FORENSIC MEDICAL DETERMINATION OF SEVERITY OF CHEST INJURIES WITH THORAX TRAUMA

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ABSTRACT

Background. Closed chest trauma with rib fractures is a common injury to the external respiratory system. Victims with such an injury may be subject to forensic examination.

The aim of the study was to determine the severity of injuries in patients with closed chest trauma with violation of the integrity of the costal skeleton, treated in a specialized surgical hospital, to establish additional criteria for forensic diagnosis of such trauma.

Materials and Methods. 71 medical cards of inpatients, patients with chest injuries who were treated at Kharkiv Institute of General and Emergency Surgery named after V.T. Zaitsev were analyzed. A forensic medical evaluation of closed chest injuries with rib fractures was performed according to the severity of injuries according to clinical observations. Morphological and clinical approach was used to determine severity of injuries.

Results. Severe injuries were found in 14 (19.7%) cases of injuries, mainly with the occurrence of a life-threatening phenomenon, namely acute respiratory failure. Moderate injuries were found in 57 (80.3%) cases of chest injuries with rib fractures in the absence of danger to life.

Conclusions. It is established that in the available scientific and methodological literature there are no diagnostic morpho-clinical signs for qualitative forensic assessment and prediction of the final results of closed chest injuries, there are different views on forensic assessment. It is determined that when applying the morphological and clinical approach of forensic assessment, additional diagnostic criteria for closed chest injuries, should be considered when determining the severity of injuries: dynamics and duration of recovery of post-traumatic morphological and functional changes of injured organs. or the entire respiratory system (lungs), the occurrence of life-threatening phenomena. The ways of further improvement of forensic diagnostics in the assessment of these injuries by the degree of their severity are identified.

Keywords: *forensic examination, chest injury, diagnostic criteria, severity of injuries*.

INTRODUCTION

Chest injuries are a common type of injury, both in peacetime and in wartime [1, 2]. At the closed injuries of the thorax first of all its bone basis is broken [3, 4]. This circumstance is the main cause of trauma to the thoracic cavity [5]. Closed chest trauma can primarily adversely affect the smooth functioning of the external respiratory system [6, 7]. Victims with non-fatal closed blunt chest trauma (CBCT) with fractures of the ribs require a forensic examination to determine severity of injuries [8–10].

In accordance with the current regulations of Ukraine, in particular, according to the "Rules of forensic determination of the severity of injuries" (enacted by the order of the Ministry of Health of Ukraine No.6 from 17 Jan 1995) in classifying such injuries to one or another severity, criteria "danger to life", "permanent loss of general ability to work", "duration of health disorder" may be used [11]. However, as shown by the study of special literature, there are two opposing approaches in the forensic assessment of CBCT and, accordingly, the application of certain qualification criteria [12, 13]. Some experts propose the so-called morphological approach, in which may be used morphological, post-traumatic changes, lung rupture, hemopneumothorax to identify the damage as life-threatening and allow it to be assessed as severe [10, 14]. According to other experts, it is necessary to apply a morpho-clinical approach, in which in addition to the morphology of the injury, it is necessary to assess the presence of clinical signs of life-threatening conditions, including

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acute respiratory failure (ARF) [11, 12]. And only in the case of its presence can the damage be assessed as life-threatening and be classified as grievous bodily harm. Otherwise, the criterion of "duration of health disorder" or "permanent loss of general ability to work" of regulatory documents should be used for forensic assessment. Thus, the presence of these two opposing views shows the lack of a unified scientific and methodological approach in the forensic assessment of CBCT. This can in some cases lead to underestimation or overestimation of the severity of injuries and, accordingly, to expert errors [13]. This in turn can lead to incorrect classification of the crime by law enforcement agencies.

Purpose, subjects and methods:

1. The purpose of the study was to determine the severity of injuries in patients with closed blunt chest trauma with a violation of the integrity of the costal skeleton, treated in a specialized surgical hospital, to establish additional criteria for forensic diagnosis of such trauma.

2. Subjects & Methods

The material for the analysis was medical records of inpatients who were treated during the recent decade at Kharkiv Institute of General and Emergency Surgery named after V.T. Zaitsev. In total, medical records were processed retrospectively in 71 patients. The study material was divided into 3 groups depending on the dynamics of morpho-functional post-traumatic changes in the thoracic organs responsible for respiratory function, the final results and the presence of life-threatening phenomena in patients. The first group included patients with positive dynamics, but incomplete recovery functions of the chest and the disappearance of post- traumatic morphological changes: up to 6 days (subgroup "a"), during from 7 to 21 days (subgroup "b"), in the period over 21 days to 31 days (subgroup "c"), for a period of more than 1 month, up to 2 months (subgroup "d"), for a period of more than 2 months, up to 3 months (subgroup "e"), for a period of more than 3 months, up to 1 year (subgroup "f"). The second group included patients who lost part or all of their respiratory organ (lung) as a result of the injury. The third group included the patients who developed an acute life-threatening condition against a background of CBCT, namely ARF. The following methods were used in the study: registration method – the obtained data were entered into specially developed registration cards; standard method of descriptive statistics; forensic – determined the nature of the injuries, determined the severity of injuries. This study was permitted by the commission on ethics and bioethics of Kharkiv National Medical University. During the examination, oral and written consent was obtained from all victims.

Results and discussion

The analysis of observations showed that among the causes of CBCT domestic injuries occupied the first place. According to the mechanism of damage in all cases there was shock effect of blunt solid objects on the chest. CBCT prevailed in males – 58 (82%) cases, of working age 20–50, had 35 (49%) patients. It should be noted that the distribution of patients obtained by the mechanism of damage, age and sex in general coincides with the literature [1, 4].

The lesions detected in patients in the observation groups were systematized and morpho-clinical variants of CBCT were identified (*Table*). The table shows that 16 (22.5%) patients with rib fractures from the first group did not have any intrapleural injuries and complications. Intrapleural injuries and complications occurred in 55 (77.5%) patients with rib fractures of the first, second and third groups. Hemothorax occurred in 9 (12.7%) cases of CBCT with fractures of several ribs, in 1 (1.4%) case with fractures of one rib. Coagulated hemothorax occurred in 8 (11.3%) cases of CBCT with fractures of several ribs. Pneumothorax occurred in 10 (14.1%) cases of CBCT with fractures of several ribs, in 1 (1.4%) case with fractures of one rib. Hemopneumothorax occurred in 18 (25.4%) cases of CBCT with fractures of several ribs, in 3 (4.2%) cases with fractures of one rib. Post-traumatic pleurisy occurred in 6 (8.5%) cases, mainly in patients of the first group, encapsulated hydrothorax occurred in 1 (1.4%) case in a patient of the first group. Post-traumatic chondroma of the ribs occurred in 1 (1.4%) case in a patient of the first group, bronchopleurothoracic fistula occurred in 1 (1.4%) case in a patient of the third group. Pulmonary contusion was reported in 4 (4.2%) patients, mostly of the third group. Post-traumatic pneumonia occurred in 4 (5.6%) cases in patients of the first group.

Existing post-traumatic morphological changes were detected mainly by X-ray examination of the chest, which was performed in all patients. This study revealed fractures of the ribs, air, blood, fluid in the pleural cavity, changes in the parenchyma of lung tissue. Computed tomography was performed in some observations in order to clarify the results of X-ray examination, or in cases where the X-ray examination was not infor-

Table. Variations of closed chest injuries in the observed groups.

The nature of the injury	Observation groups								Total	%
	I						II	III		
	a	b	c	d	e	f				
CBCT, fractures of several ribs, without complications	3	12							15	21.2
CBCT, fracture of one rib, without complications	1								1	1.4
CBCT, fractures several ribs, the presence of intrapleural complications and injuries:										
- hemothorax		4	1					1	6	8.6
- hemothorax, exudative pleurisy		3							3	4.2
- clotted hemothorax		1		1				1	3	4.2
- clotted hemothorax, pleural empyema		1	1						2	2.8
- clotted hemothorax, lung contusion				1					1	1.4
- pneumothorax		2						2	4	5.6
- pneumothorax, sternal fracture		1	1					2	4	5.6
- hemopneumothorax	2	4		2				1	9	12.8
- hemopneumothorax, lung contusion							1		1	1.4
- hemopneumothorax, hemothorax								1	1	1.4
- hemopneumothorax, pleurisy				1		1			2	2.8
- hemopneumothorax, pleurisy, diaphragm rupture	1	1							2	2.8
- hemopneumothorax, pneumonia						1			1	1.4
- hemopneumothorax, sternal fracture, contusion of lungs								2	2	2.8
- clotted hemothorax, pneumothorax				1					1	1.4
- clotted hemothorax, pneumothorax, wound lungs, pleurisy								1	1	1.4
- encapsulated pleurisy, pneumonia				1					1	1.4
- sacculated hydrothorax					1				1	1.4
- post-traumatic chondroma of the ribs				1					1	1.4
- bronchopleurothoracic fistula								1	1	1.4
- pneumonia, sternal fracture						1			1	1.4
CBCT, fracture of one rib, the presence of complications and combined injuries:										
- hemothorax, pleurisy					1				1	1.4
- pneumothorax		2						1	3	4.2
- hemopneumothorax	2								2	2.8
- hemopneumothorax, pneumonia					1				1	1.4
Total	9	31	3	8	3	3	1	13	71	100

mative enough. In this case, computed tomography is the most informative in the diagnosis of such injuries [15, 16].

Among the medical care provided to patients in the observation groups, conservative therapy was provided in 25.4% of cases. The main method of surgical treatment of CBCT in the observation groups was drainage of the pleural cavity according to Bülau (73.2% of cases), more severe surgery, resection of the lower lung, was performed in 1.4% of cases. It should be noted that our established terms of hospital stay, types of medical care provided to patients, the duration of the disorder in the observation groups, which can be seen from the table above, generally do not contradict the available literature data, and in some cases complement them [2, 4, 10].

Forensic assessment of clinical observations was performed using a morpho-clinical approach, which must be applied in accordance with current

state regulations [11, 12]. At the same time, according to these documents, the presence of ARF of any severity, including mild, already allows to determine the presence of a life-threatening condition in the victim. Therefore, in the forensic assessment of CBCT established the presence of ARF, which was mostly mild on the set of clinical signs.

Thus, according to the results of forensic assessment of clinical observations of CBCT we have established the following degree of severity of injuries. Serious bodily injuries according to the criterion of "danger to life" item 2.1.3 of item "O" of the "Rules…" were found in 13 (18.3%) patients of the third group with CBCT, who had signs of acute respiratory failure. At the same time, patients had intrapleural complications and injuries: in 1 (1.4%) case of hemothorax, in 2 (2.8%) cases of folding hemothorax, in 3 (4.2%) cases of pneumothorax, in 6 (8.5%) cases of hemopneumothorax, in 1 (1.4%) case bronchopleurothoracic fistula.

We also found serious bodily injuries in 1 (3.2%) case in a patient with CBCT of the second group according to the criterion "health disorder associated with permanent disability of at least one third" of paragraph 2.1.6 of the "Rules…". At the same time the patient had multiple rib fractures, hematoma, contusion of the lung, pulmonary hemorrhage, performed surgery – "Resection of the lower lobe of the lung".

Moderate injuries that caused a long-term health disorder lasting more than 3 weeks (more than 21 days), paragraph 2.2.1 "c" of the "Rules…", were found in patients of the first group: 16 (22.5%) cases of CBCT with fractures of the ribs, without complications; 41 (57.7%) cases of CBCT with rib fractures, intrapleural complications and combined injuries, of which 9 (12.2%) cases of hemothorax, 5 (7.1%) cases of collapsed hemothorax, 8 (11.3%) cases of pneumothorax, 15 (21.1%) cases of hemopneumothorax, 2 (2.8%) cases of encapsulated pleurisy, 1 (1.4%) case of chondroma of the ribs, 1 (1.4%) case of sternal fracture, pneumonia.

The morpho-functional approach used by us in the forensic assessment of clinical observations in determining the severity of CBCT with damage to the costal skeleton, showed a sufficient level of justification for the established severity of injuries. At the same time, if we applied a purely morphological approach, which is proposed by some experts [10, 13, 14], the number of unreasonably established by us serious injuries would be greater. This, in turn, could lead to incorrect classification of the gravity of the crime and the establishment of a degree of legal responsibility for its commission.

Conclusions

1. Our findings suggest that intrapleural injuries and complications occurred in 43.7% of patients with CBCT with rib fractures undergoing inpatient treatment. Injuries with signs of danger to life account for 18.3% of cases.

2. In the structure of forensic assessment of CBCT with rib fractures, according to clinical observations, severe injuries account for 19.7% of cases. They are established mainly in the event of acute respiratory failure. 80.3% of CBCT cases with rib fractures, in the absence of danger to life, were classified as moderate injuries.

3. The available scientific and methodological literature does not contain clear diagnostic morphological and clinical criteria for qualitative forensic assessment and prediction of the final results of CBCT.

4. When applying the morphological and clinical approach, the additional diagnostic criteria for CBCT assessment should be considered when determining the severity of injuries: the dynamics and duration of recovery of post-traumatic morpho-functional changes of injured organs, loss of part or all of the respiratory organ (lungs), the emergence of life-threatening phenomena.

The prospect of further research is to conduct research to study all possible morphological and clinical manifestations of the studied injury, followed by development of a clear algorithm for forensic expert research in these cases.

DECLARATIONS:

Statement of Ethics

The authors have no ethical conflicts to disclose.

Consent for publication

All authors give their consent to publication.

Disclosure Statement

The authors have no potential conflicts of interest to disclose.

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Data Transparency

The data can be requested from the authors.

References

1. Styazhkina SN, Distanova AA, Hadeev YaR. Klinicheskij sluchaj zakrytoj travmy grudnoj kletki posle dorozhno-transportnogo proisshestviya [Clinical case of closed chest injury after a traffic accident]. Modern Science. 2020;3(1):316–9. [In Russian].

2. Karmy-Jones R, Wood DE. Traumatic injury to the trachea and bronchus. Thorac Surg Clin. 2007;17:35–46.

3. Gasymzade GSH. Comparative characteristics of computed tomography and radiography in the diagnosis of blunt chest trauma. KMZh. 2020;6(101):926-9. [in Russian].

4. Balci AE, Balci TA, Eren S, Ulkü R, Cakir O, Eren N. Unilateral posttraumatic pulmonary contusion: findings of a review. Surg. Today. 2005;35(3):205–10.

5. Kovalev BV, Dzhuvalyakov PG, Tat'yanchenko VK, Krasenkov YuV, Suhaya YuV. Peculiarities of pathogenesis in chest trauma. AMZh. 2016;1(4):136-143. [in Russian].

6. Tetenev FF, Bodrova TN, Tetenev KF, Karzilov AI, Levchenko AV, Kalinina OV. The study of the function of the apparatus of external respiration. Fundamentals of Clinical Physiology of Respiration: Textbook. 2nd ed., add. and correct. T.: " Sand manufactory"; 2008. 164 p. [In Russian].

7. Madani A, Pecorelli N, Razek T, Spicer J, Ferri LE, Mulder DS. Civilian airway trauma: a single-institution experience. World J Surg. 2016;40:2658–66.

8. Payne-James J, Richard Martin J. Simpson's Forensic Medicine R.M., 14th Edition 14th Edition. USA, Boca Raton: CRC Press; 2019. 353 p.

9. Pillay VV. Textbook of Forensic Medicine and Toxicology. 19th Edition. India: Paras Medical Publisher; 2019. 800 p.

10. Kupryushin AS, Efimov AA, Loginov SN, Vishnyakova ZHS, Latynova IV, Semina MN, et al. Clinical manifestations and forensic evaluation of hemothorax]. SNMZh. 2017;13(2):221–4. [In Russian].

11. Pravyla sudovo-medychnoho vyznachennia stupenia tiazhkosti tilesnykh ushkodzhen [Rules for forensic medical assessment of bodily injuries severity]. In: Order of the Ministry of Health of Ukraine, No.6 on 17 Jan 1995. "Pro rozvytok ta vdoskonalennia sudovo-medychnoi sluzhby Ukrainy". ["On the development and improvement of the forensic medical service of Ukraine"]. [In Ukrainian].

12. Naida AI, Malyk OR. Sudova medytsyna: kompleksnyi navch. posib. [Forensic medicine: a comprehensive textbook]. K.: Atika; 2012. 272 p. [in Ukrainian].

13. Klevno VA, Maksimov AV. Kliniko-morfologicheskij analiz oshibochnoj diagnostiki travmy grudnoj kletki i zhivota [Clinical and morphological analysis of erroneous diagnosis of trauma to the chest and abdomen]. VMV. 2019;3(63): 31–6.

14. Klevno VA. Bogomolova IN. Opredelenie stepeni tyazhesti vreda zdorov'yu. Primenenie pravil i medicinskih kriteriev. Otvety na voprosy [Determining the severity of harm to health. Application of rules and medical criteria. Answers on questions]. M.: GEOTAR-Media; 2010. 136 p. [In Russian].

15. Le Guen M, Beigelman C, Bouhemad B, Wenjïe Y, Marmion F, Rouby JJ. Chest computed tomography with multiplanar reformatted images for diagnosing traumatic bronchial rupture: a case report. Crit Care. 2007;11(5):R94. DOI: 10.1186/cc6109. PMID: 17767714.

16. Newbury A, Dorfman JD, Lo HS. Imaging and management of thoracic trauma. Semin Ultrasound CT MR. 2018;39(4):347–54.

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