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Boiko V.V.,
Zamiatin P.M.,
Zamiatin D.P.
State Institution "V. T. Zaitsev Institute of General and Emergency Surgery NAMS Ukraine", Kharkiv, Ukraine

SURGERY OF CORDIAL DAMAGES

Abstract. *The experience of the clinic staff of the Institute of General and urgent surgery. T. V. Zaitsev NAMS of Ukraine concerning surgical treatment of various heart damage, including mine-explosive gunshot and bullet wounds. The analysis of the highly-specialized surgical care with the use of modern technology. Experience of providing surgical care to victims with injuries of the heart. The data relating to the substantive provisions about the anatomical background of various wounds and dependence clinical manifestations, diagnosis and treatment of patients. Discussed generally accepted statements, the classification of these injuries, the optimal algorithms of diagnostic and therapeutic measures. Summarizes the main provisions of the surgical doctrines in the provision of medical care in surgical hospitals General profile and the possibility of its improvement in the treatment of patients in specialized clinics. Special attention is given to surgical tactics aimed at timely and effective damage detection of intracardiac structures, restoring the integrity of the vital vessels and tissue, including the use of technologies of artificial blood circulation. Described surgical technique depending on the localization and extent of the damage. Recommendations for intensive care and anesthesia support at all stages of treatment of victims with injuries of the heart. The article discussed data on the use endocardial assisted shunting and circulation in typical damage to intracardiac structures; videoarticles and angiographic minimally invasive surgical procedures.*

Key words: *mine-explosive and gunshot wounds ball heart, diagnosis, surgical tactics.*

Introduction. Nowadays, one of the greatest dangers of human life are mine-explosive and bullet heart damage. Among other damages the heart damage is characterized by high risk of the deaths (8,3-40,0 %) but , at the same time, there is a high rehabilitation opportunity and patients preservation of efficiency who survived due to the qualified medical aid. The success of the surgical treatment of those who have heart wounds depends on the chosen tactic which remains the subject of discussions.

Materials and methods. In the clinic of the department " Institute of General and Emergency surgery named after V.T. Zaitseva NAMS of Ukraine over 410 victims with heart injuries have been treated, among which 307 were diagnosed with penetrating injures, 74 - mine-explosive and bullet injuries, 34 – inner heart structures damage. We have reviewed clinics perennial experience in surgical treatment of patients with different heart lesions. The main group was 276 victims per period of 2001-2015 with application of modern innovations and an observation group – 134 injured who treated at the institution's clinic in 1969-2000.

The diagnoses were established objectively using radiological, electrocardiographic, ultrasound, echocardiographic and phonoscopic methods of computer tomography. The additional diagnostic information was obtained in the research of acid-base parameters, coagulation, serum electrolytes, hemoglobin and hematocrit. The statistical processing of researching results was carried out of using a standard application package such as R, Microsoft Excel 2007 and STATISTICA 6.0. All data were processed by the method of statistics variation using student's criterion. There were used correlation, many factoring system and regression analysis for choosing the most informative indicators.

Results and discussion. It should be distinguished three main mechanisms of hemodynamic disorders with heart damage: acute blood loss, hypovolemia, tamponade of the heart and disturbance of the heart's pumping function which are caused by the damage of the myocardium, coronary arteries, valves, interstices and leading paths. Attached to the heart wounds the typical for cardiograms is the teeth reduction in the voltage, displacement of the interval S-T above the isolation, signs of myocardial infarction.(table 1)

Clinically cardiac injuries are diagnosed and based on Beck's triad:

Table 1

Frequency of electrocardiographic changes registration in patients suffering from mine-explosive heart damage (%)

Indicator	Comparison group	Main group
Change of the T teeth	56 (75,7)	40 (74,0)
Heart rhythm disturbance	51 (68,9)	33 (61,1)
Deflection of the electric heart axis	34 (45,9)	16 (29,6)*
Change of the P teeth	26 (35,1)	9 (16,7)**
Change of the segment	26 (35,1)	8 (14,8)**
Conduction disturbance	7 (9,5)	3 (5,6)

*Notes: * - P < 0,05, ** - P < 0,01 compared with those who were not heart injured*

- an abrupt drop of blood pressure
- rapid and significant increase of central venous pressure
- an abrupt relaxation of heart tones and – absence of heart pulsation during the X-ray examination

A valuable diagnostic and, in some cases, therapeutic event for the detection and evacuation of blood from the pericardium is its puncture. In recent years, we use the needle Veresha as a less traumatic and thoracic port. Also, endovideotoracoscopy is performed and during which the localization of heart wounds is determined, pericardium integrity, the presence of blood in the chest cavity and a warm shirt, hematomas of the heart and pericardium; pericardioscopy as a diagnostic and therapeutic measure and subxyphoid pericardiotomy. In th clinic, an algorithm for diagnostic manipulations was created in case of wounded heart suspicion.

According to the clinic, the informative of heart damage symptoms was: deafness of the heart tones – 97,0%; the pain in the area of the heart – 25,0%; systolic noise at the top – 8,3%; pericardial friction noise – 5,0%; tachycardia (HS > 120 min^{-1}) – 15,0%; reduction of systolic pressure (< 60 mm hg.art.) – 46,0%; lowering pulse pressure (< 15 mm hg.art.) – 43,0%. In case of the damage suspicion between the atrial and interventricular membrane it is possible to use a simplified verification of blood leakage trough the traumatic defect. To do this, you should perform a blood sample from the right atrium (the using of the central vein) and make a puncture of the pulmonary artery (when there is no arterial access) and an aorta with subsequent blood transfusion and determination of the blood saturation with oxygen (the using of the gas analyzer).

Q_p:Q_s = (Sat(aorta) – Sat(SVC)) / (Sat (vena pulmonalis)) – Sat (arteria pulmonalis)), where Q_p – pulmonary circulation; Q_s – systemic circulation; Sat aorta – arterial saturation (necessary puncture of the aorta or using of the blood collection from the peripheral arterial line); Sat (SVC) – mixed venous carbonation (the using of the blood transfusion from the central venous catheter or right anesthetic puncture); Sat (vena pulmonalis) – lung vein saturation (usually taken in 100%); Sat (arteria pulmonalis) – saturation in the lung artery (necessary execution of the pulmonary artery puncture with subsequent blood transfusion).

This equation can be used to determine the relative flow of the blood between the body and the lungs. In patients without damage between the ventricular and periapinal membranes this ratio will be equal to 1 (that means that the blood flow in the lungs and in the body is the same). In patients who have inter-ventricular or periactrial membrane damage the blood flow in the lungs will be higher than in the aorta and this ratio will be higher than 1. This is a reliable definition of the shunt presence in the membranes of the heart.

The realization of this research allows surgeon perform a diagnosis after sewing of the heart wound, in case of the interventricular or periactrial membrane suspicion of the damage and determine the degree of the membrane damage severity already on the operating table. When the ratio Q_p: Q_s is in range from 1 to 2 there are moderate defects of the membrane that require cardio surgeon consultation in the next day. When this number is 2 or more these are major defects and the definition of further treatment tactics should be carried out immediately.

After analyzing the obtained data it is possible to suspect and sometimes completely diagnose intracardiac damage, which allows to solve the issue of further surgical-organizational tactics intraoperatively and urgently. During the surgical intervention, all victims with heart wound was advised to use transtreatment ultrasound

examination of the heart chambers. In some cases, angiographic examination of heart cells by known techniques helps to verify the diagnosis.

Modern technologies are widely used in the clinic and the active surgical tactic allows to avoid diagnostic errors and choose the most correct type of surgical intervention. The most important component of surgical care when there are heart injures is reinfusion of blood that significantly reduces the volume of the hemotransfusion. In clinics there are many reliable and easy in exploitation different systems for blood reinfusion, the question of the device choice is determined mainly by the cost and availability of consumables, as well as the clinics priorities.

In the clinic, an access tj the damaged interventricular membrane is proposed through the recanalized entrance channel in the myocardium of the ventricle under artificial blood circulation.

A portable system of extracorporeal circulation Cardiohelp (Maquet, USA) which, fistly, was designed for carrying out of an emergency room during transportation and in extraordinary situations deserves particular attention. The benefits of this system for treating heart injuries are: the possibility of rapid cannulation of the femoral vessels by Seldinger which gives an opportunity to use system even on the reception or by the brigades of an ambulance; ease of work, lack of special infrastructure, low risk of air embolism; a variety of regimes depending on the clinical situation with the possibility of circulatory support up to 7 l/min; continued circulatory support up to 14 days at one oxygenator.

To take into account achieved results, the use of an emergency room in urgent cardiac surgery of heart injuries has a great prospects. Modern systems for extracorporeal circulation are safe, reliable, easy to use and must become an integral part of the technological arsenal of general surgical clinics dealing with the provision of an emergency care for injuries. Using an emergency room while there are heart injuries allows to rapid stabilization of hemodynamics, complete full correction of intracardiac lesions and , if it's necessary, transporting a patient to a specialized center.

In the table 2 below was not taken into account the experience of treating 74 troops and civilians who came from the ATO zone because the conditions for their delivery to medical

Table 2

Characteristic of victim groups

Indicator	Comparison group (n=134)	Main group (n=276)
Time from heart injury, hour	2 ±0,28	2,78 ± 0,32
Time before operation, hour	0,42 ± 0,02	0,31 ± 0,01*
The size of the heart wound, centimeters	1,42 ± 0,18	1,48 ± 0,23
Arterial pressure on the upper limbs, mm.hr.st. Systolic diastolic	 82,20 ± 3,37 42,60 ± 3,00	79,73± 4,35 41,02 ± 3,52
Heart rate, min^{-1}	102,18 ± 2,23	116,12 ± 3,2*
Central venous pressure, mm.hr.st.	126,31 ± 8,51	121,24 ± 9,57
Blood in the pleural cavity, ml	845,44 ±55,32	753,68 ±70,02
Blood in the pericardium, ml	251 ± 15,86	240,72 ±18,56
Hemoglobin, g/l	105,14 ± 2,73	107,15 ± 3,29
Bed day, days	18,09 ± 1,23	14,34 ± 1,32*

*Notes: *— P < 0,05 differences with the comparison group*

institutions and the distribution to specific hospitals did not coincide with the average sample of patients in Kharkiv and Kharkiv region.

The significant differences in central venous pressure between the main group (121,24 ± 9,57) mm.hr.st. and comparison group (126,31 ± 8,51) mm.hr.st. also, the amount of blood in the pleural and pericardial cavities, respectively (753,68± 70,02)ml, (240,72 ± 18,56) ml in the main and (845,44 ± 55,32) ml, (251 ±15,86) ml in the comparison group was not noticed. The heart rate was reliably higher in the main group (116,12 ± 3,2) min^{-1} than in the comparison group (102,18 ± 2,23) min^{-1} that can indicate more severe traumatic injury in the wounded of a main group. The concentration of hemoglobin in the blood with which the injured came was: in the main (107,15 ± 3,29) g/l and in the comparison group (105,14 ± 2,73) g/l, the sizes of heart injuries in the main group (1,48 ± 0,23) centimeters and in the comparison group (1,42 ± 0,18) centimeters did not differ.

A significant decrease in the time that passed from the hospitalization of the victim to the operation in the main group (0,31 ± 0,01hour) showed the effectiveness of the developed scheme for the organization of diagnostic and therapeutic tactics in the injured with heart injuries. Besides, a weighty decrease in the number of bed days to (14,34 ± 1,32) days attracts attention what indicates an improvement in the quality of both diagnostic and therapeutic measures.

The most important causes of the fatal consequences are late delivery of victim to medical center, tamponade of heart, untimely surgical intervention with intense blood loss, as well as hard thoraco-abdominal damage with heart wounds and organs of the belly cavity. The analysis of fatality gives the clearest idea about the effectiveness in using developed approaches in the treatment of injured with heart injuries. Patients death was observed at different times of stay in a hospital. The statistical importance of the differences was estimated with a help χ^2 (table 3).

With the number of freedom degrees for this table which is equal to one (v=1), the probability of differences between the main and control group more than 5%, it can be argued that reducation of mortality in the main group is statistically reliable.

Posttraumetic pericarditis and septic complications were the most frequently observed postoperative complications. Only 3 patients with intracardiac injuries were registered, 20 surgical interventions were performed on the damage of patients intracardiac structure after heart injury (table 4).

Table 3

Statistical importance of the differences by deaths

Indicator	Comparison group		Main group		χ^2
	Abs.	%	Abs.	%	
Surviving	97	72,39	225	81,52	4,15
Death	37	27,61	51	18,48	

*Notes: * - v = 1, α = 5 %*

Mortality in this group was 15% (3 patients0 which was the most often associated with severe purulent-septic and infectious complications.

Conclusions. Timely delivery of the victim to a surgical clinic; conducting resuscitation measures fully, aimed at eliminating shock manifestations and heart temponade; urgent surgical intervention for vital signs and effective resuscitation and anesthetic support; sewing heart wounds , reliably bleeding stop, relief of the tamponade phenomena and blood loss; intraoperative diagnostics of intracardiac injuries; surgical correction of intracardiac injuries using artificial blood circulation technology; adequate postoperative integrative therapy should be considered as basic principles of surgical care in case of heart damage on the basis of given data.

Table 4

Posttraumetic pericarditis

Disturbance	The number of injured	
	Abs.	%
Traumatic defect of atrial fibrillation	1	5
Traumatic defect of interventricular membrane	13	65
Left ventricular aneurysm	1	5
Traumatic valve insufficiency	3	15
Traumatic defect of sinus Valsavi	1	5
Intraventricular conduction disturbance	1	5
In all:	20	100

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