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RETROSPECTIVE ANALYSIS OF TREATMENT OUTCOMES IN POLYTRAUMA PATIENTS WITH MULTIPLE LONG BONE FRACTURES OF LOWER EXTREMITIES

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Abstract

The aim: to conduct retrospective analysis of treatment outcomes in polytrauma patients with multiple long bone fractures of lower extremities.

Materials and methods: retrospective study of treatment results in patients hospitalized to the polytrauma department of Kyiv City Clinical Hospital №17 from January 2013 to December 2016.

Results: among patients with polytrauma and multiple long bone fractures of lower extremities, males dominated (67.9%) and the main cause of injury was a road accident (73.3%). The most common localizations of injuries were chest trauma (82.4%), traumatic brain injury (74.8%). The severity of injury was 29.2 ± 10.5 points according to the Injury Severity Score (ISS), degree of consciousness disorders was 9.1 ± 3.3 points in conformity with Glasgow Coma Scale (GCS). Patients developed complications, including nosocomial pneumonia (40.5%), acute respiratory distress syndrome (ARDS) (19.1%) and fat embolism syndrome (10.7%), as well as sepsis (28.2%) and multiple organ failure (MOF) (16.0%). Mortality rate was 24.4%.

Conclusion: It was found that among patients with polytrauma and multiple long bone fractures of lower extremities males dominated on the basis of gender, the main cause of injury was a road accident. The most common localizations of injuries were chest trauma and traumatic brain injury. Among controversial issues of treatment and diagnostic process are low frequency of pelvic binder application, ultrasound according to focused assessment with sonography for trauma (FAST) protocol and whole body multispiral computed tomography (WBMCT), which should be performed in 100.0% of patients with high-energy trauma at the time of admission to the hospital. In addition, frequency of Early Total Care (ETC) tactics application was too low, and definitive osteosynthesis in some cases was performed unreasonably late, using conservative fixation methods, which is a cause of complications and treatment prolongation in patients with polytrauma.

The most common complications were pulmonary: nosocomial pneumonia, ARDS and fat embolism syndrome. Mortality rate was 24.4%.

Keywords: polytrauma; long bone fractures; definitive osteosynthesis; complication; outcomes

Introduction

Severe trauma is one of the leading causes of death among young people. In addition to fatal outcome, patients with polytrauma have damage of several organs and systems that cause disability in far terms. Due to significant achievement in emergency medicine, anesthesiology, surgery, traumatology and other specialties, the frequency of adverse treatment outcomes, in particular development of complications, including fat embolism syndrome, pulmonary embolism, nosocomial pneumonia, acute respiratory distress syndrome, multiple organ failure, remains high.

Discussion issue in orthopedics and traumatology is a choice of treatment tactics, in particular methods of fracture fixation and surgical intervention timing in patients with severe associated trauma, and it requires further research.

The aim of the research. To conduct a retrospective analysis of treatment outcomes in polytrauma patients with multiple long bone fractures of lower extremities.

Materials and methods

Study design: retrospective study of treatment outcomes in patients hospitalized to the polytrauma department of Kyiv City Clinical Hospital №17 (KCCH No17) from January 2013 to December 2016.

Inclusion criteria: patients hospitalized to the polytrauma department of KCCH No17 with polytrauma; patient age ≥ 18 years; presence of open, closed multiple long bone fractures of lower extremities (2 or more segments), one of which is femur; severity of injury according to the Injury Severity Score (ISS) ≥ 18 points.

Exclusion criteria: absence of medical documentation at the time of the study, and information about full assessment of treatment outcomes.

Injury severity of separate localizations was assessed by the Abbreviated Injury Scale (AIS) [1]. According to the anatomical criterion, severity of injury was assessed by the ISS [2] and the New Injury Severity Score (NISS) [3]. The extent of impaired consciousness was determined by the Glasgow Coma Scale (GCS) [4]. Severe, life-threatening injury was defined as 4 or more points in concordance with the AIS, and severity of the patient's general condition was determined by the Clinical Grading System (CGS) criteria [5].

Endpoints: treatment outcomes were evaluated by "endpoints", including frequency of complications, such as: nosocomial pneumonia, acute respiratory distress syndrome (ARDS), fat embolism syndrome, sepsis, pulmonary embolism, multiple organ failure (MOF), as well as duration of mechanical ventilation (MV); length of stay (LOS) in intensive care unit (ICU), hospital length of stay (HLOS) and mortality.

Pneumonia was diagnosed according to the criteria of the Clinical Pulmonary Infection Score (CPIS) ≥ 6 points [6]. ARDS was diagnosed in accordance with the "Berlin Definition" from 2012 [7]. Fat embolism syndrome was diagnosed in compliance with the Gurd and Wilson's scale. The diagnosis of sepsis was defined according to the criteria "Sepsis II" from 2001 [9] and "Sepsis-III" from 2016 [10]. The diagnosis of "non-fatal pulmonary embolism" was defined by the results of angiopulmonography. MOF was diagnosed on the basis of the Sepsis-related Organ Failure Assessment (SOFA) scale [11].

Statistics. The normality distribution was checked using the Shapiro-Wilk test. Under normal distribution, the data is presented as mean, standard deviation \pm (SD). Statistically significant differences were considered if $p < 0.05$.

Results and discussion. Retrospective treatment analysis of patients with associated trauma and multiple long bone fractures of lower extremities received inpatient treatment in KCCH No17 from January 2013 to December 2016, was conducted to assess the choice of treatment tactics, timing and stabilization methods of multiple long bone fractures of lower extremities, frequency of complication development and mortality.

Among 163 patients diagnosed with polytrauma and multiple long bone fractures of lower extremities, 32 patients were excluded from the study because of absence of medical documentation and/or absence of information about full assessment of injury characteristics, choice of tactics, and treatment outcomes.

The study included 131 patients. The average patient age was 41.5 ± 16.8 (from 18 to 81 years). According to the gender, males dominated 67.9% (89 men). The presented data are ambivalent with literature data [12, 13].

The dominant cause of severe associated damages was road accidents - 96 (73.3%). This category included patients injured in an accident as car drivers 25 (26.0%) or passengers 13 (13.5%), as motorcycle drivers or passengers 30 (31.3%), cyclists 5 (5.2%), and pedestrians 23 (24.0%). Catastra was the cause of injuries in 26 patients (19.8%) fell from a height of 3 to 36 meters. The "others" category included 9 patients injured for various reasons and circumstances. Taking into consideration that proportion of these mechanisms of injury was low (6.9%), they were included in the "others" category.

According to the literature, the most often injuries and the main causes of death in patients with severe trauma are traumatic brain injury [14] and chest trauma [15].

In conformity with inpatient cards, dominant injury localizations were chest trauma in 108 patients (82.4%) and traumatic brain injury in 98 patients (74.8%).

Severe traumatic brain injury was diagnosed in 29 patients (21.1%), severe chest trauma was diagnosed in 55 patients (42.0%), abdominal and internal organ injuries in 20 patients (15.3%), musculoskeletal injuries in 14 patients (10.7%).

According to the analysis, the average duration from injury to patient hospitalization was 39.8 ± 15.8 minutes. Too high duration of patient delivery to hospital after an injury is due to problems with evacuation from location of events.

At the time of hospitalization, 34.4% of patients had signs of shock (systolic blood pressure (sBP) < 90.0 mm Hg), and average sBP was 98.9 ± 46.4 mm Hg. 13 patients (9.9%) with arterial hypotension (sBP ≤ 90 mm Hg) required vasopressor support and 7 patients (5.3%) required cardiopulmonary resuscitation.

In addition, significant tachycardia of 113.6 ± 47.2 beats / min was noticed. Algover's index at the time of patient admission to the polytrauma department was 1.2 ± 0.6 , indicating on deficit of circulating blood volume (CBV) of the second degree, and blood loss in the range of 20-25% (about 1.0-1, 2 l). At the same time, blood loss volume according to drug cards was 3.7 ± 1.5 liters, so we can conclude that the Algover index cannot accurately estimate blood loss volume in patients with multiple long bone fractures of lower extremities with severe associated trauma, which, in our opinion, depends on a number of factors, including arterial hypo / hypertension, brady / tachycardia, activation of human compensatory mechanisms due to severe trauma.

Early accurate assessment of injury severity and general clinical condition of a patient with polytrauma is crucial for the choice of further treatment tactics [13].

According to inpatient cards, injury severity according to the ISS scale was 29.2 ± 10.5 points. Injury severity according to the NISS scale, in contradistinction to the ISS scale, estimates three severest injuries regardless of localization, was 36.5 ± 12.4 points. The reason for high injury severity rates by the NISS scale was damage to several organs in one cavity (ruptures of liver, spleen, kidneys, intestines or ruptures of both lungs, heart contusion with multiple rib fractures).

Impairment of consciousness occurred in the majority of patients hospitalized to the polytrauma department 101 (77.1%). The degree of consciousness disorders according to GCS was 9.1 ± 3.3 points at the time of hospitalization.

According to general condition severity, patients included in the study were divided: satisfactory condition 9 (6.9%), moderate 23 (17.6%), severe 53 (40.5%) and extremely severe 46 (35.1%).

We were unable to perform adequate assessment of general patient condition severity according to the CGS, as notes that could confirm assessment of patient condition severity by the CGS in inpatient cards in most cases had been missing, as well as some indicators of instrumental, laboratory and clinical examinations by 4 parameters (shock, acidosis, coagulation and soft tissue injuries).

Ultrasound examination according to the focused assessment with sonography for trauma (FAST) protocol was performed in 94 patients (71.8%), among them 38 patients (40.4%) were with positive FAST protocol.

Multispiral computed tomography of separate localizations was performed in 89 patients (71.8%), among them primary whole body multispiral computed tomography (WBMCT) was performed in 31 patients (34.8%), composed only 23.7% of the total number of patients.

Body temperature monitoring is one of important issue of diagnostic and treatment tactics in patients with severe trauma, as one of the components of the "death triad". Registration of body temperature at the time of hospitalization was performed in 26 patients (10.7%).

Among the patients included in the study, pelvic ring injuries were diagnosed in 27 patients (20.6%). Information on application of pelvic binder is available only in 4 inpatients cards (3.1%), although according to international protocols, the pelvic binder should be applied to all victims of high-energy trauma, regardless of the mechanism of injury, clinical presence or absence of pelvic fractures [16].

In patients with severe associated trauma, priority tasks in care are to avoid massive bleeding and control hemostasis. In addition to blood loss from internal organs of abdominal and thoracic cavities, there is also blood loss due to pelvis and limb bone damage. At the time of hospitalization, 3 patients (2.3%) were admitted to the polytrauma department with hemostatic tourniquet applied to limb because of arterial bleeding.

According to the study conditions, patients had fractures of two or more segments. The total number of multiple long bone fractures of lower extremities was 286, of which 151 fractures of femur (52.8%) and 135 (47.2%) fractures of tibia.

Fractures of two segments of lower extremities predominated in the majority of patients (111 (84.7%)), but there were patients with fractures of three (16 (12.2%) and four long bones) (4 (3.1%)). By fracture location according to anatomical bone region, fractures of diaphyseal region were dominated - 202 (70.6%).

One third of fractures by the criterion of skin integrity damage was open - 91 (31.8%). Given that III degree fractures by the classification of Gustilo-Anderson due to vascular disorders and massive soft tissue damage delay the definitive osteosynthesis, but the study was retrospective due to the fact that degree of open fracture was assessed only by notes in medical documentation, without specified classification, patients with open fractures \geq III degree were excluded from the study.

The choice of treatment tactics, in particular the method of long bone fractures of lower extremities fixation and the term of its implementation in patients with polytrauma is debatable issue, because different treatment tactics application often differs between trauma centers [17, 18, 19].

The question about criteria for particular tactic application is controversial. Using the Early Total Care (ETC) tactic, the definitive osteosynthesis of all fractures is performed, but when the Damage Control Orthopedics (DCO) tactic is chosen, temporary fracture stabilization is provided with subsequent replacement of the fixation method [18].

According to the analysis, ETC tactics were used only in 2 patients (1.5%). Other patients were treated according to the tactics of DCO - 129 (98.5%).

Stabilization of multiple long bone fractures of lower extremities was provided by operative and non-operative method. In treatment of 62 fractures (21.7%) conservative fixation methods were used, including primary temporary immobilization with casts, permanent skeletal traction, without further replacement of the method by definitive osteosynthesis.

Surgical stabilization, including osteosynthesis by external fixation (ExFix) and open reduction internal fixation (ORIF) or nailing, were used in treatment of 224 fractures (78.3%), of which 37 (16.5%) without replacement of fixation method, in 187 cases (83.5%) conversion was performed.

Stabilization of fractures with ExFix as primary and definitive fixation, without further method replacement was used in treatment of 29 fractures (12.9%).

Among 224 long bone fractures of lower extremities, stabilized surgically, only in 8 cases it was performed primary definitive osteosynthesis, which is 2.8% of the total number of fractures, among them in 4 cases ETC tactics was applied.

187 fractures were treated in several stages using two fixation methods - primary temporary and definitive osteosynthesis. Initially, 59 fractures (26.3%) were stabilized by splints and casts, 128 fractures (57.1%) by ExFix.

Among 131 patients included in the study, a single-stage replacement of the fixation method of all long bone fractures of lower extremity from temporary to definitive was performed in only 27 patients (20.6%).

The term of fixation method conversion of long bone fractures is also a debatable issue. According to research, safe time to perform the definitive osteosynthesis of long bone fractures of lower extremities is the "window of opportunity" from 5th to 10th days. Definitive osteosynthesis performed during the period from 2th to 5th days after injury is the cause of complications and death of a patient [20, 21].

According to other scientists, the definitive osteosynthesis performed during the period from 2th to 5th days is safe for a patient and does not affect or even reduce frequency of complications, shorten the duration of MV, LOS ICU, HLOS [22].

The average time from the date of injury to the replacement of fracture fixation method for definitive osteosynthesis was 11.4 ± 6.7 days.

Regarding the choice of the method of definitive osteosynthesis, nailing was more often used in 139 cases (71.3%), compared to plate fixation 56 (28.7%).

The diagnosis of pulmonary embolism, according to the analysis, took place in 7 patients (5.3%). However, given that the diagnosis of non-fatal pulmonary embolism was established on the basis of angiopulmonography, so real frequency of pulmonary embolism in patients included in the group of retrospective studies may be higher.

According to inpatient cards, in the final diagnoses the wording "fat embolism syndrome" was not reflected, instead, the diagnosis of fat embolism was in 14 patients 10.7%. In addition, it was not possible to estimate accurately the number of patients with fat embolism based on the Gurd and Wilson's criteria, primarily due to the presence of PaO₂ in arterial blood not in all medical cards.

Among common complications in patients with polytrauma and multiple long bone fractures of lower extremities, there are pulmonary, among which pneumonia occupies a leading place. According to the literature, the incidence of pneumonia in this category of patients ranges from 18.1% to 50.0% [23, 24, 25].

According to inpatient cards, nosocomial pneumonia was diagnosed in 53 patients by the CPIS (40.5%).

ARDS, as the most severe form of respiratory failure, was registered in 25 patients (19.1%).

According to results of the retrospective analysis, incidence of sepsis was 28.2% (37 cases). However, given that the study included patients hospitalized from 2010 to 2016 and

the diagnosis was defined on the basis of criteria for determining "Sepsis II", so assessment of incidence of sepsis was performed according to the "Sepsis III". Among 37 patients diagnosed with sepsis based on the "Sepsis II" criteria, according to the "Sepsis III" differentiation criteria, among patients of the retrospective group according to laboratory criteria, in available medical documentation, we had the opportunity to assess only 33 patients, including sepsis diagnosed in 14 (37.8%), which is 10.7% of the total number of patients. In 4 inpatient cards there was no assessment by the SOFA scale or information for its calculation, in particular PaO₂, to determine the respiratory index.

The incidence of MOF among patients included in the study according to medical documentation was 16.0% (21 cases).

According to the literature, in this category of patients sepsis is diagnosed from 14.6% to 21.6% of cases, MOF from 12.0% to 40.2% [24, 25, 26].

The duration of MV according to inpatient cards was 17.8 ± 11.2 days. The LOS ICU among patients included in the study was 25.3 ± 15.7 days and the HLOS was 47.2 ± 23.8 days.

According to the literature, mortality among patients with polytrauma and multiple long bone fractures of lower extremities ranges from 16.9% to 35.5% [24, 25, 26, 27].

Mortality among patients included in the study was 24.4%. Among the main causes of death - hemorrhagic shock in 17 patients (53.1%), the development of MOF in 10 patients (31.3%), refractory septic shock - 5 (15.6%).

Conclusions

1. Among patients with polytrauma and multiple long bone fractures of lower extremities males dominated by gender (67.9%) and the main cause of injury was a road accident (73.3%). The most common localizations of injuries were chest trauma (82.4%), traumatic brain injury (74.8%). Severe associated injuries resulted in high severity of ISS = 29.2 ± 10.5 points, degree of consciousness impairment according to GCS = 9.1 ± 3.3 points and severity of patient's condition.

2. Among controversial and debatable issues of medical-diagnostic process were frequency of pelvic binder application (3.1% of cases), ultrasound according to the FAST protocol was performed in 71.8% of cases and WBMCT only in 23.7%, which should be performed in 100.0% of patients with high-energy trauma at the time of admission to the hospital. The frequency of ETC tactics 1.5% was too low, and definitive osteosynthesis in some cases was performed unreasonably late, in addition, 21.7% of cases of primary and

definitive and 26.3% of temporary fracture stabilization were performed conservatively in patients with severe associated trauma, which were not justified in this category of patients and caused complications and prolongation of treatment.

3. The most common complications were pulmonary: nosocomial pneumonia (40.5%), ARDS (19.1%) and fat embolism syndrome (10.7%), as well as sepsis (28.2%) and MOF (16.0 %). Mortality rate was 24.4%.

Conflicts of interest: the authors declare no conflict of interest.

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