RS Global Journals

Scholarly Publisher
RS Global Sp. z O.O.
ISNI: 0000 0004 8495 2390

Dolna 17, Warsaw, Poland 00-773
Tel: +48 226 0 227 03
Email: editorial_office@rsglobal.pl

JOURNAL	World Science
p-ISSN	2413-1032
e-ISSN	2414-6404
PUBLISHER	RS Global Sp. z O.O., Poland

ARTICLE TITLE	SURGICAL TACTICS IN PATIENTS WITH PENETRATING THORACIC INJURIES
AUTHOR(S)	Belozorov Igor, Kudrevych Oleksandr, Kosov Eugene, Rozhkova Olena, Barsukov Nikita, Veklych Viktor
ARTICLE INFO	Belozorov Igor, Kudrevych Oleksandr, Kosov Eugene, Rozhkova Olena, Barsukov Nikita, Veklych Viktor. (2021) Surgical Tactics in Patients with Penetrating Thoracic Injuries. World Science. 4(65). doi: 10.31435/rsglobal_ws/30042021/7537
DOI	https://doi.org/10.31435/rsglobal_ws/30042021/7537
RECEIVED	08 February 2021
ACCEPTED	04 April 2021
PUBLISHED	09 April 2021

SURGICAL TACTICS IN PATIENTS WITH PENETRATING THORACIC INJURIES

Belozorov Igor, *Doctor of medical Sciences, Professor, V. N. Karazin Kharkiv National University, Kharkiv, Ukraine, ORCID ID: https://orcid.org/0000-0002-4102-3220*
Kudrevych Oleksandr, *Candidate of Medicine, Associate Professor, V. N. Karazin Kharkiv National University, Kharkiv, Ukraine, ORCID ID: https://orcid.org/0000-0002-2086-8822*
Kosov Eugene, *Postgraduate student, V. N. Karazin Kharkiv National University, Kharkiv, Ukraine, ORCID ID: https://orcid.org/0000-0003-2267-1684*
Email: bestkosov@gmail.com
Rozhkova Olena, *Assistant of Department, V. N. Karazin Kharkiv National University, Kharkiv, Ukraine, ORCID ID: https://orcid.org/0000-0003-2556-2635*
Barsukov Nikita, *Assistant of Department, V. N. Karazin Kharkiv National University, Kharkiv, Ukraine, ORCID ID: https://orcid.org/0000-0001-9047-7002*
Veklych Viktor, *Assistant of Department, V. N. Karazin Kharkiv National University, Kharkiv, Ukraine, ORCID ID: https://orcid.org/0000-0001-5073-2793*

DOI: https://doi.org/10.31435/rsglobal_ws/30042021/7537

ARTICLE INFO

Received: 08 February 2021
Accepted: 04 April 2021
Published: 09 April 2021

KEYWORDS

penetrating thoracic wounds, videothoracoscopic interventions, thoracotomy.

ABSTRACT

To date, the basis of surgical tactics for chest injuries is the primary surgical treatment of the wound and drainage of the pleural cavity with dynamic monitoring and determination of indications for surgery, based on the amount of blood released by drainage, without any attempts to actively verify the nature of injuries.
Treatment of patients on the basis of the so-called "individual approach" and active-waiting tactics, taking into account clinical, radiological and laboratory data, mainly meets the recommendations of the middle of the last century.
From the standpoint of evidence-based medicine, thoracoscopy is the most effective method of topical diagnosis of traumatic hemothorax. Videothoracoscopic technologies significantly reduce the incidence of purulent intrapulmonary and pleural complications in penetrating lung injuries. Undoubted advantages of thoracoscopy are: full-fledged revision; accurate diagnosis, which eliminates doubts about the diagnosis and waiting period; determination of indications for drainage, operative thoracoscopy or thoracotomy.

Citation: Belozorov Igor, Kudrevych Oleksandr, Kosov Eugene, Rozhkova Olena, Barsukov Nikita, Veklych Viktor. (2021) Surgical Tactics in Patients with Penetrating Thoracic Injuries. *World Science.* 4(65). doi: 10.31435/rsglobal_ws/30042021/7537

Introduction. Chest injury is one of the leading causes of death from injury, as well as temporary and permanent disability in people under 40, both in our country and abroad [1].

The part of chest injuries in the overall picture of the injury is difficult to overestimate. In peacetime, closed chest injuries occur with a frequency of 10% to 35 - 50% of all injuries, and her injuries are 1 - 3%.

In peacetime, the vast majority of chest injuries (up to 97.3%) are among the so-called domestic. For most open chest injuries are not frightening in appearance: small in size, usually smooth edges of the wound. The size of the external wound does not in any way indicate the nature and extent of intrathoracic injuries [2, 3].

As a result of the rapid development of the chain of pathological syndromes, the condition of most victims on admission to the hospital is characterized by a significant degree of severity. The severity of the patient's condition is determined by the nature of organ damage, the amount of blood loss. This fact requires immediate effective diagnostic and therapeutic measures [4].

The most difficult is to determine the tactics for penetrating chest injuries and the absence of absolute indications for thoracotomy, due to the inability to verify the anatomical and topographic nature of chest injuries by non-invasive methods [5, 6].

To date, the basis of surgical tactics for chest injuries is the primary surgical treatment of the wound and drainage of the pleural cavity with dynamic monitoring and determination of indications for surgery, based on the amount of blood released by drainage, without any attempts to actively verify the nature of injuries [7, 8].

The desire to avoid mistakes forces surgeons to expand the indications for thoracotomy, which is often performed in vain or ends in the elimination of small lesions. In such cases, thoracotomy harms the victim, aggravating the severity of the condition and increasing the risk of complications in the postoperative period. Therefore it is extremely important rigorous and balanced approach in determining the indications for thoracotomy chest injuries, excluding unreasonable surgical interventions. All this emphasizes the relevance of the search for new, more effective and sparing methods for the diagnosis and treatment of chest trauma [9, 10].

Currently, in all areas of surgery there is a trend of widespread use of minimally invasive techniques [11].

Clarification with the help of videothoracoscopy of the nature of intrathoracic injuries will facilitate the choice of optimal surgical tactics, a more rigorous substantiation of indications for extensive interventions, and the maximum use of its operative capabilities - a decrease in the number of thoracotomies, a decrease in the incidence of complications and an improvement in the results of treatment of victims [12].

Materials and methods. The first group included 132 patients who were treated without the use of videothoracoscopic interventions. The second group (main) consisted of 73 patients who underwent diagnostic and therapeutic videothoracoscopic interventions.

Among the patients of the first group there were 115 (87%) men and 17 (13%) women aged 18 to 68 years (mean age - 33.9 ± 9.6 years).

In these patients, the size of the hemothorax was determined on the basis of X-ray examination, the results of pleural puncture and the amount of blood released by pleural drainage. It should be noted that due to the severity of the condition and the presence of total hemothorax 18 (13.6%) patients were immediately sent to the operating room, where they underwent emergency thoracotomy.

The operation revealed the following injuries: parenchyma of the lungs and muscular branches of the intercostal artery - 6, heart - 5, internal thoracic artery - 2, diaphragm and intercostal artery - 2, bronchi - 2, pulmonary artery - 1.

The following interventions were performed: suturing of the heart wound - 5, suturing of the lung wound - 3, ligation and suturing of the intercostal artery - 4, suturing of the internal thoracic artery - 2, suturing of the diaphragm wound and suturing of the intercostal artery - 2, suturing of the pulmonary artery wound - 1. A total of 3 (15.7%) victims died.

At the same time, one patient, who was admitted in an extremely serious condition with a heart injury, died on the operating table. Based on operative data, it was found that in 3 people the bleeding was prolonged, and its source was the branches of the intercostal artery and superficial lung wound.

In these patients, treatment could be limited to videothoracoscopic intervention.

In the postoperative period, the following complications were noted: wound suppuration - 2, postoperative pneumonia - 1, exudative pleurisy - 1, pleural empyema - 1. The frequency of postoperative complications in this group was 26.3%. All complications were eliminated with conservative measures.

The remaining 114 (86.4%) patients underwent puncture and drainage of the pleural cavity with a polychlorinated vinyl tube with a diameter of 8 mm in the 7th intercostal space along the

posterior axillary line after radiological examination. Dynamic monitoring and determining indications or contraindications to thoracotomy was conducted, based on the calculation that stood out for blood drainage without verification of the nature of the damage.

At a small hemothorax on drainage from a pleural cavity from 170 to 430 ml (on the average 261 ± 53 ml) of liquid blood separated, at an average hemothorax - from 570 to 830 ml (on the average 672 ± 64,7 ml), and at a big hemothorax - from 1070 to 1200 ml (on average - 1144 ± 30.5 ml). In this group, in 96 (84.2%) patients the bleeding was stopped, and in 18 (15.8%) - ongoing.

With ongoing intrapleural hemorrhage in 18 patients after ineffective hemostatic therapy performed thoracotomy for urgent indications. During the operation, the most common causes of ongoing bleeding were intercostal vessels - in 9, vessels of the parenchyma of the damaged lung - in 5 patients. Heart injuries were in 2 patients, large injuries of the chest wall muscles - in 2.

In the postoperative period, 2 patients died (11.1%). The following complications were noted: wound suppuration - in 2, postoperative pneumonia - in 1 case, exudative pleurisy - in 1 case, pleural empyema - in 1 case.

The frequency of postoperative complications in this group was 26.3%. All complications were eliminated with conservative measures.

Of the patients who remained unoperated urgently (96 wounded), 37 (28.03%) had complications in the form of collapsed hemothorax, and 14 (10.1%) had large pneumothorax.

Of the 37 (28.03%) patients with coagulated hemothorax, 21 patients were treated with conservative measures. However, in 16 cases, a thoracotomy was required due to treatment failure. At the same time one operated died from purulent complications.

Thoracotomy was also performed in 11 patients when it was impossible to straighten the lung due to pneumothorax that persists due to the presence of fistula of lung tissue. One of these patients in serious condition died in the postoperative period from sepsis.

Therefore, with this treatment tactic, emergency thoracotomy was performed in 19 (14.4%) patients. At the same time 3 people died.

Based on operative data, it was found that in 3 patients the bleeding was stopped, and its source was the branches of the intercostal artery and superficial lung wound. In these patients, treatment could be limited to videothoracoscopic intervention.

Urgent thoracotomy was required in 18 patients. In these observations, thoracotomy was performed late due to misdiagnosis. In the postoperative period, 2 patients died. Delayed thoracotomy for severe complications was performed in 27 (20.5%) individuals, after which 2 patients also died.

A total of 7 (5.3%) patients died with this treatment tactic, and severe postoperative complications were observed in 48 (36.4%) patients. Retrospectively, 51 (38.6%) patients could be diagnosed with intrapleural complications with the help of videothoracoscopic interventions. At the same time in 27 people delayed thoracotomy could be replaced by various videothoracoscopic (VTS) interventions.

Thus, the treatment of patients on the basis of the so-called "individual approach" and active-waiting tactics, taking into account clinical, radiological and laboratory data, mainly meets the recommendations of the middle of the last century.

The main group of the first subgroup included 73 patients who were treated with VTS. Among these patients were 68 (93%) men and 5 (7%) women aged 18 to 68 years (mean age 32.3 ± 9.4 years), detailed in section II.

The main indications for thoracoscopy were: medium and small hemothorax or hemopneumothorax, injuries in the "heart zone" of the chest without signs of cardiac tamponade, injuries in the "thoracoabdominal zone" of the chest, increasing mediastinal emphysema, pneumothorax for 3 days, coagulated hemothorax, suspected injury to the diaphragm, a foreign body in the thoracic cavity.

VTS was performed in patients with stable hemodynamic parameters. Contraindications to VTS in our observations were: total hemothorax, profuse intrapleural hemorrhage, injuries of the heart and large vessels, damage to the trachea and large bronchi, agonal condition of patients.

During the VTS, various injuries were detected. It should be emphasized that 21 (29%) patients had two or more sources of bleeding with stable or unstable hemostasis. This was emphasized equally often in both single and multiple chest injuries.

Isolated chest wall injury occurred in 12 (17%) patients; combined injury of the vessels of the chest wall, organs and anatomical structures of the chest - in 29 (39%); lung injuries - in 23 (31%);

diaphragms - in 4 (6%); pericardium and heart - in 3 (4%); thoracic lymphatic duct - in 1 (1.4%), mediastinum - in 2 (2.7%).

The sources of bleeding from the chest wall were: intercostal artery - in 18, muscular branches of the intercostal artery - in 21, internal thoracic artery - in 2 cases.

We followed the endoscopic classification of the nature of bleeding, proposed by M.M. Abakumov and co-authors in 2007. In this classification are: 1) intense bleeding; 2) moderate bleeding; 3) unstable hemostasis; 4) stopped bleeding.

Intensive is the continuation of bleeding with a constant stream of blood from the wound. In our observations, intense bleeding was diagnosed in 14 (19.2%) patients. Moderate bleeding includes leakage of blood through the pleura, which was found in 31 (42.5%) cases. Unstable hemostasis is determined by the presence of a subpleural hematoma or a wound made by a clot, after the removal of which the bleeding resumes. Unstable hemostasis occurred in 11 (15.06%) subjects. The stopped bleeding included cases of hemothorax in the absence of signs of bleeding from the wound of the chest wall and the absence of other sources of bleeding. This was observed in 17 (23.3%) patients.

Thus, in our observations in 46 (45.2%) subjects the bleeding was ongoing.

During thoracoscopy after removal of hemothorax, bleeding from intercostal vessels was also performed in 23 patients, from lung wound in 32, diaphragm wound in 1, and mediastinal wound in 2.

Videothoracoscopic interventions in the form of electrocoagulation allowed stopping bleeding from the vessels of the chest wall in 29 patients.

The use of thoracoscopy allowed correctly diagnosing the nature of the injury and avoiding traumatic thoracotomy.

In 3 cases, the stop of bleeding from the intercostal spaces was performed by suturing the artery throughout with percutaneous ligature with a stylet needle and tying the immersion suture. The entire intercostal vascular bundle was securely pressed against the rib.

By means of electrocoagulation in 13 patients reliable hemostasis and aerostasis at superficial wounds of a lung parenchyma were received.

In 6 wounded the suture was applied using Polysorb 3/0 thread with capture of the wound edges to the full depth.

In blind lung injuries in 2 observations, a thoracoscope was inserted into the wound canal for revision and removal of non-viable tissues. The wound was then sutured by grasping its bottom: the first suture leaving the long free end of the suture, and then the spiral suture tied a knot between the free end of the suture and each turn of the spiral. This prevented the formation of intrapulmonary hematomas and cavities.

At penetrating large wounds in 2 patients performed wedge-shaped or tangential resection of the lung, then performed rehabilitation and targeted drainage of the pleural cavity.

In one observation, a bleeding diaphragm wound was sutured.

In 2 patients with severe emphysema and mediastinal hematoma, mediastinotomy, removal of mediastinal hematoma and coagulation of small bleeding vessels were performed.

It should be noted that all patients after evacuation of the liquid part of the blood were diagnosed with at least partially coagulated hemothorax. It was fragmented by endoscopic clamps and aspirated by suction. This was an effective prevention of residual hemothorax. The weight of the clots ranged from 150 to 910 grams.

An important aspect of the completion of thoracoscopic interventions was adequate drainage of the pleural cavity.

Endoscopic rehabilitation was performed in 7 patients admitted from other medical institutions with a lifespan of collapsed hemothorax of more than 5 days.

A total of 66 (90.4%) patients underwent a full range of surgical interventions using videothoracoscopic technologies. The conversion required 7 (9.6%) wounded. The reasons for conversion were: heart injury - in 2, large and deep lung wound - in 2, internal thoracic artery injury - in 2, large diaphragm rupture - in 1 case.

In the postoperative period, two patients died of severe concomitant somatic pathology: dilated cardiomyopathy - 1, obesity and decompensated diabetes - 1.

After VTS complications occurred in 8 (10.9%) patients. The structure of complications was as follows: pneumonia - in 3, lung did not straighten for a long time - in 2, pleural empyema - in 2, curled hemothorax - in 1 patient. However, all complications were treated with conservative measures.

Results of the research. Research has shown that different amounts of blood accumulation in the pleural cavity after its drainage were found in 35 (20.7%) patients of the first group. At the same time 16 (21.5%) patients required a delayed thoracotomy for coagulated hemothorax.

In the second group, coagulated hemothorax was noted in only one patient.

In the first group of 11 victims, a delayed thoracotomy was performed due to prolonged lung collapse. In patients of the second group, this complication occurred in 2 observations. At the same time surgical intervention was not required.

Comparative research has shown that the use of VTS has reduced the frequency of thoracotomies by 2.1 times, the duration of drainage of the pleural cavity - 2 times, the frequency of complications - 3.3 times, the duration of inpatient treatment - 1.5 times, and mortality - 3 times.

From the standpoint of evidence-based medicine, thoracoscopy is the most effective method of topical diagnosis of traumatic hemothorax.

The results of our research have shown that videothoracoscopic technologies significantly reduce the incidence of purulent intrapulmonary and pleural complications in penetrating lung injuries. Undoubted advantages of thoracoscopy are: full-fledged revision; accurate diagnosis that eliminates doubts about the diagnosis and waiting period; determination of indications for drainage, operative thoracoscopy or thoracotomy.

Table 1. Comparative evaluation of treatment results of open chest trauma with and without using of videothoracoscopy.

Indicators	Traditional treatment (n-132)	VTS (n-73)	P	Performance indicators
Frequency of thoracotomy, %	27 (20,5%)	7 (9,6%)	<0,05	Reduction 2.1 times
Duration of intervention, min	94,2	55	<0,05	Reduction 1,7 times
Duration of drainage, days	6,3	3,2	<0,05	Reduction 2 times
Frequency of complications, %	48 (36,4%)	8 (10,9%)	<0,05	Reduction 3,3 times
Duration of treatment, days	27,2	18,1	<0,05	Reduction 1,5 times
Mortality, %	7 (5,3%)	2 (2,7%)	-	Reduction 2 times

Conclusions. VTS interventions do not replace traditional surgery in the presence of absolute indications for thoracotomy. It is not advisable to perform thoracoscopy with unstable hemodynamics due to blood loss, as there is a high probability of detection of undamaged during thoracoscopy damage to the heart or large vessels on the background of ventilation of one lung.

Absolute contraindications to thoracoscopy are: reliable signs of damage to the heart and main vessels; hemopericardium and cardiac tamponade; hemomediastinum with compression of the respiratory tract and main blood vessels. If there are reliable clinical and radiological signs of rupture of the trachea or large bronchi, an emergency thoracotomy is also required. The use of VTS has opened not only endless diagnostic possibilities, but also a new strategy of thoracic surgery. In many cases of penetrating chest injuries, VTS interventions have become the method of treatment of choice.

VTS is an effective method of topical diagnosis of penetrating chest injuries. With the help of VTS technology in 66 (90.4%) patients managed to perform the full scope of surgery. The conversion required 7 (9.6%) wounded. Comparative studies have shown that the use of VTS in penetrating chest injuries has reduced the frequency of thoracotomies by 2.1 times, the duration of drainage of the pleural cavity - by 2 times, the frequency of complications - by 3.3 times, the duration of inpatient treatment - by 1.5 times and mortality - 2 times.

The results of our research have shown that VTS technologies significantly reduce the incidence of intrapleural complications in penetrating thoracic injuries.

Conflict of interest. The authors do not declare a conflict of interest.

REFERENCES

1. Ramachandran A et al (2017), Comparison of epidemiology of the injuries and outcomes in two first-level trauma centers in colombia using the pan-american trauma registry system, "World Journal of Surgery", 1–7.
2. Ruelas O.S., Tschautscher C.F., Lohse C.M. and So (2018), Analysis of prehospital scene times and interventions on mortality outcomes in a national cohort of penetrating and blunt trauma patients, "Prehospital Emerg Care", 22, 691-697.
3. Kim, M., and Moore, J.E. (2020), Chest Trauma: Current Recommendations for Rib Fractures, Pneumothorax, and Other Injuries, "Curr Anesthesiol Rep", 10, 61–68.
4. Battle CE, Hutchings H, and So (2012), Risk factors that predict mortality in patients with blunt chest wall trauma: a systematic review and meta-analysis, "Injury", 43(1), 8–17.
5. Khomenko, I., Gerzhyk, K., and So (2018), The place and role of videothoracoscopic surgical interventions in war wounds and injuries of the chest organs, "Reports of Vinnytsia National Medical University", 22(3), 522-524.
6. Boyko, V. V et al. (2020), Determination of therapeutic and diagnostic tactics in penetrating shooting and punch-cutting injuries of the chest using spiral computer tomography, "Kharkiv Surgical School", 4, 47-54.
7. Huis MA, Craft SA, and So (2018), Blunt Cardiac Trauma Review, "Cardiol Clin.", 2, 183-191.
8. Kruit N et al. (2019), Assessment of safety and bleeding risk in the use of ECMO for multi-trauma patients: a multicentre review, "J Trauma Acute Care Surg*.",* 86, 967–973.
9. McDonald Johnston, A. and Alderman, J.E. (2020), Thoracic Injury in Patients Injured by Explosions on the Battlefield and in Terrorist Incidents, "Chest", 157, 888–897.
10. Avaro J-P, De Lesquen H, and So (2017), Specific elements of thoracic wound management, "J Visc Surg.", 1, 31-33.
11. R.M. Afzal, et al. (2018), Thoracic impalement injury: a survivor with large metallic object in-situ, "Chin. J. Traumatol.", 21, 369-372.
12. Y.W. Liu et al. (2018), Survival of the fittest: the role of video-assisted thoracoscopic surgery in thoracic impalement injuries, "J. Thorac. Dis.", 10 (7), 4445-4452.