



Injuries caused by a military explosive device to children

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ABSTRACT

The purpose of this work is to disclose the case of a child injury caused by a military explosive device. Seven minors aged 12 to 14 years received multiple injuries of varying degrees of severity from the explosion of military devices in living quarters. One child was in critical condition. She was a 14-year-old girl with a severe traumatic shock. The explosive injury indoors shows the high volume and traumatic injuries. In case of difficult trauma even a standard, properly applied hemostatic tourniquet may not be effective enough. Children who have severe traumatic shock, a greater positive hemodynamic effect from high-speed large-score infusion-transfusion therapy should be expected than infusion of sympathomimetics.

Key words: Case report; Children injuries; Military explosive device

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INTRODUCTION

According to the World Health Organization (WHO), every year in the world, about 5.8 million people die from trauma and the consequences. In low and middle income countries the mortality rate from trauma reaches 90%.^{1,2}

Of all the injuries received in zones of military conflict, about 70% are explosive injuries,³ of which 20-60% are among the children of the civilian population.⁴ During the course of the literary search, no data were found on the statistics of explosive trauma caused by lethal weapons in territories outside the zones of military conflicts, including and/or among the children's population. We publish this report of an explosion to unveil the case of children trauma caused by a military explosive device.

CASE REPORT

In May 2016, a territorial central hospital, which is a non-specialized medical institution with a general profile surgical facility received information from the emergency medical service about seven juveniles aged 12 to 14 who received multiple injuries as a result of an explosion of a military device (presumably - a military anti-personnel grenade). The explosion took place in a living room. One injured person died on the spot. Six injured children were evacuated to the hospital. The distance from the place of explosion to the hospital was 20 km. Due to the lack of detailed information about the status, volume and nature of injuries of the injured persons, the hospital administration decided to call for additional resources before the arrival of emergency medical teams such as additional medical

staff and deploying of additional anti-shock chambers and operational rooms.

At 9:40 pm the injured children were brought to the reception department, where triage was carried on:

- the condition of 4 children was considered as moderate-severe as a result of numerous small fragmentary wounds on various parts of the body (12 to 34).

- the condition of one child was regarded as difficult as a result of about 18 small fragmentary wounds on various parts of the body, two of which were penetrating into the cranial cavity with a disturbance of consciousness at the level of moderate coma - 8/15 Glasgow Coma Scale (GCS) score.

- the condition of one child was regarded as critical, as a result of decompensated traumatic shock caused by incomplete traumatic amputation of both lower extremities at the level of the thighs, plus penetrating wounds of the abdominal cavity.

At the prehospital stage injured children underwent emergency treatment to stop the bleeding, and anti-shock measures were undertaken by emergency brigades.

Regarding the limited resources of the local non-specialized medical institution on the principle of "on their own", narrow-profile specialists were called from a regional multidisciplinary, specialized medical institution located at a distance of 40 km, who arrived at the territorial hospital at 10:20 pm.

After examination, the concerned specialists made a decision to evacuate the victims with moderate to severe injuries to a regional multidisciplinary specialized medical center with the help of specialized ambulance service.

The Caucasian girl 14, in the critical medical state was hospitalized to the anti-shock chambers of the local non-specialized hospital immediately after admission to the hospital; surgical and anesthetic departments of the institution started active surgical treatment without waiting for the arrival of senior consultants. The time elapsed after the injury was 30 min.

At the pre-hospital stage, the injured girl had been provided with the following medical aid: hemostatic harnesses on injured limbs, immobilization of the limbs, infusion of hydroxyethyl starch and isotonic saline solutions through peripheral venous catheters, and analgesia with narcotic analgesics.

At the time of admission to the hospital, the state of the victim was critical: the risk of death for the pediatric

mortality rate (version 2)⁵ was 88%. The assessment of the pediatric score of injuries⁶ was +1 point, which corresponds to the degree of injury being "life-threatening injuries". The level of consciousness was 8/15 on GCS. The skin was pale with marble shade; nails were cyanotic, and she was in hypothermia (35.5 °C). Breathing was rapid – 25/min, but there was no wheezing. Radial pulse could not be palpated; carotid pulses were weak; heart sounds were dull with tachycardia up to 150 beats per minute. Non-invasive blood pressure (NIBP) and pulse oximetry saturation were not recordable.

The nature of traumatic injuries: both lower limbs at the level of the legs and upper third of the thighs were deformed, the shaft of the femur was completely broken and the soft tissues were crushed. On the upper third of both thighs above the lesion site were harness hemostatic overlays applied at the pre-hospital stage. There is no pulsation in the arteries below the injury site. At the front abdominal wall, 3 cm above the symphysis pubis in the midline, there was a torn wound about 4x1 cm, penetrating into the abdominal cavity, which did not bleed.

■ The results of laboratory and other diagnostic tests done immediately after hospitalization were as follows:

- blood analysis: anemia (hemoglobin – 5.7 g/dL, red blood cells – 1.8x10⁹/L), thrombocytopenia - 66x10⁹/L; neutrophilic leukocytosis (leukocytes - 12x10⁹/L, immature neutrophils 27%);
- biochemical blood test: hypoproteinemia (total protein - 36.5 g/L), hyperglycemia - 12.96 mmol/L, hypokalemia - 2.76 mmol/L;
- coagulogram: hypocoagulation state (prothrombin time -18.6 sec, international normalized ratio (INR) - 2.0; plasma fibrin - 1.5 g/L);
- clinical analysis of urine: proteinuria - 0.73 g/L, glucosuria - 2.86 mmol/L, hematuria; –
- ultrasound examination of body cavities: signs of profuse bleeding not detected
- X-ray examination of the limbs and skull: no signs of skull bone fractures; radiographs of the extremities - multiple fractures of the bones of both legs and hips with displacement, in the soft tissues, multiple foreign bodies of high density are visualized.

No other laboratory and diagnostic facility was available at our medical institution. The patient is put

on a controlled mode of artificial ventilation (CMV). Intravenous catheterization of both subclavian veins by Seldinger technique done (central venous pressure - negative). Iso- and hypertonic electrolyte solutions plus hydroxyethyl starch solutions were infused in the ratio of 1:2, and later on transfusion of blood components was started. The plan of initial infusion therapy was set at a volume of 30 ml/kg in the first 10 min, then 60 ml/kg/hour with correction of the volume of infusion in hemodynamic response. Other drugs given included inj. dopamine 15 mg/kg/min infusion, etamsylate (a haemostatic drug), tranexamic acid, ceftriaxone, and dexamethasone.

After intensive therapy for one hour, tachycardia was reduced to 120/min, NIBP increased to 80/40 mmHg, central venous pressure - 0 mm H₂O, and pulse oximetry saturation - 92%. There was a continued blood loss from the injured tissues of the limbs despite the correct application of hemostatic tourniquets. Subsequent infusion therapy did not lead to improved hemodynamic parameters, which caused suspected non-motile bleeding that continued. At 11:30 pm, the patient was transported to the operating room. Operative intervention was carried out during 6 hours by brigades of abdominal, vascular surgeons and traumatologists. During the operation, numerous fractured fractures of the legs and thighs, fragmentation of the magistral vessels of the hips, defecation and necrotizing of soft tissues in the lesions, penetrating wounds of the abdominal cavity with trauma of the small intestine and its ripple with non-motile bleeding were revealed. The state of the tissues and vessels of the extremities, and the extent of anatomical damage to these, was assessed for their viability. Subsequently both limbs had to be amputated at the level of the upper third of the thigh. Intestinal damage and injuries were sutured, surgical hemostasis was performed, the abdominal cavity closed with bilateral drains in place. Anesthetic support during surgery was performed under total intravenous anesthesia with mechanical ventilation using diazepam, ketamine, fentanyl, sodium oxide butyrate. For muscle relaxation we used pipecuronium bromide. During the first hour of surgery hemodynamics remained unstable with periods of arterial hypotension up to 70/30 mmHg and tachycardia of up to 130 beats per minute, controlled with increased rate of infusion with the addition of epinephrine and phenylephrine. After surgical hemostasis, hemodynamics were stabilized (NIBP - 110/70 mmHg, HR - 80 beats per min), after which we reduced the rate of infusion and tapered off the vasopressor drugs. SpO₂ remained at 92-98%

during the entire surgical intervention. Total volume of infusion in the peri-operative period (7 hours) was 14300 ml [isotonic saline - 4100 ml, hypertonic saline - 1600 ml, hydroxyethyl starch - 4000 ml, blood components - 4600 ml]. Urine output was 7,200 ml (17.1 ml/kg/h) for 7 hours of treatment. In the early postoperative period of the infusion-transfusion therapy, artificial ventilation and sympathomimetic support, and antibiotic therapy was continued. During the day, the patient made remarkable recovery, so artificial ventilation was stopped. Stability of hemodynamics allowed a reduced amount of fluid therapy, and removal of sympathomimetic drugs. Urine output was 5 ml/kg/h, edema was not observed. On the next day, the patient was transported to a regional multidisciplinary specialist hospital by specialized ambulance service.

DISCUSSION

Explosive injuries are usually of a multiple nature.⁷ In this case, a large amount of tissue damage and significant injuries were due to an explosion in a closed room. Despite the effectiveness of the medical care provided to the victim, it should be noted that the time from the moment of injury to hospitalization should be minimum, since minimizing the transport time directly affects the survival of the victims.⁸ Involvement of additional medical teams and triage allowed to use resources effectively to provide medical care to the victims. In conditions of the serious trauma of extremities and soft tissue fragmentation, the standard method of applying hemostatic tourniquet has not demonstrated its complete effectiveness. In such a case, it is likely to be useful to apply additional methods of temporary stopping of bleeding, such as an adhesive elastic bandage.⁹ This case shows a greater contribution to the hemodynamic recovery in children with severe traumatic shock using fast and large amounts of infusion solutions to replace the lost volume of circulating blood than infusion of sympathomimetic and vasopressor drugs. This effect is reflected even in the routine control of hemodynamic indices in conditions of limited diagnostic resources. On the background of preserved renal function, there were no signs of an inadequate redistribution of fluid between the fluid compartments. This coincides with the data of other authors,^{10,11} which prove the difference in the hemodynamic response to infusions in adults and children: the former group exhibit fluid leak in the intercellular space, while in pediatric patients, the intravascular fluid retention is better with later correction of water balance with the kidneys.

CONCLUSION

Explosive trauma in a closed room shows a higher degree of tissue damage. The effectiveness of the treatment of mass explosive trauma depends upon the nature of organizational measures. In conditions of high trauma of limbs and soft tissues fracture, a properly applied, standard hemostatic tourniquet may not be sufficiently effective, which will require the use of additional methods of temporary stopping of bleeding.

Children with severe traumatic shock should be expected to have a greater positive hemodynamic effect from high-speed large-scale infusion-transfusion therapy than from infusion of sympathomimetics.

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