

## TREATMENT OF PATIENTS WITH CONCOMITANT TRAUMA TO THE ORGANS OF SEVERAL CAVITIES AND TO THE MUSCULOSKELETAL SYSTEM

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**Abstract.** The aim of the study was to improve the results of treatment of patients with severe combined trauma of the organs of several cavities (skull, thoracic and abdominal cavities, retroperitoneal space) and of the musculoskeletal system.

**Materials and research methods.** The study involved 72 patients treated between 2013 and 2017 in a Level I trauma center established at the Republican Clinical Hospital of the Ministry of Health of the Kabardino-Balkarian Republic.

The Injury Severity Score (ISS) index was used to determine the severity of injury; "department of military field surgery, condition, admission" scale was used to assess the state of the injured.

**Results of the study and their analysis.** Analysis of the findings showed the following: in severe combined injuries the main causes of death are: shock, cerebral edema and dislocation, posttraumatic pneumonia, multiple organ failure, acute respiratory failure, pulmonary embolism and DIC syndrome.

The most satisfactory treatment outcomes can be achieved only with the use of a care tactic based on the principles of staged surgical treatment "Damage control".

The time frame and the sequence of surgical treatment of injuries depend on their severity, degree of life threatening and prevailing injury.

**Key words:** musculoskeletal system, organs of several cavities, patients, severe combined trauma, treatment

**Conflict of interest.** The authors declare no conflict of interest

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## ЛЕЧЕНИЕ ПОСТРАДАВШИХ С СОЧЕТАННОЙ ТРАВМОЙ ОРГАНОВ НЕСКОЛЬКИХ ПОЛОСТЕЙ И ОПОРНО-ДВИГАТЕЛЬНОЙ СИСТЕМЫ

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**Резюме.** Цель исследования – улучшение результатов лечения пациентов с тяжелой сочетанной травмой органов нескольких полостей (череп, грудная и брюшная полости, забрюшинное пространство) и опорно-двигательной системы (ОДС).

**Материалы и методы исследования.** В исследовании участвовали 72 пациента, лечившихся в 2013–2017 гг. в травмоцентре I уровня, созданном на базе Республиканской клинической больницы Минздрава Кабардино-Балкарской Республики.

Для определения степени тяжести травмы использовали индекс Injury Severity Score (ISS); для оценки тяжести состояния пострадавших – шкалу «кафедра военно-полевой хирургии, состояние, поступление» (ВПХ – СП).

**Результаты исследования и их анализ.** Анализ результатов исследования показал: при тяжелых сочетанных повреждениях основной причиной смерти являются: шок, отек и дислокация головного мозга, посттравматическая пневмония, полиорганная недостаточность, острая дыхательная недостаточность (ОДН), тромбоэмболия легочной артерии (ТЭЛА) и ДВС-синдром.

Наиболее удовлетворительные результаты лечения можно получить только при применении тактики оказания медицинской помощи, базирующейся на принципах этапного хирургического лечения «Damage control».

Временные рамки и последовательность оперативного лечения полученных повреждений зависят от их тяжести, степени угрозы жизни и от преобладающей травмы.

**Ключевые слова:** лечение, опорно-двигательная система, органы нескольких полостей, пациенты, тяжёлая сочетанная травма

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**Relevance of the study.** Combined trauma of the organs of several cavities and the musculoskeletal system is the most severe type of trauma. The peculiarities of this pathology are the greatest severity of concomitant injuries (more than 45 points according to ISS), massive blood loss, and the need to use both Damage control surgery and Damage control orthopedic tactics [1-3]. The urgency of the problem of treatment of such patients is determined by their increasing number and the share of combined injuries in the total structure of trauma, as well as by the duration of treatment, high lethality and disability [4-8].

Despite certain successes in providing medical care to such patients, the problem of their treatment is far from being solved. A limited number of works are devoted to the treatment of this type of injuries, and the treatment methods proposed in them are sometimes directly opposite [9-11]. More than half of patients with concomitant injuries are admitted to the hospital in severe shock, and one in three of them dies. According to different authors, complications in polytrauma develop in 28.0%-94.0% of cases, mortality reaches 70.0%, and disability occurs in 45.0% of cases, mainly as an outcome of musculoskeletal trauma [2, 6, 11, 12].

The aim of the study was to improve treatment outcomes in patients with severe combined trauma of several cavities (skull, thoracic and abdominal cavities, retroperitoneal space) and the musculoskeletal system.

**Materials and methods of research.** The paper presents an analysis of treatment of 72 patients with combined trauma of multiple cavity organs (skull, thoracic and abdominal cavities, retroperitoneal space) and musculoskeletal system treated at the Level 1 Trauma Center of the Republican Clinical Hospital in 2013-2017. The Level 1 Trauma Center was established on the basis of the Republican Clinical Hospital of the Ministry of Health of the Kabardino-Balkarian Republic on October 1, 2010. The main task of the trauma center specialists is to provide specialized, including high-tech, medical care to polytrauma patients. The Trauma Center provides round-the-clock specialized medical aid to the injured with polytrauma of any complexity. Its staff includes all necessary specialists – traumatologists, surgeons, a neurosurgeon, a neurologist, an ophthalmologist, an ENT doctor, a urologist and a therapist – to provide urgent specialized medical aid and further treatment.

Patients are examined using a range of modern clinical, laboratory, radiological and instrumental methods, including spiral computed tomography, intraoperative (surgical) X-ray systems (C-arc), magnetic resonance imaging, video laparoscopy, video-thoracoscopy, angiography and others.

The tactics of medical care is based on the principles of staged surgical treatment "Damage control". The main strategic task in the treatment of patients is to minimize the time of diagnostics of injuries, causing disturbances of vital functions, by combining it with measures for the elimination of life-threatening conditions. Diagnostic measures primarily

included diagnosis of internal bleeding in the abdominal and thoracic cavities, craniocerebral trauma, pelvic and long tubular bones injuries.

Among 72 patients we observed 40 (55.5%) men and 32 (44.5%) women. The vast majority (77.8%) of patients were between 20 and 50 years of age, i.e., persons of active physical labor. Most of the cases were caused by traffic accidents – 52 (72.2%) and falls from a great height – 17 persons (23.6%). Other causes of injury were in three persons (4.2%). The intensive care team of the Center for Disaster Medicine delivered 45 victims (62.5%) to the trauma center; 10 (13.9%) were delivered by ambulance; 5 victims (7.0%) were transported by auto. Twelve victims (16.6%) were transported from district hospitals. The following patients were hospitalized to the trauma center after the event: within 1 hour – 18 victims (25.0%); up to 2 hours – 27 (37.5%); up to 3 hours – 15 (20.8%); up to 6 hours – 9 (12.5%); over 6 hours – 3 victims (4.2%).

The Injury Severity Score (ISS) was used to determine the severity of injury, and the VPKh – SP (Department of Military Field Surgery scale, S – condition (sostoianie), P – admission (postuplenie) scale was used to assess the severity of the injured. With an ISS of 26-40 points, the trauma was considered to be of average severity (20 patients); 41-49, severe (30 patients); 50 points and more, extremely severe (22 patients). The condition of the victims, assessed at 21-30 points, was considered severe (52 victims), and 31-45 points – extremely severe (22 victims) according to the VPKh – SP scale. Traumatic shock was registered in 52 victims (72.2%), including: 1st degree shock – in 8, 2nd degree – in 6; II-III degree – in 32 victims. Blood loss of 1-2 liters occurred in 21 patients, up to 3 liters – in 15, more than 3 liters – in 4 patients.

The diagnosis of injuries was significantly complicated not only by the severe general state of the victims, but also by pronounced alcohol intoxication, the effect of narcotic substances, and anesthetics administered to the victims while providing them with first aid. In our observations with alcohol intoxication there were 25 victims (34.7%).

Closed craniocerebral trauma was registered in 60 victims, and open craniocerebral trauma was registered in 12 victims. Concussion of the brain was noted in 24 patients (33.3%); mild cerebral contusion – in 10 (13.4%), severe – in 28 patients (38.9%), subarachnoid hemorrhage – in 20 (27.7%); subdural hematoma – in 11 (15.2%); epidural hematoma – in 4 (5.5%); fracture of the cranial roof and base – in 15 (20.8%); fracture of facial bones – in 15 (20.8%); pneumocephaly – in two (2.7%); hemisinus – in one patient (1.3%).

Closed thoracic trauma was noted in 64 victims, and open thoracic trauma in 8 victims. Multiple rib fractures on one side – in 41 (57.0%); multiple rib fractures on both sides – in 16 (22.2%); lung contusion – in 45 (62.5%); lung rupture – in 5 (6.9%); cardiac contusion – in 12 (16.7%); diaphragm injury – in 8 (11.1%); sternum

fracture — in two (2.7%); hemopneumothorax — in 14 (19.4%); pneumothorax — in 13 (18.0%); hemothorax — in 12 (16.6%); hydrothorax — in 13 (18.0%); thoracic aortic rupture — in one victim (1.4%).

The following organs of the abdomen were more frequently injured: spleen — 33 (46.0%) victims, gastrointestinal tract (GIT) — 28 (38.8%); liver — 25 (34.7%). Kidney contusion was observed in 18 (18.7%) cases, rupture of the kidneys — in 5 (6.9%) cases, rupture of the bladder — in 7 (3.7%) cases, hemoperitoneum — in 34 (47.2%), retroperitoneal hematoma — in 19 (26.3%) cases, rupture of the vena cava — in 1 victim (1.4%).

Among the bones of the trunk and musculoskeletal system the vertebral appendages were most frequently injured — 20 patients (27.7%); bones of the pelvis — 14 (19.4%). Closed fracture of the femur was observed in 10 patients (13.8%); closed fracture of tibia bones — in 9 (12.5%), open fracture of tibia bones — in 7 (9.7%), open fracture of femur — in 6 (8.3%), dislocation of femur — in three (4.2%), fracture of clavicle — in 12 (16.6%), fracture of forearm bones — in 7 (9.7%), fracture of scapula — in 5 (5, shoulder — in two (2.7%), fracture of vertebral bodies — in 8 (11, 1%), including 3 (4, 1%) with spinal cord disruption, sacrum — in 6 (8, 3%), hand bones — in 4 (5, 5%), patella — in 2 (2, 7%), tear of both hands — in 1 (1, 4%), bone of foot — in 2 (2, 7%); multiple wounds of the trunk and extremities — 31 (43.0%).

**Results of the study and their analysis.** At the admission of a patient with combined trauma of the organs of several cavities and the musculoskeletal system the initial examination in the admission room or in the antishock operating room was performed by a surgical team and an intensive care physician. At the same time we performed general clinical examinations — blood and urine tests in dynamics, determination of amylase, diastase level, group and rhesus belonging, etc.

The tactics of care for the injured was based on the principles of staged surgical treatment "Damage control", taking into account the dominant injury. According to it, all the injured were divided into 4 main groups: Group 1 — combined injuries with dominant craniocerebral injury, severe cerebral contusion with subarachnoid or subdural hemorrhage — 28 (38.8%). Group 2 included patients with prevailing thoracic injury — 14 (19.4%); patients with moderate degree cerebral contusion, multiple rib fractures on both sides, accompanied by hemapneumothorax or pneumothorax with lung rupture — 5 (6.9%), with ruptured thoracic aorta — 1 patient (1.4%). Group 3 included patients with predominant abdominal injuries, concussion of the brain combined with spleen or liver injuries with extensive intraperitoneal bleeding — 12 (16.65%), with rupture of the inferior vena cava — one patient (1.4%). Group 4 included 11 people (22.2%) with severe cerebral contusion combined with multiple rib fractures on both sides, liver and bladder rupture, pelvic bone fracture.

The main strategic goal in treating patients was to minimize the diagnostic time of those injuries that cause impairment of vital functions. This was ensured by combining diagnostics with measures to eliminate life-threatening conditions. First of all, the diagnosis of internal bleeding in the thoracic and abdominal cavity, craniocerebral trauma, and pelvic bone injuries was performed. The victims were treated in 2 stages.

Within 6 hours of injury, the cranium, thorax, and abdomen were operated on first. A total of 144 operations were performed on organs and bones. Of these: craniotomy with removal of one subdural and one epidural hematoma, Bulau drainage of pleural cavity — 28; tracheostomy — 3; thoracocentesis — 6; thoracotomy — one; laminectomy — decompression of cauda equina — one; suturing lung wound — two; suturing of diaphragmatic cupula — 5; splenectomy — 28; suturing of liver — 18; suturing of small intestine rupture — 9; suturing of bladder — 3; epicystostomy — 2; nephrectomy — 4; suturing of stomach wound — one; cholecystectomy — 3 operations. Then the operations on musculoskeletal system were performed according to the degree of urgency. The choice of the method and time of osteosynthesis was differentiated depending on the severity of the injured person's condition, the type and localization of the fracture, taking into account the prevention and treatment of general and local complications. In the first hours after admission, along with intensive therapy and life-saving surgeries, the limb was temporarily fixed with external fixation apparatus in two cases of hip fracture and in one case of tibia fracture. Stump formation of both forearms was performed in one case. In the first three days, rod and spoke-rod apparatuses of external fixation were used in three cases of femur fracture and four cases of tibia fracture. Skeletal traction was applied to two patients with hip fracture and two patients with tibia fracture in stable condition. A plaster cast was applied to two patients with a shoulder fracture, four with a forearm fracture, and five with a clavicle fracture. During treatment, after stabilization, hip submerged osteosynthesis was performed in three patients with hip fracture (blocking intramedullary osteosynthesis — 2, plate with screws — 1); in two — with tibia fracture (blocking intramedullary osteosynthesis — 1, plate with screws — 1); plate with angular stability was used in two patients with humeral fracture.

At the time of admission, open fractures were treated in 2 stages — primary surgery and fracture stabilization. Within 6 hours of injury, primary surgical treatment was performed in 20 patients (67.1%). In 15 (32.9%) patients primary surgical treatment was delayed because of the severity of their condition. Two patients with an open femur fracture and one patient with a tibia fracture got external fixation devices. For open fractures at different times after admission, immersion plate osteosynthesis was performed in two patients with a hip fracture, in three patients with a tibia fracture, in one patient with a shoulder fracture and in two patients with a clavicle fracture. Intramedullary osteosynthesis with blocking was performed in four cases (femur — 2, tibia — 2). Repeated osteosynthesis operations were performed in four cases: in two cases — angularly stable plate osteosynthesis for hip fracture; in two cases — blocking intramedullary osteosynthesis with tibia fracture. In two cases the pelvic bones were fixed with a Ganz frame.

Thirty-two patients (44.5%) died in the intensive care unit and in the inpatient departments of the hospital at different terms. Within an hour — 8 patients (25.8%); within 24 hours — 12 (38.8%); within a week — 8 (25.8%); and within more than a week — 3 patients (9.6%).

Complications of the abdominal organs and musculoskeletal system in survivors (Group 1) and deceased patients (Group 2) are presented in Table 1.

**Число пациентов с осложнениями со стороны полостных органов и опорно-двигательной системы, чел./%**  
 Number of patients with complications of cavitory and respiratory organs, pers./%

Клиническая группа Clinical group	Число пациентов, чел. Number of victims	ОНМК* и дислокация головного мозга Acute circulatory disorder and cerebral dislocation	Пневмония Pneumonia	Плеврит Pleuritis	Полиорганная недостаточность Multiple organ failure	Острая дыхательная недостаточность Acute respiratory failure	ТЭЛА Pulmonary embolism	Перитонит Peritonitis	ДВС-синдром Disseminated intra-vascular clotting syndrome	Сепсис Sepsis
1-я	40	1/2,5	9/22,5	7/17,5	1/2,5	2/5,0	–	–	–	1/2,5
2-я	32	9/28,1	6/18,7	4/12,5	4/12,5	2/6,3	2/6,3	2/6,3	1/3,1	–

Окончание таблицы 1/Ending of table No. 1

Клиническая группа Clinical group	Двуст. гнойный бронхит Bilateral purulent bronchitis	Цистит, уретрит Cystitis, urethritis	Панкреатит Pancreatitis	Остеомиелит Osteomyelitis	Нагноение раны Wound festering	Итого пациентов с осложнениями Total number of patients with complications	Число пациентов с шоком, чел. Number of patients with shock, degree			Итого пациентов с шоком, чел./% Total number of patients with shock
							I ст.	II ст.	III ст.	
1-я	1/2,5	2/5,0	–	1/2,5	2/5,0	27/67,5	7	4	15	26/65,0
2-я	–	–	1/3,1	–	–	31/96,8	1	2	23	26/81,2

\* ОНМК – острое нарушение мозгового кровообращения / Acute circulatory disorder

Таблица 2 / Table No. 2

**Число пациентов с отдаленными результатами лечения**  
 Long-term results of treatment

Число пациентов, чел. Number of patients	Результат лечения, чел./% Results of treatment, pers./%			Группа инвалидности, чел. Disability group, pers.			Итого пациентов с инвалидностью, % Total, %
	хороший / good	удовлетв. / satisfactory	неудовл. / unsatisfactory	I	II	III	
31	9/29,0	11/35,4	11/35,4	1	3	7	35,4

Table 1 shows that the patients died mainly from shock, cerebral edema and dislocation, pneumonia, multiple organ failure, acute respiratory failure, TELA and DIC, and these parameters were significantly lower in survivors. Thus, in the total number of survivors (40) complications were observed in 27 patients (67.5%); in the total number of deaths (32) – in 31 patients (96.8%).

The proportion of patients with various degrees of shock was 65% and 81.2% among survivors and deceased patients, respectively.

Long-term treatment results (6 months to 4 years) were studied in 31 patients (70.7%). Long-term results of treatment were assessed according to a three-point system: good, satisfactory, unsatisfactory.

A *good result* was the absence of complaints about the functioning of the cavity organs, bone fusion with complete restoration of the segment functions.

*Satisfactory result* meant presence of minor abnormalities from the cavity organs in the form of recurrent headaches, pain at physical activity, and from the injured limb – not sharply pronounced curvature of its axis and limitations of mobility in the joints.

*Poor outcome* is the presence of complications on the side of the cavitory organs (often recurrent headaches, postoperative ventral hernia, adhesions, etc.), fracture complications with osteomyelitis or significant limitation of joint mobility. The following table shows the long-term results of treatment (Table 2).

Table 2 shows that the proportion of patients with satisfactory and unsatisfactory treatment results is a total of

70.8%. This can be explained by the severity of the trauma received and the late delivery of the victims from the district hospitals. Group I disability was established for one patient, Group II disability for three, and Group III disability for seven patients.

Thus, the proportion of patients with disabilities in the total number was 35.4%.

### Conclusion

1. The main causes of death at severe combined injuries are: shock, cerebral edema and dislocation, posttraumatic pneumonia, multiple organ failure, acute respiratory failure, pulmonary embolism (TELA) and DIC.

2. The primary goals in treatment of such patients are minimization of diagnostic time of those lesions which cause vital functions impairment and early elimination of life-threatening disorders.

3. In treatment of this category of patients the most satisfactory results can be obtained only with the tactics of medical care based on the principles of staged surgical treatment, "Damage control".

4. The earlier resuscitation and antishock measures are started, the more chances for favorable outcome of this category of patients treatment are. One of the causes of high mortality is the late delivery of the injured to the specialized hospital.

5. The time and sequence of surgical treatment of the received injuries depend on their severity, on the degree of threat to life and the prevailing trauma.

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