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FEATURES OF SURGICAL TREATMENT OF ESOPHAGEAL INJURIES COMPLICATED BY PURULENT MEDIASTINITIS

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Ключевые слова: *перфорация пищевода, гнойный медиастинит, хирургическая тактика*

Abstract. Features of surgical treatment of esophageal injuries complicated by purulent mediastinitis.

Shevchuk I.M., Snizhko S.S. *The aim of the work is to improve the results of treatment of patients with esophageal perforations complicated by purulent mediastinitis. Examination and treatment of 30 patients with esophageal perforation (EP) complicated by purulent mediastinitis were performed. The causes of EP were foreign body damages in 12 (40%) of 30 patients, spontaneous rupture of the esophagus – in 11 (36.6%), iatrogenic damage to the esophagus – in 7 (23.4%) patients. The main method of surgical treatment of esophageal perforations complicated by acute purulent mediastinitis is thoracotomy with suturing of the perforated wall of the esophagus and sanation of mediastinal tissue. In case of purulent melting of the esophageal wall and total mediastinitis with severe endogenous intoxication, surgical interventions should be aimed at minimizing surgical trauma and elimination of the purulent process in the mediastinum using video-assisted thoracoscopy. The use of developed surgical tactics for the treatment of esophageal perforations complicated by acute purulent mediastinitis with intramediastinal administration of antibacterial drugs and the method of irrigation of the esophageal sutures contributes to a significant rapid reduction in endogenous intoxication, namely leukocytosis units up to 2.103 ± 0.182 d. units ($p < 0.001$) with normalization of the indicator on the 5th day from the beginning of treatment, the severity of the condition on the APACHE II scale in the modification of Radzikhovsky AP from 14.91 ± 1.80 points at the time of hospitalization to 9.4 ± 0.3 points on the second day after surgery ($p < 0.001$), the severity of patients' condition on the SOFA scale on the 3rd day to 3.221 ± 0.445 points, on the 5th day – 1.832 ± 0.219 points ($p < 0.001$), the level of C-reactive protein on the 2nd day after surgery decreased from 236.2 ± 21.4 mg/l to 144.3 ± 9.3 mg/l, and on the 3rd day was 112.1 ± 7.2 mg/l (in both cases $p < 0.001$), reducing the content of procalcitonin from 8.7 ± 0.9 ng/ml to 3.828 ± 0.251 ng/ml on the 2nd day after surgery. The use of this surgical tactic allows you to quickly eliminate the purulent process in the mediastinum, reduce the healing time of the perforation of the esophagus and reduce mortality from 28.5 to 6.2%.*

Реферат. Особенности хирургического лечения повреждений пищевода в условиях гнойного медиастинита. Шевчук И.Н., Снижко С.С.

Цель работы. Улучшить результаты лечения больных с перфорациями пищевода в условиях гнойного медиастинита. Проведено обследование и лечение 30 больных с перфорацией пищевода (ПС) в условиях гнойного медиастинита. Причинами ПС были повреждения инородными телами у 12 (40%) из 30 больных, спонтанный разрыв пищевода (синдром Бурхава) – у 11 (36,6%), ятрогенные повреждения пищевода – у 7 (23,4%) больных. Основным методом хирургического лечения перфораций пищевода в условиях острого гнойного медиастинита является торакотомия с ушиванием перфорированной стенки пищевода и санацией клетчатки средостения. При гнойном расплавлении стенки пищевода и тотальном медиастините с явлениями выраженной эндогенной интоксикации операционные вмешательства должны быть направленными на минимизацию хирургической травмы и ликвидацию гнойного процесса в средостении с использованием видео-ассистированной торакокопии. Применение разработанной хирургической тактики лечения перфораций пищевода в условиях острого гнойного медиастинита с применением интрамедиастинального введения антибактериальных препаратов и метода орошения швов пищевода способствует достоверному быстрому снижению показателей эндогенной интоксикации, а именно: лейкоцитарный индекс интоксикации снизился почти втрое – с $6,412 \pm 1,108$ ус. ед. до $2,103 \pm 0,182$ ус. ед. ($p < 0,001$) с нормализацией показателя на 5-й день от начала лечения, тяжести состояния по шкале APACHE

II в модифікації Радзиховського А.П. с 14,91±1,80 балла на время госпитализации до 9,4±0,3 балла уже на вторые сутки после операции (p<0,001), тяжести состояния больных по шкале SOFA уже на 3-и сутки до 3,221±0,445 балла, на 5-е сутки 1,832±0,219 балла (p<0,001), уровень С-реактивного белка уже на 2-е сутки после операции снизился с 236,2±21,4 мг/л до 144,3±9,3 мг/л и на 3-и сутки составлял 112,1±7,2 мг/л (в обоих случаях p<0,001), снижение содержания прокальцитонина с 8,7±0,9 нг/мл до 3,828±0,251 нг/мл на 2-е сутки после операции. Применение разработанной хирургической тактики позволяет быстрее ликвидировать гнойный процесс в средостении, сократить сроки заживления перфоративного отверстия пищевода и снизить летальность с 28,5 до 6,2%.

Esophageal perforation (EP) is a serious complication of diseases and medical manipulations and the treatment of EP in the development of acute purulent mediastinitis (APM) is of particular relevance. Tactics of treatment of non-complicated EP are known in the modern literature, however methods of surgical treatment of EP in the conditions of APM remain debatable [3, 5, 7]. The treatment of EP in the conditions of APM involves the simultaneous treatment of two serious diseases and the invention of pathogenetically sound tactics of surgical treatment is the goal of our work.

APM, as a complication of EP, is a complex form of surgical infection with an extremely severe course, rapid development of organ dysfunction, high frequency of sepsis, septic shock and is accompanied by high mortality. Thus, according to the authors, sepsis in APM is diagnosed in 50-100% of patients, and mortality rates range from 16 to 80% [4].

Methods of surgical treatment of EP in the conditions of APM cause numerous discussions among the authors. Types of surgical interventions, access to the esophagus, the volume of the operation, the feasibility of suturing the perforation of the esophagus, operations aimed at excluding the esophagus from the digestive act, providing nutrition to patients in the postoperative period are controversial [6, 8].

At present, no methods of local antibacterial therapy in purulent mediastinal tissues have been developed, only methods of its drainage have been proposed. Many options for mediastinal drainage have been proposed, but most of them are either ineffective or very traumatic. These techniques are not effective enough and need improvement [2, 4].

The aim of the work is to improve the results of treatment of patients with esophageal perforations in the conditions of purulent mediastinitis.

MATERIALS AND METHODS OF RESEARCH

We examined and treated 110 patients with APM receiving treatment at the Ivano-Frankivsk Regional Clinical Hospital in the period from 2004 to 2019. Among these patients, the cause of APM were EP, diagnosed in 30 (81.1%) patients, which were the subject of our study. The causes of EP were damage to the esophagus caused by foreign bodies in

12 (40%) of 30 patients, spontaneous rupture of the esophagus (Burkhave syndrome) – in 11 (36.6%), iatrogenic damage to the esophagus – in 7 (23.4%) patients.

The analysis of efficiency and consequences of the methods of surgical treatment of EP and APM offered by us was carried out. All 30 patients with EP were divided into 2 groups: Group I (main) – 16 (53.3%) patients who underwent the developed tactics of surgical treatment using intramediastinal administration of antibacterial agents (IMAA) [2] and permanent irrigation of sutures of the esophageal perforation (PISEP) [3] and group II (comparative) – 14 (46.7%) patients who underwent traditional methods of treatment. All patients with EP and APM were operated.

To assess the effectiveness of treatment, we studied the terms of esophageal wound healing according to contrast radiological examination and esophagogastrosopy (EGDS), changes in leukocyte intoxication index (LII), C-reactive protein (CRP), procalciton. The dynamics of determining the severity of patients was performed by the APACHE II scale in the modification of Radzikhovskiy AP and SOFA (Sequential Organ Failure Assessment) [10].

For statistical processing, we used the Open Value Subscription for Microsoft® Office ProPlusEducation AllLng License/Software AssurancePack Academic OLV 1License LevelE Enterprise 1Year license program (license program number is confidential). To objectively judge the reliability of the results of the study a variational-statistical method of analysis of the results using a personal computer IBM 586 and an application program for working with spreadsheets Microcoft Exel were used [1].

RESULTS AND DISCUSSION

For successful treatment of patients with APM, it is important to choose a surgical access to determine the extent of operation. We took into account the location of the EP and the condition of the esophageal wall, the nature of the purulent process of the mediastinum (limited or diffuse) and the presence of complications. It is the choice of operative tactics in EP patients in the conditions of purulent lesion of mediastinal tissue that was

considered crucial for successful treatment of patients. The main surgical interventions in EP in the conditions of APM carried out by us included:

- lateral thoracotomy, mediastinotomy, suturing of the perforation of the esophagus with active drainage of the mediastinum and pleural cavity;
- lateral thoracotomy, suturing of EP and imposition of esophagostomy and gastrostomy;
- lateral thoracotomy, mediastinotomy, suturing of EP and gastrostomy;
- lateral thoracotomy, mediastinotomy and mediastinal drainage;
- Razumovsky's cervicotomy, mediastinotomy, opening of the upper mediastinum, suturing of EP and drainage of the pleural cavity according to 2-3 Bulau drainages;
- video-assisted thoracoscopy (VATS).

One of the main methods of surgical treatment was lateral thoracotomy on the affected side depending on the location of esophageal perforation with mediastinotomy and suturing of the perforation and adjustment of the system for active drainage of the mediastinum and pleural cavity using 3-4 drainages. This type of surgical treatment was performed in 13 (43.3%) patients (one died, postoperative mortality was 7.7%). Thoracotomy for suturing the perforation of the esophagus was used in the early stages of the disease in the absence of purulent melting of the esophageal wall, as well as in localized forms of APM or total APM for complete visual inspection of all mediastinum.

Lateral thoracotomy with perforation suturing and esophagostomy and gastrostomy according to Kader was performed in 2 (6.5%) patients from the comparison group, postoperative mortality was 100%. Both patients were diagnosed with Burhave syndrome (1) and failure of the sutures of the esophagoenteroanastomosis (1), which was detected on the 3rd day after Lewis surgery under the condition of total purulent melting of the mediastinal tissue. We believe that the use of major surgical interventions, such as gastrostomy or jejunostomy can cause excessive surgical trauma and increase the anesthetic risk, which can be a direct threat to the patient's life.

Lateral thoracotomy with mediastinotomy and suturing of the perforation of the esophagus and gastrostomy according to Kader was performed in 3 (9.7%) patients (one died, postoperative mortality was 33.3%). The main causes of mortality were the spread of purulent process in the mediastinum with the lesion to all its departments, widespread pyopneumothorax, the development of severe sepsis and multiple organ failure.

Cervical mediastinotomy with opening of the upper mediastinum, suturing of the perforation of the esophagus and active drainage of mediastinal tissue and pleural cavity was performed in 2 (6.5%) patients (postoperative mortality - 0%) with local forms of APM located only within the upper mediastinum.

Video-assisted thoracoscopy (VATS) was performed in 9 (29.1%) patients of the main group (one died, postoperative mortality 11.1%).

To improve the results of treatment, we proposed a method of intramediastinal administration of antibacterial agents (IMBA) (US Pat. No. 128808). In this case we found that antibacterial agents introduced into the tissue of the upper mediastinum in one hour were spread to all parts of the mediastinum (Pat. of Ukraine 105664). To improve the results of treatment we also proposed a method of permanent irrigation of sutures of the esophageal perforation (PISEP) after suturing of its perforation.

The esophageal perforation were sutured in all cases, except for purulent melting of the esophageal wall. Suturing of the esophageal perforation was performed in 21 (70%) patients. IMBA and PISEP were performed in all patients. A catheter for permanent irrigation of the esophageal sutures was placed along the sutures of the esophageal wall and mediastinal tissue. 87.5% of the mediastinal pleura were used to strengthen the sutures in the main group of patients, as well as the flap of the sternocleidomastoid muscle and the posterior wall of the pericardium in diagnosed exudative pericarditis – in 12.5% of patients.

In control esophagogastroduodenoscopy (EGDS) and X-ray examination of the esophagus in the main group on day 7-8 after surgery a complete sealing of the perforated sutures in 6 (37.5%) patients was noted, a decrease in the size of the esophageal perforated area – in 9 (56.2%). At the same time, on day 14 after surgery, the sealing of the perforation sutures was noted in 12 (65%), reduction of the size of the esophageal perforation site – in 3 (18.7%) patients. Failure of the esophageal sutures on day 2-3 after surgery was detected in 7 (43.7%) patients of the main group, in whom IMBA and PISEP were performed, in patients of the comparison group suture failure was diagnosed in 12 (85.7%). According to X-ray contrast esophagography, the size of the esophageal perforation decreased in 6 (85.7%) patients of the main group, which helped to improve the course of the disease, reduce the time of elimination of perforation and improve the prognosis. We believe that in the case of postoperative failure of the esophageal sutures, the separation of its lumen from the infected mediastinal

tissue, even for 2-3 days, prevents reinfection and helps to separate the purulent process in the mediastinum.

Some authors believe that the intersection of the cervical esophagus is indicated only in esophageal-tracheal fistulas [11]. However, in our work we rarely performed esophagostomy – only in 2 patients. In one patient with traumatic injury of the esophagus in the cervical region and in one patient with purulent melting of the esophagus and total APM. These operations are quite technically difficult and are accompanied by additional surgical trauma, which is not always justified in patients with severe endogenous intoxication (EI).

The problematic issue is to determine the rational surgical tactics of treatment of total APM during lateral thoracotomy on the affected side and in the presence of complications on the opposite side. Pleural exudate in the unaffected half of the chest was diagnosed in 6 (42.8%) patients of the main group. At the same time, VATS was considered justified, and pleural empyema was diagnosed in 4 patients and exudative pleurisy – in 2 patients. An additional mediastinotomy was performed in VATS, the exudate was evacuated and the pleural cavity was drained according to Bülow.

Minimally invasive methods of surgical treatment (VATS) were performed in 9 (29.1%) patients of the main group (one died, postoperative mortality was 11.1%). We consider the main advantages of VATS to be the minimal trauma of these operations, reduction of the duration of surgical interventions and good visualization of the mediastinum. VATS is effective in patients with severe sepsis with multiple organ failure, in which advanced surgical methods are a direct threat to the patient's life due to significant surgical trauma. Another advantage of VATS is the reduction of the probability of suppuration of postoperative wounds. In VATS in a short time period (20-40 minutes) it is possible to carry out effective drainage of paraesophageal and mediastinal tissue and pleural cavity.

We consider that indications for VATS are: purulent lesions of all parts of the mediastinum with melting of the esophageal wall and the impossibility of its suturing, with large damage to the esophageal wall longer than 7-8 cm, high probability of failure of the esophageal sutures in total damage to mediastinal tissue, patients with multiorgan dysfunction phenomena and at the V-th degree of anesthesiological risk to be the. VATS is effective in perforation of the esophagus in the conditions of local APM and in the presence of pyopneumothorax or pleural empyema. The main task of the VATS is

the rehabilitation of the affected purulent areas and the establishment of adequate and complete drainage of paraesophageal and mediastinal tissue. The pleural cavity after surgery was drained with 2-4 drains. At the same time in 3-4 weeks after the operation, the esophageal-pleural fistula was formed, which closed on its own in 3-5 weeks.

The gastrostomy operation was performed in 5 (13.5%) patients in total purulent melting of the esophageal walls in TM and failure of the esophageal sutures after resection of the esophagus for tumor (1). 4 (80%) patients died. Therefore, we are not in favor of conducting extended operations in the context of APM with severe EI. Nutrition of such patients should be only parenteral until the time of removal from the critical state, followed by the imposition of a gastrostomy according to the Stamm-Senn-Kader in a more favorable period.

In the main group of patients on day 1 after surgery, the LII decreased by almost three times – from 6.412 ± 1.108 c.u. to 2.103 ± 0.182 c.u. ($p < 0.001$) with normalization of the indicator on day 5 from the start of treatment. In the comparison group LII on day 1 significantly decreased from 6.106 ± 0.509 c.u. to 3.217 ± 0.214 c.u. ($p = 0.999$) and remained higher than in the main group on day 5 after surgery at the level of 2.621 ± 0.308 c.u. Changes in LII are shown in Figure 1.

In patients of the main group faster normalization of the analyzed indicators was noted from the first days from the moment of carrying out surgical intervention. In particular, we observed a rapid decrease in the severity of the condition in patients of the main group by APACHE II scale in the modification of Radzikhovsky AP (2015) from 14.91 ± 1.80 points at the time of hospitalization to 9.4 ± 0.3 points on day 2 after surgery ($p = 0.999$). Changes in indicators by APACHE II scale in the modification of Radzikhovsky AP indicate a more rapid elimination of purulent-inflammatory process in the mediastinum with the use of IMBA and PISEP in the main group of patients (Fig. 2).

In the main group a decrease in the severity of the condition of patients by the SOFA scale was noted on day 3 to 3.221 ± 0.445 points, on day 5 – to 1.832 ± 0.219 points. In the comparison group the severity of the condition on day 3 was 6.781 ± 0.526 points and it remained high on day 5 – 4.537 ± 0.521 points ($p = 0.999$).

The level of CRP in patients of the main group on day 2 after surgery decreased from 236.2 ± 21.4 mg/l to 144.3 ± 9.3 mg/l and on day 3 it made up 112.1 ± 7.2 mg/l (in both cases $p = 0.999$) with normalization of the indicator on day 10. In the

comparison group the level of CRP on day 2 remained high, being 212 ± 11.3 mg/l and gradually

decreased to day 15 from the time of surgery, reaching the upper limit of normal in not all patients.

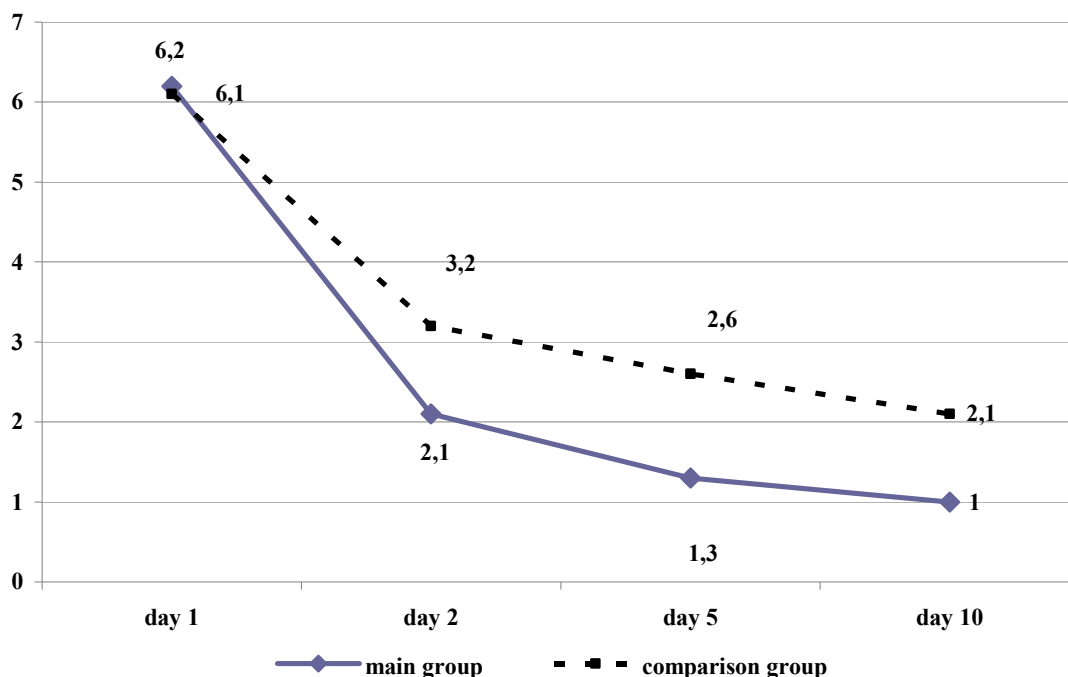


Fig. 1. Changes of LIH indicators by Ya.Ya. Kalf=Kalif in patients of the main and comparison group

There was noted a rapid significant decrease in the content of procalcitonin in all examined patients of the main group. At the time of hospitalization, the average content of procalcitonin was 8.7 ± 0.9 ng/ml,

on day 1 after surgery there was a decrease to 3.828 ± 0.251 ng/ml, on day 3 – to 2.392 ± 0.373 ng/ml and normalization on day 7 – 1.253 ± 0.095 ng/ml ($p=0.999$).

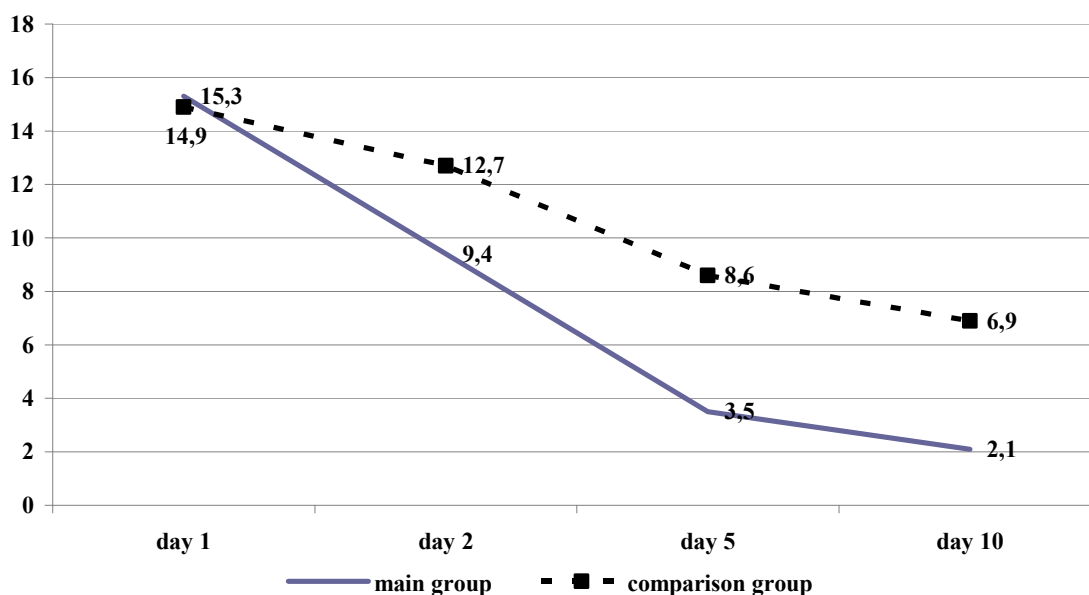


Fig. 2. Changes in severity of condition by APACHE II scale in modification of Radzikhovsky AP in patients of the main and comparison group

This rapid and significant decrease in EI, namely LII, CRP and procalcitonin, in the main group confirms the effectiveness of the developed tactics of surgical treatment of patients with EP in APM due to the wider use of minimally invasive treatment methods (VATS) which reduce the operating trauma and the application of IMBA and PISEP methodology developed by us.

It is the high level and long-term existence of EI that led to the development of sepsis, refractory septic shock and multiorgan failure, which were the direct causes of death. In the main group, 1 (6.2%) patient died who had a spread of the process by the type of necrotizing fasciitis with rapid spread to all parts of the mediastinum, the rapid development of sepsis, rapidly progressing multiorgan failure. Despite active surgical tactics and intensive care, the patient died on day 3 from the onset of the disease. The remaining 15 patients in the main group recovered and were discharged in satisfactory condition on average on day 21 ± 3.4 after surgery.

In the comparison group 4 (28.57%) out of 14 patients died. The causes of death were late appeal for treatment to medical institutions, which led to refractory septic shock, increasing multiorgan and cardiovascular insufficiency. The length of stay in the hospital was 29 ± 3.1 days.

Our surgical tactics coincide with the well-founded opinion of many scientists on the need for strictly individualized treatment tactics, which should be based on rational intensive care measures and priority use of minimally invasive methods with open surgery in the development of prevalent forms of APM [2, 4, 9].

Summarizing our experience in the use of minimally invasive methods of surgical treatment, namely VATS in esophageal lesions in the context of APM, we believe that VATS has undeniable advantages over advanced surgery. In patients with diagnosed EP and APM, VATS in most cases provides sufficient radicalism with minimal trauma. In many cases VATS is the method of choice for the final determination of the extent of the lesion and surgical tactics of treatment.

Gastrostomy aimed at feeding and prevention of the gastroesophageal reflux remains a debatable issue. We believe that the indications for gastrostomy are the impossibility of conducting a probe into the stomach and the established fact of gastroesophageal reflux. After the operation, we repeatedly injected (2-5 times) into the stomach a

solution of methylene blue in 300-500 ml of sodium chloride solution through a nasogastric tube. Reflux of contrast material into the esophagus and drainage of the pleural cavity was observed in only 3 (10%) out of 30 patients with damage to the esophagus at the site of the cardiac sphincter. We were able to avoid reflux of gastric contents into the lumen of the esophagus, giving patients a semi-sitting position during feeding and the first hours after. To prevent reinfection of the EP from the esophageal cavity when swallowing the contents of the oral cavity, the oral cavity and the esophageal lumen were rehabilitated.

Thus, we consider lateral thoracotomy, suturing of the perforation of the esophageal wall (at I and II degree) and drainage of the mediastinum and pleural cavity as the main methods of surgical treatment of primary APM. Thus, in the main group of patients the main methods of surgical treatment were lateral thoracotomy, mediastinotomy, suturing of the EP with drainage of the mediastinum and VATS with the use of IMBA and PISEP. In purulent melting of the esophageal wall and total APM with the phenomena of the expressed EI, surgical interventions should be directed on minimization of a surgical trauma, elimination of purulent process in a mediastinum and provision of drainage of the mediastinum and pleural cavity. VATS meets such criteria.

CONCLUSIONS

1. The main method of surgical treatment of esophageal perforations in the conditions of acute purulent mediastinitis is thoracotomy with suturing of the perforated wall of the esophagus and rehabilitation of the mediastinum.

2. In prevalent forms of acute purulent mediastinitis with purulent melting of the esophageal wall, the operation of choice is video-assisted thoracoscopy.

3. The use of intramediastinal administration of antibacterial drugs and the method of irrigation of the esophageal sutures allows you to quickly eliminate the purulent process in the mediastinum, reduce the healing time of the perforation of the esophagus and reduce mortality from 28.5% to 6.2%.

Conflict of interests. The authors declare no conflict of interest.

REFERENCES

- Ivchenko GI, Vtlvedev YuI. Introduction to mathematical statistics. Moscow: publishing house LCI; 2010. p. 600. Russian.
- Snizhko SS. [Analysis of the results of treatment of patients with esophageal injuries complicated by acute purulent mediastinitis]. *Art of medicine*. 2018;4(8):158-62. Ukrainian.
- Shevchuk IM, Snizhko SS, Andreyeshchev SA. [Surgical treatment of patients with esophageal perforation complicated by acute purulent mediastinitis]. *Clinical surgery*. 2018;85(11):13-17. Ukrainian.
- Mircea Chirica, Michael D Kelly, Stefano Siboni, Alberto Aiolfi, Carlo Galdino Riva, Emanuele Asti. Esophageal Emergencies: WSES Guidelines *World J Emerg Surg*. 2019 May 31;14:26. doi: <https://doi.org/10.1186/s13017-019-0245-2>
- Mustafa Kupeli, Abdullah Dogan. Successful Treatment of a Late Diagnosed Esophageal Perforation With Mediastinitis and Pericardial Abscess. *J Coll Physicians Surg Pak*. 2018 Dec;28(12):972-3. doi: <https://doi.org/10.29271/jcpsp.2018.12.972>
- Markar SR, Mackenzie H, Wiggins T, et al.. Management and Outcomes of Esophageal Perforation: A National Study of 2,564 Patients in England. *Am J Gastroenterol*. 2015 Nov;110(11):1559-66. doi: <https://doi.org/10.1038/ajg.2015.304>
- Sasha Still, Marissa Mencio, Estrellita Ontiveros, James Burdick, Steven G Leeds. Primary and Rescue Endoluminal Vacuum Therapy in the Management of Esophageal Perforations and Leaks. *Ann Thorac Cardiovasc Surg*. 2018 Aug 20;24(4):173-9. doi: <https://doi.org/10.5761/atcs.0a.17-00107>
- Kruger M, Decker S, Schneider JP, Haverich A, Schega O. Surgical treatment of acute mediastinitis *Chirurg*. 2016 Jun;87(6):478-85. doi: <https://doi.org/10.1007/s00104-016-0171-8>
- Pezzetta E, Kokudo T, Uldry E, Yamaguchi T, et al. The surgical management of spontaneous esophageal perforation (Boerhaave's syndrome) – 20 years of experience. *Biosci Trends*. 2016 May 23;10(2):120-4. Russian. doi: <https://doi.org/10.5582/bst.2016.01009>
- Singer M, Deutschman CS, Warren Seymour C, Manu Shankar-Hari, Djillali Annane, Bauer M, et al. "The Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3)". *JAMA*. 2016;315(8):801-10. <https://doi.org/10.1001/jama.2016.0287>
- Vest Michael T, Dross Peter. Boerhaave Syndrome. *J Am Osteopath Assoc*. 2018 Nov 1;118(11):764. doi: <https://doi.org/10.7556/jaoa.2018.165>

СПИСОК ЛІТЕРАТУРИ

- Ивченко Г. И., Медведев Ю. И. Введение в математическую статистику. Москва: Издательство ЛКИ. 2010. 600 с.
- Сніжко С. С. Аналіз результатів лікування хворих із пошкодженнями стравоходу, ускладненими гострим гнійним медіастинітом. *Art of medicine*. 2018. Т. 4, № 8. С. 158-162.
- Шевчук І. М., Сніжко С. С., Андрєєщев С. А. Хірургічне лікування хворих з перфорацією стравоходу, ускладненою гострим гнійним медіастинітом. *Клінічна хірургія*. 2018. Т. 85, № 11. С. 13-17.
- Esophageal Emergencies: WSES Guidelines / Mircea Chirica et al. *World J Emerg Surg*. 2019. 31 May. (Vol. 14, No. 26). DOI: <https://doi.org/10.1186/s13017-019-0245-2>
- Kupeli Mustafa, Dogan Abdullah. Successful Treatment of a Late Diagnosed Esophageal Perforation With Mediastinitis and Pericardial Abscess. *J Coll Physicians Surg Pak*. 2018. Dec. (Vol. 28, No. 12). P. 972-973. DOI: <https://doi.org/10.29271/jcpsp.2018.12.972>
- Management and Outcomes of Esophageal Perforation: A National Study of 2,564 Patients in England / S. R. Markar et al. *Am J Gastroenterol*. 2015. Nov. (Vol. 110, No. 11). P. 1559-1566. DOI: <https://doi.org/10.1038/ajg.2015.304>
- Primary and Rescue Endoluminal Vacuum Therapy in the Management of Esophageal Perforations and Leaks / Sasha Still et al. *Ann Thorac Cardiovasc Surg*. 2018. 20 Aug. (Vol. 24, No. 4). P. 173-179. DOI: <https://doi.org/10.5761/atcs.0a.17-00107>
- Surgical treatment of acute mediastinitis / M. Kruger et al. *Chirurg*. 2016. Jun. (Vol. 87, No. 6). P. 478-485. DOI: <https://doi.org/10.1007/s00104-016-0171-8>
- The surgical management of spontaneous esophageal perforation (Boerhaave's syndrome) – 20 years of experience / E. Pezzetta et al. *Biosci*

Trends. 2016. 23 May. (Vol. 10, No. 2). P. 120-124.
DOI: <https://doi.org/10.5582/bst.2016.01009>

10. The Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3) / M. Singer et al. *JAMA*. 2016. Vol. 315, No. 8. P. 801-810.
DOI: <https://doi.org/10.1001/jama.2016.0287>

11. Vest Michael T., Dross Peter. Boerhaave Syndrome. *J Am Osteopath Assoc*. 2018. 1 Nov. (Vol. 118, No. 11). P. 764. DOI: <https://doi.org/10.7556/jaoa.2018.165>

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