Case Report

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Prognosis, Early Diagnosis and Treatment of Multiple Organ Failure in a Patient With Severe Concomitant Trauma

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ABSTRACT On the example of a clinical observation, we demonstrate the possibilities of dynamic multimodality imaging techniques and clinical and laboratory data, taking into account the severity of the concomitant trauma, which allow us to reflect objectively the dynamics of post-traumatic changes in the organs and tissues and predict the course of multiple organ failure (MOF). Consistency and adequate choice of treatment tactics with early use of active detoxification methods contribute to a favorable outcome.

Keywords: concomitant trauma, treatment, complications, MOF, diagnostic radiology (radiography, computed tomography, laboratory methods, ultrasound examination)

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BP - blood pressure
EFD - external fixation device
ALT - alanine aminotransferase
AST - aspartate aminotransferase
APTT - activated partial thromboplastin time
CAI - closed abdominal injury
CHI - closed head injury
MV - mechanical ventilation
RI - resistance index
CPK - creatine phosphokinase
AKI - acute kidney injury
PI - pulsatility index
PCT - procalcitonin
MOF - multiple organ failure
FFP - fresh frozen plasma
PHA - proper hepatic artery
TBT - tracheobronchial tree
HR - heart rate
CRP - C-reactive protein

Over the past decades, there has been an improvement in the diagnosis and treatment of patients with concomitant trauma, but sepsis and multiple organ failure (MOF) still remain the main cause of death [1–10].

The multiplicity of sources of pain, bleeding, impaired respiratory function, damage to brain structures that disrupt the central regulation in concomitant trauma lead to an increased catecholamine release that occurs at the initial stage, as well as at the acute and late stages of sepsis, associated with an increase in pro-inflammatory cytokines [10]. It is a complex interplay of cytokine storm, systemic inflammation, endothelial dysfunction, capillary leak syndrome, and pathological hemostasis. Subsequently, this contributes to the development of such complications as septic syndrome and MOF syndrome [5, 6, 11, 12]. A variety of markers and predictors of MOF do not have high specificity and sensitivity [3].

Elimination of the likelihood of developing MOF components is the main way to reduce mortality. Not only early diagnosis and the dynamics of the MOF course, but also the use of methods of extracorporeal hemocorrection play a key role in the treatment of MOF [13–17]. A unified approach to assessing the nature of the injury and understanding the patterns of the traumatic process, an objective evaluation using instrumental, clinical and laboratory indicators make it possible to develop tactics for resuscitation, surgical procedures, and postoperative period, which incorporates the principle of advanced treatment at all stages of patient care.

Aim of the study: On the example of a clinical observation of a patient with a severe concomitant trauma, to show the dynamics of the function of vital organs and systems, diagnosis, development factors and treatment of the main components of MOF.

Patient B., 40 years old, was brought by an ambulance team on January 23, 2022 at 11:27 pm to the N.V. Sklifosovsky Research Institute for Emergency Medicine after falling from the 5th floor (cleaning the roof). General condition: extremely severe; consciousness — medical sedation and relaxation; tracheal intubation, mechanical ventilation (MV) through an orotracheal tube, peripheral vein catheterization were performed at the prehospital stage. Position: passive. Pupils OD>OS, anisocoria, photoreaction was depressed. The skin was pale, moist, diffuse cyanosis. There was bleeding from a wound in the area of an open forearm fracture on the left. The patient was connected to a Dräger ventilator through an orotracheal tube in SIMV mode with the following parameters: Vt 680 ml, PS+15 cm H2, PEEP+5 cm H2O, f-18, FiO2 — 60%.

During the sanitation of the tracheobronchial tree (TBT), a small amount of hemorrhagic discharge was obtained. Systolic and diastolic pressure: not defined. Heart rate (HR): 71 beat per minute. Comprehensive shock therapy was started, including infusion of crystalloid and colloid solutions, vasopressor support with norepinephrine at the rate of 1.5 μg/kg/min, and dopamine —16 mg/kg/min. Abdomen on palpation: soft, painless, no dullness in sloping areas. On auscultation: no peristalsis. A small amount of gastric discharge was obtained after installing a nasogastric tube. During bladder catheterization 50 ml of urine with blood was evacuated; macrohematuria.

In order to stabilize the patient condition, shock therapy was continued, including transfusion of 1360 ml of fresh frozen plasma (FFP), 1100 ml of red blood cell (RBC) suspension, and 250 ml of platelet concentrate. In parallel with the therapeutic measures, a minimal complex of x-ray examinations was carried out in the conditions of the intensive care unit using mobile devices (mobile X-ray equipment and an ultrasound unit).

According to the chest x-ray examination: contusion, hypoventilation of the left lung, minimal hydrothorax on the left. Dislocated multiple fragment fracture of the left humerus. Multiple fragment transtrochanteric-subtrochanteric fracture of the left femur with displacement of the distal fragment along the width (Fig. 1).

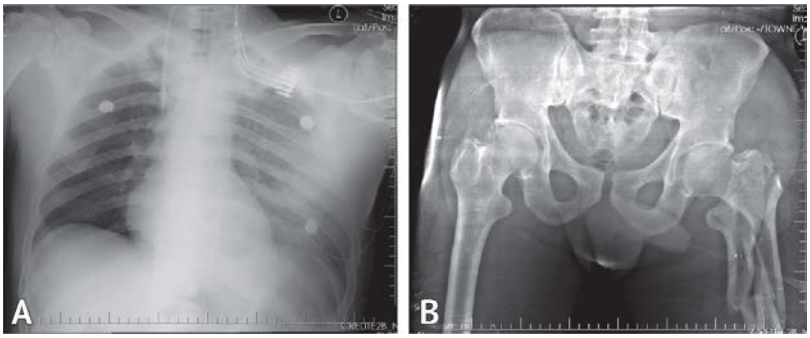

Fig. 1. Radiographs: A — a chest X-ray. Soft tissue injury in the chest wall; B — X-ray of pelvic and hip bones. Multifragmentary transtrochanteric-subtrochanteric fracture of the left femur with displacement of the fragments along the width

The abdominal ultrasound reveals signs of free fluid in the abdominal cavity, diffuse changes in the pancreas; no damage to the spleen was found; additional structures in the bladder (blood clots); decreased airiness of the pulmonary tissue on the left - lung contusion.

During cystography, a water-soluble contrast agent Ultravist (in a dilution of 1: 3 to 300 ml) introduced through the Foley catheter tightly filled the bladder. Its contours were clear and even. Leakage of the contrast agent beyond the contours of the bladder was not noticed.

In connection with the blood penetrating the TBT, fiberoptic bronchoscopy was performed. In the lumen of the lower lobe of the left lung, streaks of blood were determined. Sanitation was performed. At the time of examination, there was no evidence of ongoing pulmonary hemorrhage.

Based on the findings of the examination, a diagnosis was made: Severe concomitant trauma. Closed head injury (CHI). Contusion of the left lung, intrapulmonary bleeding, closed abdominal injury (CAI). Closed fracture of the proximal end of the left humerus. Open (GA II) fracture of the distal humeral metaepiphysis, proximal metaepiphysis of the ulna on the left. Closed fracture of the left femur.

In the process of shock therapy, a repeated abdominal ultrasound after 2 hours revealed separation of the peritoneal sheets up to 2 cm. Due to the presence of hemoperitoneum and trauma of the abdominal organs, the patient was sent to the operating room. A laparotomy was performed. In the abdominal cavity, 800 ml of blood was collected by a cell salvage autotransfusion device. The revision revealed multiple ruptures of the spleen; a hematoma of the gastroepiploic ligament. A splenectomy was performed. Hemostasis in the hematoma of the greater curvature of the stomach was achieved by suturing. The abdominal cavity was drained. During the ongoing laparotomy, due to a diaphragmatic hernia on the left and the presence of a left-sided hemothorax in the eighth intercostal space, a drainage tube was installed along the mid-axillary line into the left pleural cavity. 1000 ml of liquid blood was simultaneously evacuated. In connection with the ongoing intrapleural bleeding left anterolateral thoracotomy was performed. About 600 ml of blood with clots was found in the pleural cavity. The revision revealed a hematoma of the lower lobe of the left lung measuring 7.0□6.0 cm, with a defect in the area of 8, 9 segments, with moderate blood leakage and air inflow. The lung defects were sutured with U-shaped Vicryl sutures to achieve aerostasis and hemostasis.

A further revision revealed defects in the parietal pleura at the level of the 8th–9th ribs along the paravertebral line with bleeding from an intercostal artery. Hemostasis was achieved by stitching the bleeding vessel. No other damage was found. An additional drainage tube was installed in the 2nd intercostal space along the midclavicular line. Layered suturing of the thoracotomy wound was performed. Subsequently, under the control of an optical transducer, closed intramedullary osteosynthesis of the left femur with a locking pin, temporary surgical fixation of the left shoulder and forearm with an external fixation device were performed. Primary surgical treatment of the wound of the left forearm was carried out (Fig. 2 C).

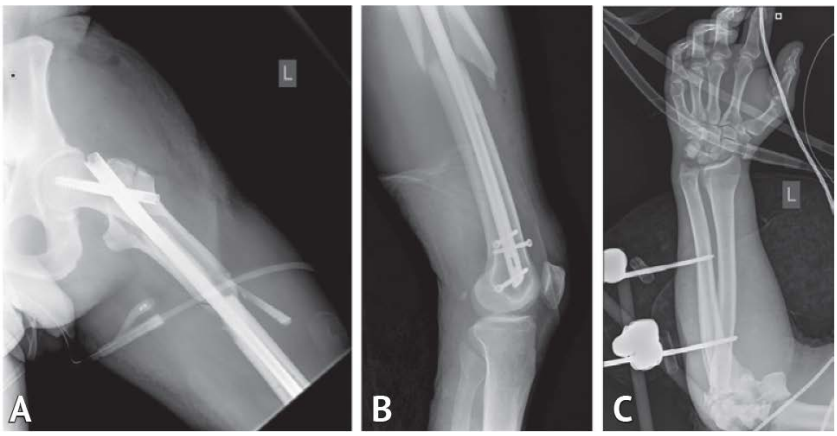

Fig. 2. Radiographs: A, B — X-ray of the left femur. Condition after intramedullary and transosseous metal osteosynthesis of the upper third of the femur with a nail and screws; C — X-ray of the left forearm. Condition after application of an external fixation device

The total blood loss during surgery was about 5000 ml. 2000 ml of autocomponents were reinfused, 1130 ml of erythrocyte suspension, 590 ml of FFP, 160 ml of cryoprecipitate, and 250 ml of thrombus mass were transfused. The volume of transfused blood components was monitored by laboratory parameters and the clinical picture.

Postoperative diagnosis: Concomitant trauma. Injury Severity Score (ISS) was 50, the Abbreviated Injury Scale (AIS)>4, the Glasgow coma scale score - 10. CHI. Contusion of the lower lobe of the left lung, pulmonary hemorrhage, multiple rib fractures with damage to the intercostal artery, left-sided hemothorax, CAI. Splenic trauma, hematoma of the greater curvature of the stomach. Hemoperitoneum. Closed fracture of the proximal end and open (GA II) comminuted fracture of the distal metaepiphysis of the left humerus. Open (GA II) comminuted fracture of the left olecranon. Closed pertrochanteric fracture and displaced fracture of the diaphysis of the left femur. Pulmonary hemorrhage the source of which was, most likely, the lower lobe of the left lung (I.Yu. Korzheva modified classification - grade 2C) and the intercostal artery. Erosive tracheobronchitis.

Shock therapy was continued to stabilize the patient condition. Taking into account the need for prolonged mechanical ventilation and adequate sanitation of the TBT, on the 2nd day the patient underwent a surgery: a low tracheostomy.

The entire treatment period can be divided into four stages. The first stage -1st-2nd day - recovery from shock. The second stage - 3rd-6th day - post-traumatic period. The third stage - 7-25th day - septic shock and MOF, the fourth stage - 26-40th day - traumatic depletion, treatment of pseudomembranous colitis and musculoskeletal rehabilitation.

First stage. In the early postoperative period, the patient's condition remained severe. Mechanical ventilation was continued in SIMV mode: Vt 680 ml, PS + 15 cm H2), PEEP + 5 cm H2O, f-18, FiO2 - 60%. The pallor of the skin, pastosity of the subcutaneous tissue persisted. HR: 120 bpm, blood pressure (BP): 110/70 mm Hg. In 12 hours from the moment of surgery, the discharge through the drainage from the pleural and abdominal cavities amounted to 800 ml. Initial infusion therapy was performed to normalize the volemic status and lactate level. To maintain a mean arterial pressure at the level of more than 65 mm Hg, inotropic and vasopressor drugs were used. Hemodynamic parameters, oxygenation, ventilation, thermometry were monitored, laboratory control was carried out. To assess the state of the lungs and pleural cavities, as well as the adequacy of the installation of the drainage tube, X-ray and ultrasound of the chest were performed in dynamics (2nd day). The X-ray examination showed contusion of the lower lobe of the lung. Venous plethora (Fig. 3 a, b).

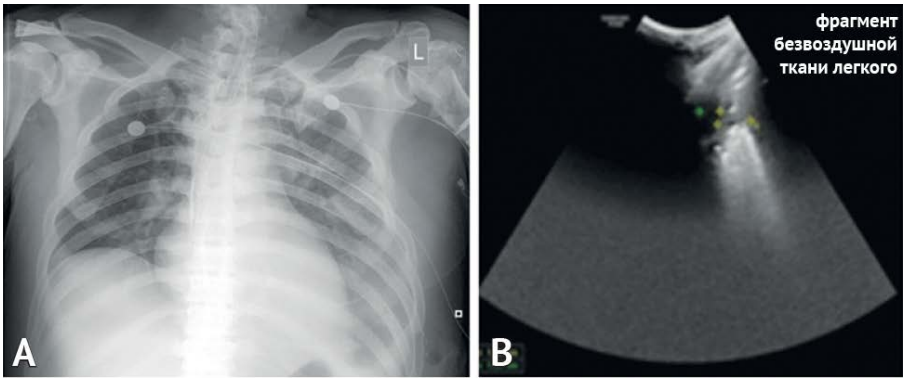

Fig. 3. A — chest X-ray. Hypoventilation in the lower sections on the left, hydrothorax on the left, a humerus fracture on the left; B — ultrasound image of the airless lower lobe of the left lung (contusion)

According to the ultrasound from January 24, 2022, there was a 1.2 cm separation of the pulmonary pleurae in the sinus on both sides, at the level of the 5th–6th intercostal space along the periphery, the left lung of medium echogenicity was airless to a depth of 1.5 cm.

Anemia was noted in the patient's laboratory parameters: the number of erythrocytes decreased to 2,36·1012/l, hemoglobin - 68 g/l, thrombocytopenia - 35·109/l, consumption coagulopathy phenomena: a prolonged prothrombin time to 24 s, activated partial thromboplastin time (APTT) - up to 38.4 s, D-dimer - up to 12.8 μg / ml, with a decrease in anticoagulation factors: antithrombin III up to 38%, protein C - 27%, hypoproteinemia - 27.8 g/l, hypoalbuminemia - 15.9 g/l. Due to severe bleeding, anemia and coagulopathy, 1150 ml of RBC suspension, 1480 ml of FFP, 500 ml of platelet concentrate were transfused.

Intensive treatment was continued, including vasopressor support with norepinephrine of 0.3 μg/kg/min, infusion therapy, and enteral nutrition. In order to prevent purulent inflammatory changes, antibiotic therapy was started (ceftriaxone + sulbactam 6.0 per day). By the end of the 2nd day the patient was taken out of shock.

Second stage. On the 3rd day the patient's condition remained consistently severe. On January 31, 2022, the ventilator was switched to BIPAP (Biphasic Positive Airway Pressure) mode.

Analyzing laboratory data, the patient showed a picture of rhabdomyolysis: an increased level of creatine phosphokinase (CPK) up to 16,157 U/l, aspartate aminotransferase (AST) - 541 U/l, alanine aminotransferase (ALT) - 168 U/l, an increase in markers of systemic inflammation: C- reactive protein (CRP) up to 138 mg / l, procalcitonin (PCT) - 10.2 ng / ml. The level of total protein and albumin on the background of transfusion therapy was stabilized at 50.4 g/l and 30.4 g/l, respectively.

In order to detoxify and prevent the progression of acute kidney injury (AKI) associated with rhabdomyolysis, plasmapheresis was performed for 2 hours with the removal of 1200 ml of plasma and the replacement of FFP in the same volume. After the plasmapheresis procedure, a decrease in the level of CPK to 7064 U/l, AST - 300 U/l, ALT - 129 U/l, PCT - to 2.6 ng/ml was observed. The creatinine level during the therapy decreased from 149.9 to 90.6 μmol/l.

Ultrasound showed initial signs of a decrease in hepatic hemodynamics: linear velocity of blood flow in the proper hepatic artery (PHA) 60 cm/s, resistance index (RI) - 0.71, pulsatility index (PI) in PHA -1.5. During a renal system examination, an increase in the length of the kidneys up to 12.0 cm was noted; in the study of arterial blood flow at the level of the parenchyma, arteries with an increase in RI -0.7 were detected. These facts were indicative of functional kidney failure.

During ultrasound of the pleural cavities, the dissociation of the pleura at the level of the sixth-seventh intercostal space to 0.8-1.1 cm was preserved; an increase in the zone of the airless lung to a depth of 1.8-3.0 cm was noted; the lung was on the periphery of medium echogenicity; arterial blood flow was not traced in the color Doppler flow mapping (Fig. 4).

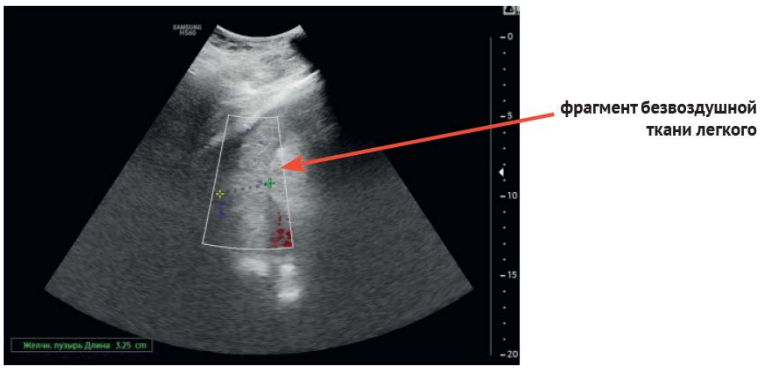

Fig. 4. Ultrasound image of the contusion of the left lung. The ultrasound image shows a fragment of the lower lobe of the airless left lung, the structure with medium echogenicity, Color Doppler flow imaging does not trace arterial blood flow

The patient underwent a complex intensive therapy, including blood transfusion. In laboratory parameters, anemia persisted with a trend towards normalization of the indicators, the number of erythrocytes increased from 2,93·1012/ l to 3,05·1012/ l, hemoglobin level - from 84 to 89 g/l, normalization of platelet count from 78 to 108·109/l was noted, leukocytosis increased from 7,6 to 10,7·109/l, lymphopenia progressed from 8 to 2%. Hypoproteinemia of 57–58 g/l persisted, albumin level was 33.4–31.0 g/l. The level of CPK progressively reduced to 5117 U/l, AST to 253 U/l, creatinine to 74.7 μmol/l. D-dimer decreased by the 4th day to 4.9 μg/ml, during the second stage the APTT level remained at 24.1–24.4 s, thrombin time was 18.5–17.5 s, prothrombin time remained prolonged: 17–19 s.

It was not possible to perform computed tomography (CT) of the chest and abdomen due to the severity of the patient condition and superimposed metal structures on the upper limbs.

The third stage - from the 6th to the 20th day is associated with the development of sepsis, septic shock and MOF

The course of the disease was complicated by the development of bilateral pneumonia with increased bilateral pulmonary infiltrates. On the 4th day, Entercoccus faecium of 10*4 was isolated in the bronchial wash culture. On January 29, 2022, on the 6th day after the injury, the patient developed septic shock with negative dynamics. Against the background of hyperthermia up to 40°C, edema of the subcutaneous fat of the upper and lower extremities was observed. MV continued in BIPAP mode with inspiratory pressure Pins 19, f 18/min, support pressure level 14 mbar; PEEP 7 mbar, FIO2 — 45%. Respiratory failure increased, respiratory index (PaO2/FiO2) decreased to 210 mm Hg (PaO2 - 94.5 mmHg). The auscultation of the respiratory system: breathing was harsh, weakened in the lower sections, scattered dry and moist rales were heard. Marked hypotension: BP of 80/40 mm Hg, tachycardia (HR of 130 beats/min), swollen abdomen, copious loose stools. The rate of diuresis was reduced to 200 ml. In laboratory parameters, attention was drawn to an increase in leukocytosis up to15,5·109/l, an elevated concentration of band neutrophils up to 29%, lymphopenia 2.9%, increased lactate levels up to 4.5 mmol/l.

Manifestations of acute liver failure and stage 2 AKI were revealed: an increased level of total bilirubin to 56.7 μmol/l, creatinine - 262.7 μmol/l, urea - 26.8 mmol/l. The indicators of total protein decreased sharply to 37 g/l, albumin to 16.5 g/l, with hyperglycemia up to 13.8 mmol/l, electrolyte imbalance with hypernatremia up to 151 mmol/l, hyperchloremia 113 mmol/l, the level of procalcitonin exceeded 200 ng/ml, CRP was 313 mg/l, and presepsin was 1542 pg/ml.

During bronchoalveolar lavage, Acinetobacter baumannii 10*6 and Klebsiella pneumoniae 10*7, in blood cultures Acinetobacter baumannii 10*8 were detected. Chest X-ray showed signs of bilateral pneumonia (Fig. 5).

Fig. 5. Chest X-ray. Bilateral lower lobe pneumonia with signs of hypoventilation

According to the ultrasound data on the 7th day, an enlarged liver, as well as a slight decrease in liver hemodynamic parameters were noted: an increase in the blood flow velocity in the PHA and an increase in RI to 0.7, PI - 1.5, a decrease in the liver vascular index to 15 (in normal 17.2), there is an increase in the size of the kidneys, an increase in the RI to 0.7, signs of toxic changes and a reduction in renal perfusion. The colon was located along its entire length with walls thickened up to 1.1 cm, the structure of medium echogenicity, in the left sections of reduced echogenicity, the lumen of the ascending section expanded to 4.4 cm, there was a heterogeneous content in the lumen. Diagnostic ultrasound revealed the echographic picture of pseudomembranous colitis (Fig. 6). Ultrasound examination of the lungs confirmed the presence of a small bilateral hydrothorax, revealed infiltrative-inflammatory changes in the lower sections on both sides.

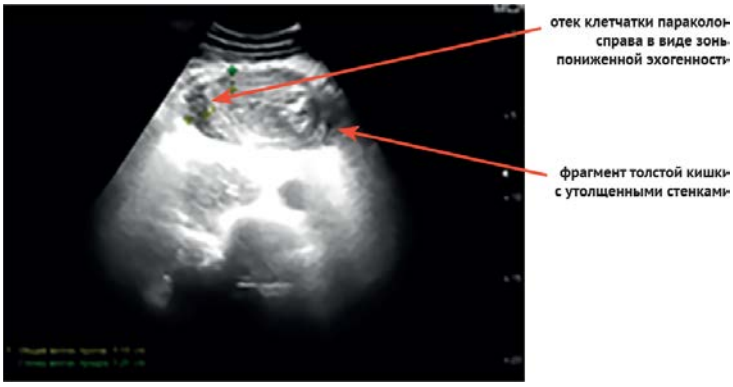

Fig. 6. Ultrasound image of a fragment of the ascending colon with thickened walls of 1.1 cm thick, structure with medium echogenicity. Edema of paracolon tissue on the right with decreased echogenicity (expansion up to 7 mm)

Instrumental examinations showed manifestations of organ failure of the lungs, liver, kidneys, and colon. To clarify the presence of a concomitant nature of the traumatic changes, a whole body CT (WBCT) with intravenous bolus contrast was performed. At the same time, there were no CT signs of pathological changes in the brain or skull bones. Chest CT revealed signs of infiltrative-inflammatory changes in both lungs (most likely of bacterial origin), bilateral hydrothorax, displaced fractures of the 7th–11th ribs on the left, displaced fractures of the distal metaepiphysis of the left humerus and olecranon of the left ulna, displaced fracture of the coracoid process of the left scapula.

Abdominal CT showed signs of free fluid in the abdominal cavity, hyperpneumatization of the small and large intestine, fractures of the transverse processes of the L2, L3, L4 vertebrae on the left. Subcapsular rupture of the right kidney was not ruled out. CT scan of the pelvic bones showed multifragmented transtrochanteric-subtrochanteric fracture of the left femur with displacement of fragments up to 18 mm (Fig. 7).

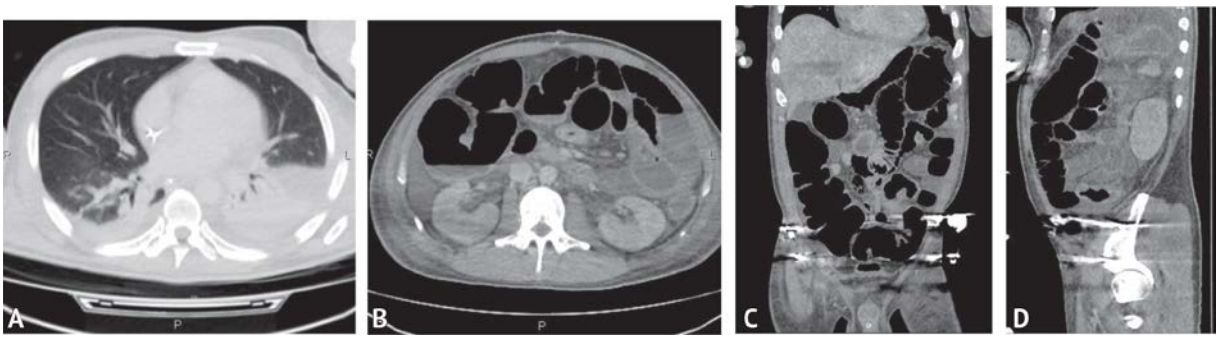

Fig. 7. A – axial computed tomography of the chest. Bilateral pneumonia; B, C, D. Computed tomography of the abdomen in axial (B), frontal (C) and sagittal (D) planes. Hyperpneumatization of the small and large bowel loops, edema of the paracolytic tissue. The intestinal wall is not thickened

The patient was prescribed intensive therapy for septic shock, including vasopressor drugs (norepinephrine 0.3–0.5 μg/kg/min), and a change in antibiotic therapy (meropenem and vancomycin) was made. Taking into account the progression of MOF syndrome, stage 2 AKI, acute liver failure, acute respiratory distress syndrome, increasing endotoxemia in the patient with sepsis and septic shock, methods of extracorporeal hemocorrection were applied.

Starting from January 31, 2022, 7 procedures of prolonged and long-term hemodiafiltration lasting 86 hours were carried out, with an achieved daily dose of 24.9 ml/kg/h. High cutoff hemofilters (up to a molecular weight of 40 kDa) Ultraflux EMiC2, Fresenius Medical Care (Germany), capable of eliminating chemokines and cytokines were used. On February 03, 2022, a session of selective hemosorption of lipopolysaccharides was held using a Toraymyxin PMX-20 column (Toray Industries, Tokyo, Japan). Against the background of ongoing therapy, the patient's condition showed a positive trend. The body temperature returned to normal, on February 3, 2022, vasopressor support was discontinued, its duration was 4 days, pulmonary gas exchange improved, the PaO2/FiO2 index increased from 87 to 190–276 mm Hg. On February 10, 2022, with normalization of respiratory function, the patient was transferred to spontaneous breathing, the duration of mechanical ventilation was 18 days.

An improvement in the laboratory parameters was observed, thus from January 31, 2022 to February 09, 2022 a normalization of the lactate level, a decrease in the number of leukocytes from 40,9·109 / l (maximum value) to 15,6·109 / l, banded neutrophils - from 36 to 2% was noted, the relative lymphocyte count increased from 2 to 6%, platelets - from 88·109/l to 444·109/l. A significant decrease in the markers of systemic inflammation was noticed, for example, in the indicated period the level of procalcitonin decreased from more than 200 ng/ml to 17.9 ng/ml and returned to normal values - 0.87 ng/ml - by February 14, 2022, CRP - 313 mg/l and 181 mg /l, respectively, a decrease to 89 mg/l was noted on February 18, 2022. Against the background of the ongoing multicomponent therapy for sepsis and MOF syndrome, a gradual restoration of the functions of vital organs was observed. The level of total bilirubin reached a maximum on February 05, 2022 - 86.5 μmol/l and decreased to normal values on February 14, 2022; the creatinine level reached a maximum on January 31, 2022 - 262.7 μmol/l, remained moderately elevated during 7 days of renal replacement therapy, and returned to normal values on February 11, 2022; the urea level returned to normal values by February 21, 2022.

Against the background of transfusion therapy, active parenteral nutrition, the level of albumin remained reduced, thus on the 5th day after the development of septic shock, its value was 22.6 g/l, by the 10th day - 24.5 g/l and returned to normal values only by 27th day, anemia also persisted for a long time, the level of D-dimer, with a maximum rise to 43.9 μg/ml, after 23 days from the onset of septic shock remained 6.1 μg/l.

The conducted therapeutic measures allowed us to stabilize the patient's condition. The patient was transferred to pressure support ventilation. However, subfebrile hyperthermia in the patient persisted; frequent loose stools with a volume of 500–1000 ml per day were observed; the study of feces revealed C. difficile. The ongoing treatment for colitis with vancomycin 500 mg orally 4 times a day for 30 days and continued antibiotic therapy, as well as extracorporeal detoxification had a significant clinical effect. However, C. difficile was still detected in the stool cultures. On February 15, 2022, i.e. on the 21st day, the patient was transferred to spontaneous breathing followed by decannulation.

Fourth stage. Against the background of wound depletion, therapy was continued aimed at treating pseudomembranous colitis, correcting dysproteinemia, and preparing and performing precise fixation of the fractures. For further treatment, the patient was transferred to the Department of Traumatology. A control chest X-ray showed positive dynamics in the form of a decrease in the intrapulmonary hematoma on the left (Fig. 8a). During a control CT scan of the left upper limb (Fig. 8b–g) in the diaphysis of the left humerus and the bones of the left forearm, channels from the external fixation device were visualized (a condition after EFD removal), a multifragmentary fracture of the proximal humerus on the left with signs of bone callus formation, a fracture of the coracoid process of the left scapula with a medial and downward displacement of the distal fragment were still observed, a multifragmentary complex intra-articular fracture of the distal metaepiphysis of the left humerus with multidirectional displacement of the fragments, a multifragmentary displaced fracture of the olecranon of the left ulna were determined. Subsequently, on the 65th day after the injury, the final fixation of the fractures of the humerus was performed and the treatment of pseudomembranous colitis was continued. Recovery.

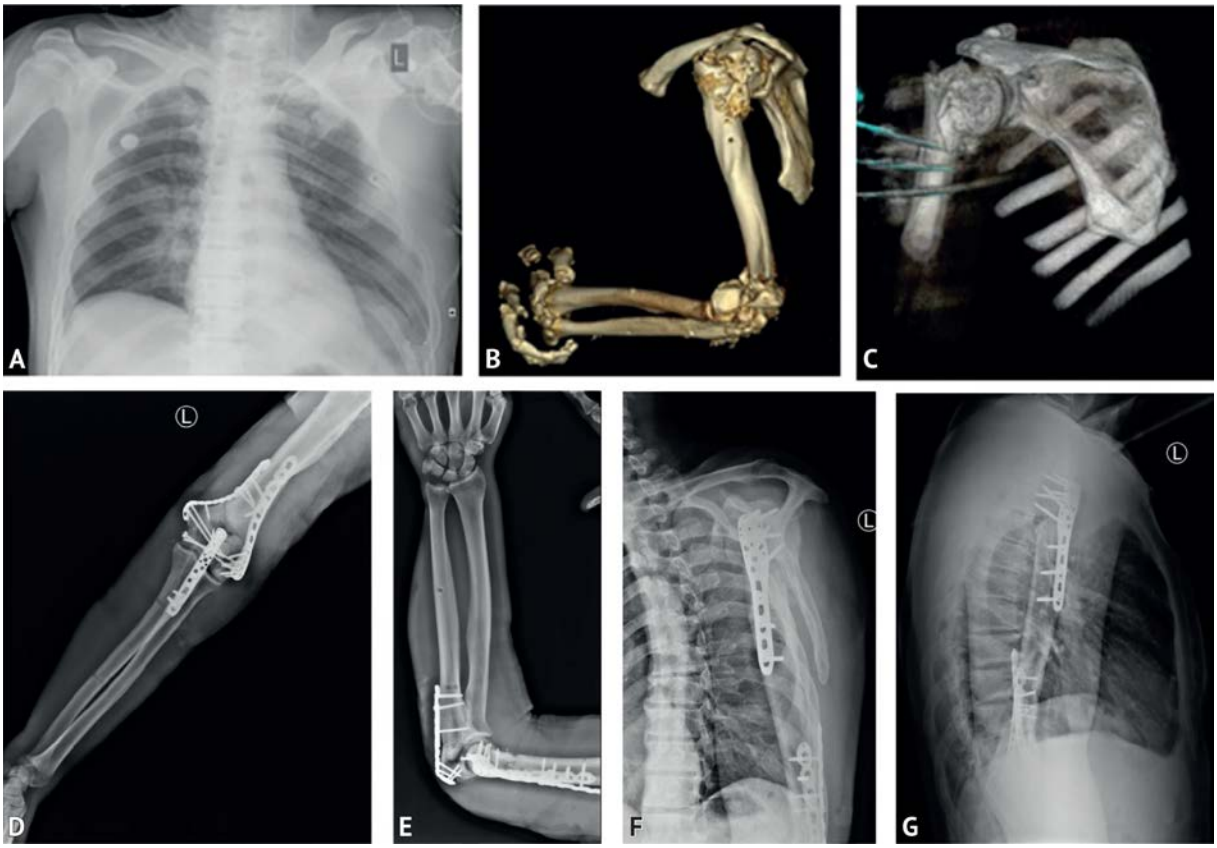

Fig. 8. A — chest X-ray. In the lower lateral section on the left, an inhomogeneous shadow with an indistinct contour is determined, most likely diffuse intrapulmonary hemorrhage, positive dynamics; B, C — multifragmented surgical neck fracture, and in the lower third of the humerus with displacement of the fragments; D–G — condition after extraosseous and transosseous metal osteosynthesis of fragments of the lower third of the radius, left olecranon and the surgical neck of the humerus

DISCUSSION

The existing approaches to assessing the severity of MOF in patients with concomitant trauma are retrospective in nature and point to the fact of damage that has already taken place [1]. Early diagnosis and prognosis of MOF includes age, comorbidity, injury severity score (ISS) [16, 17].

In our observation, the initial ISS was 50, which included multiple fractures of the limbs, pelvic bones, trauma to the chest and abdomen, and blood loss of more than 5000 ml. These injuries indicated the development of an unfavorable prognosis. Of great importance in this case were timely diagnosis and surgical treatment of damaged

organs of the chest and abdomen, shock therapy, early assessment of organ failure, its correction, programmed staged surgical bone fracture repair (Damage control orthopedics - DCO) [18–21]. This approach made it possible to avoid early complications.

It is known that disorders of the hemostatic system (platelet count and APTT, fibrin/fibrinogen degradation products, procoagulant phospholipid activity, thrombomodulin activity, etc. [22–24], thrombocytopenia and monocytopenia, lymphopenia [25–27]) are particular examples of MOF prediction; the dynamics of CRP concentration correlates with the development of MOF in patients with severe trauma. Plasma concentration of procalcitonin in the early stages after injury is also a predictor of MOF and death [28, 29].

In our case, both after the injury and in the first 5 days of the post-traumatic period, the patient's hemostasis was significantly impaired; ultrasound and ultrasonic Doppler examinations revealed an increase in the size of the liver, spleen, changes in the RI of parenchymal organs and in the condition of the colon walls. This reflected the increase in severity of the patient's condition and indicated the development of MOF. The clinical picture and positive blood cultures indicated the presence of bacterial shock. The use of extracorporeal hemocorrection in the early postoperative period played a key role in the treatment for MOF and sepsis.

Analyzing this clinical observation, it should be noted that the use of biomarkers of systemic inflammation played an important role in decision making to apply a combination of extracorporeal hemocorrection methods (selective hemosorption of lipopolysaccharides and prolonged/long-term methods of renal replacement therapy using ultra-high permeable phenine nanotube membranes). These methods are aimed at interrupting the cascade of pathological reactions associated with the activation of mononuclear phagocytes by endotoxin, and the elimination of cytokines and other inflammatory factors to prevent the progression of multiple organ dysfunction syndrome, and the development of immune paralysis. Early use of extracorporeal detoxification methods, in the absence of renal dysfunction and hemodynamic disorders, increased its effectiveness and contributed to the treatment for MOF.

Further complex therapy contributed to the gradual normalization of laboratory parameters, and instrumental evaluation of the state of the patient's organs indicated positive dynamics and recovery from MOF.

CONCLUSIONS

1. Dynamic complex diagnostic radiology, timely surgical treatment and clinical and laboratory data, taking into account the severity of the concomitant trauma, help objectively reflect the course of post-traumatic changes in organs and tissues, make it possible to determine their nature and predict the course of multiple organ failure.

2. Consistency and adequate choice of treatment strategy with the early use of extracorporeal hemocorrection methods, including selective sorption of endotoxin, contribute to a favorable outcome.

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