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The Influence of Traumatic Injuries Early Diagnosis on the Development of Pulmonary Complications in Patients with Multisystem Chest Trauma

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RATIONALE Despite the existing progress in providing care to victims with severe multisystem chest injury using advanced diagnostic methods, a high mortality rate remains, reaching 20-30%.

The purpose of the study. To assess the impact of early diagnosis and correction of thoracic injuries on the development of complications in patients with multisystem trauma.

MATERIAL AND METHODS The results of diagnosis and treatment of 89 patients with severe multisystem blunt chest trauma were studied. According to the time of admission at the Institute, the patients were divided into two groups: Group I, who were admitted to the Institute in the first hours after the injury (51 patients), and group II, who were transferred from other medical institutions on the 3rd-7th day (38 patients). CT was performed as a standard method of diagnosis and monitoring the dynamics of the process. With the development of purulent-inflammatory pulmonary complications, a bacteriological study of bronchoalveolar lavage was performed. Treatment measures included complex intensive therapy, drainage of the pleural cavity and, if necessary, emergency surgical interventions.

RESULTS In group I, lung contusion occurred in 43 (84%) patients, and after 7-10 days, the contusion foci partially regressed in 20 (46.5%) patients. In 8 (16%) patients with lung rupture, infiltrative changes in the lung were resolved on the 18th-30th day, while 4 (50%) of them had pneumonia outside the contusion zones. In group II, the injuried were admitted to a ventilator and inflammatory changes in the lungs were found in 30 patients (79%). Lung rupture due to contusion was present in 2 (5.2%). When comparing the groups by the isolated microflora composition, we found that in patients of group II, Acinetobacter spp. (46.7% vs. 17.1% in group I patients, p=0.021), Enterococcus spp. (30.0% and 8.6%, respectively, p=0.058), and Klebsiella pneumoniae (46.7% and 37.1%, p=0.6) were more frequently isolated. Meantime, Staphylococcus aureus was not found in these patients, while it was detected in 14.3% of patients from group I (p=0.09). Medical care in group I was rendered according to the principles of the "golden hour": within the first hour from the moment of admission, the victims with the presence of pneumothorax and hemothorax had the pleural cavity drained. In group II, this procedure was performed in other medical institutions, and in 5 victims, it was additionally performed at our Institute.

CONCLUSIONS Early computed tomography diagnosis of multisystem trauma makes it possible to assess the severity of injuries to the chest organs and other areas of the body and work out the treatment tactics. A comprehensive approach to the management of injuried, including early diagnosis of trauma, drainage of the pleural cavity, determination of management tactics, bacterial assessment of the lower respiratory tract sputum, help to reduce infectious complications rate by mean of 45.46%.

Keywords: multisystem chest trauma, computed tomography, bacterial monitoring, treatment, complications

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AISThorax, Abbreviated Injury Severity thorax Score
APACHE, Acute Physiology Age Chronic Health Evaluation system
ARDS, acute respiratory distress syndrome
CT, computed tomography
ISS, Injury Severity Score
LRT, lower respiratory tract
LRTS, lower respiratory tract sputum
MLV, mechanical lung ventilation
MOF, multiple organ failure
NFGNB, non-fermenting gram-negative bacilli (bacteria)
TBI, traumatic brain injury

INTRODUCTION

Despite the existing progress in rendering care to the casualties with severe multisystem trauma at all stages of treatment using advanced diagnostic methods [1-7], a mortality rate still remains high, reaching 20-30% [8-12]. Mortality is often due to the development of complications, so 25-40% of patients with chest trauma have various complications, which are often associated with mechanical lung ventilation (MLV) [13-21].

Chest trauma has a direct impact on the development of complications such as pneumonia, sepsis, and multiple organ failure (MOF) syndrome [22-25]. Traumatic abnormalities in the lung tissue in polytrauma and the overall severity of the injury play a crucial role in the etiology of pneumonia. Accurate diagnosis of chest injury and adequate treatment tactics contribute to reducing the incidence of complications.

Modern non-invasive methods of diagnostic radiology, including computed tomography (CT), provide a combination of informative value, objective recording of parameters and a high speed of making examinations and have advantages in dynamic observation [5, 6, 25].

The study purpose was to evaluate the effect of early diagnosis and correction of chest injuries on the development of complications in patients with multisystem trauma.

Study objectives:

1. To analyze the results of chest CT scan at the hospital admission of patients and following the results of treatment.
2. To analyze the results of bacteriological examination of the lower respiratory tract sputum (LRTS).
3. To analyze the treatment results in patients with severe multisystem trauma.
4. To analyze the developed complications.

MATERIAL AND METHODS

The study was based on assessing the results of diagnosis, treatment and the analysis of the complications developed in 89 casualties who were treated at the N. V. Sklifosovsky Research Institute for Emergency Medicine in 2017-2019.

The criteria for inclusion in the study were as follows: age over 18 years; severe multisystem blunt chest injury: ISS 28 or more, AIS thorax > 2 considering the associated injuries (Figure 1).

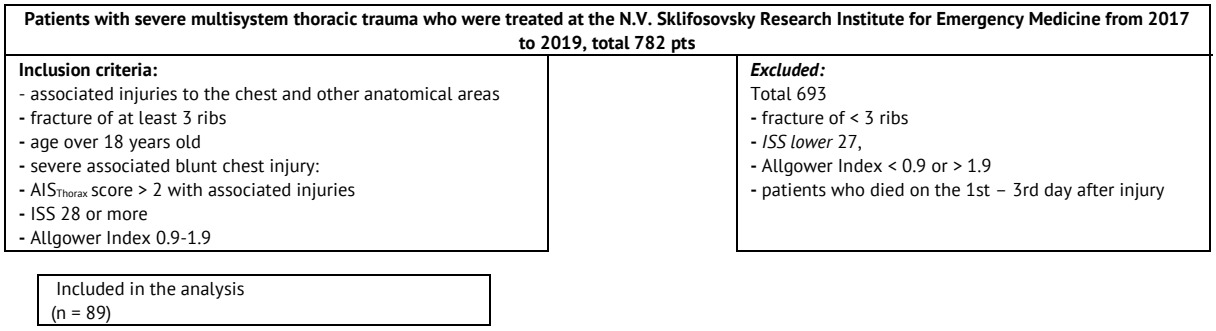

Figure. Flow diagram of patient inclusion in the study

According to the time of admission, all patients were divided into two groups (Table 1). The first group included of 51 injuried patients who were admitted at the Institute clinic in the first hours after the injury; the second group included 38 patients who were transferred from other institutions on the 3rd-7th days after the injury.

The patient age was 40±15 years in group I, and 43±14 years in group II. There were no statistically significant differences between the groups in age (Table 1). The ratio of men and women was 3:1 in group I, 2:1in Group II.

Table 1

Distribution of patients by severity and mechanism of injury

	Group I (n = 51)	Group II (n = 38)	Significance of differences
Length of hospital stay at the Institute clinic	The first hours after the injury	Transfer from other medical institutions (3rd – 7th day)	
Age	40 ± 15 years old	43 ± 14 years old	p = 0.34
Gender (m/f), ratio	3:1	2:1	
Mechanical lung ventilation, n = 80	42 (82.35%)	38 (100%)	p = 0.02
Mechanism of injury:			
- fall from height of over 3 meters	22 (43.1%)	8 (21.1%)	p = 0.05
- car injury	13 (25.4%)	17 (44.7%)	p = 0.09
- train injury	9 (17.6%)	3 (7.8%)	p = 0.31
- motorcycle injury	1 (2.0%)	5 (13.2%)	p = 0.10
- fall off a bike	2 (3.9%)	0	
- other types of injuries	4 (7.8%)	5 (13.2%)	p = 0.64

According to the mechanism of injury, in group I the most common injuries were a fall from a height of more than 3 meters (43.1%) and auto trauma (25.4%); in group II, auto-trauma prevailed (44.7%) followed by a fall from a height of more than 3 meters (21.1%). The most common additional injuries in group I and group II were, respectively: the musculoskeletal system injury (72.5% and 78.9%), the injury of pelvic bones (52.9% and 55.2%), head trauma (37.2% and 52.6%), and abdominal injuries (56.8% and 44.7%).

Eighty patients (42 in group I, and 38 in group II) were on mechanical ventilation through endotracheal or tracheostomy tubes (ventilation duration from 2 to 60 days). In the N. V. Sklifosovsky Research Institute for Emergency Medicine, there were no differences between the groups in the basic principles of medical care. Therapeutic measures included complex intensive care, drainage of the pleural cavity and, if necessary, emergency surgical interventions.

CT was performed as a standard method of diagnosing and monitoring the dynamics of the process. No special preparation was required to conduct an emergency investigation. All studies were performed according to the standard protocol. To exclude damage to the main vessels and to reliably assess the lung tissue condition and intrapleural contents, the study was supplemented with intravenous administration of a contrast agent.

All patients with multisystem trauma underwent CT examinations of the brain and cervical spine alongside with chest and abdominal scans on day 1 of admission to the Institute clinic. CT of the thoracic spine was additionally performed in 23 patients, CT of the pelvic bones in 32 patients, CT of the facial skeleton with the construction of three-dimensional reformations in 11 patients. That made possible to diagnose all associated injuries of the multisystem trauma in the shortest possible time and determine the treatment tactics.

When patients developed pyo-inflammatory pulmonary complications, a bacteriology study of bronchoalveolar lavage was performed to study the etiological factor, and the material was selected using devices that allowed minimizing contamination of samples with upper respiratory tract microflora. A bacteriology study was performed on the 1st day after the complication occurred, and then, if necessary.

The samples were cultured on standard nutrient media using generally accepted methods (according to the current regulatory documentation). Identification of isolated microorganisms and determination of sensitivity to antibacterial drugs were performed using a WalkAway 40 automatic microbiological analyzer. The etiological significance of the isolated microorganisms was judged by the constancy index – the number of biomaterial samples in which microorganisms of a particular taxonomic groups were found. The total values of constancy indices can exceed 100%, since in most of the studied samples, microorganisms were present in associations.

STATISTICA 12.0 software package (Stat.Soft, Inc.) was used for statistical processing of the obtained results. All samples were tested for normality of the distribution using the Kolmogorov-Smirnov test. The mean value and mean square deviation were calculated. To compare variables with a normal distribution, we used the paired Student's t-test (for linked and independent samples). The chi-square ($\chi 2$) test was used to compare the nominative data2. The differences between the results obtained were considered statistically significant at $p<0.05$..

RESULTS

MAKING DIAGNOSIS

According to CT data, the rate of detecting the polyfocal rib fractures along two lines was similar in the groups: 35% (n=20) in group I, and 35% (n=13) in group II; but in group I, unilateral fractures prevailed (58%), while in group II bilateral ones prevailed (53%). Sternal fractures were detected in 5 patients of group I (9%), and in 2 patients of group II (5.2%). Based on CT data, the following types of injuries were identified (Table 2).

Table 2

Distribution of victims by the type of chest injuries

Nature of chest injury	Group I n = 51 (100%)	Group II n = 38 (100%)	Significance of differences
Unilateral rib fracture	30 (58.8%)	18 (47.4%)	p = 0.39
Bilateral rib fracture	21 (41.2%)	20 (52.6%)	p = 0.39
Polyfocal rib fracture along two lines	20 (39.2%)	13 (34.2%)	p = 0.79
Pneumothorax	35 (68.6%)	5 (13.2%)	p = 0.0001
Lung contusion and rupture	43 (84.3%)	2 (5.3%)	p = 0.0001
Hemothorax	30 (58.8%)	2 (5.3%)	p = 0.0001
Clavicle fracture	8 (15.7%)	4 (10.5%)	p = 0.69
Sternum fracture	5 (9.8%)	2 (5.3%)	p = 0.69
Fracture of the scapula	8 (15.7%)	3 (7.9%)	p = 0.44
Heart contusion (sternum fracture and clinical findings)	2 (3.9%)	1 (2.6%)	p = 0.79
Aortic injury	4 (7.8%)	0	p = 0.21
Injury of the brachiocephalic veins of the trunk	1 (1.96%)	0	p = 0.88
Diaphragmatic rupture	2 (3.9%)	3 (7.9%)	p = 0.73
Tracheobronchial tree injury	3 (5.9%)	0	p = 0.35

According to the severity of injuries to the chest bone skeleton in the compared groups, the injuries were similar. In Group I, at the first CT scan of the lungs, against the background of diffuse opacities of the "ground glass" type, there were delimited zones of oval or irregular shape with a density of soft tissues and blood: they corresponded to a contusion with a lung rupture and a hematopneumatocele formation.

Subsequently, the lung contusion regressed, and new infiltrative changes were observed outside the contusion areas during the control CT scan. Even at the first CT scan upon admission to the Institute, the majority of patients in group II had consolidation of the lung tissue in the lower lobes along with traumatic changes in the lungs with the preserved bronchial airiness, which corresponded to inflammatory infiltration. It was difficult to assess the severity of the lung tissue injury in group II, since the inflammatory changes had been added by the time of patient admission to the Institute.

The majority of patients in group I were found to have intrapleural contents: pneumothorax was present in 35 patients (68%), hemothorax in 30 (58%).

In group I, lung contusions of varying severity were observed in 43 patients (84%, n=51), ranging from 17 to 900 cm3 in the extent. During dynamic follow-up after 7-10 days, the foci of lung contusion, according to CT data, partially regressed in 20 patients (46.5%, n=43). In the presence of lung rupture with hematopneumatocele formation in 8 patients (16%), the infiltrative lung abnormalities safely resolved at a later time on days 18-30, meanwhile 4 (50%) of them had pneumonia added outside the contusion zones.

In one case, suppuration of the hematopneumatocele was found, which required drainage. In 4 patients with complicated massive blood loss, acute respiratory distress syndrome (ARDS) developed on the 4th-6th day after the injury. Inflammatory changes in the lungs in group I were observed in 16 patients (31%) on days 6-10, in 9 (18%) patients after 2 or more weeks.

The injuried of group II, were admitted to the Institute regardless of the severity of the lung tissue injury on a ventilator. Inflammatory changes in the lungs at admission were confirmed by CT data in 30 patients (79%). Lung rupture with the formation of hematopneumatocele against the background of a contusion was seen in 2 (5.2%) patients; in one of the cases, the suppuration of the hematopneumatocele was observed at the same time, in the other case with multiple rib fractures and the presence of an extensive wound, pleural empyema was observed.

TREATMENT

Emergency surgical interventions on the thoracic organs were performed in 4 patients with AISThorax of gr. 5 in group I: thoracotomy was performed in 2 cases, lobe removal for bronchial injury in one case, suture of the lung tissue rupture in the other. In the 3rd case, the thoracotomy performed was associated with a large laceration of the chest and a severe contusion of the lung, which required wound treatment and rib fixation. In the 4th case, a growing mediastinal hematoma required a sternotomy with suturing of the injuried superior vena cava. There were no emergency interventions in group II.

Urgently delayed interventions were performed in 5 patients of group I AISthorax of gr. 5: in 4 cases they were for aortic trauma, where, after the elimination of hemothorax, its stenting was performed 3–5 days later; and in one case, thoracotomy, lower lobectomy were performed for recurrent pulmonary hemorrhage 14 days later.

There were two interventions performed at the Institute in group II: in one patient with AISthorax of gr. 5 it was for suture incompetence and pleural empyema; on day 7 after the injury, the cleansing and additional drainage of the pleura and soft tissues were performed. In the other case, thoracoscopy was performed for clotted hemothorax in a patient with AISthorax of gr. 4.

Medical care in group I was provided according to the principles of the "golden hour": during the first hour from the moment of admission, the patients with pneumothorax and hemothorax had the pleural cavity drained. In group II, this procedure was performed in other medical institutions upon admission there, and in 5 patients that additional procedure was made at the Institute.

In Group I, ventilators were used in 40 patients (78%), while maintenance ventilation was performed in 5 cases. Tracheostomy was performed in 35 patients (69%). Mechanical ventilation was performed for a mean of 8-12 days or longer.

When conducting targeted therapy in patients with multisystem chest traumaThe basic antimicrobial agents were inhibitor-protected cephalosporins of the third generation (cefoperazone/sulbactam); carbapenems (meropenem and imipenem/cilastatin) in maximum therapeutic dosages. Aminoglycosides (amikacin), (polymyxin B) tigecycline were used for the combination. The duration of antibacterial therapy was from 7 to 14 days, and from 21-28 days in case of generalized bacterial processes.

BACTERIOLOGICAL MONITORING

Sixty five patients were bacteriologically examined, with 55 samples from 35 patients in group I and 52 samples from 30 patients in group II.

When comparing the groups according to the composition of the isolated microflora we found that in patients of group II, the most commonly isolated from LRTS were Acinetobacter spp. (46.7% vs. 17.1% for patients of group I, p=0.021) and Enterococcus spp. (30.0% and 8.6%, respectively, p=0.058), and Klebsiella pneumoniae (46.7% and 37.1%, p=0.6) (Table. 3). While Staphylococcus aureus in group II patients was not found, whereas it was found in 14.3% of patients from group I (p=0.09).

Table 3

Frequency of isolation of microorganisms from LRTD in case of complications in patients with multisystem trauma (in %)

Microorganisms	Group I (n = 35)	Group II (n = 30)	Significance of differences, p
Acinetobacter spp.	17.1	46.7	0.021
P. aeruginosa	25.7	23.3	0.95
K. pneumoniae	37.1	46.7	0.6
E. coli	14.3	23.3	0.54
P. mirabilis	5.7	3.3	0.89
Serratia sp.	5.7	0	0.54
Enterobacter spp.	5.7	16.7	0.31
Enterococcus spp.	8.6	30.0	0.058
S. aureus	14.3	0	0.09
Staphylococcus spp.	5.7	twenty	0.17
Candida spp.	8.6	13.3	0.83
Stenotrophomonas maltophilia	2.9	0	0.94
Other NFGNB	0	3.3	0.94
Other microorganisms	0	3.3	0.94
No growth	8.6	3.3	0.72

Notes: НГОБ — non-fermenting gram-negative bacteria; ОНДП — lower respiratory tract discharge

Analysis of the results of bacteriology studies showed that the complications in the lower respiratory tract (LRT) were more often caused by associations of microorganisms (Table 4), while in patients of group II, associations of microorganisms were detected almost 2 times more often in 86.7% versus 45.7% among the primary hospitalized patients (p=0.001). The mean number of strains per sample was 2.3 and 1.5, respectively.

Table 4

The frequency of isolation of associations of microorganisms from the discharge of the lower respiratory tract in case of complications in victims with multisystem trauma (in %)

Incidence of microorganism isolation	Group I, n = 35	Group II, n = 30	Significance of differences, p
Associations	45.71	86.7	p = 0.001
Monoculture	45.71	10.0	p = 0.004

Thus, when complications in LRT occurred, differences were found in the composition of the leading pathogens: Acinetobacter spp., Enterococcus spp., and K. pneumoniae prevailed in patients of group II, in addition, associations of microorganisms were found much more often in them, and the mean number of strains per sample was also higher. K. pneumoniae and P. aeruginosa prevailed in Group I patients.

When determining the sensitivity of isolated microorganisms to antibacterial drugs, a high prevalence of resistant strains was found among the leading pathogens of pyo-inflammatory diseases of LRT (Table 5). Non-fermenting gram-negative bacteria (NFGNB) (Acinetobacter spp., P. aeruginosa, etc.) had the greatest resistance.

In particular, the resistance of NFGNB to amikacin was 85.7% of all isolated strains in patients of group I and 80.0% of those in group II, 90.0% and 66.7% were resistant to meropenem, 77.8% and 66.7% to imipenem, respectively. Enterobacteria were more sensitive to the tested antibacterial drugs: resistance was 50.0% to amikacin in both groups, 50.0% in group I and only 22.2% in group II to meropenem, 26.7% and 17.6% to imipenem, respectively. The observed differences between the groups were not statistically significant (p=0.78).

Table 5

Resistance to antibacterial drugs of the leading microorganisms isolated from the LRTD of patients with severe multisystem trauma (% of the number of isolated strains)

Microorganism	Amikacin		Meropenem		Imipenem	
	Group I	Group II	Group I	Group II	Group I	Group II
Enterobacteriaceae (total)	50	50	50	22.2	26.7	17.6
NGOB (total)	85.7	80	90	66.7	77.8	66.7

Notes: НГОБ — non-fermenting gram-negative bacteria; ОНДП — lower respiratory tract discharge

When assessing the sensitivity of gram-positive microorganisms to antibiotics, we found that all Enterococcus spp. isolated during this study Enterococcus spp. were sensitive to vancomycin (both in groups I and II). Significant differences were observed among Staphylococcus spp.: in patients of group I, the number of methicillin-resistant (MR) strains was only 14.3%, while in group II it was 83.3% (p=0.00001).

Thus, when determining the sensitivity of microorganisms isolated from LRT to antibacterial drugs, we revealed that in all patients with severe multisystem trauma complicated by pyo-inflammatory processes in the LRT, resistant strains are widespread among the pathogens.

COMPLICATIONS

In the course of the post-traumatic period, along with pneumonia, other complications were identified, which were divided into infectious and non-infectious (Table 6). Non-infectious complications occurred on days 1-10 after the injury. Thus, in group I, bleeding into bronchus was associated with a severe lung injury and required urgently delayed surgical treatment. The development of acute renal failure in 3.9% (2 cases), ARDS in 7.8% (4 cases) was observed in patients of group I, while in group II, the ARDS was observed in one case (2.6%). Lung atelectasis was detected in 3 patients (5.9%) of group I and in 1 patient (2.6%) of group II. The hydrothorax revealed in 5 patients (9.8%) of group I and in 4 (10.5%) patients of group II required additional drainage of the pleural cavity for 7-10 days; the brain edema in patients with severe traumatic brain injury (TBI) was observed in 2 patients (5.9%) of group I and in one of group II (2.6%).

Table 6

Complications in patients with chest trauma on the background of associated injuries (in %)

Complications	Group I,, n=51 (100%)	Group I,, n=38 (100%)	Significance of differences, p
Non-infectious			
Bleeding into bronchus	1 (1,9)	0	0,88
Hydrothorax	5 (9,8)	4 (10,5)	0,81
Acute renal failure	2 (3,9)	1 (2,6)	0,78
Atelectasis	3 (5,9)	1 (2,6)	0,83
ARDS	4 (7,8)	1 (2,6)	0,56
Cerebral edema associated with severe TBI	3 (5,9)	1 (2,6)	0,83
Low limb deep vein thrombophlebitis	1 (1,9)	0	0,88
Total	19 (37,3)	8 (21)	0,16
Infectious			
Pneumonia, unilateral	4 (7.8)	6 (15.8)	p = 0.40
Pneumonia, bilateral	21 (41.2)	20 (52.6)	p = 0.39
Purulent tracheobronchitis	12 (23.5)	14 (36.8)	p = 0.26
Clotted infected hemothorax	2 (3.9)	1 (2.6)	p = 0.78
Sepsis (MOF)	6 (11.8) *	12 (31.6)	p = 0.04
Meningitis	2 (3.9)	1 (2.6)	p = 0.78
Pleural empyema	0	1 (2.6)	p = 0.88
Hematopneumatocele suppuration	1 (1.9)	1 (2.6)	p = 0.61
Pancreatic necrosis with parapancreatic fluid collections	1 (1.9)	3 (7.9)	p = 0.41
Acute cholecystitis	2 (3.9)	0	p = 0.61
Urinary tract infection	3 (5.9)	0	p = 0.35
Colitis due to C. difficile	2 (3.9)	0	p = 0.61
Total	56 (109.8)	59 (155.26)	p = 0.003

Notes: ОРДС — acute respiratory distress syndrome; ПОН — multiple organ failure; ЧМТ — traumatic brain injury

Infectious lesions of the lungs and bronchial tree more often developed in patients of group I on days 7-10, while in patients of group II they were diagnosed immediately upon admission to the Institute on days 3 and 7 after the injury.

During the treatment, bilateral pneumonia was the most common complication observed in both groups: in 21 patients (41.2%) of group I, in 20 (52.6%) patients of group II. Purulent tracheobronchitis was detected in 12 (23.5%) and 14 (36.8%) patients, respectively. All patients were on mechanical ventilation.

Two patients (3.9%) of group I and 1 patient (2.6%) of group II were found to have clotted hemothorax on day 7 after the injury. Meningitis was observed in patients of both groups: in 2 (3.9%) patients in group I and

in 1 (2.6%) patient of group II. Suppuration of hematopneumatocele in both groups developed by the 3rd week and was observed in isolated cases in both groups: in 1 (1.9%) case in group I, and in 1 (2.6%) case of group II. The complications such as parapancreatitis, pseudomembranous colitis caused by Clostridium difficile were found in few cases. Sepsis with the MOF development was observed in 6 (11.8%) patients in group I, in 12 (31.6%) patients of group II; the observed differences in sepsis between the groups were statistically significant (p=0.04).

Of the 89 injuried, 65 survived, with a mortality rate of 26.9%. In group I, 13 (22.4%) died, 11 patients (28.9%) died in group II. The leading cause of death in group I on days 6-10 was acute respiratory distress syndrome in 3 patients (23.1%), and the head injury with brain edema in 3 patients (23.1%) on the background of pneumonia; in the later the time, the main cause of death was sepsis in 3 (23.1%) and MOF also in 3 patients (23.1%) on the background of pneumonia. In Group II, sepsis prevailed in 5 (45.5%) and MOF in 5 patients (45.5%) in combination with pneumonia (Table 7).

Table 7

Complications in fatalities with associated trauma (% of deaths)

Causes	Group I, *n*=13 (100%)	Group II, *n*=11 (100%)	Significance of differences, *p*
Pneumonia	7 (53.8)	9 (81.8)	0.31
Bronchopneumonia with abscess formation	2 (15.4)	1 (9.1)	0.88
ARDS	3 (23.1)	1 (9.1)	0.71
ARDS at later phase	1 (7.7)	0	0.93
TBI. Cerebral edema	3 (23.1)	2 (18.2)	0.83
Hemorrhage into the cerebral ventricle	1 (7.7)	0	0.93
Meningitis, ventriculitis	2 (15.4)	1 (9.1)	0.88
Cerebral edema with destruction of myelin sheaths	2 (15.4)	0	0.54
Sepsis	3 (23.1)	5 (45.5)	0.47
MOF	3 (23.1)	5 (45.5)	0.47
Tracheoesophageal fistula	1 (7.7)	1 (9.1)	0.54
Necrotizing nephrosis	0	1 (9.1)	0.93
Fat embolism	1 (7.7)	1 (9.1)	0.54
Pleural empyema	0	1 (9.1)	0.93
Pseudomembranous colitis	1 (7.7)	0	0.93
Pancreas focal necrosis	2 (15.4)	0	0.54
Renal failure	1 (7.7)	0	0.93
Pleural empyema on the right	0	1 (9.1)	0.93

Notes: ОРДС — acute respiratory distress syndrome; ПОН — multiple organ failure; ЧМТ — traumatic brain injury

Thus, in group I, pneumonia against the background of lung contusion developed in cases where the lung contusion was being resolved in most cases, while in group II, the inflammatory changes in the lungs were already at the time of transfer to the Institute and the course of the inflammatory process acquired a generalized character in 45.5%, which was the cause of their death. Only in one case, in a group II patient, the cause of death was the chest injury complicated by soft tissue phlegmon and pleural empyema against the total bilateral pneumonia.

DISCUSSION

Currently, the diagnosis and treatment of blunt chest trauma includes a set of measures aimed at assessing the severity of the injury and eliminating known pathogenetic mechanisms, including recovery from shock, adequate anesthesia, blood loss replacement, oxygenation, and determination of management tactics.

It is known that injuries to organs and tissues cause both local and general responses of the body due to the production of pro-inflammatory cytokines, which depends on the severity of the injury, the body's response to it, the characteristics of life support measures and the correction performed. It was noted that in patients, such parameters as the severity of injury (ISS) and the critical need for prehospital intubation increase the risk of developing pneumonia [11-1]. In addition, the risk of developing pneumonia also increases in the presence of a chest injury, severe TBI, or large blood loss [11, 13, 23]. A lung contusion plays a considerable role in the development of lung complications.

CT can both objectively assess the state of lung tissue and damage to other organs and systems, and also determine the dynamics of traumatic changes in the lung tissue in all injuried [6, 22, 25].

The obtained results show that in the injuried admitted to the Institute after trauma, with a timely drainage of the pleural cavity for pneumohemothorax, the injuries of the lungs AISthorax at least 2.4 had resolved by day 6-7; more severe injuries with the presence of pneumatohematocele had resolved by day 21 or later, infection was observed in a few cases, in one and the other groups.

Emergency and urgently delayed surgical treatment of patients with AISthorax of at least 5 provided hemo- and aerostasis. The ARDS development in these patients was observed both in massive blood loss, and with severe trauma as well. The developed management tactics in group I made it possible to avoid inflammatory phenomena in the lungs on days 6-10 in 49.01% of cases, while in patients transferred to the Institute, inflammatory phenomena in the lungs were already observed on days 3 and 7 after the injury.

The analyzed results of bacteriology studies of LRTS showed that complications were caused by associations of microorganisms, meanwhile they were detected almost 2 times more often in the patients transferred from other medical institutions than in those who were primarily hospitalized ($p=0.04$).

When determining the sensitivity of isolated microorganisms to antibacterial drugs, a high prevalence of resistant strains was found among the leading pathogens. Microbiology monitoring made it possible to identify the etiological structure of infectious complications and timely correct antibacterial therapy.

In the course of the post-traumatic period, along with pneumonia, other complications were identified, which were divided into infectious and non-infectious. The non-infectious complications in group I were associated with the severity of the chest injury, the amount of blood loss, occurred on the 1st-10th day after the injury and included bleeding into the bronchus, the development of acute renal failure, ARDS; meanwhile in group II, the ARDS and lung atelectasis were observed.

Infectious complications were of one type, the most common were bilateral pneumonia, purulent tracheobronchitis, sepsis, which prevailed in group II.

Improvement of the diagnostic system for admission of the injuried at early stages after injury, ensuring the respiratory function of the lungs, identifying the indications for early surgical intervention, and bacteriological monitoring are the priority measures.

Thus, the outcome of the injury, along with adequate life support measures, depends on timely diagnosis of injuries, identification of dominant damage, and determination of the condition severity.

The priority in intensive care is to control the life-threatening consequences of trauma. Correction of pathological abnormalities in the chest (elimination of pneumothorax and hemothorax by pleural cavity drainage), selection of the timing of surgical intervention on the intrathoracic organs, musculoskeletal system and head contribute to reducing the incidence of pulmonary complications.

CONCLUSIONS

1. Early computed tomography diagnosis of multisystem trauma makes it possible to assess the severity of injuries to the chest organs and other areas of the body and determine the treatment tactics.
2. An integrated approach to the management of the injuried, including am early diagnosis of trauma, the pleural cavity drainage, choosing the management tactics, bacterial assessment of the lower respiratory tract sputum help to reduce infectious complications by a mean of 45.46%.

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