MODERN ENDOSCOPIC TECHNOLOGIES IN THE COMPLEX TREATMENT OF ACUTE PLEURAL EMPYEMA IN CHILDREN

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Relevance. Acute pleural empyema in children is a severe purulent-inflammatory lung disease that occurs in the context of complicated destructive pneumonia.

Study objective. To improve surgical treatment outcomes for acute pleural empyema in children through the introduction of modern endoscopic technologies.

Materials and methods. From 2017 to 2024, 126 children aged 1 to 17 years with acute pleural empyema were examined and treated at the TashPMI Pediatric Surgery Clinic. The primary diagnostic methods for establishing the diagnosis of acute pleural empyema and the clinical stage of the disease were chest radiography, transthoracic scanning, CT, bronchoscopy, clinical laboratory testing, and bacteriological examination of bronchial and pleural effusion.

Results. For the purpose of conducting the study, our patients were divided into two comparative groups. The first control group consisted of 61 (48,4%) patients, the second main group – 65 (51,6%) patients. The results of treatment of patients of the first control group (61 observations) showed that the effectiveness of puncture-drainage interventions was noted in 26 (42,6%) patients, however, in the remaining 35 (57,4%) patients of the control group, performing puncture-drainage interventions alone was not only ineffective, but also insufficient. Additionally, performed sanitation bronchoscopies in 28 (45,9%) patients contributed to aspiration of pathological contents from the lobar and segmental bronchi, in 7 (11,5%) observations in children of the control group, unsatisfactory treatment results were noted. In 33 (50,8%) patients of the second main group (65 observations), delayed (late) video-assisted thoracoscopic sanitation of the pleural cavity was performed; primary video-assisted thoracoscopic surgery was performed in 31 (47,7%) observations. Of the 65 patients in the main group, bronchoscopic sanitation to eliminate bronchial conduction disorders concluded the surgical intervention in 62 (95,4%) cases.

Conclusions. Thus, it is important to note that endoscopic surgical interventions in children are characterized by high precision, minimal invasiveness, minimal blood loss, and a low rate of intraoperative and postoperative complications.

Keywords: *children, acute pleural empyema, bronchoscopy with short-term bronchial occlusion, video-assisted thoracoscopic pleural sanitation*.

Introduction. Acute pleural empyema in children is a severe purulent-inflammatory lung disease that occurs against the background of complicated destructive pneumonia. Determining the indications, choosing tactics and sequence of various methods of surgical treatment of acute pleural empyema in children is a pressing issue. Despite the many existing treatment methods for acute pleural empyema, the results in the immediate and long-term follow-up periods remain disappointing. In most cases, the reasons for unsatisfactory treatment results are the unjustified choice of the method and technique of surgical intervention. Traditional puncture-drainage interventions with long-term conservative therapy for acute pleural empyema in children can currently only be effective at the onset of the disease. In purulent-fibrinous and fibrin organization stages, puncture treatment methods in most cases do not provide a significant positive effect, this is due to the polyvalent resistance of microorganisms and their aggressiveness. In the presence of negative dynamics and the lack of effect from long-term conservative treatment, in case of worsening manifestations of respiratory failure due to chronic purulent intoxication and formation of abscesses, sanitation of the pleural cavity is indicated, pneumolysis or decortication of the lung. Due to the increasing resistance of microflora, the structure of the causes of acute pleural empyema has changed, which created certain preconditions for revising treatment tactics, as new opportunities emerged in the treatment of this pathology using modern minimally invasive endoscopic treatment methods [1, 5, 7, 8, 9, 11, 12, 13].

The introduction of modern endoscopic technologies into clinical pediatric surgery has enabled the use of effective bronchoscopic and videothoracoscopic debridement methods in the treatment of acute pleural empyema in its early stages. This, in turn, has allowed for the rapid resolution of the pathological process during the acute period of pleural empyema, as well as the prevention of a protracted course of the disease and the avoidance of severe pulmonary-pleural complications. Consequently, the early use of videothoracoscopic interventions in this patient population is more

effective, as it prevents the transition of acute pleural empyema into a chronic form, leading to a significant improvement in the results of surgical treatment. Currently, the indications for the use of minimally invasive endoscopic interventions in purulent-inflammatory diseases of the lungs and pleura are constantly expanding; these methods serve as a worthy alternative to traditional surgery. At the same time, it is necessary to improve therapeutic measures aimed at addressing all stages of the etiopathogenesis of the destructive process that leads to acute pleural empyema in children [2, 3, 4, 6, 10, 14].

Purpose of the study – to improve the results of surgical treatment of acute pleural empyema in children through the implementation of modern endoscopic technologies. **Research materials and methods**. From 2017 to 2024, 126 children aged 1 to 17 years with acute pleural empyema underwent inpatient examination and treatment at the pediatric surgery clinic of TashPMI.

The main diagnostic methods for establishing the diagnosis of acute pleural empyema and the clinical stage of the disease were chest X-ray, transthoracic scanning, MSCT, bronchoscopy, and clinical and laboratory studies, as well as bacteriological examination of discharge from the bronchi and pleural cavity.

Study results. To conduct randomized studies over a long period and compare the effectiveness of the surgical treatment provided, our patients were divided into two comparable groups. The first control group consisted of 61 (48.4%) patients who underwent traditional surgical interventions such as: puncture and drainage of the pleural cavity; when necessary, traditional thoracotomy with sanation bronchoscopy was performed. The second main group consisted of 65 (51,6%) patients who underwent minimally invasive interventions, which included videothoracoscopic operations with the simultaneous performance of sanation bronchoscopy and broncho-occlusion.

The treatment results for patients in the first control group (61 observations) showed that the effectiveness of puncture-drainage interventions was noted in 26 (42,6%) patients and consisted of the regression of the purulent-inflammatory process in the lung and pleural cavity, improvement in respiratory function, and normalization of cardiovascular function. A reduction in chest pain indicated a significant decrease in irritation of the parietal pleura and a reduction in interstitial edema against the background of ongoing anti-inflammatory treatment. Also, the mechanism of earlier relief of pleural pain and the favorable course of the inflammatory process in these patients with acute pleural empyema was associated with an anti-exudative effect. The disappearance of the auscultatory picture of acute pleural empyema characterized the resolution of inflammatory processes in the pleura and the relief of the inflammatory process as a whole against the background of stimulated interstitial drainage, which was regarded as a good treatment result.

However, in the remaining 35 (57,4%) patients of the control group, the performance of only puncture-drainage interventions proved to be not only ineffective but also insufficient, which manifested in the progression of the purulent-inflammatory process in the bronchi and the absence of full lung aeration due to its collapse on the affected side. Additionally performed sanation bronchoscopies in 28 (45,9%) patients contributed to the aspiration of pathological contents from the lobar and segmental bronchi, as well as the adequate performance of selective endobronchial lavage, which was regarded as a satisfactory treatment result. In 7 (11,5%) observations among children of the control group, unsatisfactory treatment results were noted, despite the differentiated approach in the application of the aforementioned therapeutic tactics. This depended on the timing of the patients' admission to our clinic, as well as the adequacy of drainage and sanation of the purulent encapsulated cavity, which became the cause of a protracted purulent-inflammatory process with a transition to fibrinothorax. Multispiral computed tomography with three-dimensional (3D) reconstruction

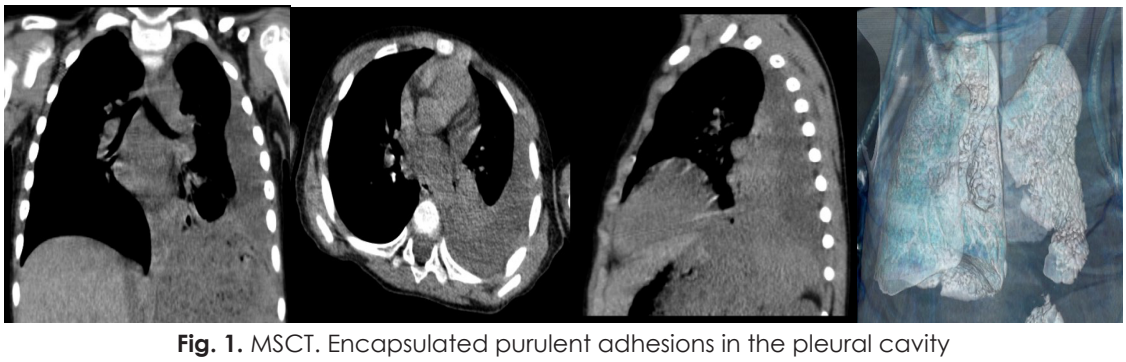


Fig. 1. MSCT. Encapsulated purulent adhesions in the pleural cavity

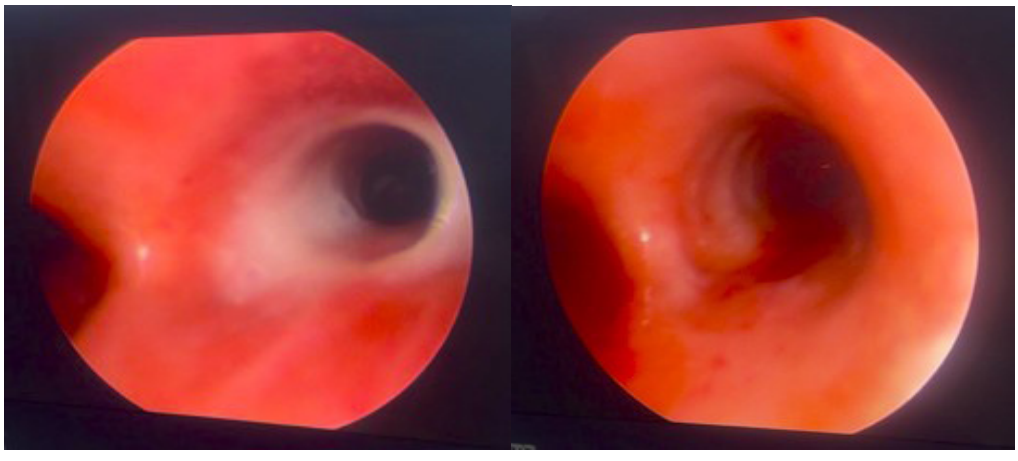
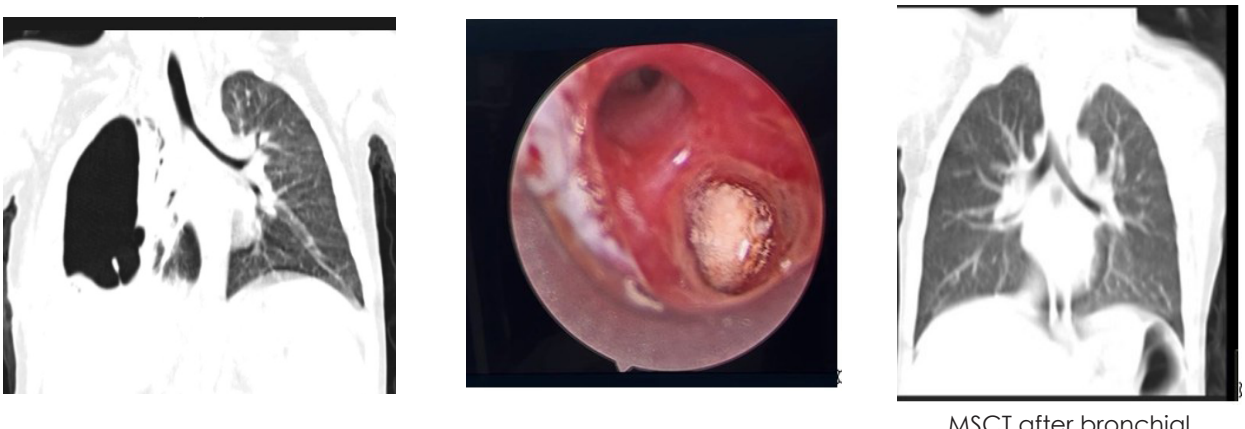


Fig. 2. Effectiveness of sanitizing bronchoscopy in acute pleural empyema (before and after its performance)

performed in these patients allowed us to identify undrained encapsulated purulent foci in the pleural cavity with multiple fibrous strands, as well as separation and thickening of the pleural layers, which prevented lung expansion (fig. 1).

In connection with this, after preoperative preparation, these 7 patients of the control group underwent a more technically complex operation – open thoracotomic debridement of the pleural cavity, which in 3 cases was performed along with lung decortication. Lung decortication was performed in stages and was accompanied by the dissection of fibrous adhesions, followed by pneumolysis or pleurectomy; the operation was completed with thorough hemostasis, debridement of the pleural cavity, and restoration of lung airtightness.

Treatment of patients in the second main group (65 observations) with acute pleural empyema was based on performing endoscopic and video-assisted thoracoscopic interventions. In 33 (50.8%) observations, patients underwent delayed (late) video-thoracoscopic sanitization of the pleural cavity due to the ineffectiveness of puncture-drainage interventions. Early primary video-thoracoscopic surgical intervention was performed in 31 (47,7%) observations in patients in the purulent-fibrinous stage and the stage of fibrin organization. However, in 1 (1,5%) observation of a patient in the main group, due to the ineffectiveness of the above-mentioned interventions, a forced measure was the performance of open thoracotomic sanitization of the pleural cavity. It should be noted that in 62 (95,4%) cases of the 65 patients in the main group, the completion of surgical interventions was the performance of bronchoscopic sanitization to eliminate bronchial patency disorders. This factor is an important task in the complex treatment of acute pleural empyema in children, as impaired bronchial patency leads to respiratory failure and atelectasis of the affected lung lobes. Active endoscopic sanitization of the tracheobronchial tree had a positive effect on the course of the purulent-destructive process in the lung, allowing for its expansion and an increase in the volume of atelectatic pa-



MSCT before broncho occulsion

Short term bronchial occulsion

MSCT after bronchial occulsiom

Fig. 3. Short term brochial occulsion

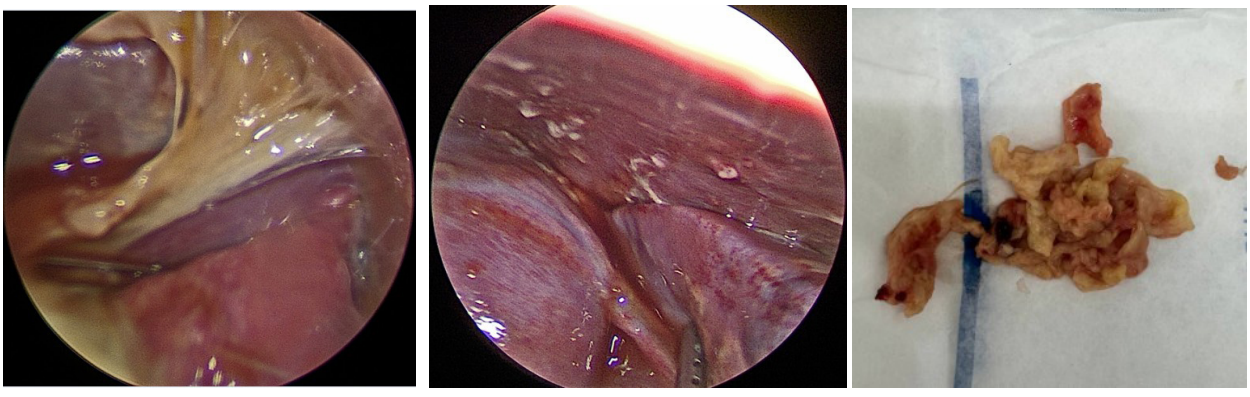


Fig. 4. Fibrin deposits removed videothoracoscopically from the pleural cavity (debridements)

renchyma, as well as preventing bronchogenic dissemination of purulent infection. This was important considering that purulent endobronchitis, often encountered in acute pleural empyema, contributes to the progression of the destructive process in the lung. The effectiveness of such tactics was evaluated according to the following main criteria: the elimination of bronchial obstruction and the restoration of the ventilation-respiratory function of the lungs, which were noted during the performed sanitizing bronchoscopy (fig. 2).

It should be noted that therapeutic sanitizing bronchoscopy, which was performed in 62 (95,4%) observations, proved to be effective in 46 patients. In 16 observations, a single sanitizing bronchoscopy proved insufficient for the complete sanitization of the tracheobronchial tree. In this regard, in 14 observations it was performed twice, and in 2 cases sanitizing bronchoscopy was performed 3 times. All repeated sanitizing bronchoscopies were performed in 16 patients with the purulent-fibrinous stage and the stage of fibrin organization of acute pleural empyema, as the restoration of lung aeration in these patients was not in full volume.

In 11 (16,9%) patients of the main group with a functioning bronchial fistula, short-term bronchial occlusion was performed. A sterile pressed microporous dry "Merocel" sponge was used as an obturator, which was cut to the size of the fistula and tightly inserted into the bronchial lumen. The effectiveness of short-term bronchial occlusion was manifested by the cessation of bronchial discharge into the pleural cavity and a significant reduction in the phenomena of respiratory failure. In all cases of short-term bronchial occlusion, patients underwent complex conservative treatment with the prescription of anti-inflammatory and symptomatic therapy (fig. 3).

Videothoracoscopic interventions were performed for the purpose of comprehensive and targeted local impact on microbial flora, cleansing foci of pulmonary destruction of purulent-necrotic tissues, as well as fibrin deposits and encapsulated purulent cavities in the pleural cavity (fig. 4).

This significantly contributed to the prevention of the development of a massive adhesion process in the pleural cavity with the transition of acute pleural empyema into a chronic form of the disease. Also, if necessary, videothoracoscopy allowed us to perform pneumolysis or lung decortication for its full aeration and sanitation of the pleural cavity. The duration of the videothoracoscopic intervention averaged from 40 to 55 minutes; blood loss during the intervention did not exceed 10–25 ml. After completion of the videothoracoscopic intervention, therapeutic bronchoscopy was performed in all cases.

After the videothoracoscopic interventions, all patients remained in the intensive care unit for the first 24 hours and were then transferred to the ward. The average length of stay was 12/pm^2 days, after which patients were discharged from the hospital to continue treatment at their place of residence. There were no complications during the video-endosurgical operations in our observations; in the postoperative period, in 2 cases on the 5th and 6th days after surgery during the removal of the drainage tube from the pleural cavity, pneumothorax occurred, which was eliminated by repeated drainage of the pleural cavity. In the postoperative period, all patients received conservative therapy. The ongoing complex conservative therapy and videothoracoscopic sanitation of the pleural cavity were aimed at stimulating reparative processes and the immune forces of the child's body, and targeted local impact on the microbial flora. Their combined use for the treatment of acute pleural empyema allowed us to prevent more severe complications and the transition of the disease into a chronic form.

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