Tactics of Treatment of Fractures of Tubular Bones

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ABSTRACT

The growth of traffic flows, industry, as well as changes in the socio-spiritual life of society lead to an increase in the frequency and severity of injuries.
In this article highlights tactics of treatment of fractures of tubular bones.

Keywords: medicine, tactics of treatment, tubular bones, anatomy of human, injury, patient.

Bone regeneration represents a complex process, of which basic biologic principles have been evolutionarily conserved over a broad range of different species. Bone represents one of few tissues that can heal without forming a fibrous scar and, as such, resembles a unique form of tissue regeneration. Despite a tremendous improvement in surgical techniques in the past decades, impaired bone regeneration including non-unions still affect a significant number of patients with fractures. As impaired bone regeneration is associated with high socio-economic implications, it is an essential clinical need to gain a full understanding of the pathophysiology and identify novel treatment approaches.

To date, injury, both intentional and unintentional, accounts for 9% of all causes of death in the 53 member States of the WHO European Region. Every year, about 800,000 people lose their lives as a result of trauma and violence. In many ways, the danger of severe and even fatal complications is due to simultaneous damage to several areas of the body with combined injuries of the extremities and various segments of the musculoskeletal system (SMS) with multiple injuries, a variety of their combinations in localization, nature and severity. These circumstances determine the maximum labor intensity, complexity, and high cost of providing medical care and treatment to this contingent of victims. A feature of severe combined and multiple limb injuries is the high incidence of complications of traumatic disease (TD), high mortality, long duration of inpatient treatment and subsequent rehabilitation, high proportion of unsatisfactory anatomical and functional results, high disability

Increasingly, they acquire multiple and combined character and the term polytrauma is used to denote two types of injuries - multiple and combined injuries. One of the most severe and most frequent injuries of the musculoskeletal system are fractures of long tubular bones, which occur in 90.5- 100% of patients with multiple and in 62.0-78.9% of patients with combined trauma.

Currently, despite the significant success of injury surgery, the mortality rate of polytrauma victims, the vast majority of whom have fractures of long tubular bones, ranges from 3.8 to 45.3%. The level of disability varies

from 10.3% to 43.4% depending on the duration of follow-up, the treatment methods used and the structure of patients. One of the main reasons for the unsatisfactory outcomes of treatment of victims with polytrauma are tactical and technical errors due to insufficient knowledge of the course and healing of injuries in the context of the development of traumatic disease. Traditionally, until recently, conservative methods prevailed in the treatment of fractures of long tubular bones in patients with polytrauma in domestic traumatology.

Early osteosynthesis of fractures of long tubular bones and pelvis has become a fundamental achievement in the treatment of combined and multiple injuries. It formed the basis of a new strategy - the strategy of orthopedic or surgical resuscitation, which is based on the concept of traumatic illness.

However, if the main direction of surgical treatment of polytrauma victims becomes clearer, then there are a wide variety of views on the choice of injuries to be primarily stabilized, the time and method of osteosynthesis of fractures of long tubular bones. These issues are especially relevant in the acute period of traumatic illness. If almost any methods of fracture treatment can be used in a delayed and planned manner, then urgently most domestic authors and some foreign ones prefer transosseous osteosynthesis.

In the choice of therapeutic tactics in patients with fractures of long tubular bones in the acute and early periods of traumatic illness, both unjustified radicalism, leading to an increase in mortality, and refusal of surgery, fraught with a real threat of severe complications, are dangerous. Therefore, an objective quantitative assessment of the severity of injuries and the severity of the condition of the victims is of great importance for the successful treatment of patients with polytrauma, which would make it easier to choose the right treatment tactics.

Recognizing all the positive things that have been achieved in the treatment of fractures of long tubular bones in patients with polytrauma, it should be said that there are no algorithms for surgical tactics depending on the general condition of patients and the nature of limb damage in the acute and early periods of traumatic illness. Injuries of the musculoskeletal system have not been identified, the stabilization of which must be performed urgently, there are no clear criteria for performing operations of delayed osteosynthesis, there is no differentiated approach to methods of fixing fractures of long tubular bones.

Thus, to date, the literature has not sufficiently covered the issues of choosing the order, time, methods and stages of osteosynthesis of fractures of long tubular bones in the acute period of traumatic illness, depending on the general condition of patients with polytrauma, the nature of the fracture itself.

In the prospective group of victims, on the one hand, modern principles of treatment of severe multiple injuries were used, on the other hand, the functional orientation of surgical treatment of fractures of long tubular bones. The combination of these two treatment directions turned out to be possible with the use of three new technologies. Objectification of therapeutic tactics. Currently, there are several methods of objectification of therapeutic tactics.

The study used a method for determining therapeutic tactics based on the prognosis of the outcome of treatment. The victims with a favorable prognosis (115 patients) had no life-threatening consequences of injury, traumatic shock, and all vital functions were in a state of compensation. All the victims of this group underwent surgical treatment of bone fractures in the 1st period of TD. The victims with a positive prognosis (75) appeared to be a more severe group, with a severe component of multiple trauma. 14 (18.7%) of them were diagnosed with traumatic shock. Some of their vital functions were impaired, needed intensive correction, and in general their condition was regarded as subcompensated.

At the same time, 16 patients with the best indicators of the severity of the condition for this group at admission (HPV-SP = 21-26 points) underwent the full volume of surgery on the upper extremities in the 1st period of TB. The remaining 31 patients (VPX-SP = 27-31 points)

underwent surgical treatment according to the tactics of ZMHL. The most severe group consisted of victims with an unfavorable prognosis (38). They arrived in a state of traumatic shock. Their condition required resuscitation measures to restore vital functions, so it was generally assessed as decompensated.

Outcomes and complication rates following the treatment of long-bone fractures are not well established and depend on multiple factors such as fracture type, patient comorbidities, and surgical approach. A better understanding of the utilization of surgical treatment method by fracture anatomy and patient presentation would be helpful to benchmark current patterns of care for healthcare payers, clinicians, manufacturers, and patients. This study used administrative claims data to evaluate the treatment patterns for long bone fractures (i.e., fractures of the femur, tibia and humerus); and to determine the factors contributing to the use of IMN versus other internal fixation devices.

As a first consequence of fracture and vascular disruption, bone marrow and vascular leakage create a local hematoma containing bone and immune cells. The formation of the fracture hematoma is essential for adequate bone healing, as it is characterized by high osteogenic potency. This characteristic is mainly attributed to cells first described in the 1962 as unspecialized osteoprogenitor cells, nowadays known as mesenchymal stem cells (MSC). They possess osteogenic, chondrogenic and adipogenic differentiation potential. Additional cells found abundantly in the fracture hematoma include platelets and macrophages. Of note, particular cytokines which activate the clotting cascade in the fracture hematoma also activate local phagocytic effector cells such as macrophages which remove bone and tissue debris at the fracture site. Although temporary, local hypoxia causes bone and soft tissue necrosis at the fracture site, cytokine release and migration of pro-inflammatory immune cells. This creates an inflammatory environment that is characterized by increased local blood flow and vascular permeability, promoting further influx of pro-inflammatory cells and increased cytokine production.

As new technologies are developed and, in several cases, have revolutionized whole industries, the field of medicine is no exception. Huge progress has been made in the field of tissue engineering. One the one hand, advances in biology allow the production of bioinspired tissue which resembles the properties of native tissue. On the other hand, modern technologies such as 3D printing enable scientists to produce customized implants with high structural complexity on the nanoscopic level. In the case of non-unions with impaired local biology combined with the challenging tissue characteristics of bone and the often-large defects, patients could profit tremendously from these novel approaches, and current expectations are high. Up to now, 3D printed scaffolds are used in orthopedic trauma surgery to improve pre-operative planning with personalized anatomic models, and to overcome complex anatomic differences or defects which cannot be met with conventional implants. 3D printed implants are successfully used in maxillofacial and pelvic reconstructive surgery, however, currently used implants have no or only limited biologic activity. This is surprising, as 3D printed scaffolds were experimentally shown to be able to exert osteoconductive effects. Therefore, future research will focus on how to enhance the biologic activity of these implants by adding osteoinductive and osteogenic properties by integration of growth factors or stem cells. Furthermore, their function as a vehicle for drug delivery must be addressed.

The main principle of treatment of patients with polytrauma is early recovery of damage. Open fractures of long tubular bones, closed hip fractures and fractures of the shoulder and collarbone in combination with thoracic trauma are injuries that are subject to priority surgical stabilization as a matter of urgency.

In the acute period of polytrauma, internal osteosynthesis is the method of choice for closed fractures and stable condition of patients. In open fractures and unstable condition of

patients, transosseous osteosynthesis is the method of choice.

The remaining fractures can be stabilized in a delayed manner and the criterion for the possibility of delayed osteosynthesis is to reduce the number of points to 50-60 on the APACHE III scale.

Surgical treatment should begin with a dominant lesion. In the presence of two or more such injuries, simultaneous operations are shown. The necessary conditions for early recovery of injuries in patients with polytrauma are adequate anesthesiological support and high-quality replenishment of blood loss.

The proposed tactics for the treatment of fractures of long tubular bones in patients with polytrauma allowed to reduce mortality by 11.8%, reduce the index of complications by 0.52, reduce the duration of inpatient treatment by 12 days and obtain positive functional results in 93.4% of cases.

Practical recommendations

1. Treatment of patients with fractures of long tubular bones in polytrauma should be carried out in specialized hospitals from the standpoint of the concept of traumatic disease, which provides for early recovery of damage. It is advisable to identify fractures that are subject to urgent and delayed surgical stabilization. With the compensated condition of patients (0-1-2 degree shock), surgical interventions on fractures of long tubular bones can be performed in full. In case of decompensated condition of patients (shock of 3-4 degrees), only emergency operations are performed to a minimum extent.

2. The criterion for the possibility of delayed operations on fractures of long tubular bones in polytrauma can be a decrease in the number of points on the APACHE III scale to 50-60 with a dynamic assessment of the condition of patients.

3. The possibilities of early recovery of polytrauma injuries can be expanded through simultaneous operations and the use of intraoperative hardware autohemotransfusion in the complex treatment of blood loss.

Despite tremendous scientific and clinical effort, impaired bone healing still represents a complex and challenging complication following a fracture. A detailed case history, state-of-the-art diagnostics, and individualized treatment concepts are crucial for optimal patient outcome. Scientific advances in deeper understanding the molecular processes governing fracture healing have resulted in the identification of key mediators which can potentially be targeted to promote bone regeneration. The improvement of currently available bone substitute materials and the development of innovative biomaterials have significantly contributed to expand available treatment options. Therefore, further research and identification of novel therapeutic approaches with adequate safety profiles fulfills an essential clinical need, to promote bone regeneration and restore bone defects in patients suffering from non-unions.

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