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# Contemporary Principles of Diagnosis and Treatment for Pleural Empyema

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**Abstract** **Introduction.** Diagnosis and treatment of pleural empyema remains an urgent problem in surgery. The term "pleural empyema" or "pyothorax" is considered to be limited or widespread inflammation of the visceral and parietal pleura, occurring with the accumulation of pus in the pleural cavity and accompanied by signs of purulent intoxication. **The purpose of the study** – to examine the principal causes and factors associated with purulent pleuritis, and to develop tactical and technical approaches to improve the efficacy of comprehensive treatment for pleural empyema using modern technologies. **Materials and research methods:** A total of 102 patients with pleural empyema, aged between 20 and 80 years, were observed; 79 (78%) were men and 23 (22%) were women. 89 (88%) of the participants were residents of rural areas. There were 12 patients, comprising 11% of urban dwellers. **The results of the study and their discussion.** The study's results indicated a rise in pleural empyema instances, increasing from 8 cases in 2021 to 2025. In recent years, patients have frequently been admitted in critical condition due to a prevalent form of the disease, particularly following the rupture of a suppurative echinococcal cyst, cystic cavities, and lung abscesses into the pleural cavity. Based on the location of fluid accumulations in the pleural cavity, we have classified the following forms of pleural empyema among our patients. **Conclusion.** The examination of treated cases indicates a rise in the number of patients with pleural empyema, escalating from 8 instances in 2021 to 26 in 2025. The utilization of computed tomography, ultrasonography, and videothoracoscopy has markedly enhanced the identification of pleural empyema, particularly in cases of blocked forms.

**Keywords** Pleural empyema, Clinic, Diagnostic, Combined treatment

## 1. Introduction

Diagnosis and treatment of pleural empyema remains an urgent problem in surgery. The term "pleural empyema" or "pyothorax" is considered to be limited or widespread inflammation of the visceral and parietal pleura, occurring with the accumulation of pus in the pleural cavity and accompanied by signs of purulent intoxication [1]. According to a number of authors, in almost 90% of patients, pleural empyema occurs as a result of complications of the purulent-inflammatory process in the lungs (against the background of acute pneumonia, 4%, lung abscess – 9-11%, with lung gangrene – 80-95%) [2,3]. As a result of wounds and injuries to the chest organs – 6-12%, the main cause is illiquid post-traumatic pleurisy and hemothorax [1,4,5].

Postoperative pleural empyema accounts for 2 to 28% of the cause, and most often occurs after pneumonectomy [5,8]. During bacteriological examination of the contents Gram-negative flora occurs in 20-30% of cases in the oral cavity. Gram-positive flora is sown in 30-40%, mainly S. aureus, S. pneumoniae, S. pyogenes.

In 20-30%, the flora is mixed, combined with non-clostridial anaerobes [5-7].

**The purpose of the study** – to examine the principal causes and factors associated with purulent pleuritis, and to develop tactical and technical approaches to improve the efficacy of comprehensive treatment for pleural empyema using modern technologies.

## 2. Materials and Research Methods

A total of 102 patients with pleural empyema, aged between 20 and 80 years, were observed; 79 (78%) were men and 23 (22%) were women (Table 1). 89 (88%) of the participants were residents of rural areas. There were 12 patients, comprising 11% of urban dwellers.

Among the 102 treated patients, 60 (59%) presented with a chronic form, while 42 (41%) exhibited an acute type of pleural empyema. A whole pleural lesion due to a purulent-inflammatory process was noted in 76 (75%) patients, while 26 (25%) exhibited a localized form of the disease. Sixty-five (64%) individuals experienced right-sided empyema, while thirty-seven (36%) had left-sided empyema.

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**Table 1.** Distribution of patients by age and sex (n – 102)

| Paul | Total patients | | of these, by age (in years) | | | | | |
|---|---|---|---|---|---|---|---|---|
| | abs. h. | % | 20-30 | 31-40 | 41-50 | 51-60 | 61-70 | Over 70 years old |
| Man | 79 | 77 | 10 | 12 | 15 | 18 | 13 | 11 |
| The woman | 23 | 23 | 3 | 6 | 4 | 4 | 4 | 2 |
| Total | 102 | 100,0 | 13 | 18 | 19 | 22 | 17 | 13 |
| % | | 100,0 | 12,7 | 17,6 | 18,6 | 21,6 | 16,7 | 12,7 |

Clinical examinations were performed in accordance with an established protocol. The patient's medical history and complaints were considered, and objective and supplementary examination methods were conducted. For diagnostic purposes, conventional radiography, computed tomography (CT), ultrasound examination, thoracoscopy of the pleural cavity, laboratory and microbiological analyses of pleural cavity contents, and histological evaluation of pleural biopsy material were employed.

## 3. The Results of the Study and Their Discussion

The study's results indicated a rise in pleural empyema instances, increasing from 8 cases in 2021 to 2025. In recent years, patients have frequently been admitted in critical condition due to a prevalent form of the disease, particularly following the rupture of a suppurative echinococcal cyst, cystic cavities, and lung abscesses into the pleural cavity. Based on the location of fluid accumulations in the pleural cavity, we have classified the following forms of pleural empyema among our patients.

In our study of 45 patients, we found that pleural empyema occurred in 53.8% of cases due to pneumonia complicated by pleurisy of various origins, resulting from infection entering the pleural cavity via lymphogenic or hematogenic routes. In 21 instances, suppuration of pleural effusion was associated with the emergence of necrotic foci in the pulmonary parenchyma, resulting in the establishment of a bronchopleural fistula.

In 15 cases (11.5%), patients were admitted due to the rupture of a suppurative echinococcal cyst into the pleural cavity, resulting in the development of a pyopneumothorax. Thirteen patients (12.7%) with polycystic lung disease experienced pyopneumothorax due to the rupture of one or more subpleurally situated abscesses or purulent cysts into the pleural cavity.

Factors contributing to pleural empyema are extensive and complex, resulting in the development of a bronchopleural fistula.

Pleural empyema developed in 8 cases (7.8%) due to the suppuration of hemothorax associated with rib fractures. In 8 individuals (7.8%), the etiology of empyema was an abrupt rupture of pulmonary air cysts. In 6 (5.8%) diabetic individuals with diabetic nephropathy, hydrothorax was worsened by pleural empyema. Following surgery on the thoracic and abdominal organs, 5 individuals (4.9%) experienced recurrent pleural cavity infections, resulting in pleural empyema. In 2 individuals (1.9%), pleural empyema developed due to the collapse of a lung tumor. Our observations indicate that the existence of a bronchopleural fistula consistently serves as both a contributory and exacerbating element in the purulent-inflammatory process within the pleural cavity, resulting in a protracted course of pleural empyema.

Patients were categorized into two groups based on the disease onset and the duration of the inflammatory process. The initial cohort with acute pleural empyema comprised 41 patients who had experienced 8-12 weeks after the disease's onset. The second cohort with a chronic disease trajectory comprised 61 individuals who had experienced symptoms for over 12 weeks following disease onset. The synchronization of the acute process was induced by multiple variables. Frequent inadequate management of acute pulmonary suppuration, accompanied by pyopneumothorax, resulted in chronic empyema.

Our observations indicate that the clinical presentations of pleural empyema, irrespective of etiology, predominantly exhibited common symptoms. The patients primarily expressed concerns with the following symptoms: cough with purulent sputum, dyspnea, pleuritic chest discomfort, fever, and indications of intoxication.

Persistent and recurrent coughing episodes accompanied by substantial sputum production suggested the existence of a bronchopleural fistula. In the early phases of the disease, individuals with complete and subtotal empyema experience significant discomfort and dyspnea. They frequently adopted a constrained semi-sitting posture. In cases of minor empyema that were delimited (lumped), the pain condition was less prominent.

Upon inspection of the chest, the compromised side was noted to lag during respiration. The intercostal gaps were enlarged and flattened as a result of exudate pressure. The presence of exudate in the pleural cavity was marked by diminished or absent vocal tremors and respiratory sounds.

In individuals with pleural cavities containing only exudate, the upper boundary of dullness aligned with the Ellis-Damoiseau-Sokolova line, which extends laterally and superiorly from the spine to the posterior axillary lines, then descends anteriorly to the mid-clavicular line.

Typically, when a significant volume of pus accumulates in the pleural cavity, patients exhibit displacement of the mediastinal organs towards the unaffected side and compression

of the healthy lung. In individuals with pyopneumothorax, a dull percussive sound was observed under the upper horizontal boundary indicating pus collection, while a tympanic sound was noted above the area of air accumulation. Auscultation was used to assess the reduction or near-total absence of respiratory sounds and heightened bronchophony in the region of exudate buildup. In the context of a bronchopleural fistula and an adequately drained bronchial cavity, heightened bronchial respiration (amphoric) was seen. Concurrently, patients had abundant purulent sputum accompanied by an offensive odor. Multiple organ failure was found in 25 cases among our patients at the clinic.

The analyses indicated that alterations in the overall clinical parameters of blood and urine in pleural empyema were consistent with those observed in other severe purulent diseases.

The general blood test indicates high leukocytosis (exceeding 10×10^9/l), a pronounced leftward shift in leukocyte count, and elevated ESR. Anemia was frequently noted. The plasma protein content diminished, primarily attributable to albumin. Albuminuria and the presence of granular and hyaline casts were identified in the urine. The cytological and histological analysis of pleural cavity contents is crucial for diagnosis and guiding antibiotic selection.

**Table 2.** Causes of empyema

| № | Reasons | Quantity | |
|---|---|---|---|
| | | abs. h | % |
| 1 | After pneumonia and pleurisy | 45 | 44,1% |
| 2 | Breakthrough of an echinococcal cyst into the pleural cavity | 15 | 14,7% |
| 3 | Complication of purulent-necrotic processes in the lungs (abscess, polycystic kidney disease) | 13 | 12,7% |
| 4 | Bullous lung disease complicated by pyopneumothorax | 8 | 7,8% |
| 5 | After injury (hemothorax) | 8 | 7,8% |
| 6 | Diabetes mellitus | 6 | 5,8% |
| 7 | After surgical intervention on the organs of the thoracic and abdominal cavities | 5 | 4,9% |
| 8 | C-R of the lung | 2 | 1,9% |
| | Total | 102 | 100% |

**Table 3.** Seeded flora during back-seeding of the contents of the pleural cavity

| | Title | Quantity | |
|---|---|---|---|
| | | abs.h. | % |
| 1 | staphylococci | 30 | 29,4% |
| 2 | pneumococci | 18 | 17,6% |
| 3 | klebsiella pneumonia | 15 | 14,7% |
| 4 | streptococci | 15 | 14,7% |
| 5 | hemofilus influenza | 14 | 13,7% |
| 6 | candida alvicans | 10 | 9,9% |
| | Total | 102 | 100% |

Table 3 reveals that during bacteriological testing, staphylococci were isolated from the pleural cavity contents in 30 instances (29.4%), pneumococci in 18 patients (17.6%), and Klebsiella pneumonia in 15 patients (14.7%). Streptococci and Haemophilus influenzae were identified in 15 (14.7%) individuals, while Candida albicans was isolated from punctate in 10 (9.9%) patients.

X-ray examination was important in diagnosing pleural empyema in our practice. During diagnosis and treatment, chest X-rays were consistently conducted in two projections for all patients.

This approach provided insights into the localization, prevalence, and quantitative attributes of the process within the pleural cavity.

Presently, the emergence of advanced radiation diagnostic techniques in challenging circumstances enables the establishment of an accurate and reliable diagnosis. In our study, the definitive diagnosis for 20 patients with difficult situations was established by X-ray computed tomography (CT). The application of RCT enabled a comprehensive evaluation of the accumulated effusions, pleural leaflet thickness, and isolated lesions in the pleura.

The ultrasonography evaluation of the pleural cavity plays a crucial role in diagnosis. Ultrasound was employed in 39 individuals with restricted fluid accumulations to ascertain the location and facilitate drainage of the occluded pleural cavities. Among these, 6 instances demonstrated the existence of an echinococcal cyst in the lower lung regions, with extensions into the pleural cavity.

Video thoracoscopy has recently been introduced. A visual inspection of the pleural cavity and lung surface was conducted in 17 instances via a video thoracoscope, the fluid's characteristics were assessed, and a biopsy was obtained for histological analysis.

In our practice, the management of patients with pleural empyema was predominantly focused on the impact of the underlying disease, including its kind and stage, the causation of pleural effusion, the characteristics of the effusion, and the overall health status of the patients.

Our experience indicates that the paramount prerequisite for maximizing outcomes in pleural empyema, regardless of etiology, is the prompt and sustained application of several conservative strategies and surgical procedures. We identify the following provisions as the primary components in the intricate pathogenetic treatment of patients: a) the administration of antibiotics to inhibit, diminish, or attenuate the antigenic effects originating from the primary site and eliciting an inflammatory response in the pleura; b) the sanitation of the pleural cavity through the evacuation of its contents and, if warranted, irrigation; c) the utilization of desensitizing and anti-inflammatory agents designed to address the heightened permeability of the pleura and to influence both local and systemic manifestations of pleurisy.

In the majority of patients, empyema management commenced with a pleural puncture.

Upon the presence of pus, we consistently emptied the pleural cavity. Drainage was operational with equipment

generating a negative pressure of 10-30 cm of water. or passive, as indicated by Buell. In 56 instances, the purulent-inflammatory condition in the pleura was resolved with effective drainage and systematic irrigation of the pleural cavity with antiseptics, in conjunction with comprehensive conservative therapy. A 1:1000 solution of furacillin, 0.2% decosone, and an aqueous solution of chlorhexidine were utilized for washing.

Surgical intervention is frequently necessary in cases of chronic pleural empyema, irrespective of the underlying reasons. Surgical intervention has historically been and continues to be a challenging endeavor. A prolonged purulent -inflammatory process, accompanied by a bronchopleural fistula, frequently resulted in significant alterations to the parietal and visceral pleura, as well as the development of blocked cavities.

For many years, thoracoplasty was the most efficacious surgical technique for persistent pleural empyema in our practice, despite its traumatic nature and resultant significant chest deformity.

Thoracoplasty has been infrequently employed in recent decades, as it has nearly become obsolete due to its non-physiological nature and inadequate efficacy. We frequently commenced radical procedures - pleurectomy (Delorme operation). This operation yielded satisfactory results in 21 instances.

In this procedure, the entire modified parietal pleura is entirely excised, together with the visceral pleura, which may occasionally be accomplished in a single unit, referred to as one "bag." In 10 patients with a cystic lung lesion, the procedure involved lobectomy and partial lung decortication.

In the case of a bronchial fistula, lung tissue and the associated fistula were either removed or the fistula was sutured utilizing various techniques. Upon successful sealing, the lung expands adequately, occupies the pleural cavity, so restoring its function and eradicating the purulent cavity.

In 15 patients, a breakthrough into the pleural cavity from a suppurated echinococcal cyst of the lung and the diaphragmatic surface of the liver occurred, necessitating the removal of the freely situated chitinous membrane, along with cleaning and partial decortication of the lung.

Pleurectomy surgery is complex and distressing. The situation was occasionally worsened by significant hemorrhage and acute shock, necessitating meticulous preoperative patient preparation aimed at alleviating anemia, hypoproteinemia, and enhancing respiratory function.

Multiple problems were noted in the postoperative period: pleural cavity hemorrhage in three patients, recurrence of bronchial fistula, and pleural empyema in eight cases. In instances of hemorrhage, retoracotomy was conducted in every case, effectively halting the bleeding. The primary cause of hemorrhage was identified as tiny veins distributed across the whole area of the excised pleura.

In two instances of illness recurrence, surgical intervention was repeated, while in six cases, a favorable outcome was attained by conservative treatment.

All procedures were conducted under general anesthesia utilizing an endobronchial double-lumen tube for distinct lung intubation.

## 4. Conclusions

The examination of treated cases indicates a rise in the number of patients with pleural empyema, escalating from 8 instances in 2021 to 26 in 2025. The utilization of computed tomography, ultrasonography, and videothoracoscopy has markedly enhanced the identification of pleural empyema, particularly in cases of blocked forms. An appropriate amalgamation of intricate etiopathogenetic therapy, prompt drainage of the pleural cavity, and timely radical surgical surgery has markedly enhanced treatment outcomes in both acute and chronic forms of pleural empyema. The management of pleural empyema, seen as a polyetiological condition, must be thorough.

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