

FORENSIC MEDICAL ASPECTS OF THE SEVERITY OF CHEST INJURIES ACCORDING TO THE RESULTS OF THE EXAMINATION OF PATIENTS IN A SPECIALIZED HOSPITAL¹Kharkiv National Medical University (Kharkiv, Ukraine)²Kharkiv Regional Bureau of Forensic Medical Examination (Kharkiv, Ukraine)

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Closed chest trauma can cause impaired functioning of the respiratory system. Victims with closed chest trauma may be subject to forensic medical examination. The purpose of the study is to determine the severity of closed blunt chest trauma from a forensic perspective based on the results of an examination of patients in a specialised hospital to identify additional diagnostic criteria. The material for the study was the medical records of 103 inpatients of the Zaycev V.T. Institute of General and Emergency Surgery. Considering the diagnostic examination of the victims in the observation groups, the severity of the injuries was determined. Severe bodily injuries were diagnosed in 19 (18.4%) cases of closed chest injuries with acute respiratory failure and loss of part or all of an organ (lung). Injuries of moderate severity were diagnosed in 70 (67.9%) cases of closed chest trauma, mostly with rib fractures, in the absence of life-threatening injuries. Minor injuries were diagnosed in 14 (13.6%) cases of chest trauma without rib fractures with intrapleural injuries and complications or without any complications. It has been established that in the forensic assessment of closed chest injuries, additional diagnostic criteria should be considered: the presence of acute respiratory failure, the dynamics and duration of recovery of post-traumatic morphological and functional changes in injured organs, and the loss of part or all of an organ (lung).

Key words: forensic medical examination, chest injury, diagnostic criteria, severity of injuries.

Connection of the publication with planned research works.

The research work is a fragment of the research work "Determination of the statute of limitations for death and the degree of severity of bodily injuries by forensic diagnostic features" (state registration number 0121U110929).

Introduction.

Closed blunt chest injury (CBCI) is a common type of injury to the respiratory system [1-3]. In this case, the victims often suffer damage to the ribs, internal organs, lungs, and pleural cavity tightness [4-6]. Determining the severity of bodily injuries is one of the main tasks in victims with non-fatal CBCI who become the subject of forensic examination [7-9].

The study of special literature sources [8, 10-13] shows that different approaches can be applied to using criteria in the forensic medical assessment of these injuries. There are contradictions in the classification of life-threatening CBCI from a forensic perspective. Following the current regulatory documents of Ukraine, in particular, according to the "Rules for Forensic Determination of the Severity of Bodily Injuries" (enacted by Order of the Ministry of Health of Ukraine № 6 of 17.01.1995), CBCI should be assessed as serious bodily injuries only in the presence of life-threatening phenomena listed in para. 2.1.3 "o", in particular acute respiratory failure [14]. Some scientists consider all CBCI with hemopneumothorax as serious bodily harm, as life-threatening. At the same time, they do not consider the nature and severity of the injuries, life-threatening phenomena [9, 11, 12].

The aim of the study.

To determine the severity of closed blunt chest injury from the forensic point of view based on the results of

the examination of patients in a specialised hospital to identify additional diagnostic criteria.

Object and research methods.

The data from 103 medical records of patients who have been treated at the V.T. Zaitsev Kharkiv Institute of General and Emergency Surgery over the past ten years were used in this study. Four groups of victims were identified. The first group included patients with full recovery of the function of their injured organs within 21 days. The second group consisted of patients with positive dynamics but incomplete disappearance of post-traumatic morphological changes and restoration of chest organs function: within 6 days (subgroup "a"), within 7 to 21 days (subgroup "b"), within 21 days to 31 days (subgroup "c"), within 1 month up to 2 months (subgroup "d"), for more than 2 months up to 3 months (subgroup "e"), for more than 3 months up to 1 year (subgroup "f"), for more than 1 year (subgroup "g"). The third group included patients who had lost part or whole of their respiratory organ (lung). The fourth group included patients with acute respiratory failure. The following methods were used in the study: registration method – the data obtained were entered into specially designed registration cards; standard method of descriptive statistics, comparative statistics (Student's criterion); forensic method – the nature of injuries was determined, the severity of injuries was established; X-ray method; ultrasound diagnostics.

Research results and their discussion.

The analysis of observations allowed us to identify morphological and clinical variants of CBCI in patients in the observation groups, which we summarised in **table 1**.

In addition, we found that male patients were the most frequently diagnosed with CBCI – 88 (85.4%) cases, and 47 (45.6%) patients were of working age

20-50 years. Domestic traumas are the most common cause of CBCI. The impact of blunt, hard objects on the chest was the leading mechanism of injury in all cases. The table shows that patients had rib fractures in 71 (68.9%) cases. Intrapleural injuries and complications occurred in 55 (53.4%) patients with rib fractures. In 35 (33.9%) cases of CBCI in the absence of rib fractures, intrapleural injuries and complications occurred.

The existing post-traumatic morphological changes were detected mainly using chest X-ray examination, which was performed in all patients (table 2). The following radiological changes were detected. On admission, the left lung was compressed mainly with air in 25 (24.3%) patients, the right lung in 20 (19.4%) patients had a collapse rate of 33.8±2.7% and 37.6±3.9%, and Pt2<0.01 was significantly different from the control values. After the treatment, there were radiological statistically significant Pt2<0.01 signs of lung expansion of 2.8±0.6 and 1.4±1.0% (Pt1<0.01).

Radiological signs of post-traumatic inflammation in the form of lung tissue infiltration on the left at admission were present in 17 (16.5%) and on the right in 11 (10.7%) patients and accounted for 23.8±2.5% and 26.4±3.3%, and were significantly Pt1<0.01 different from the control values. After the treatment, there were also radiological statistically significant Pt2<0.01 signs of a decrease in the % of infiltrative changes to 1.9±0.9% and 1.4±1.0% (Pt1<0.05).

Radiological signs of blood in the left pleural cavity at admission were present in 26 (25.3%) patients and in the right in 27 (26.2%) patients, and on average, they were 442.4±82.9 and 453.7±67.7 ml and significantly Pt1<0.01 different from the control values. After the treatment, these indicators also decreased significantly Pt2<0.05 and amounted to 20.6±4.2 and 37.2±6.7 (Pt1<0.01).

Blood clots in the pleural cavities during hospitalisation occurred in 5 (4.9%) patients, and on average, this indicator was 750±205 ml, and significantly, Pt1<0.05 differed from the control values. After the treatment, this indicator also decreased significantly Pt2<0.01 and amounted to 20±4.1 (Pt1>0.05).

Exudate in the pleural cavities during hospitalisation was present in 11 (10.7%) patients, and on average, this indicator was 220.8±66.9 ml, and significantly, Pt1<0.01 differed from the control. After the treatment, this indicator also decreased statistically significantly Pt2<0.01 and amounted to 42.5±23.5 (Pt1<0.01).

Radiological signs of rib consolidation during hospitalisation were detected in 65 (63.1%) patients, which amounted to 15.4±3.6% and significantly

Table 1 – Morphological and clinical variants of closed chest injuries

Nature of injury	Observation groups								Total	%		
	I	II									III	IV
		a	b	c	d	e	f	g				
CBCI, rib fractures		4	12							16	15,6	
CBCI, rib fractures, intrapleural injuries and complications:												
– haemothorax			7	1			1		1	10	9,7	
– coagulated haemothorax				2	3			1	2	8	7,8	
– pneumothorax		2	5		1				3	11	10,7	
– haemopneumothorax		3	7		2	2	1		6	21	20,4	
– pleural effusion, hydrothorax					1	1				2	1,9	
– pneumonia, sternum fracture					1					1	1,0	
CBCI, without rib fractures, presence of intrapleural injuries and complications:												
– haemothorax		2	3	1	1					7	6,8	
– coagulated haemothorax			1		1					2	1,9	
– pneumothorax	1	2	1		1			1	1	7	6,8	
– haemopneumothorax		1	1	1					2	5	4,8	
– post-traumatic pleural empyema				1						1	1,0	
– post-traumatic lung abscess					1					1	1,0	
– hernia of the diaphragm							1	1		2	1,9	
– pleural effusion					1		1			2	1,9	
CBCI, contusion, presence of intrapleural injuries:												
– bruised lung, pulmonary bleeding								1		1	1,0	
– post-traumatic pneumonia			4	1						5	4,8	
– contusion, pulmonary gangrene, haemothorax								1		1	1,0	
Total	1	14	41	7	13	3	4	1	4	15	103	100

Pt1<0.01, which differed from the control group. After the treatment, this indicator also increased significantly Pt2<0.01 45.1±4.0 and amounted to 20±4.1 (Pt1<0.01).

The mediastinum was shifted to the left or right in 8 (7.8%) patients; at hospitalisation, this indicator was 15.4±3.6 and significantly, Pt1<0.01 differed from the control values. After treatment, this indicator returned to normal.

The X-ray examination clearly shows the positive dynamics of pathomorphological changes in patients with CBCI, but some minor residual changes are still observed in some cases.

While in the hospital, patients underwent a computed tomography scan of the chest cavity. The following pathological changes were found, as shown in table 3.

A computed tomography scan was performed to clarify the results of an X-ray examination or in cases where the X-ray examination was not sufficiently informative. This examination revealed rib fractures, air, and blood in the pleural cavity.

While in the hospital, patients also underwent an ultrasound examination of the pleural cavity. The following pathological changes were observed, as shown in table 4.

Based on the results of the forensic assessment of the clinical observations of the CBCI, we established the following degree of severity of bodily injury. Severe bodily injuries according to the criterion of «life-threatening» para. 2.1.3 subpara. «o» of the «Rules...» were established in 15 (14.6%) patients with CBCI who had signs of acute respiratory failure.

Table 2 – Radiological parameters of the injured persons

Nature of changes	Research stage	Indicator
Left/right lung collapse by air in % (M±m)	During hospitalisation	33,8±2,7/37,6±3,9 Pt1<0,01; Pt2<0,01
	During discharge	2,8±0,6/2,6±0,7 Pt1<0,01
	Control	0±0
Infiltration of lung tissue on the left/right side in % (M±m)	During hospitalisation	23,8±2,5/26,4±3,3 Pt1<0,01; Pt2<0,01
	During discharge	1,9±0,9/1,4±1,0 Pt1<0,05
	Control	0±0
Blood clots in pleural cavities, ml (M±m)	During hospitalisation	750±205 Pt1<0,05;Pt2<0,05
	During discharge	20±4,1 Pt1>0,05
Blood in the left/right pleural cavity, ml (M±m)	During hospitalisation	442,4±82,9/453,7±67,7 Pt1<0,01; Pt2<0,05
	During discharge	20,6±4,2/37,2±6,7 Pt1<0,01
	Control	0±0
Exudate in pleural cavities in ml (M±m)	During hospitalisation	220,8±66,9 Pt1<0,01; Pt2<0,01
	During discharge	42,5±23,5 Pt1<0,01
	Control	0±0
Consolidation of ribs, %	During hospitalisation	15,4±3,6 Pt1<0,01; Pt2<0,01
	During discharge	45,1±4,0 Pt1<0,01
	Control	0±0
Mediastinum shifted to the left or right, %	During hospitalisation	15,4±3,6 Pt1<0,01
	During discharge	0±0 Pt1<0,01
	Control	0±0

Notes: 1. Pt1 – significance of differences by Student’s criterion in comparison with the control group; 2. Pt2 – significance of differences by Student’s criterion in comparison of indicators at hospitalisation (first study) and discharge (second study).

We also established severe bodily injuries in 4 (3.9%) cases of CBCI in patients of group III according to the criterion «persistent loss of at least one-third» of para. 2.1.6 of the «Rules...».

We assessed the injuries of moderate severity, which caused a long-term health disorder lasting more than

Table 3 – Computed tomography scans of the injured persons

Nature of changes	Research stage	Indicator
Left/right lung collapse by air in % (M±m)	During hospitalisation	43,7±10,2 Pt1<0,05; Pt2<0,05
	During discharge	4,3±10,2 Pt1<0,05
	Control	0±0
Consolidation of ribs, in % (M±m)	During hospitalisation	30±12,1 Pt1<0,01; Pt2>0,05
	During discharge	66±12,1 Pt1<0,01
	Control	0±0
Blood in pleural cavities in ml (M±m)	During hospitalisation	702,5±211,8 Pt1<0,05;Pt2<0,05
	During discharge	58,4±17,6 Pt1<0,05
	Control	0±0

Notes: 1. Pt1 – significance of differences by Student’s criterion in comparison with the control group; 2. Pt2 – significance of differences by Student’s criterion in comparison of indicators at hospitalisation (first study) and discharge (second study).

three weeks (more than 21 days), para. 2.2.1 «с» of the «Rules...», as follows: 16 (15.5%) cases of CBCI with rib fractures, without complications; 40 (38.8%) cases of CBCI with rib fractures, intrapleural complications and combined injuries. In addition, 14 (13.6%) cases of CBCI without rib fractures, with intrapleural injuries and complications, were classified as moderate injuries according to the same criterion.

Thirteen (12.6%) cases of CBCI, without rib fractures, with intrapleural injuries and complications, were

Table 4 – Indicators of ultrasound examination in injured persons

Nature of changes	Research stage	Indicator
Blood in pleural cavities, ml (M±m)	During hospitalisation	161,5±49,1 Pt1<0,01; Pt2<0,01
	During discharge	9,2±3,2 Pt1<0,05
	Control	0±0
Exudate in the pleural cavity in the left/right, ml (M±m)	During hospitalisation	238,9±54,2/165,7±31,3 Pt1<0,01; Pt2<0,05
	During discharge	57,2±33,1/40±31,2 Pt1>0,05
	Control	0±0

Notes: 1. Pt1 – significance of differences by Student’s criterion in comparison with the control group; 2. Pt2 – significance of differences by Student’s criterion in comparison of indicators at hospitalisation (first study) and discharge (second study).

assessed as minor bodily injuries that caused a short-term health disorder, according to para. 2.3.2 «a» of the «Rules...».

According to para. 2.3.2 «b» of the «Rules...», 1 (1.0%) case of CBCI without rib fractures and pneumothorax was classified as minor bodily injury.

Conclusions.

1) In clinical practice, the leading place is occupied by injuries with fractures of the rib frame of the chest (68.9%), often with the presence of intrapleural injuries and complications (53.4%). Injuries with signs of organ or partial organ loss and life-threatening injuries accounted for 18.4%.

2) The main research method to detect the presence and dynamics of morphological changes in CBCI is the method of radiological diagnosis. Additionally, computed tomography and ultrasound can be used. These methods are the leading ones for the correct forensic assessment of the severity of CBCI.

3) According to clinical observations in the distribution of the severity of CBCI, severe injuries account for 18.4% of patients with acute respiratory failure and loss of part or all of an organ (lung). Moderate injuries ac-

count for 67.9% of patients with mostly non-life-threatening rib fractures. Minor injuries account for 13.6% of cases in patients without rib fractures, with the presence or absence of intrapleural injuries and complications in cases of minor injuries.

4) Appropriate scientific and methodological literature containing clear diagnostic morphological and clinical signs is needed for a qualitative forensic medical assessment and prediction of the final results of CBCI.

5) Additional diagnostic signs should be used to assess the outcome of CBCI: the presence of dynamics and duration of recovery of posttraumatic morphological and functional changes in injured organs, which can be confirmed primarily by X-ray examination, the occurrence of acute respiratory failure, loss of part or all of an organ (lung).

Prospects for further research.

They should include the study of all possible morphological and clinical manifestations of the trauma under investigation and the development of a clear technology for conducting forensic medical examinations.

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СУДОВО-МЕДИЧНІ АСПЕКТИ ТЯЖКОСТІ ТРАВМ ГРУДНОЇ КЛІТКИ ЗА РЕЗУЛЬТАТАМИ ОБСТЕЖЕННЯ ПАЦІЄНТІВ НА БАЗІ СПЕЦІАЛІЗОВАНОГО СТАЦІОНАРУ

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Закрита травма грудної клітки може стати причиною порушення функціонування органів апарату зовнішнього дихання. Постраждали з закритою травмою грудної клітки можуть стати об'єктом для проведення судово-медичної експертизи. Мета роботи полягає у встановленні з судово-медичних позицій тяжкості закритої тупої травми грудної клітки за результатами обстеження пацієнтів на базі спеціалізованого стаціонару для виявлення додаткових діагностичних критеріїв. Матеріалом для роботи слугували медичні карти 103 стаціонарних хворих Харківського інституту загальної та невідкладної хірургії імені В.Т. Зайцева. З урахуванням діагностичного обстеження постраждалих в групах спостережень визначено ступінь тяжкості тілесних ушкоджень. Тяжкі тілесні ушкодження встановлені в 19 (18,4%) випадках закритих травм грудної клітки з виникненням гострої дихальної недостатності та втратою частини або всього органу (легені). Ушкодження середньої тяжкості встановлені в 70 (67,9%) випадках закритих травм грудної клітки переважно з переломами ребер за відсутності небезпеки для життя. Легкі тілесні ушкодження встановлені в 14 (13,6%) випадках травми грудної клітки без переломів ребер з наявністю внутрішньоплевральних ушкоджень і ускладнень або без будь-яких ускладнень. Встановлено, що при судово-медичній оцінці закритих травм грудної клітки необхідно враховувати додаткові діагностичні критерії: наявність гострої дихальної недостатності, динаміку та тривалість відновлення посттравматичних морфо-функціональних змін травмованих органів, втрату частину або всього органу (легені).

Ключові слова: судово-медична експертиза, травма грудної клітки, діагностичні критерії, ступінь тяжкості тілесних ушкоджень.

Зв'язок публікації з плановими науково-дослідними роботами.

Наукова робота є фрагментом НДР «Визначення давності настання смерті та ступеня тяжкості тілесних ушкоджень за судово-медичними діагностичними ознаками» (№ державної реєстрації 0121U110929).

Вступ.

Закрита тупа травма грудної клітки (ЗТТГК) є частим видом ушкоджень органів апарату зовнішнього

дихання [1-3]. При цьому у постраждалих часто ушкоджуються ребра, внутрішні органи, легені, порушується герметичність плевральної порожнини [4-6]. Визначення ступеня тяжкості тілесних ушкоджень є одним із головних завдань у постраждалих з несмертельною ЗТТГК, які стають об'єктом судово-медичної експертизи [7-9].

Дослідження спеціальних літературних джерел [8, 10-13], показує, що можуть застосовуватись різні