

Development of Innovative Rod Apparatus for Treatment of Long Bones of the Lower Limb in Multiple and Combined Injuries

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Relevance: Pelvic injuries can be considered one of the most severe types of musculoskeletal trauma, primarily because they are more often than others accompanied by death, long-term disability, and disability [1–4]. The reason for this lies in the anatomical structure of the pelvis and the organs contained in it. The severity of pelvic trauma is determined by severe pain, massive blood loss and traumatic shock [5, 6]. According to summary statistics, disability after a pelvic injury accounts for 3% of the total number of those examined for polytrauma. After conservative treatment, 22–66.7% of victims have permanent disability, which is almost 3 times higher than this figure in operated patients [1, 3, 7–9]. The mortality rate for pelvic injuries is 10–46.3%, and it is especially high in the group of patients with concomitant trauma—up to 50% [1, 4, 9, 10]. Modern achievements in solving this complex multifaceted problem are inextricably linked with issues related to improving diagnostics, tactics, methods and means of surgical treatment of severe pelvic injuries. The use of highly informative radiation methods in recent decades, in particular computed tomography, in the diagnosis of pelvic fractures has made it possible to reduce the proportion of diagnostic errors before the introduction into practice of unified scales for assessing the severity of the patient's condition, tactical schemes of treatment and diagnostic measures, according to which treatment measures for pelvic fractures belong to the priority category. The improvement of treatment results was greatly facilitated by understanding the effect of early external fixation of unstable pelvic fractures. Today, most experts recognize that fixation has an anti-shock effect, provides prevention of hypostatic complications and a good functional result [4, 5, 7, 8]. Urgent fixation of unstable pelvic ring injuries with simple devices is included in the algorithm for the treatment of severe injuries - ATLS (Advanced Trauma Life Support) [9].

Keywords: polytrauma, central circulation, infusion therapy, fixation.

Purpose of the study. To develop an algorithm for predicting the course of TB and treating patients with severe injuries, assessing the effectiveness of its use;

Study design and treatment of patients with multiple injuries

On the basis of the Department of Traumatology, Orthopedics and Primary Care of the Multidisciplinary Clinic of the Tashkent Medical Academy, the Department of Emergency Traumatology provided surgical and conservative treatment to 226 patients with fractures of long bones due to multiple and combined injuries.

The victims were divided into 2 groups: the main and control groups. The main group consisted of 112 (49.6%) patients who underwent early osteosynthesis of multiple fractures of the long bones of the lower extremities in the acute and early periods of TB from the moment of injury: of these, 72 (64.3%) underwent early osteosynthesis in the acute period of TB patient, early delayed osteosynthesis was performed in 26 (23.2%) patients in the early period of TB. In 14 (12.5%) patients, osteosynthesis of multiple fractures of the lower extremities was performed at a later stage of TB. The reason for this was severe trauma and unstable hemodynamics, as well as concomitant somatic diseases. Surgical interventions were performed only for vital indications for damage to internal organs.

The control group consisted of 114 (50.4%) patients who underwent osteosynthesis of multiple fractures of the long bones of the lower extremities, mainly in the second period of TB in a delayed or planned manner, that is, after surgical intervention on damaged internal organs.

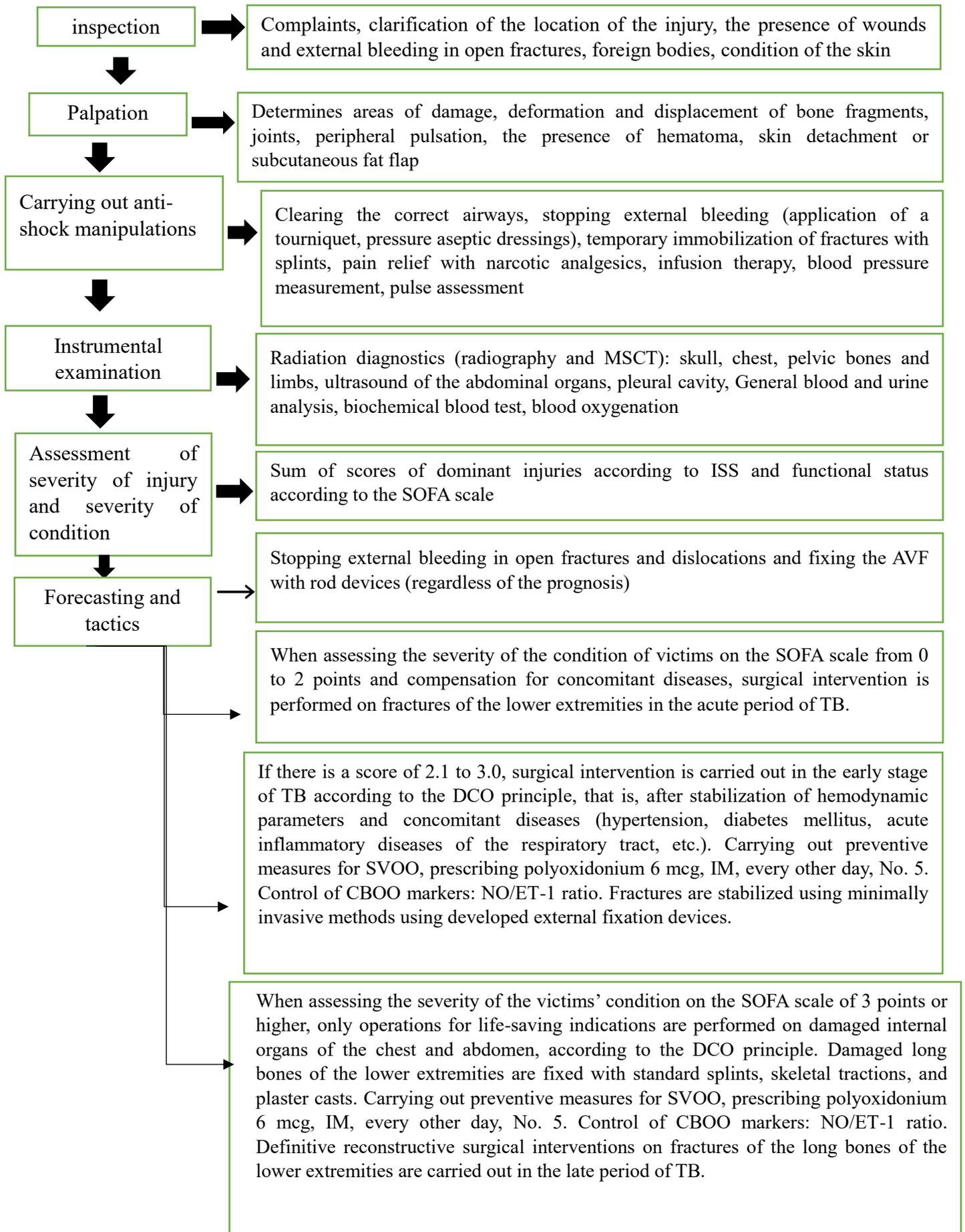
The criterion for the distribution of patients according to the severity of injury and dominant injuries was assessed using the IIS scale. After identifying the quantitative boundaries of the ISS of victims, the average value of severity scores in the studied patients was determined. Thus, the average value of ISS scores in victims with injuries of moderate severity was 17.3 ± 0.9 points; severe – 22.6 ± 1.1 and extremely severe – 29.6 ± 2.8 points.

According to the severity of injury, patients were distributed as follows: on the ISS scale 29.6 ± 2.8 points - in 24 (10.6%) patients, in 66 (29.2%) patients the severity of injury was assessed at $22.6 \pm 1, 1$ points and in 136 (60.1%) patients it was estimated at 17.3 ± 0.9 points. It should be noted that in 90 (39.8%) patients the severity of the injury was assessed as severe and extremely severe.

Research result. After patients with combined and multiple injuries are admitted to the shock ward of the emergency room, while complaints are clarified (if the patient is conscious), blood pressure is measured, infusion therapy is started to inflame the central circulation, and physical examination methods are performed: the area of damage is determined, the presence of deformation and external bleeding, the presence of foreign bodies, then the deformation and mixing of bone fragments is assessed, pulsation in the peripheral vessels is determined, the local temperature of the skin is assessed, the degree of soft tissue damage during detachment of the skin-subcutaneous fat flap in the presence of wounds. If necessary, the upper respiratory tract is cleaned, a tourniquet or a pressure aseptic bandage is applied to stop the bleeding, pain relief is performed with narcotic analgesics and after immobilization of the injured limbs with standard splints, an X-ray of the head, cervical vertebrae, chest, pelvic bones and injured limbs is performed, an ultrasound scan of the abdominal and pleural cavity. In the shock ward of the patient, a traumatologist, a neurosurgeon, a surgeon and a resuscitator jointly conduct a joint examination and determine the tactics for introducing the victim. After relative stabilization of hemodynamics, the patient is transported to the intensive care unit. In the intensive care unit, continuing anti-shock measures, according to indications, a subclavian catheter is inserted and CVP is measured and, in order to control diuresis, a urinary catheter is inserted into the bladder. After stabilization of hemodynamics and if necessary, MSCT of the skull, chest, spine, pelvic bones and injured limbs is performed. A general blood and urine test and blood biochemistry are performed: bilirubin fractions, ALT, AST, urea and creatinine. According to radiological diagnostics (X-ray, MSCT, ultrasound) and clinical analysis data, dominant injuries are identified in order to clarify the patient's life-threatening injuries and surgical tactics based on a dynamic prognosis. The algorithm for diagnostic and treatment tactics for patients with multiple injuries is presented in Fig. 5.1.

After hemodynamic stabilization, the severity of the injury is assessed using the ISS scale and the severity of the condition using the SOFA scale. Next, the forecast is determined taking into account the score. Regardless of the prognosis for external bleeding on open fractures and dislocations. The AVF is fixed with rod devices. When assessing the severity of the condition of victims on the SOFA scale from 0 to 2 points and compensation for concomitant diseases, osteosynthesis was performed on fractures of the lower extremities in the acute period of TB.

If there is a score of 2.1 to 3.0, surgical intervention is carried out in the early stage of TB, taking into account the DCO principle, that is, after stabilization of hemodynamic parameters and concomitant diseases (hypertension, diabetes mellitus, acute inflammatory diseases of the respiratory tract, etc.). Carrying out preventive measures for SVOO, prescribing polyoxidonium 6 mcg, IM, every other day, No. 5. Monitoring SVOO markers: NO/ET-1 ratio. Stabilization of fractures is carried out using minimally invasive methods using developed external fixation devices.



Rice. 5.1. Algorithm of diagnostic and treatment tactics patients with multiple injuries

Polyoxidonium 6 mcg, IM, every other day, No. 5. Control of CBOO markers: NO/ET-1 ratio. Definitive reconstructive surgical interventions on fractures of the long bones of the lower extremities are carried out in the late period of TB.

Thus, based on the presented algorithm, diagnostic and treatment tactics were carried out in 156 (69%) patients combined and multiple injuries in 70 (31%) patients with fractures of the long bones of the lower extremities. Of the 226 patients, fractures of the long bones of the lower extremities were combined with traumatic brain injury in 55.3%, chest trauma (rib fractures, pneumo-, hemothorax) was 15%, pelvic bone fractures were 15%, and forearm fractures were 11.9%, abdominal trauma (contusion of abdominal organs, damage to the liver, spleen, damage to the intestinal wall, intestinal mesentery) - 11.5%, fracture of the spine - 8.8%, fracture of the humerus - 6.2%, fracture of the heel bones - 2.65%, fracture of the patella - 0.88%, damage to the great vessels and peripheral nerves of the upper extremities, 0.44% each, respectively.

Dominant limb injury was diagnosed in 26 (12.4%) victims.

The choice and tactics of osteosynthesis of fractures of long bones of the lower extremities were determined using the ISS injury severity scale. Basically, osteosynthesis of fractures of long bones was carried out using developed rod devices for single injuries, the purpose of which was to prevent complications and early activation victims, especially the elderly. The timing of the surgical intervention depended on the severity of the condition of the victims, which was assessed using the SOFA scale and, based on data from SVOO markers, was determined to predict the development of purulent-infectious complications by determining the concentration of ET-1 and NO and their ratios in the patient's blood serum. In addition, the degree and course of shock and concomitant illnesses were taken into account.

Conducting surgical interventions is an important anti-shock factor, however, the wrong choice and tactics must not be forgotten, and untimely implementation can aggravate the patient's condition. Only a comprehensive assessment of the severity of the injury and the severity of the patient's condition will determine the golden time for surgical interventions on fractures of the long bones of the lower extremities.

When the condition of the victims was stable or conditionally stable, on the ISS scale <17 points (shock I - II degree) and the severity of the condition of the victims was assessed on the SOFA scale from 0 to 2 points and compensation for concomitant diseases, submersible, BIOS, intra- and extramedullary osteosynthesis, ANF with a rod or Ilizarov apparatus and was performed in the acute period of TB.

In a compensated state and on the injury severity scale ISS -17-25 points and in the presence of a SOFA scale from 2.1 to 3.0 points, after resuscitation measures and infusion therapy, taking into account the principles of "Damage control orthopedics", the damaged limbs were temporarily fixed in plaster bandages or skeletal traction and after relative stabilization of hemodynamics, minimally invasive surgical interventions were performed using developed rod devices, BIOS, intramedullary pin, Ilizarov apparatus or wires. Also, osteosynthesis of damaged limbs depended on the nature of the fractures, the severity of the injury and the severity of the patients' condition and was carried out in acute and early periods of TB.

In a decompensated state (ISS <26 points, stage III-IV shock), on the SOFA scale - 3 points or higher, taking into account the principles of "Damage control orthopedics", the injured limbs were fixed with plaster casts. Osteosynthesis of damaged limbs was performed in the late period of TB, in the absence of purulent-infectious complications.

Osteosynthesis of fractures of long bones of the lower extremities must adhere to the following requirements: be able to stabilize fractures in a short time with low traumatic features, especially with

extensive damage to the great vessels of the extremities; the possibility of stable fixation with the elimination of vascular ischemia that occurs after bone fractures.

The choice of surgical methods for treating fractures in the acute and early stages of TB was determined by the severity of the injury of the victims, its location and the nature of the fractures, and preference was given to the newly designed rod devices developed by ANF. Indications for the use of the developed external fixation rod apparatus 1 and 2 models:

- open bone fractures of the long bones of the lower extremities;
- diaphyseal fractures;
- fractures of the proximal end of the femur type A and B;
- for the purpose of early stabilization of fractures, as an anti-shock measure;
- to facilitate patient care and early activation and rehabilitation;
- Reduces the possibility of developing various hypostatic complications.

Conclusions. Traditional methods of treating fractures were used in a delayed or planned manner. With an assessment of the severity of the injury and the severity of the condition of the victims in the dynamics of the acute and subacute periods of TB and on the indicators of hemodynamic stability of patients with dominant injuries with combined injuries, osteosynthesis of fractures of the long bones of the lower extremities was performed after surgical interventions on the dominant injuries of the internal organs of the chest, abdominal organs and skulls. The motivation for performing osteosynthesis of fractures of the lower extremities in the acute and early stages of TB was: to reduce pain on the injured limbs, to prevent ARDS, fatty and thromboembolism, infectious complications and the frequency of deaths arising from TB, to facilitate care for seriously ill patients, and to improve the quality of life casualties and a reduction in bed days.

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