Case Report

Innovative Management of Multiloculated Empyema Using Makeshift Medical Thoracoscopy and Intrapleural Streptokinase: A Comprehensive Case Report and Literature Review

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Abstract:

Empyema is a complex disease state with often debilitating morbidity, protracted lengths of stay, and inordinate expenses associated with its diagnosis and management. Conventionally, complicated parapneumonic effusions/empyema are managed with systemic antimicrobials, adequate drainage of the pleural space, and surgery. Video-assisted thoracoscopic surgery (VATS) has become standard practice for surgical management; however, this modality is often not possible in the setting of minimal resources or patients who have physiological instability that may preclude general anesthesia with single lung ventilation. Thus, in certain clinical settings, alternative, less invasive methods need to be devised. We present a comprehensive case report, compiled in accordance with CARE (CAse REport) guidelines, of a morbidly obese, hypertensive, 71-year-old man with advanced COPD who presented with what eventually evolved into a life-threatening, multiloculated iatrogenic empyema secondary to blind needle thoracentesis attempts. As this patient was determined to be a high-risk surgical candidate for VATS secondary to hypoxemic respiratory failure and disturbed pulmonary parenchyma, an improvised medical thoracoscopic procedure utilizing local anesthesia was performed with creation of a working port using a 10mm rigid laparoscopic trocar and use of a flexible video bronchoscope to function as the thoracoscope. Chemical adhesiolysis with intrapleural streptokinase monotherapy was accomplished after achieving partial mechanical adhesiolysis. In this case report, we will discuss the pathology of pleural space infection, causes and rising risk of iatrogenic pleural seeding, the changing epidemiology of the Streptococcus anginosus group, the physics behind improvised thoracoscopic instrumentation, and the continuing controversial discussion regarding cost-efficient intrapleural fibrinolytic use.

Introduction

Empyema is an ancient disease in which there is a collection of pus inside the pleural space. Although there have been monumental advances in antibiotics, advanced thoracic imaging, and interventional pulmonology, the incidence of infected parapneumonic effusion and empyema has been on the rise on a global scale among both pediatric and adult populations. Complicated parapneumonic effusions (CPE) and empyema are associated with exceptionally high healthcare resource utilization, carrying one of the highest average costs per admission among acute pulmonary conditions.[1] Furthermore, the condition is associated with an overall mortality rate ranging from 15% to 20%, which escalates exponentially in elderly populations, immunocompromised cohorts, and those with significant cardiopulmonary comorbidities.[2]

The widely accepted standard of care for complicated pleural infections mandates the prompt and complete evacuation of the infected pleural fluid, deployed synergistically with targeted, broad-spectrum systemic antibiotic therapy. However, the intrinsic pathophysiology of empyema frequently leads to the development of dense intrapleural loculations, fibrinous septations, and a thick pleural peel. These formidable structural barriers severely compromise the efficacy of standard closed-tube thoracostomy, resulting in inadequate fluid drainage, persistent sepsis, and progressive respiratory failure. In such complex clinical instances, current consensus guidelines from professional bodies, including the American Association for Thoracic Surgery and the British Thoracic Society, consistently recommend early surgical

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consultation for operative decortication via Video-Assisted Thoracic Surgery (VATS).[3,4]

Despite the unparalleled anatomical clearance provided by VATS, the procedure mandates general anesthesia and single-lung ventilation—interventions that introduce prohibitive physiological risks to patients suffering from severe cardiopulmonary comorbidities, such as advanced COPD, pulmonary hypertension, and acute hypoxic respiratory failure. Furthermore, the global landscape of healthcare is highly variable. In resource-limited or constrained settings, immediate access to rigid thoracoscopes, specialized thoracic surgical suites, or the highly expensive dual-therapy intrapleural fibrinolytics (tissue plasminogen activator [tPA] and deoxyribonuclease) endorsed by recent landmark trials may be severely restricted or entirely unavailable.[5]

Simultaneously, the exponential rise in diagnostic and therapeutic pleural interventions has brought the safety and efficacy of physical examination-guided (blind) thoracentesis under intense scrutiny. Blind pleural procedures possess a well-documented historical association with elevated rates of iatrogenic pneumothorax, inadvertent visceral lacerations, "dry taps," and the highly perilous introduction of cutaneous or environmental pathogens directly into the sterile pleural space, precipitating iatrogenic empyema.[6] This exhaustive case report delineates the triumphant clinical management of a life-threatening, iatrogenically induced, loculated *Streptococcus* empyema. The clinical narrative underscores a highly adaptive, multidisciplinary approach to interventional pulmonology. By deploying a makeshift pleuroscopic setup and sequentially administering intrapleural streptokinase monotherapy, the clinical team successfully circumvented the need for high-risk thoracic surgery. This case thereby provides a critical, evidence-based framework for managing complex pleural sepsis when standard surgical and pharmacological avenues are obstructed by patient physiology or resource constraints.

Clinical Case Presentation

The case report is about a 71-year-old male patient with hypertension, severe COPD, and hyperuricemia. He was morbidly obese and had a smoking history of 25 pack-years. He was transferred to our facility due to deterioration of the patient's condition after being treated at two prior facilities.

The patient's symptoms appeared 2 weeks before the current admission. He had high-grade fever, productive cough, severe chest pain that was exacerbated upon inspiration, and rapidly progressive shortness of breath. The patient had primarily presented to a local primary healthcare facility, where he was found to have a left-sided moderate pleural effusion. A diagnostic fluid aspirate was suggestive of an exudative parapneumonic effusion. He was prescribed a short oral course of empirical antibiotics. Rather than improving, the patient's condition deteriorated rapidly over the next few days. High-grade fever persisted, and respiratory symptoms worsened; therefore, he was transferred to another advanced inpatient facility for better care.

Upon admission to the secondary facility, radiological imaging demonstrated a rapid, persistent re-accumulation and expansion of the left-sided pleural effusion. The clinical team elected to perform a second phase of pleurocentesis. The laboratory reports from this second aspiration yielded findings similar to the first, though noting an increase in cellularity. In response, the medical team escalated the pharmacological strategy, initiating broad-spectrum intravenous antimicrobial therapy comprising Meropenem and Levofloxacin to cover potential resistant hospital-acquired and atypical pathogens. Despite this robust antimicrobial coverage, the patient's condition did not improve much; an HRCT scan of the chest showed moderate to severe left-sided pleural effusion, but there was the presence of multiple septations, definitively indicating that the disease had advanced into a complex fibrinopurulent phase.

The patient was then seen by a thoracic surgeon, who had planned to perform a Video-Assisted Thoracic Surgery (VATS) procedure for thorough decortication and pleural lavage. Although VATS is a minimally invasive surgery, it still demands general anesthesia and single-lung ventilation.[7] But considering the patient's advanced age, multiple comorbid conditions, and acute Type I respiratory failure, this procedure was deemed too risky. They decided to transfer the patient to a third facility with a minimally invasive approach to clearing the pleural fluid and septations.

Upon arrival at the tertiary interventional pulmonology facility, the patient exhibited severe respiratory distress. He demonstrated profound hypoxia, requiring up to 10 liters of supplemental oxygen per minute via a non-rebreather mask simply to maintain an oxygen saturation (SpO_2) above 88%. He was tachycardic, tachypneic, and exhibited the use of accessory muscles of respiration.

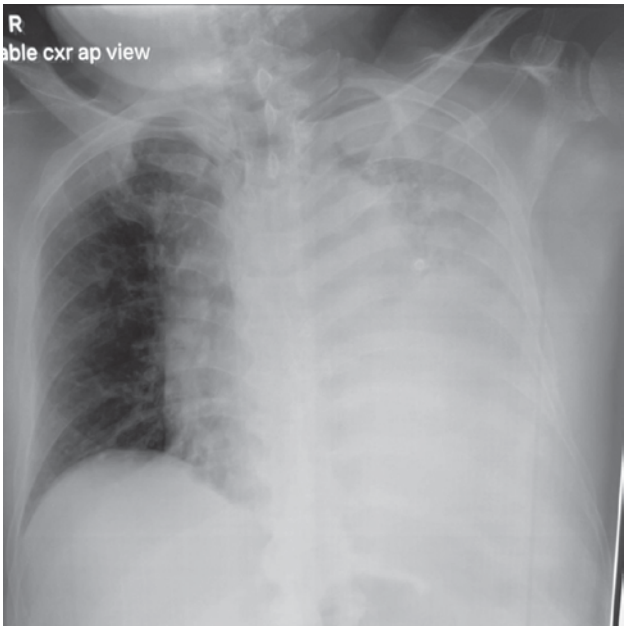


Fig 1: Chest Xray (AP view) at initial presentation at the Tertiary care center

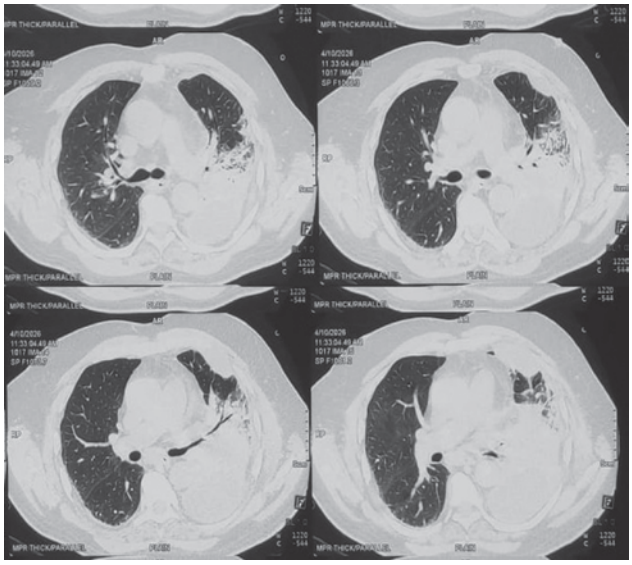


Fig 2: CT scan of the patient showing left-sided encysted Pleural fluid effusion and consolidation.

During the comprehensive physical examination, focusing specifically on the posterior thorax, a critical diagnostic clue was discovered: the presence of multiple, distinct cutaneous prick marks and localized, healing lacerated injury marks concentrated extensively over the left posterior chest wall. Detailed history-taking from the patient and his accompanying relatives confirmed that all prior thoracentesis attempts at the referring facilities were performed utilizing the traditional, physical examination-guided "blind" technique, entirely devoid of real-time thoracic ultrasound (TUS) guidance.

To accurately delineate the complex pleural anatomy, a comprehensive point-of-care Thoracic Ultrasound (TUS) was immediately performed at the bedside. The ultrasound definitively demonstrated a highly complex, multiloculated pleural effusion with thick, echogenic septations that compartmentalized the fluid. Furthermore, sonographic imaging revealed a highly suspicious cavitary lung lesion within the consolidated underlying pulmonary parenchyma, strongly suggestive of a contiguous primary lung abscess that serves as the nidus of the pleural inflammation.

Interventional Strategy Phase I: Makeshift Medical Thoracoscopy

As discussed earlier, the gold standard in these cases is VATS, but due to the high anesthetic risk, the option of Medical thoracoscopy (MT) was sought under only regional anesthesia, in an awake patient, using only local anesthetic agents to apply an intercostal block. The classic MT technique utilizes either a rigid thoracoscope (typically 7–9 mm in diameter) or a semi-rigid pleuroscope (7 mm).[8] The semi-rigid instrument possesses a control handle identical to a standard flexible bronchoscope, but features a rigid 22-cm proximal shaft coupled with a 5-cm flexible distal tip. In this case, due to resource limitations, a flexible bronchoscope was utilized, and a 10mm laparoscope trocar was used as a conduit for the scope. Once the 10mm laparoscopic trocar was successfully introduced via the 6th intercostal space on the left mid-axillary line, the initial fluid drained from the largest sonographically identified pocket was frankly purulent, confirming the severity of the infection. Subsequently, a standard flexible video bronchoscope was advanced through the trocar to serve as the makeshift pleuroscope.

While the pure flexible bronchoscope inherently lacks the rigid external shaft necessary for aggressive, sweeping mechanical decortication, it offers unparalleled maneuverability within confined spaces, boasting a two-way tip angulation capability of 160 degrees upward and 130 degrees downward. This extreme flexibility allowed the operator to seamlessly navigate through the highly complex, three-dimensional web of fibrinous septations, visualize cryptic pockets of the pleural cavity, and utilize standard 2.8-mm working channel bronchoscopic biopsy forceps to physically grasp and disrupt loculations.

Direct visualization of the pleural cavity revealed a grossly dirty, highly inflamed environment. The visceral pleura, parietal pleura, and the internal chest wall were densely coated with thick, exudative fibrinous material, and multiple dense septations compartmentalized the entire cavity. Due to the severe density of the septated pleura, sweeping maneuverability of the flexible bronchoscope was inherently limited, preventing complete mechanical clearance. Nevertheless, several major loculations were systematically disrupted, which immediately resulted in the drainage of significant volumes of additional sequestered pus.

Multiple targeted pleural biopsies were meticulously obtained from abnormal-looking, thickened areas of the parietal pleura and dispatched for histopathological examination (HPE). The aspirated purulent fluid was collected and sent for exhaustive biochemical, cytological, and microbiological profiling. Following maximal feasible mechanical adhesiolysis, a large-bore 32 Fr chest drain was placed in situ through the entry tract, guided by the thoracoscope to rest in the most dependent position, and connected to a closed water-seal drainage system to facilitate continuous evacuation.

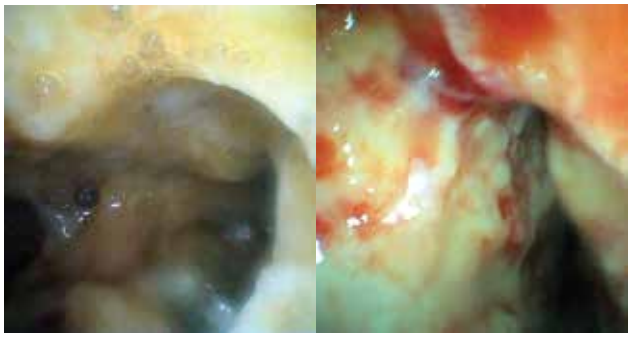


Fig 3: Pleuroscopic view of the interior of the pleural cavity, showing thick pus, and multiple septations.

Recent literature robustly validates this makeshift approach. Multiple studies and case series demonstrate that utilizing a single-use or reusable flexible video bronchoscope via an intercostal conduit is a highly feasible, remarkably safe, and cost-effective alternative for the definitive diagnosis and acute

management of complex pleural effusions in resource-limited settings. While the diagnostic yield is statistically comparable to dedicated semi-rigid pleuroscopes (approximately 91%),[9,10] operators must remain cognizant of the biomechanical limitations when attempting to fracture heavily organized, late-stage adhesions. In the present case, this exact limitation was preemptively acknowledged, and mechanical adhesiolysis was performed strictly to the maximum safe extent before transitioning to advanced pharmacological solutions.

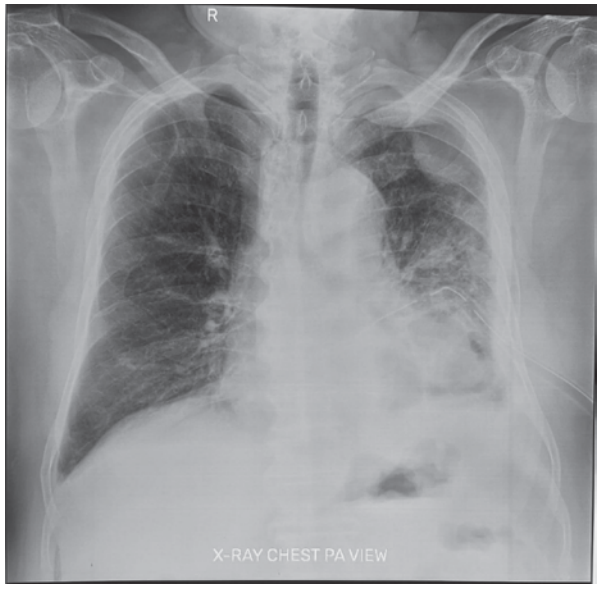


Fig 4: 2nd POD Chest Xray of the patient, showing significant expansion of the lung parenchyma.

Interventional Strategy Phase II: Antimicrobial Pharmacotherapy

Simultaneous with the mechanical clearance of the pleural space, systemic eradication of the virulent bacterial load was initiated. Empiric, highly potent, broad-spectrum intravenous antimicrobial therapy was aggressively optimized, reflecting the critical nature of the patient's presentation and the high likelihood of complex, resistant organisms due to prior antibiotic exposure and multiple hospital transfers. The customized pharmacological regimen included: Piperacillin-Tazobactam, Moxifloxacin, and Linezolid.

Interventional Strategy Phase III: Intrapleural Fibrinolytic Therapy (IPFT)

On postoperative day 1, following the makeshift thoracoscopy, comprehensive clinical and radiological assessments indicated significant, albeit partial, lung expansion compared to the initial presentation. By day 2, the patient's severe clinical symptoms had markedly resolved, and the supplemental oxygen demand decreased drastically from the initial 10 liters down to a highly manageable 1–2 liters per minute via nasal cannula.

However, despite the initial success of the mechanical adhesiolysis and systemic clinical stabilization, the chest tube drainage rapidly declined, plateauing at a minimal output of approximately 100 mL per 24 hours. Follow-up chest radiography confirmed that while there was evident initial radiological improvement, substantial loculated fluid collections and thickened septations remained unresolved within the pleural space.

This plateau in drainage is a classic and dangerous sequela in severe empyema. The intense local inflammatory response continues to drive the rapid, relentless reformation of dense fibrin webs, threatening to transition the patient into the terminal organizing phase (trapped lung), which would necessitate the very VATS decortication the team was desperately attempting to avoid.

To aggressively address this, the multidisciplinary team made the critical decision to initiate chemical adhesiolysis utilizing Streptokinase as the agent for the Intrapleural Fibrinolytic Therapy (IPFT). Adhering to established protocols, a meticulously prepared dose of 250,000 IU of Streptokinase, completely dissolved in 100 mL of sterile Normal Saline, was instilled directly into the pleural space via the indwelling 32 Fr chest drain.[11] This procedure was applied sequentially over two consecutive days.

Following each instillation, the chest drain was securely clamped for a period of 3 to 4 hours. This crucial dwell time allows the enzymatic agent to distribute uniformly throughout the compartmentalized pleural cavity, facilitating maximum biochemical degradation of the dense fibrinous septations before being flushed out.

The clinical response to the chemical adhesiolysis was immediate and profound. Post-instillation, there was a dramatic resurgence in pleural fluid drainage, rapidly increasing to approximately 250 mL over the subsequent 24 hours. This massive clearance of previously sequestered, infected fluid was accompanied by vigorous adjunctive non-pharmacological therapies, including intensive daily chest physiotherapy, targeted limb physiotherapy to prevent deconditioning, formal psychological counseling, and optimal pharmacological management of the patient's underlying severe COPD via bronchodilators and systemic corticosteroids.

Over the following three days post-streptokinase administration, the fluid collection gradually and predictably tapered to a minimal, clear, serous output. Given the near-complete evacuation of the pleural space and the stabilization of pulmonary mechanics, the massive 32 Fr chest drain was successfully and safely removed on day 10 post-procedure.

The pleural fluid analysis definitively confirmed a severe bacterial infection within the pleural space. Crucially, the final microbiological cultures of the pleural fluid yielded a heavy, pure growth of *Streptococcus* species (*Streptococcus anginosus*, SAG), unequivocally confirming the clinical suspicion of an iatrogenically introduced SAG infection. Furthermore, exhaustive histopathological examination (HPE) of the targeted pleural biopsies demonstrated extensive acute and chronic inflammatory cellular infiltrates consistent with a severe pyogenic infectious process. This definitive histological analysis completely excluded any underlying

occult malignancy or granulomatous disease, such as Tuberculosis, validating the chosen therapeutic pathway.

The patient completed an intensive, total three-week course of targeted intravenous antibiotic therapy (Piperacillin-Tazobactam, Moxifloxacin, Linezolid) within the inpatient setting. Following the cessation of IV therapy and the confirmation of stable inflammatory markers, he was transitioned to a highly bioavailable oral antimicrobial regimen comprising Cefpodoxime, Clindamycin, and Moxifloxacin to ensure complete eradication of the SAG pathogens. He was subsequently discharged to his home environment in stable condition.

Outpatient Follow-up

The patient returned to the interventional pulmonology clinic for a scheduled, comprehensive outpatient follow-up two weeks post-discharge. The clinical transformation was profound and highly satisfactory. He remained completely afebrile, hemodynamically stable, and, remarkably for a patient with severe baseline COPD, required absolutely zero supplemental oxygen at rest or during mild exertion.

His physical endurance had improved drastically; he reported the ability to walk continuously for 40 minutes without experiencing any significant exertional dyspnea, a testament to both the eradication of the empyema and the rigorous inpatient pulmonary rehabilitation. A follow-up standard posterior-anterior chest X-ray revealed near-complete radiological resolution of the left-sided pleural effusion, with excellent, symmetrical re-expansion of the left lung parenchyma and no evidence of residual trapped lung or significant pleural thickening.

Furthermore, comprehensive serological inflammatory markers, including C-reactive protein (CRP) and total leukocyte counts, which were critically elevated upon initial admission, had completely normalized. The patient completed his prescribed home course of oral antibiotics for a total of two weeks post-discharge, requiring no further invasive interventions.

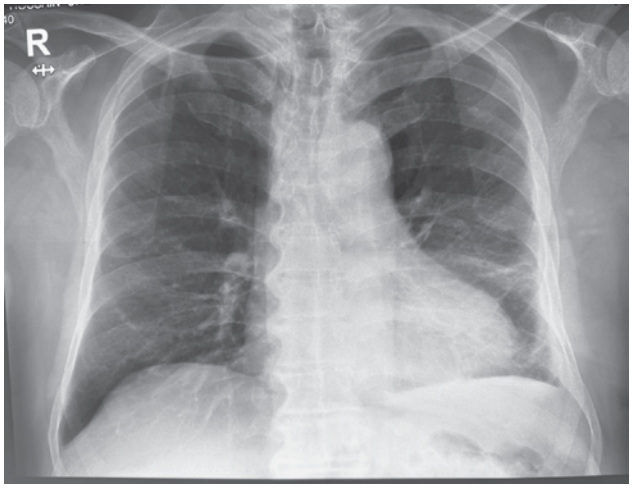


Fig 5: Complete Lung expansion with mild pleural thickening of the patient on follow up after completion of the oral antibiotic therapy.

Discussion

This case highlights several important considerations in the management of complex pleural infection. To fully comprehend the complexities of the interventions required in this case, it is essential to first understand the pathophysiology of parapneumonic effusions and empyema. The progression of pleural space infection is classically divided into three distinct stages: the exudative phase, the fibrinopurulent phase, and the organizing phase.[12] The exudative phase is characterized by accumulation of sterile fluid as a result of the inflammatory reaction due to adjacent pneumonia or lung abscess. If the primary infection remains inadequately treated, or if bacterial translocation occurs (either contiguously or iatrogenically), the condition rapidly deteriorates into the fibrinopurulent phase. This stage is defined by direct bacterial invasion of the pleural space, leading to an overwhelming influx of polymorphonuclear leukocytes and the accumulation of frank pus. In the final organizing phase, fibrinoblasts proliferate within the fibrin matrix. Dense layers of collagen matrix are deposited in layers in between the parietal and visceral pleura.

Historically, pleural fluid aspiration was performed relying solely on physical examination findings—specifically, dullness to percussion and decreased breath sounds. However, this blind approach is no longer validated and carries significant, heavily documented complications like iatrogenic pneumothorax, visceral pleural laceration, solid organ puncture (hepatic or splenic), and "dry taps". In 2008, a national safety alert was raised in the United Kingdom explicitly calling for a definitive change in clinical practice to guard against the avoidable, life-threatening complications of blind pleural procedures.[13] This was then mandated and codified in the 2010 British Thoracic Society (BTS) guidelines.[14] Beyond the immediate mechanical complications of pneumothorax and hemorrhage, repeated blind punctures through the dermal layers drastically increase the risk of translocating normal cutaneous and subcutaneous flora directly into the sterile, nutrient-rich environment of a pre-existing parapneumonic effusion. In this patient, the initial pleural fluid at the primary facility was described as a simple effusion responsive to basic aspiration. The subsequent, rapid transition into a highly loculated, purulent empyema following multiple blind passes strongly suggests an iatrogenic inoculation.

This suspicion of iatrogenic inoculation was definitively confirmed when subsequent pleural fluid cultures yielded a heavy growth of *Streptococcus* species. In the context of modern empyema microbiology, this finding is highly significant. Historically, community-acquired empyemas were dominated by infections with *Streptococcus pneumoniae* and *Staphylococcus aureus*. However, recent epidemiological shifts over the past decade indicate that the *Streptococcus anginosus* group (SAG)—comprising *S. anginosus*, *S. intermedius*, and *S. constellatus*—has rapidly surpassed both *S. pneumoniae* and *S. aureus* to become the leading microbial agent responsible for severe, loculated empyemas.[15]

SAG organisms are ubiquitous, facultative anaerobic

commensals of the human oropharynx, upper respiratory tract, gastrointestinal tract, and, importantly, the skin. While they coexist benignly as part of the normal flora, they exhibit profound pathogenicity when introduced into sterile spaces. SAG bacteria are characterized by exceptionally high virulence and a unique, intrinsic propensity for abscess formation (correlating precisely with the cavitary lung lesion seen on this patient's LUS) and the induction of rapid, severe loculations within the pleural space, often within 48 hours of inoculation.[16]

Second, the case demonstrates the effectiveness of combining mechanical and chemical septolysis in multiloculated empyema. While VATS remains an established treatment option, operative morbidity and mortality may be prohibitive in elderly patients with severe COPD and respiratory compromise. Awake medical thoracoscopy allowed immediate source control, evacuation of purulent collections, partial adhesiolysis, and acquisition of diagnostic tissue while avoiding general anesthesia. Residual organized loculations inaccessible to mechanical disruption were subsequently addressed using intrapleural streptokinase, which significantly improved pleural drainage and facilitated near-complete lung re-expansion. The sequential hybrid approach proved particularly valuable in this high-risk patient.

Finally, this case demonstrates procedural adaptability in a resource-limited setting. The improvised use of a laparoscopic trocar as a pleural access conduit combined with a therapeutic flexible bronchoscope provided adequate visualization and maneuverability within the pleural cavity despite the absence of dedicated pleuroscopy equipment. Such innovation may represent a feasible alternative in selected centers lacking advanced thoracoscopic resources.

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