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## Surgical treatment of patients with perforation of the esophagus with complicated acute purulent mediastinitis

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### Abstract

**Aim:** To improve the treatment of patients with perforation of the esophagus with complicated acute purulent mediastinitis.

**Materials and Methods:** During 2004-2018 at the Department of Thoracic Surgery, Ivano-Frankivsk Regional Clinical Hospital, we examined and treated 30 patients with perforation of the esophagus with complicated acute purulent mediastinitis. The age of patients is from 21 to 76 years, on average  $36,3 \pm 3,9$  years. Men were 21(70%), women 9 (30%).

**Results:** At the application of intramediastinal administration of antibacterial drugs and the method of irrigation of the seams of the esophagus, a faster elimination of purulent-inflammatory process in the mediastine was observed. Complete sealing of the joints of the perforated part of the esophagus in 6 (37.5%) patients, reduction of the size of the defect of the esophagus wall - in 9 (56.2%) patients.

**Conclusions:** 1. Sewing of the perforation of the esophagus should be performed to distinguish the esophagus from the mediastinum, localization of the purulent process in the mediastinum and to stabilize the general condition of the patient.

2. Mini invasive surgical treatment using video-assisted thoracoscopy can serve as a selection option for patients with perforation of the esophagus in the common forms of acute purulent mediastinitis for the rehabilitation and drainage of the purulent-inflammatory process in the mediastinum, stabilization of the patient's condition and prevention of septic complications.

3. The use of intramediastinal administration of antibacterial drugs and the method of irrigation of the seams of the esophagus can improve the results of treatment, reduce endogenous intoxication, improve the healing of perforation of the esophagus, and eliminate the purulent process in the mediastinum.

**Keywords:** Perforation of the esophagus, mediastinitis, treatment of perforations of the esophagus

### Introduction

Perforation of the esophagus (PE) is accompanied by acute purulent mediastinitis (APM) in 67-84% of patients [1]. In the structure of the PE, the leading place belongs to iatrogenic damage, which reaches 52.5-80.6% [1, 2]. Most often, PE are diagnosed during drunkenness after chemical burns in 1-30% of patients, pneumocardi dilatation of achalasia cardia - in 0.2-11%, removal of foreign bodies - at 0.22-9.35%, stenting of inoperable tumors - at 7 - 11%, endoscopic sclerosis of varicose veins of the esophagus - in 1-6% of patients [3]. In recent years, there is an increase in the number of cases of spontaneous rupture of the esophagus (Burhave syndrome) [2, 4]. Already after 6 hours after an PE, histological examination at the wall of the esophagus reveals purulent infiltration of all layers against the background of numerous hemorrhages [1, 4]. One day after the PE, the defects are gray in color, when pushed from the wound, manure is isolated, and the histologic pattern is characterized by a sharp full-blot and diffuse infiltration of tissues by neutrophilic leukocytes [6]. 12-24 hours after the PE there is an expanded clinical picture of acute purulent mediastinitis (APM) and sepsis [5]. Mortality at the PE of the complicated APM reaches 40,9-80% [1, 6].

APM is one of the most dangerous forms of surgical infection [4]. Mortality in patients with APM is according to various authors from 17 to 80% [3, 4]. The severity of the APM is due to the presence in the middle of the central sympathetic and parasympathetic nerves, important blood and lymph vessels. Mediastinum also intensively absorbs tissue breakdown products, which promotes the rapid development of severe intoxication [1, 4]. Sepsis is diagnosed in 45 - 100% of cases, multiple organ failure syndrome (MOFS) in 9 - 17% of cases [5]. A number of authors believe that poor blood supply to the purulent mediastinum is a key issue, which leads to insufficient effective antibacterial therapy in the center of infection [2].

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The choice of surgical tactics in patients with PE, complicated APM remains the subject of discussion. According to some authors, today there is no single tactic of surgical treatment of PE complicated APM [7]. Severe endogenous intoxication, hemostasis disorder, multiple organ dysfunction - all this limits the amount of surgical intervention. Proceeding from this, some authors recommend only drainage of purulent foci and pleural cavity [8]. Other researchers recommend supplementing the drainage of mediastinal fluid in the site of the "exception" of the digestive esophagus by superimposition of the esophagostomy on the neck and the ligature exclusion of the esophagus at the level of the esophageal-cardiac transition with the addition of gastrostomy [2]. Some authors point to the encouraging results of suturing the esophagus, regardless of the period of perforation [9]. Several authors are convinced that the development of APM sewage of the esophagus wound has no meaning due to the "programmed" failure of seams. At the same time there are supporters of the use of radical surgical intervention - resection of the esophagus [10].

This prompts scientists to find new treatments that would provide the most effective antibacterial action in purulent cell mediastinum, provide for the permanent removal of purulent masses and adequate drainage and sanation of affected areas.

**Purpose:** to improve the treatment of patients with perforation of the esophagus with complicated acute purulent mediastinitis.

**Materials and Methods:** During 2004-2018 at the Department of Thoracic Surgery, Ivano-Frankivsk Oblast Clinical Hospital, we examined and treated 30 patients with PE and APM. The age of patients is from 21 to 76 years, on average  $36,3 \pm 3,9$  years. Men were 21 (70%), women 9 (30%).

The main causes of PE were damage to the external organs of the esophagus wall, which were diagnosed in 12 (40%) of 30 patients. The most frequent perforations occurred in the zone of the second anatomical narrowing - in 7 (58.3%), in the lower esophagus - in 5 (41.6%) patients and in the cervical department - 2 (16.7%) patients. The traumatic agent was mainly ticks (fish, chicken), needles, prickly objects. The time from the moment of entering the extraneous body to the time of hospitalization ranged from several hours to 4 days, on average,  $1.14 \pm 0.4$  days. In PE, foreign bodies were mostly marked by limited forms of APM - in 8 (75%) patients, and only 2 (25%) of patients had a purulent process in the form of phlegmons with the development of total APM. So, in 6 (50%) out of 12 patients the posterior APM developed, in 2 (25%) upper, and in 2 (25%) - total. The limited APM localized at the perforation site, its size differed and depended on the time from the moment of perforation. At hospitalization of patients up to 1 day from the moment of PE (5 patients), localized APM was in all (100%) patients, on the 2nd day hospitalized 4 patients, of which local APM was diagnosed in 3 (75%) patients, total - in 1 (25%). For the third day, 2 patients were hospitalized, among which one localized and one patient was diagnosed with total APM.

The second most frequent cause of the syndrome with the development of APM is spontaneous rupture of the esophagus, or Burhave syndrome, which was noted in 11 (36.6%) patients. In all cases, the rupture of the wall occurred in the lower third of the esophagus. In this case, in 7 (63.6%) cases, the gap is established on the right wall and in 4 (36.4%)

- the left wall of the esophagus. In the state of alcoholic intoxication Burhave syndrome developed in 8 (72.7%) patients. The size of the rupture of the esophagus wall ranged from 2 cm to 9 cm. When spontaneous rupture of the esophagus, 8 (72.7%) of 11 patients were diagnosed with posterior APM, total - in 3 (37.3%) patients. In the case of Bourhave syndrome, with the PE often observed with the development of pneumothorax, the mediastinal pleura was discontinued - in 6 (54.5%) patients. At the same time, at the discontinuity of the visceral pleura, local cases of APM were observed due to the release of purulent contents from the mediastinum in the pleural cavity. The probability of developing APM in patients with PE with spontaneous rupture is 100%, that is, the development of APM was observed in all surveyed patients with Burhave syndrome.

Yatrogenic damage of the esophagus with the development of APM was diagnosed in 7 (23.4%) patients. The main causes of iatrogenic PE were: PE as a result of the removal of the exterior body of the esophagus - in 3 (42.8%) patients, bulging of the esophagus with rigorous pulmonary tuberculosis in patients with cicatricial constriction of the esophagus after chemical burn - in 2 (28.6%), diagnostic EGDS - 1 (14.3%) and the syndrome during endoprosthesis in a patient with a tumor of the middle third of the esophagus - 1 (14.3%) of the patient. In the group of patients with iatrogenic PE in all (100%) patients, we were diagnosed with local forms of APM, due to timely diagnosis of PE and appropriate surgical treatment. The probability of developing APM in patients with iatrogenic PE was 30.4%, that is, the development of APM was observed in 7 out of 23 examined patients with diagnosed iatrogenic PE.

We conducted an analysis of the effectiveness and consequences of our proposed surgical treatment. To do this, all patients were divided into 2 groups - the first group - the main, 16 (53.3%) patients we used developed tactics of surgical treatment using intramedistal administration of antibacterial agents (IMAA) and esophageal sewage irrigation (ESI) with a constant rejuvenation of the surrounding mediastinal fluid. The second group - control, 14 (46.7%) patients, who used the traditional methods of treatment.

### Research Results

In order to improve the treatment results, we proposed a surgical tactic for treating PE and APM, which involves intramediscinative administration of antibacterial drugs (IMAA) and esophageal sewage irrigation (ESI) with the continuous rehabilitation of mediastinal mediastinal tissue. At the same time, we proved that with IMAA, antibacterial agents spread to all mediastinal departments within 1 hour (patent for utility model No. 105664). This method is as follows: a puncture of the anterior-upper mediastinum was performed over the jugular incision, using a set for the subunit venous puncture using Seldinger's technique, a catheter was inserted into the mediast, which was connected to the drip system. Afterwards, patients were given mediastinum solutions of antibiotics (levofloxacin 500 mg, ceftriaxone 1.0 g) and antiseptics (decasan) in a drop of 60 drops per minute for 2 hours with alternating antibiotics and antiseptic solutions in the mediastinum.

The esophageal sewage irrigation (ESI) of the site of perforation of the esophagus with the constant rehabilitation of the surrounding mediastinum cellulitis is as follows: after sewing the perforated wall of the esophagus along the seams throughout, a polychlorovinil catheter was placed from the

droplet system with multiple perforated apertures. The catheter was removed through the pleural cavity and the chest wall on the shortest path from the outside. Through this catheter, after an operation period, were given antiseptic agents (deccasan, chlorhexidine). Antiseptics were injected dropwise 40-60 drops per minute for 3-4 hours in the morning and 3-4 hours in the evening, the volume of injected antiseptic solutions was 2- 3 liters per day. At the same time there was a constant irrigation of seams of anastomosis and surrounding tissues of mediastinum with antiseptic solutions,

mechanical washing and permanent removal of purulent masses. To remove rinsing solutions to the perforation site, a thick drainage was applied to ensure active aspiration. Surgical tactics in patients with primary APM depended on the cause, localization, prevalence of purulent process in the mediastinum, and time from the onset of the disease to hospitalization in a specialized hospital. The choice of surgical treatment of PE in conditions of purulent mediastinitis is crucial in the successful treatment of patients. All patients with PE and APM have been operated - Table 1.

**Table 1:** The nature of surgical interventions and mortality in patients with perforation of the esophagus, complicated by acute purulent mediastinitis

Operations	Number of patients n= 30	Died n= 5
thoracotomy, mediastinotomy, suturing of the perforation aperture	13 (43,3%)	1 (7,7%)
thoracotomy, mediastinotomy	2 (6,6%)	1 (50%)
thoracotomy, mediastinotomy, suturing of the perforation aperture, gastrostomy	3 (10%)	1 (33,3%)
thoracotomy, mediastinotomy, suturing of the perforation aperture, gastrostomy, esophagostomy	3 (10%)	1 (33,3%)
VATS, mediastinotomy	7 (23,3%)	1 (14,3%)
Cervicotomy, mediastinotomy, suturing of the perforation aperture	2 (6,6%)	0
Total...	30 (100%)	5 (16,6%)

To determine surgical access and volume of operation, we took into account the location of the PE, the state of the perforated part of the esophagus, the nature of the APM (limited or diffuse), the localization and form of APM and the presence of complications. Thoracotomy, mediastinotomy, suturing of the perforation aperture of the esophagus with active drainage of the mediastinum and pleural cavity 3-4 drainages were performed in 13 (43.3%) patients (died 1, postoperative lethality 7,7%). Indications for this surgical intervention were: early terms from the onset of the disease in the absence of purulent melting of the wall of the esophagus and with the technical possibility of sewing the PE; limited forms of APM; total APM, if necessary, complete visualization of all divisions of mediastinum.

In the early stages (up to 1 day from the onset of the disease), thoracotomy was performed depending on the site of the syndrome, mediastinotomy over the affected area of the mediastinum, removal of necrotic and purulent masses, mobilization of the damaged area of the esophagus. At the same time, the maximum disclosure of all affected areas of the mediastinum under the control of vision was conducted with a detailed revision of all divisions of the mediastinum. The affected area of the esophagus was sewn by two row seams - the mucous membrane and muscle membrane. In the main group of patients to the site of the esophagus joints a catheter was drained for irrigation and permanent removal of purulent masses and used IMAA (7 patients). The operation was completed by the introduction of 3 drainages: one to the place of the perforation of the esophagus, to remove solutions of antiseptics and manure directly from the site of the syndrome, 2nd drainage - in the back sinus of the pleural cavity, 3rd drainage - air - to the top of the lungs. All drainages were connected to an active aspiration system in order to create negative pressure in the pleural cavity and active withdrawal of purulent contents. Negative pressure is important for the rapid spreading of the lungs and, accordingly, the localization of purulent process in the pleural cavity. We used this surgical tactic in 7 (53.8%) patients in the main group and 6 (46.2%) in the control group. Thoracotomy, mediastinotomy, sewing of the perforation of the esophagus was used at the PE with the development of

total APM. Widespread access to thoracotomy is necessary for the detailed visualization of all mediastinal departments. In this case, the disclosure of all affected parts of the mediastinal pleura, removal of necrotic tissues and purulent masses. The question of sewing the aircraft remains controversial. According to our experience, sewage of an PE is not indicated with purulent melting of the esophagus wall under conditions of total APM and for late hospitalization of patients. In other cases, we consider the sewing of the aircraft to be expedient and justified. Thus, in 10 (76.9%) patients we carried out sewing of PE with 2-row knot suture threads "Vikryl" 3.0 or "Dexon" II, seam failure was detected in 7 (70%) patients, however, the size of the perforated The esophagus hole decreased with 6 (85.7%) patients, which improved the course of the disease, reduced the period of healing of the perforation and improved the prognosis. Even in the event of insolvency of sutures in the area of the syndrome, the separation of the lumen of the esophagus from the mediastinum even for 2-3 days, helps to prevent its re-infection, prevents the spread of purulent infection and promotes the localization of purulent process in the mediastinum, stabilizing the general condition of the patient by reducing the signs of purulent intoxication. Died 1(3.3%) of the patient in the control group with septic shock and MOFS.

Nutrition in patients in the early period after such operations was carried out parenterally and through nasogastric tube, and from the 2nd week were supplemented with partial enteral nutrition in the absence of the esophageal-pleural fistul.

Thoracotomy, mediastinotomy and drainage of mediastinum as a "operation of despair" were performed in 2 (6.5%) patients in the control group (2 died, postoperative lethality 100%). This operation was performed on the extremely difficult condition of patients, with total APM and MOFS. Additional operations to "escape" the esophagus were impossible due to the critical condition of the patients.

Thoracotomy, mediastinotomy, suturing of the perforation aperture and gastrostomy by Kader were performed in 2 (6.5%) patients in the control group, postoperative lethality was 100%. These were patients with PE on the basis of the Burhave syndrome (1) and the failure of the seizures of the

esophagonectomy (1), which was diagnosed on the 3rd day after the operation of Lyus against the background of a total APM clinic. In our opinion, expanding the volume of surgical intervention for the purpose of overlaying gastrostomy or jaunostomy is not always justified, as it is accompanied by an additional trauma, increases anesthesiological risk, which can create a direct threat to the patient's life.

Thoracotomy, mediastinotomy, suturing of the perforation aperture and gastrostomy by Kader were used in 3 (9.7%) patients (one patient died, postoperative lethality was 33.3%). The cause of death were total APM, pyopneumotoraks, sepsis and MOFS.

Cervicotomy according to Razumovsky, mediastinotomy, disclosure of the upper mediastinum, suturing of the perforation aperture and drainage of the pleural cavity 2-3 drainages for Bulaw performed in 2 (6.5%) patients (postoperative lethality - 0%). These were patients with limited APM, which spread only within the upper mediastinum and was not accompanied by signs of sepsis or MOFS.

Video-assisted thoracoscopy (VATS) with PE was used in 9 (29.1%) patients in the main group, one patient died (postoperative lethality was 11.1%). The advantages of the VATS are minimal operational trauma, reducing the time of operation. Of particular relevance, this component of the VATS acquires in the conditions of an operation intervention in severe condition of the patient, in conditions of APM and sepsis. Another advantage of the VATS is minimization of the problem of postoperative wound suppuration in the places of overlapping ports. At the VATS in a short time (20-40 minutes) can be effective drainage – parasophageal, mediastinal and pleural cavity.

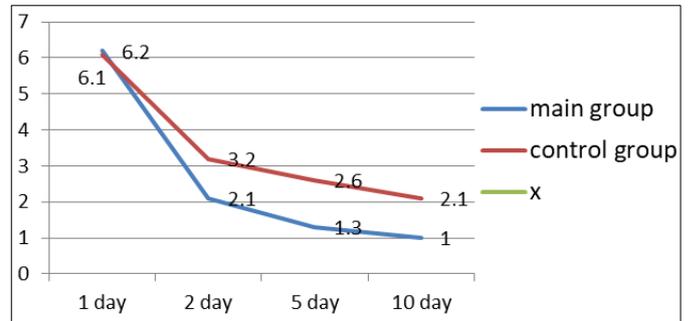
Indications for the implementation of the VATS we consider the purulent lesion of mediastinum with purulent melting of the wall of the esophagus, with significant defects of its wall, a length of more than 7-8 cm, the predicted failure of the seams of the esophagus under conditions of total APM, in the presence of MOFS, in patients with V-th degree anesthetic risk. The use of the VATS is justified in the syndrome, complicated by limited APM, as well as in pneumonia or empyema pleura.

The purpose of the VATS should be considered sanitation and drainage of parasophageal fiber and mediastinum. Compulsory drainage of the pleural cavity was carried out with 2-3 drainages for Bulaow. The indicated allowed to localize the suppurative process in the mediastinum and pleural cavity, to achieve rapid parsing of the peptic lung, to stabilize the patient's condition. Under these conditions, for 3-4 weeks after the operation, the esophagus-pleural fistula was formed, which in 3-4 weeks closed independently. Stitching of the functioning esophageal pleural fistulum is indicated by the complete elimination of the inflammatory process in the mediastinum and pleural cavity in the functioning of the esophageal-pleural fistula after 4 weeks from the moment of the PE with the use of lateral thoracotomy. All patients, where surgical tactics provided the VATS, used IMAA.

Thus, in the main group of patients, the main methods of surgical treatment were thoracotomy, mediastinotomy, sewage of the syndrome with drainage of the mediastinum and the VATS using IMAA and ISE. To evaluate the treatment efficacy, we studied the dynamics of terms of healing of esophageal wounds according to the data of the contrast x-ray of the esophagus and EGDS, dynamics of the endogenic intoxication, namely the of leukocyte index of

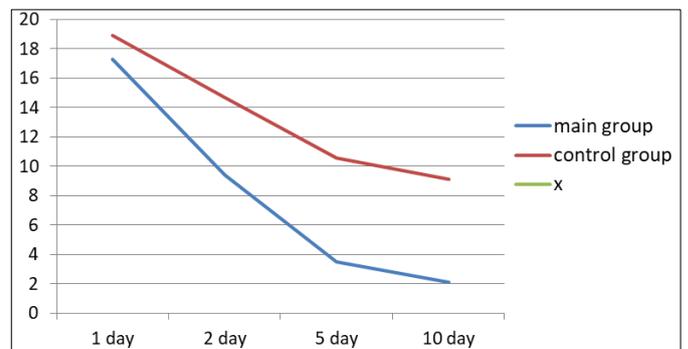
intoxication (LII) and the APACHE II scale in the modification of AP. Radzihovsky, which does not require the analysis of additional laboratory data and indicators of blood gases, which is not always possible to conduct in a hospital.

In the main group of patients, already on the first day after the operation, LII dropped almost threefold - from 6.2 to 2.10 CU. with the normalization of the indicator on the 5th day. In the control group, LII dropped from 6.1 to 3.2 CU for the first day. and remained elevated at the 5th day from the date of the transaction at 2.6 CU, as shown in Fig.1.



**Fig 1:** Dynamics of indicators of leukocyte index of intoxication in patients of the main and control groupe of patients.

A similar picture was observed on the APACHE II endotoxiosis assessment scale. Thus, for the main group, the index of endogenous intoxication was  $17.3 \pm 1.6$ , the first day it was marked down to  $9.4 \pm 0.8$  with the normalization of the index for the 5th day from the time of the operation. In group 2, the APACHE II index was  $18.9 \pm 2.0$ , the first day it was marked down to  $14.7 \pm 1.2$ , the 5th day after surgery, to  $10.6 \pm 0.7$ , which testifies to the continuation of the purulent-inflammatory process in the mediastinal fiber.



**Fig 2:** Dynamics of indicators of endogenous intoxication on APACHE II scale in Radzihovsky's modification in patients with primary and control groups.

These indicators of the EI dynamics indicate a much faster elimination of purulent-inflammatory process in the mediastinum with the use of IMAA and ISE in the main group of patients.

At the control performed by EGDS and X-ray contrast study of the esophagus in the main group of patients, for 7-8 days from the time of operation, complete sealing of the joints of the perforated area of the esophagus was observed in 6 (37.5%) patients, the decrease in the size of the defect of the esophagus wall was observed at 9 (56, 2%) patients. At day 14, full hermetic seams of the perforated part of the esophagus were observed in 12 (65%) patients, decrease in the size of the defect of the esophagus wall - in 3 (18.7%) patients.

In the control group of patients for 7-8 days from the time of operation, complete sealing of joints of the perforated area of the esophagus was found in 2 (14.3%) patients, reducing the size of the defect of the esophagus wall in only 3 (21.4%) patients. At day 14, complete sealing of joints of the perforated portion of the esophagus was observed in 4 (28.6%) patients, decrease in the size of the defect of the esophagus wall - in 5 (35.7%) patients.

In the main group of patients died 1 (6.2%) of the patient who observed purulent-necrotic development of the process with rapid spread to all divisions of the mediastinum, sePEis, increasing polyorganic insufficiency, rapid development of cardiovascular insufficiency. Despite active surgical tactics and introspective infusion therapy, he died on the 3rd day after the onset of the disease. The remaining 15 patients were discharged from the hospital in a satisfactory condition by an average of  $21 \pm 3.4$  days. In the comparison group, 5 (35.7%) of 14 patients died. The reasons for lethality were late medical treatment, refractory septic shock, increasing polyorganic and cardiovascular insufficiency. The average bed-day in the control group of patients was  $29 \pm 3.1$  days.

**Discussion of research results:** The main methods of surgical treatment of the patients in the main group were thoracotomy with mediastinotomy, esophageal sewage and drainage of the mediastinum, and the VATS using IMVA and ESI. Sewing of the perforation of the esophagus we consider it necessary in all cases except purulent melting of the wall of the esophagus. This reduces the re-infection of the mediastinal, reduces the size of the PE or completely eliminates the damage. In order to rejuvenate and permanently remove purulent mass from the site, ESI should be used in all cases, which greatly improves the outcome of treatment with the PE and reduces the endogenous intoxication. Summarizing our small experience of using the VATS in patients with PE, complicated APM, we believe that this method has undoubted priorities prior to thoracotomy. According to the diagnosis of the PE, complicated APM, the minimally invasive surgical intervention in some cases can provide sufficient radicalism of intervention with minimal traumatism. In diagnostically difficult situations, the VATS should be the method of choice for the final determination of surgical treatment tactics.

### Conclusions

1. The choice of surgical tactics should be individual in each individual case. The main purpose of surgical treatment is to eliminate the purulent-inflammatory process in the mediastinum and stabilize the condition of the patients.
2. With perforation of the esophagus, complicated by acute purulent mediastinitis, expanded operations in the esophagus are accompanied by high rates of postoperative lethality, which limits their use in patients with sepsis and multiple organ failure.
3. Sewing of the perforation of the esophagus should be performed to distinguish the esophagus from the mediastinum, localization of the purulent process in the mediastinum and to stabilize the general condition of the patient.
4. Low-invasive surgical interventions using video-assisted thoracoscopy can serve as a selection option for patients with perforation of the esophagus in the common forms of acute purulent mediastinitis for the rehabilitation and

drainage of the purulent-inflammatory process in the mediastinum, stabilization of the state of patients and prevention of septic complications.

5. The use of intramedical administration of antibacterial drugs and the method of esophageal sewage irrigation can improve the results of treatment, reduce endogenous intoxication, improve the healing of perforation of the esophagus, and eliminate purulent process in the mediastinum.

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