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Pediatric high-energy and other traumatic injury: Cases and reviews

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***Abstract*---**The article describes rare cases from the practice of pediatric orthopedist-traumatologist. Modern household appliances are often the reason for children to receive significant and severe injuries that increase the risk of disability for life. The peculiarity of the child's body is that at different ages the same traumatic force causes completely different results, which must be taken into account in the practice of traumatology. The aim of this work is to comparative assessment of injuries depending on the magnitude of the traumatic impact, the condition of bone tissue, and the development of optimal methods of treatment of these injuries. The basis of the work is the results of examinations of patients of the trauma department of the regional children's hospital with rare injuries over the past 10 years. The basic methods of examination were X-ray, computed tomography. It was found that there is a direct dependence of the severity of the injuries on the age of the child, the duration of the traumatic impact, its area and treatment tactics. Summarizing the data obtained, we believe that in the case of destructive effects of injuries, it is advisable to use adequate, active, early surgical tactics.

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Introduction

The results of urbanization, the achievements of the scientific and technical process have significantly affected the lives of children [1,2]. According to the WHO, the main cause of death among people under 45 is trauma ahead of cardiovascular and cancer [3,4,5]. Traumatic shock, massive blood loss, infectious complications (sepsis) - the three main causes of high mortality from severe trauma [6,7,8]. Modern household appliances have significantly changed the rules of life, behavior, set a number of warnings that should not be violated. Even a special term "high-energy trauma" was introduced [9,10,11]. Such injuries occur when traumatic forces exceed 10 to 12 times the force of gravity acting on a person in an upright position [12,13,14]. Particularly dangerous devices and tools that conceal high-energy capabilities - straw choppers, irons, Bulgarians, planers, wood chips, chainsaws, cultivators, mowers, axes. muscle mass, nervous system, disorders of blood supply [15-24]. The duration of the traumatic effort and simple damage is crucial in the development of high-energy injuries in children [25,26].

If the influence of strong energy is concentrated on a small area of the anatomical part of the child's body for a short time, then there are various wounds - scalped, stabbed, cut, crushed, bruised, ground [27-30]. Most often such injuries are received from cutting and prickly objects - knives, scissors, needles, spitz, nippers, scythes [31,32,33]. In such cases, a huge traumatic force is concentrated and damages a relatively small part of the body [34,35]. Particularly dangerous are stab wounds that penetrate the chest, lungs, joints, muscles (penetrating wounds) [36,37,38]. Due to the development and modernity of mankind and the constant desire to improve in modern medicine there are very good opportunities for the treatment of injuries and traumas of any kind and complexity [39,40]. In addition to the well-known surgical and minimally invasive methods of treatment in recent years are gaining popularity and other alternative and no less effective methods [41,42]. One such method is platelet-rich blood plasma treatment, which has received good reviews of treatment by many specialists [43,44,45]. It is actively used not only because it is effective but also because it has many advantages, one of which is its ease of receipt and low cost of use [46,47,48]. Mesenchymal stem cells are also very popular with modern scientists, who are famous for migrating to the affected area immediately after administration and thanks to nanocells begin to restore the damaged structure of any complexity and area of the lesion [49,50,51].

Materials and Methods

The basis of the work is the results of examinations of patients of the trauma department of the regional children's hospital with rare injuries over the past 10 years. The basic methods of examination were X-ray, computed tomography.

Results and Discussions

Clinical case. A 7-year-old boy was stabbed by a metal rod 50 cm long and 1 cm thick due to a fall. Examination revealed that the rod pierced through the upper part of the posterior surface of the left thigh in the oblique direction. Fortunately, the rod did not damage bone, large blood vessels or nerve trunks. A penetrating penetrating wound with a metal rod of the upper third of the left thigh was diagnosed. After removal of the rod, the wounds healed without complications and the child was discharged from the hospital a week later in satisfactory condition. The most severe treatment is high-energy injuries from the meat grinder. Such wounds are scalped, crushed, ground, cut, contaminated, torn. The child's fingers are amputated along with torn tendons that are attached far from the wound to the forearm bones. *Clinical case.* A 2-year-old 2-month-old child dipped his hand into a working electric meat grinder. The right hand was pulled into the unit at the elbow, the fingers were wound on the auger and protruded around the neck of the device. When the handle was released from the meat grinder, the brush resembled a ground cutlet. Fingers were broken, displaced in many places, soft tissues were crushed, scalped, ground, contaminated with minced meat, onions, garlic, bread. With great difficulty it was possible to completely restore the anatomical structure of the handle. In the process of growth (observation for 3 years) traumatic scars on the hands caused restrictions on the extension of the fingers of the hand - post-traumatic, scarring, flexion contractures. Given the rule of "paired cases", a similar injury was observed a week later in girls of the same age, but the meat grinder was larger and more powerful, so despite all our efforts there was a traumatic amputation of the fingers of the right hand - a lifelong disability.

The combination of long-term and strong mechanical impact on a large area of the child's body (leg, arm) causes a special type of high-energy injuries - compartment syndrome. Despite numerous studies, the final pathogenesis of this lesion has not been sufficiently studied. *Clinical case.* Newborn K. the third day after birth. As a result of prolonged lying on the right handle, necrosis of the phalanges of the fingers of the right handle occurred (Fig. 1). Apparently, the right hand was squeezed by the baby's body (lying on the right side), resulting in damage to muscle mass, increased subfascial pressure, and reduced tissue perfusion to below vital levels. Positional compartment right hand syndrome was diagnosed. According to the religious beliefs of the parents, the operative treatment was postponed. Necrosis progressed rapidly, capturing the entire forearm, so in order to save the child's life, an urgent operation was performed - amputation (exarticulation) of the right forearm at the level of the elbow joint. After the operation, the child recovered and was discharged in satisfactory condition. Disability for life.

Fig 1. Positional compartment cider in the newborn

The child may be injured in the womb. We observed severe ischemic injuries and rare fractures. Among the ischemic injuries, an extremely severe injury was observed - Folkman's ischemic contracture. I believe that the development of Folkman's ischemic contracture can also be considered as a kind of high-energy injury. *Clinical case.* Observed a rare injury that occurred in the womb. In the newborn there was a umbilical cord entanglement of the right forearm. After childbirth, there was a trophic wound (bedsore) on the forearm, paresis of the radial nerve, combined flexion-extension contractures of the finger joints of the hand, partial occlusion of the radial artery. Folkman's contracture of the right hand was diagnosed (Fig. 2). Probably the pressure of the umbilical cord on the forearm was so strong that bedsores formed and regional blood supply disorders occurred, as a result of which muscle cells died and were replaced by connective tissue that is unable to contract. The flexors of the hand are especially sensitive to damage. According to the literature, necrosis of muscle fibers occurs 4-6 hours after the onset of ischemia [4]. Dispensary observation for 4 years. Combination (conservative, operative) therapy during this time did not give the desired result. The right hand has significantly and permanently lost its functional purpose, deep disability.

Fig 2. Folkman's contracture on the right in the newborn due to the umbilical cord wrapping the forearm

Clinical case. A rare trauma was observed in utero. Childbirth is normal, without features, there was no injury. A newborn in the area of the right parietal bone was found to be 1 cm deep oval in shape with gentle smooth contours 3 cm in diameter with no signs of inflammation, not painful on palpation. The child is healthy, no signs of damage to the central nervous system. X-ray examination of the skull revealed a local indented oval fracture up to 3 cm of the right parietal bone without damage to the inner plate, depth of indentation 1 cm. The big question for the doctor and parents was - when did the skull fracture occur? My mother remembered, at first glance, a small event that put everything in its place. Living in the village, the pregnant mother went to milk a cow. The threshold of the stable was frozen and covered with ice crust, on which she slipped and fell on her buttocks. Excessive flexion of the pregnant mother's buttocks caused the costal arch to strike the baby's head (buttocks), causing a compressed fracture of the right parietal bone. Such fractures should be monitored if there is no brain damage. Clinical observation for 7 years did not reveal any abnormalities in the child's health. The coincidence of a number of negative factors contributed to such damage. Impact of the mother's bone structure (costal arch), location of the baby's head (buttocks, injury mechanism (excessive flexion), excessive force of impact (high-energy trauma), fragility of the skull bones (bone has not yet completed its development). In this case, high-energy trauma is considered a special clinical case, because in a normal child such a force of impact would obviously not provoke such a fracture. Sometimes the concept of high-energy trauma is relative. If the bone is soft, such efforts may be small. In this case, use the term - pathological fracture. congenital imperfect osteogenesis, marble disease, etc. The main cause of the disease are genetic disorders, more than 200 mutations are known in genes that distort the structure of collagen type 1 (Col 1A1, Col 1A2) - the main protein of bone tissue [5]. sharply reduced, which causes frequent fractures, skeletal growth disorders, debilitating deformities of the extremities, spine.

Clinical case. The girl B. from the age of three had frequent fractures due to relatively minor injuries. Examination revealed the classic triad of this disease 1. Blue sclera. 2. Fragile bones. 3. Amber teeth. Characteristic changes were revealed on a series of radiographs (more than 30 images); thinning of the cortical layer; total osteoporosis of the bones; frequent fractures. Diagnosed with congenital osteogenesis, late form. Observation for 28 years. The fractures stopped completely at the age of 14 (this is a big mystery). The consequences of the disease in childhood make themselves felt - shortening of the right thigh by 4 cm, compensatory scoliosis with pain, osteochondrosis of the spine with protrusion of the discs, pathological remodeling of the tubular bones, total caries, astheno-depressive syndrome. She gave birth to a boy and a girl with the same disease. There was a family (hereditary predisposition) dependence - mother, daughter, son. Pathogenetic treatment is unknown.

No less interesting is another case. It is known that bone tissue in children and adolescents has significant plasticity and ability to adapt. When the load is relatively large and long, there are areas of pathological reorganization of bone tissue. There are various names of such changes in the literature: Loose zone, stress fracture, marching foot, marching fracture (March Fracture), congested foot, recruit fractures, Deutschlander syndrome, metatarsal insufficiency [6].

Most often such fractures are observed in athletes, recruits in the first days of military service, when after cross-country races, marches, intensive physical training there is an excessive overload of skeletal bones. More than 80% of such changes occur in the feet [6]. The cause of this disease has not been studied, treatment is symptomatic, the main thing is to eliminate excessive stress.

Clinical case. A 17-year-old boy, K., complained of pain in both legs, which intensified during walking and running. Ill for several months. I did not do sports. Examination revealed limping on both legs. The length of the legs is the same. On palpation there is pain in the proximal ends of both legs. Skin over the legs of normal color, no signs of inflammation. The review radiograph of the tibia revealed transverse enlightenments 1-2 mm wide at the level of the proximal ends of the tibia with a pronounced periosteal reaction in the form of a spindle-shaped callus. The series of computed tomograms shows lines of pathological reorganization (marching fractures) of the proximal part of the tibia with muff-like periosteal layers above them (Fig. 3).

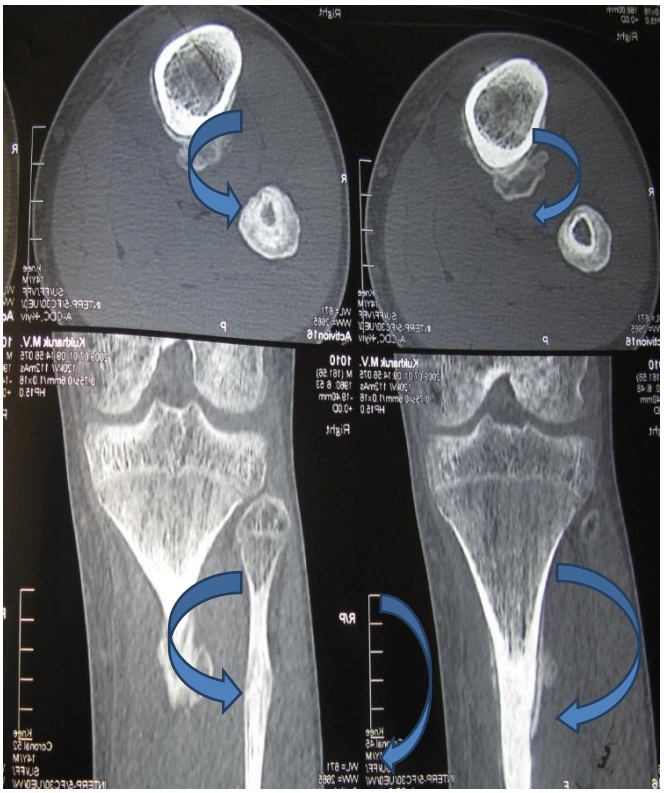

Fig 3. Looser's tibia, Deutschlander syndrome

A rare primary-chronic form of pathological functional reorganization of the bone tissue of the proximal part of both legs at the stage of fusion was diagnosed. Conservative therapy is prescribed. Re-examination a year later - the boy is healthy.

Conclusion

Summarizing the data obtained, we believe that in the case of destructive effects of injuries, it is advisable to use adequate, active, early surgical tactics. Delays in surgery due to both the fault of the parents and the peculiarities of the child's development (intrauterine injuries) lead to ischemic changes, contractures, trophic disorders and sometimes amputations. Injuries, and their consequences, received in childhood can be manifested throughout life in the form of disability. The duration of the traumatic effort and the area of the injury are crucial in the development of high-energy injuries in children.

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