

## HEART INJURIES: MAIN CLINICAL SYMPTOMS

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Injuries to the heart are uncommon in peacetime, yet they result in life-threatening conditions, which makes timely diagnostics a crucial factor in saving patients' lives. In this connection, it is important to define the main signs of heart injuries. This study aimed to analyze the basic clinical symptoms associated with various wounds to the heart. We have retrospectively analyzed such symptoms registered in 86 patients with varying chest injuries that affect the heart. All patients were treated in the emergency surgery unit of the Engels Town Hospital from 1991 to 2017. 41 (47.6%) patient had stab wounds, and there were 45 (52.3%) cases of gunshot wounds. 23 (26.7%) patients had chest injuries affecting heart exclusively, while for 63 (73.2%) the consequences were wounds to other organs. We found that the clinical picture depends on the kind of injury to the heart: stab and slash wounds translate into more pronounced symptoms, while gunshot wounds do not produce such an effect. Accepting patients, practitioners should take this fact into account. The misdiagnosis rate for stab and slash heart wounds is 9.7%, that for gunshot wounds — 17.7%, the latter being the result of vagueness of the clinical picture. The clinical signs are most pronounced in the cases of stab and slash wounds to the heart.

**Keywords:** heart wounds, diagnostics, diagnostic mistakes

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## ОСНОВНЫЕ КЛИНИЧЕСКИЕ СИМПТОМЫ ПРИ РАНЕНИЯХ СЕРДЦА

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Ранения сердца в мирное время нельзя отнести к самым распространенным, однако повреждение этого органа угрожает жизни, и своевременная диагностика влияет на спасение жизни. В связи с этим актуальным является выявление основных признаков повреждения сердца. Целью исследования было провести анализ основных клинических симптомов, возникающих при различных ранениях сердца. Был проведен ретроспективный анализ основных симптомов, возникающих при различных ранениях груди с повреждением сердца у 86 пациентов, находившихся на лечении в экстренном хирургическом отделении городской больницы города Энгельса в период с 1991 по 2017 г. Из общего количества пациентов колото-резаные ранения были зарегистрированы в 41 (47,6%), огнестрельные — в 45 (52,3%) случаях. При ранении груди только ранение сердца наблюдалось в 23 (26,7%) случаях, в остальных 63 (73,2%) случаях зарегистрированы повреждения других органов. Установлено, что различные ранения сердца имеют неодинаковую клиническую картину: она более выражена при колото-резаных и менее выражена при огнестрельных ранениях, что необходимо учитывать при поступлении таких пациентов. Диагностические ошибки при колото-резаных ранениях сердца встречаются в 9,7% случаев, при огнестрельных ранениях — в 17,7% случаев. Наиболее выражены клинические симптомы при колото-резаных ранениях сердца.

**Ключевые слова:** ранения сердца, диагностика, диагностические ошибки

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According to the literature, 10 to 19.5% of penetrating chest wounds result in injuries to the heart [1, 2, 3, 4, 5]. The associated mortality rate is up to 50% [6–8], with the main reasons thereof being massive blood loss, acute cardiac tamponade, extensive damage to intracardiac structures [3–7]. The common complications registered in patients with heart injuries shortly after surgery are pericarditis, post-traumatic pulpitis, pleurisy [9–11], as well as myocardial ischemia, surgical wound suppuration [12–15]. Diagnosing an injury to the heart, practitioners examine wound in its projection and signs of damage the organ may have received. In most cases, such examination is only visual, thus, the key task before the

surgeon is to correctly diagnose the heart wound within a very short period of time and operate on it as soon as possible.

This study aimed to analyze the basic clinical symptoms associated with various wounds to the heart.

## PATIENTS AND METHODS

To achieve the goal set, we have retrospectively analyzed the basic clinical symptoms registered in 86 patients with varying chest injuries that affect the heart. All patients were treated in the emergency surgery unit of the Engels Town Hospital from 1991 to 2017.

Inclusion criteria: a gunshot or a stab wound to the chest resulting in a heart injury; age from 18 to 50. Exclusion criteria: age under 18; agonal state at the time of admission; concomitant head, neck, limb injuries.

41 (47.6%) patient had stab wounds, and there were 45 (52.3%) cases of gunshot wounds. 23 (26.7%) patients had chest injuries affecting heart exclusively, for 63 (73.2%) the consequences were wounds to other organs and in 4 (4.6%) cases the patients had concomitant wounds to the abdomen. The other organs damaged in connection with the chest wounds were lungs (52 cases, 85.7%), ribs (4 cases, 6.3%), thoracic esophagus (3 cases, 4.7%), inferior vena cava (2 cases 3.1%), diaphragm and liver (1 case, 1.5%). None of the patients had the pericardial injury greater than 3 cm. The volume of blood found in pericardial cavities of the patients ranged from 300 to 700 ml. In most cases, clots plugged the injuries to the heart. 46 (53.4%) patients had non-penetrating wounds, while those in 40 (46.5%) patients were penetrating. 38 (44.1%) slash/stab victims exhibited penetrating wounds to their hearts, 3 (4.5%) — non-penetrating wounds; gunshots resulted mainly in non-penetrating wounds, which were diagnosed in 43 (50%) patients, while only 2 (2.3%) had gun-related penetrating wounds. All penetrating wounds were pinpoint.

In addition to hemopericardium, 75 (87.2%) patients had hemothorax; in 58 (77.3%) of them the volume of blood accumulated in the pleural cavity was 500 ml, 14 (18.6%) had about 1 l of blood there and 3 (4%) suffered from a total hemothorax. All patients were male, their mean age was  $31 \pm 2$  years.

With heart wounds, time is one of the crucial factors shaping the prognosis. Having analyzed the available data, we learned that chest slash/stab victims were brought to the hospital within  $26.7 \pm 5$  minutes from wound infliction, gunshot victims — within  $21.3 \pm 6$  minutes. 37 (43%) slash/stab victims were brought to the hospital by an ambulance, only 4 (4.7%) arrived in a private vehicle. As for the patients with gunshot wounds, all of them were delivered to the hospital by an ambulance. Thus, the majority of the wounded people considered in this study arrived to the hospital in a specialized vehicle, where the ambulance crews gave them infusions (79 patients (91.8%), in most cases — 100–1000 ml of polyglucin solution intravenously at the rate of 60–80 drops/minute), non-narcotic analgesics (56 patients (65.1%)), dressed the wound (83 patients (96.5%)), including 74 (86%) occlusive dressings). Undoubtedly, these measures had their effects on the outcomes.

At admission, 67 (77.9%) patients were experiencing shock of varying degree; they were 27 (31.3%) slash/stab victims and 40 (46.5%) men with gunshot wounds. The data show that patients with gunshot wounds are more prone to shock than those slashed or stabbed, the difference between the two groups being statistically significant ( $p < 0.05$ ). As for the degrees of shock registered, 34 patients (39.5%) had the first-degree shock, 26 (30.2%) had the second-degree shock, 7 (8.1%) experienced the third degree. Thus, at the time of admission most patients experienced first- and second-degree shock.

The condition of the patients at admission was assessed with the help of the AIS scale, where code 1 means minor severity; code 2 — moderate; 3 — serious, but not life-threatening; 4 — severe, life-threatening; 5 — critical, survival doubtful; 6 — maximum, fatal damage. Applied to the slash/stab victims considered, AIS assessment yielded the following results: 21 (24.4%) patients — code 2; 12 (13.9%) patients — code 3; 8 (9.3%) patients — code 4. As for the patients with

gunshot wounds, 18 (20.9%) of them were put into the code 2 group, the condition of 7 (8.1%) was classified as code 3, code 4 was assigned to 11 (12.7%) patients and code 5 to 9 (10.4%). Thus, gunshot victims were registered with the most severe conditions.

Assessing localization of the wounds, we delimited the "heart zone" with second rib on top, subcostal line at the bottom, midclavicular line from the right and anterior axillary line from the left. Out of the 86 patients studied, 50 (58.1%) had injuries in this zone, 38 (92.6%) of them slash/stab wounds, 12 (26.6%) — gunshot wounds.

84 patients underwent anterior-lateral thoracotomy, one patient had a sternotomy, and another had a laparotomy. In 96.7% of the patients the heart wound was sutured with interrupted stitches, 3.3% received U-shaped stitches. Separate apposition stitches were used to suture pericardial sacs in all the patients; pleural cavity drainage was placed in the II and VII intercostal spaces.

It should be noted specifically that the emergency hospital that received the patients is a level II trauma center; in such centers, ultrasound examinations are typically done around the clock. However, the patients considered in this study were not subjected to this type of examination, which, without a doubt, affected the outcomes, since sonography facilitates diagnosing and could have reduced the number of diagnostic mistakes.

We used Excel 2007, part of the Microsoft Office 2007 package, to process the data. The difference between the compared values was considered statistically significant at  $p < 0.05$ .

## RESULTS

The symptoms of penetrating wounds to the heart include signs of rapidly increasing internal bleeding, cardiac tamponade and shock. The table below contains the main symptoms registered in the patients with heart injuries.

Patients with slash/stab wounds to the heart have exhibited more clinical symptoms. The most frequent of them were localization of the wound in the heart zone (38 (92.6%) cases) and tachycardia (over 90 beats per minute, 38 (92.6%) cases), as well as expansion of the cardiac dullness percussion boundaries (31 (75.6 %) cases). Tachycardia can be explained by the body's compensatory response to acute blood loss. Symptoms observed less frequently: precordialgia (28 (68.2%) cases), venous hypertension (27 (65.8%) cases), arterial hypotension due to hemorrhagic shock (25 (60.9%) cases), dyspnea (23 (24.3%) cases), no pulse in the peripheral arteries (23 (56%) cases).

The least frequent symptoms were feeling short of breath (16 (39%) cases), neck vein swelling (10 (11.6%) cases), blue face and neck (9 (21.9%) cases). Thus, slash/stab wounds to the heart produce a fairly pronounced clinical picture, with the signs of hemorrhagic shock and cardiac tamponade at the forefront. Only 6 (14.6%) cases did not offer a clear clinical picture, the state of the patients in questions being satisfactory upon admission, without any signs of shock and cardiac tamponade. The aforementioned factors allowed diagnosing the heart injury promptly, and most of the patients were brought straight to the operating room for immediate surgery. In this group, only 10 (24.3%) patients received primary surgical treatment, while the remaining 13 (31.7%) underwent thoracotomy. 17 (41.4%) patients were subjected to additional examinations; in most cases, it was AP view chest X-ray imaging and ECG, which were mostly performed in the operating room. The well-pronounced clinical picture associated with slash/

**Table.** Frequency of occurrence of the main symptoms associated with wounds to the heart ( $M \pm m$ )

Symptoms	Frequency of symptoms by group	
	Slash/stab wounds ( $n = 41$ )	Gunshot wounds ( $n = 45$ )
Precordialgia	$28 \pm 2^*$	$10 \pm 1$
Feeling short of breath	$16 \pm 2^*$	$6 \pm 1$
Wound localization in the heart zone	$38 \pm 2^*$	$12 \pm 1$
Blue face and neck	$9 \pm 1$	$9 \pm 2$
Neck vein swelling	$10 \pm 1$	$10 \pm 1$
Dyspnea (over 25–30 per min)	$23 \pm 2^*$	$11 \pm 1$
Expansion of the cardiac dullness percussion boundaries	$31 \pm 5^*$	$7 \pm 2$
Tachycardia (over 90 beats per min)	$38 \pm 4^*$	$8 \pm 1$
No pulse in the peripheral arteries	$23 \pm 4^*$	$3 \pm 2$
Arterial hypotension (SBP less than 100 mm Hg)	$25 \pm 2^*$	$5 \pm 0,3$
Venous hypertension (CVP more than 140 mm water column)	$27 \pm 4^*$	$7 \pm 1$

Note: \* — ( $p < 0.05$ ).

stab wounds to the heart minimized the number of diagnostic mistakes made: only 4 (9.7%) patients went into surgery with a delay. In those cases, the picture was unclear, and diagnostic examinations (chest X-ray, ECG) revealed no signs of heart injury and cardiac tamponade. All these patients received primary surgical treatment. Thoracotomy was performed 3-4 hours after admission following the appearance of signs of hemorrhagic shock.

Gunshot wounds to the chest resulting in heart injuries produced a different clinical picture. Only 12 (26.6%) patients had the wound in the heart zone, while the remaining 33 (73.3%) gunshot victims had it out of this zone, which complicated diagnosing. The clinical symptoms most commonly registered in this group of patients were: dyspnea (10 (24.4%) cases), precordialgia (10 (22.2%) cases), neck vein swelling (10 (24.4%) cases), blue face and neck (9 (20%) cases), tachycardia (8 (17.7%) cases). 7 (15.5%) patients exhibited signs of expansion of the cardiac dullness percussion boundaries; 6 (13.3%) gunshot victims felt short of breath. Compared to the slash/stab wound group, patients with gunshot wounds showed signs of hemorrhagic shock less frequently; the signs were arterial hypotension (5 (11.1%) cases) and no pulse in the peripheral arteries (3 (6.6%) cases). It is safe to say that the lack of pronounced signs of heart injuries and manifestations of hemorrhagic shock made diagnosing the cases a more complicated process. At admission, with just the objective wound data available, only 12 (26.6%) patients were diagnosed with heart injuries and allowed straight into the operating room. The remaining 33 (73.3%) patients were subjected to diagnostic examinations in the reception ward, which delayed surgery. 38 (84.4%) patients underwent chest X-ray examination; in 30 cases, the results thereof allowed suspecting a wound to the heart. 29 (64.4%) patients underwent ECG, and 18 (40%) were subjected to pleural puncture. 40 patients received primary surgical treatment in the operating room. In 8 (17.7%) cases belonging to this group, the delay to surgery was from 2 to 3 hours, all of which are attributed to the unclear clinical picture. The patients went into surgery when their condition deteriorated and the signs of hemorrhagic shock became more vivid.

Having analyzed the data covering the immediate post-surgery period, we learned that in the slash/stab wound group 21 (24.4%) patients developed complications, and 12 (13.9%) cases ended in a fatality. In the gunshot wound group,

complications were registered in 34 (39.5%) cases, fatality — in 23 (26.7%) cases.

## DISCUSSION

This study shows that the clinical picture depends on the kind of injury to the heart: stab and slash wounds translate into more pronounced symptoms, while gunshot wounds do not produce such an effect; this fact should be taken into account when admitting such patients into the hospital. The main reason behind the unclear clinical picture in gunshot wound cases is the severity of the patients' condition, which results from the shock: it was registered in 46.5% gunshot victims compared to 31.3% patients with slash/stab wounds. The nature of the wound is another important factor influencing the clinical picture: for example, most of the slash/stab wounds were penetrating, which made the clinical signs more pronounced. The data we obtained are in line with the relevant research results published [16]. It should be noted that the treatment results in the gunshot wound group were worse than in the slash/stab wound group: the former group registered complications in 39.5% of cases (immediate post-surgery period) and fatalities in 26.7% of cases, whereas in the latter group the figures were 24.4% and 13.9%, respectively. The reasons behind the greater share of developed complications and fatalities associated with gunshot wounds to the heart should be researched separately and were not a subject of this study. At that, the relevant reports published indicate that the number of fatalities and complications developed following gunshot wounds can be a consequence of heart bruising resulting from the projectile's hydrodynamic impact, which influences the post-surgery recovery process significantly [17].

## CONCLUSIONS

The misdiagnosis rate for stab and slash heart wounds is 9.7%, that for gunshot wounds — 17.7%, the latter being the result of vagueness of the clinical picture. The clinical signs are most pronounced in the cases of stab and slash wounds to the heart. In order to reduce the number of diagnostic mistakes, it is necessary to apply the notion of "heart zone" when diagnosing chest injuries, subject patients to US examinations of the heart, pleural cavities, etc.

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