. A burr hole was made near the foreign body with a brace, which was expanded to 3.5 x 4,0 см. During revision of the epidural space, damage to the dura mater in the area of the exit hole and penetration of the foreign body into the brain tissue were noted. The foreign body was removed through the upper eyelid. The depth of penetration of the foreign body into the brain tissue was 15 cm. Using a microscope, a revision of the wound channel was performed, blood clots and brain detritus were removed by rinsing with warm saline and aspiration along the entire length of the wound channel. Hemostasis was performed by coagulation and using a 3% solution of H_2O_2 . The orbital superior wall fracture site was closed with spongostan. A revision of the right eye was performed, revealing a 2.0 x 100 mm skin wound on the upper eyelid 0,5 см. Upon examination, the right eyeball was intact, with enophthalmos noted. An ophthalmologist performed intraoperative ophthalmoscopy. The wounds were sutured layer by layer. Iodine was applied. An aseptic dressing was applied.

Postoperative diagnosis: Catatrauma. Severe penetrating craniocerebral trauma. Severe contusion and crushing of the brain. Perforated fracture of the upper wall of the right orbit and frontal bone with the presence of a metallic foreign body (reinforcement) without damage to the eyeball. Post-traumatic shock, stage II .

1st postoperative day: complaints of headaches, dizziness, nausea, and pain in the right eye. The patient's general condition is moderate. Breathing is regular and spontaneous. Respiratory rate is 20 times per minute. Auscultation reveals vesicular breathing in the lungs. Heart sounds are somewhat muffled and rhythmic. Pulse is 80 beats per minute. Blood pressure is 110/70 mmHg.

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Neurological status: conscious, answers questions, follows instructions. GCS – 13 points. Pupils – normal size on the left, photoreaction preserved, on the right, due to soft tissue edema, it was impossible to check. It is better to write: Pupils OD = OS . The face is symmetrical. Skin and tendon reflexes are evoked by D = S . Active movement in the limbs is preserved. Some rigidity of the occipital muscles is noted. There are no pathological signs. Pathological Babinski reflex (+/-) on both sides.

Locally: the postoperative wound in the frontoparietal region is clean and free of discharge. The wound has been debrided and an aseptic dressing has been applied. The upper eyelid wound is edematous and free of discharge. The wound has been debrided and an aseptic dressing has been applied.

The patient was prescribed antibiotic therapy, dehydration, painkillers, and neuroprotectors.

In the following days, the patient's condition remained stable and relatively satisfactory. There was no neurological deficit. Locally, the wounds were clean and free of discharge. Daily wound dressings were performed.

On November 6, 2018 (the third day after surgery), the patient was transferred from the neurointensive care unit. His condition is improving dynamically. There is no neurological deficit. Vision in the right eye is preserved. Wound healing is primary.

On the day of discharge, the neurological status: the patient is conscious. GCS = 15 points. Answers questions, follows instructions. Pupils D = S , photoreaction is preserved. Oculomotor nerve function is preserved. The face is symmetrical. Facial expressions are preserved. The tongue is in the midline. Tendon reflexes BR , TR , PR , AR are evoked, D = S. No paresis or paralysis. Sensation is not impaired. Stable in the Romberg pose. Coordination tests are performed correctly. There are no pathological signs.

Locally: healing of wounds of the soft tissues of the skull and upper eyelid is primary, no discharge.

Ophthalmoscopy: Vision in the right eye is preserved. Visual acuity is 0.9 in the right eye and 1.0 in the left eye. The optic disc is pale pink with clear borders. The arterial to venous ratio is 1.5–3.

On November 14, 2018 (11 days after admission), after the stitches were removed, the patient was discharged from the hospital in a relatively satisfactory condition to continue treatment at his place of residence under the supervision of a neurologist.

Conclusion.

1. All patients with penetrating injuries to the skull and brain should be hospitalized in specialized neurosurgical departments.
2. All victims with penetrating skull and brain injuries are recommended to undergo CT scanning in the bone and soft tissue axial projection. For victims with damage to the basal structures or the upper cranial vault, it is advisable to perform CT scanning in the coronal or sagittal projections.
3. For planning surgical access for craniobasal injuries, it is advisable to perform 3D CT reconstruction.
4. Analogue or digital craniography is useful in assessing bone lesions, the presence of air and radiopaque foreign bodies and radiopaque foreign bodies.
5. In case of injuries caused by non-magnetic objects, it is advisable to use MRI.
6. This type of injury is considered severe, but with timely and adequate surgical care and the absence of concomitant injuries and somatic pathologies, a favorable outcome can be predicted.

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Furthermore, the patient's young age also contributed to an early recovery from severe traumatic brain injury.

Thus, issues of prevention, early diagnosis, and timely surgical treatment for this category of patients remain relevant. Correct interpretation of X-ray and CT scan results, selection of the optimal surgical approach for each individual patient, adherence to surgical guidelines for managing the consequences of brain injury, and adequate postoperative intensive care are key to successful treatment of this critically ill patient population.

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