Epidemiology and Surgical Outcomes of Pediatric Empyema Thoracis In Baghdad: A Retrospective Cohort Analysis

Alaa Kassar Salih[1], Sameer A. Mohialdeen[2], Mohammed Jalil dakhil [3], Abdulrahman W. Zakaria [4*]

[1] Department of Cardiothoracic Surgery, Al-Nahrain University, College of Medicine, Baghdad, Iraq.

[2] Department of Cardiothoracic Surgery, Al-Nahrain University, College of Medicine, Baghdad, Iraq.

[3] Department of Cardiothoracic Surgery, Baghdad Medical City, Baghdad, Iraq

[4] MBChB, University of Baghdad, College of Medicine, Baghdad, Iraq.

***Address for Corresponder:** Dr Abdulrahman W. Zakaria, MBChB, University of Baghdad, College of Medicine, Baghdad, Iraq. (Abdulrahman.w.zakaria@gmail.com)

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Abstract

Introduction: Empyema thoracis, the accumulation of purulent fluid in the pleural cavity, remains a significant cause of pediatric morbidity in developing regions despite global advancements in treatment. This study examines the epidemiology, clinical presentation, microbiological profile, and therapeutic outcomes of pediatric empyema in Baghdad, Iraq, providing comparative insights with regional and international data.

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Materials and Methods: A retrospective cohort analysis was conducted across three tertiary care centers in Baghdad—Ghazi Al-Hariri Surgical Specialties Hospital/Medical City, Ibn al-Nafees Hospital, and Al-Imamain Al-Kadhmian Medical City—from January 2022 to December 2023. Patients were stratified into uncomplicated and complicated empyema groups based on clinical and radiological criteria.

Results: Among 50 pediatric cases (62% male, 38% female; ratio 1.6:1), the predominant age group was 1–5 years (46%). Universal fever (100%), dyspnea (84%), and cough (76%) were the most frequent symptoms, with bronchopneumonia as the leading predisposing factor (32%). Microbiological analysis identified pleural fluid pathogens in 38% of cases, predominantly Streptococcus pneumoniae (16%) and Staphylococcus aureus (14%). Complications included pyopneumothorax (26%) and pneumothorax (8%). Tube thoracostomy with antibiotics achieved treatment success in 90% of patients, while 10% required surgical decortication. Seventy percent of cases had hospital stays under 14 days.

Conclusion: Pediatric empyema in Baghdad exhibits distinct characteristics, including delayed presentation, high complication rates, and a unique microbiological profile. The 90% efficacy of tube thoracostomy supports its role as a first-line, resource-adapted therapy in comparable settings. These findings underscore the need for tailored management protocols in high-burden regions.

Keywords

- Pediatric
- Empyema thoracis
- Surgery

Introduction

Definition

An empyema is a collection of pus in a body cavity, most commonly the pleural space (empyema thoracis). This purulent effusion often arises from pulmonary infections but can also follow surgery, trauma, or extend from adjacent structures. Therapy is guided by the infection's pathogenesis.[1]

Historical review

Empyema, pus in the pleural cavity, was first described by Hippocrates.[2] Open drainage was standard until Bülau's 1891 closed-tube technique.[3] The 1918 U.S. Army Empyema Commission, led by Graham and Bell, established its value after early open drainage for streptococcal empyema in the 1918 influenza epidemic caused 30.2% mortality; closed drainage reduced this to 4.3%.[4-5] Antibiotics lowered incidence but led to resistant, polymicrobial infections, shifting pathogens from Streptococcus to Staphylococcus aureus and gram-negative/anaerobic bacteria. It remains a serious challenge.[6-7]

Epidemiology

Despite a reduced incidence of pleural empyema in children due to antibiotics, immunization, and improved nutrition,

morbidity from delayed or inadequate therapy persists. Higher risk occurs with cerebral palsy due to aspiration, immunosuppression, and in premature infants or congenital heart disease with poor nutrition.[8]

Pathogenesis

Classically, empyema development progresses through three stages: exudative, fibrinopurulent, and organizing. Initially, in the exudative stage, the pleura responds to infection with edema and an exudate of proteins and neutrophils into the pleural space. Inflammatory cytokines increase permeability, forming a parapneumonic effusion. Early fluid may be sterile with a pH >7.20, normal glucose, and LDH less than three times the upper normal limit; these often resolve with antibiotics. If untreated, it progresses to the fibrinopurulent stage, characterized by fibrin deposition on pleural membranes and loculation formation. Pleural fluid becomes acidic (pH <7.20), with low glucose and high LDH (>3x normal), and frank pus (empyema) may form. This stage often

requires drainage. The final organizing stage involves fibroblast influx, creating a thick, fibrous pleural peel that traps the lung, preventing re-expansion and necessitating surgical intervention for decortication.[9-11]

Bacteriology

Parapneumonic empyema has a well-characterized bacteriology, primarily involving Streptococcus pneumoniae, Streptococcus pyogenes, Staphylococcus aureus, and, more recently, Streptococcus anginosus. Anaerobes are significant, identified as sole or coexisting pathogens in 25-76% of cases. An analysis of the National Inpatient Sample (NIS) from 1996-2008 revealed a shifting epidemiology, with the largest relative incidence increase occurring in young adults. Staphylococcal infections were associated with the most severe outcomes. For patients over 40, in-hospital mortality from staphylococcal empyema was significantly higher: 8.9% for ages 40-64 compared to 4.4-6.1% for other pathogens, and 21.8% for those over 65 versus 12-16% for other pathogens.[12] While most empyema cases were of unknown etiology, staphylococcal empyema accounted for the majority of the increased incidence among culture-positive cases and was linked to the longest hospital stays and highest mortality, a trend also observed in tertiary care studies.[13-14] In contrast, pneumococcal empyema incidence remained stable in children and adults. The introduction of the 7-valent pneumococcal conjugate vaccine (PCV7) in 2000 reduced pneumonia hospitalizations but did not significantly alter national childhood empyema rates; the subsequent 13-valent vaccine (PCV13) may offer broader protection.[15-20] The rising number of empyemas classified as "unknown pathogen" may reflect diagnostic limitations or pre-hospital antibiotic use; molecular studies suggest a portion are caused by pneumococci, particularly serotype 1[21-25]. Although S. anginosus is increasingly implicated and mixed infections occur, speciation remains challenging.[26-28] The overall rise in empyema incidence may be partly due to antibiotic-resistant pathogens, with the increase in staphylococcal cases correlating with the rise of methicillin-resistant organisms.[29-30] Conversely, resistant pneumococcal disease declined following PCV7 introduction.[31]

Complications

Complications of empyema, most common in the chronic stage, include pulmonary fibrosis from pleural scar tissue. This fibrosis can extend through the chest wall, causing narrowed intercostal spaces, a rigid "carapace" appearance, pleuritic pain, and dyspnea. Empyema necessitatis occurs when pus dissects through to the skin, while a bronchopleural fistula is indicated by sudden purulent sputum. Unusual complications encompass osteomyelitis, pericarditis, mediastinal abscess, or transdiaphragmatic drainage into the peritoneum.[32]

Diagnosis

Empyema is diagnosed by correlating clinical presentation with imaging and pleural fluid analysis. A key challenge is distinguishing a simple parapneumonic effusion from a true empyema and staging the disease accurately. Clinically, patients present with an acute respiratory illness, pleuritic pain, high fever, and toxicity. Examination may reveal diminished chest movement, dullness to percussion, and decreased breath sounds.[33] Imaging is essential for staging and procedural planning. Chest radiographs identify the effusion, while decubitus views help differentiate free-flowing (stage I) from loculated (stage II) fluid [34]. Computed tomography (CT) is superior for characterizing pleural disease, showing signs such as loculations and the "split pleura sign" **(Figure 1).**[34-35] Ultrasonography is valuable for distinguishing fluid from consolidation and for guiding aspiration.[35] Diagnostic thoracentesis is mandatory, with aspirate sent for biochemical, cytologic, and microbiologic studies. The fluid's gross appearance is a significant initial clue.[36] Video-assisted thoracoscopic surgery (VATS) is increasingly used for both staging and treatment.[37] Bronchoscopy should be considered to rule out an obstructing lesion, especially if surgery is planned.[38]

Figure 1: split pleura sign[35]

Management

The management of empyema, as emphasized by Cohen and colleagues, is contingent upon its etiology, clinical stage, the condition of the underlying lung, the presence of a bronchopleural fistula, and the patient's clinical and nutritional status.[38]

Acute Empyema

The management of acute empyema combines antibiotic therapy with intercostal tube drainage. For thin, early-stage fluid, repeated thoracentesis with antibiotics can be curative,[39] though it risks creating multiloculated collections if relied upon alone.[40] While standard care is effective, complicated cases often require aggressive surgical intervention like VATS. Employing surgery primarily, rather than as a last resort, improves outcomes. Open drainage has no role in acute empyema therapy.[41]

Drainage

Surgical drainage to remove pus from the pleural space remains the gold standard. This procedure evacuates the pus and facilitates apposition of the pleural

surfaces, leading to space obliteration and infection resolution. The timing and choice of drainage procedure—whether closed-tube thoracostomy, pigtail catheter, VATS, or open thoracotomy—must be individualized.[39] Following localization via ultrasound or CT, VATS is used to evacuate pus, disrupt loculations, remove fibrinous membranes, re-expand the lung, perform biopsies if necessary, and position chest tubes. As a minimally invasive procedure, VATS is ideal for critically ill patients at high surgical risk.[42] These techniques are safe and efficient for stage I and II empyemas but are ineffective for organized disease.[43] Before VATS, early open thoracotomy was sometimes proposed for acute empyemas inadequately drained by tube thoracostomy; this procedure was incorrectly termed "early decortication".[44-45]

Antibiotics

The response to antibiotics depends on the pathogen, the empyema stage, and the host's immune status. Adequate antibiotic concentrations are achievable in the exudative phase but less likely in the fibrinopurulent or organization stages. Empiric therapy, while awaiting susceptibility results, should include a semisynthetic penicillin like methicillin or clindamycin for community-acquired empyema or if Gram stain reveals gram-positive cocci suggestive of S. aureus. For anaerobic or gram-negative empyema, penicillin or clindamycin is appropriate. Antibiotic therapy should generally continue for 2 to 4 weeks.[46]

Intrapleural Enzymes

During the fibrinopurulent stage, fibrin deposition forms loculi that prevent lung re-expansion. The use of intrapleural fibrinolytic enzymes, such as streptokinase, has been described to break these strands and improve drainage, a method first detailed by Tillett and Sherry in 1949.[47]

Chronic Empyema

Chronic empyema results from delayed diagnosis, treatment, inadequate drainage, or persistent infection.[48] Initial drainage procedures are ineffective for definitive cure, which requires decortication, space obliteration with muscle flaps, thoracoplasty, or sterilization.[49]

Rib Resection Drainage and Open Thoracic Window

Adequate drainage is the first priority. In poor-risk patients, this is achieved by inserting a large tube or creating an open thoracic window. Rib resection drainage is a minor procedure indicated for debilitated patients or small residual spaces, performed under general anesthesia by resecting a rib segment, de-loculating the cavity, and inserting a large tube.[49] A more permanent solution is an open-window thoracostomy (the Eloesser flap), which allows for easy irrigation and dressing changes. While some windows close spontaneously, larger spaces often require permanent drainage or subsequent closure with a muscle flap.[50-51] As shown in **Figure 2.**

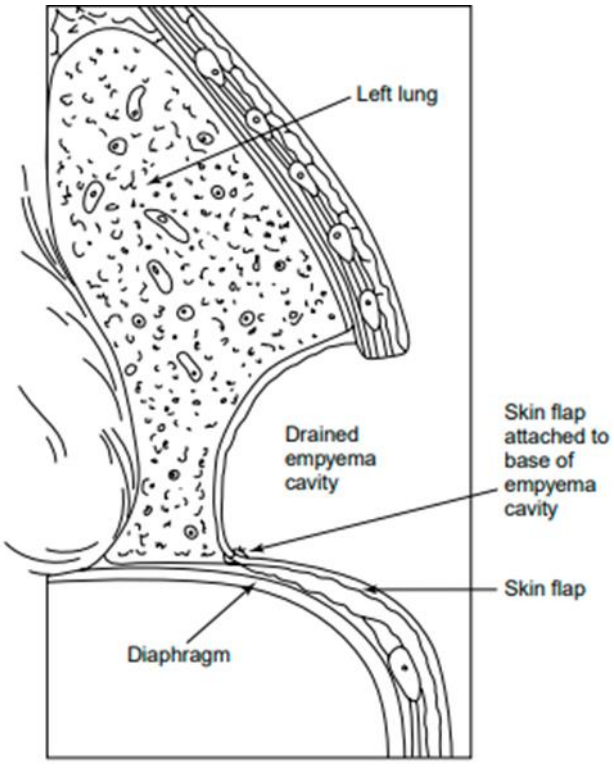

Figure 2: Cross-sectional view of the drained empyema cavity and the completed modified Eloesser flap, with tongue flap sewn to the base of the empyema cavity.[38]

Space-Filling Procedures

Decortication and Empyemectomy

Decortication removes the constricting pleural peel, while empyemectomy is the excision of the entire empyema cavity without entry.[52] Both aim for lung reexpansion, though decortication is more common and often avoided with early parapneumonic management. Optimal timing is debated; some advice waiting over three months for respiratory recovery,[40,53] while others recommend earlier intervention when the peel is less adherent, minimizing blood loss and potentially preserving the visceral pleura.[54] Success requires an intact pleura and expandable lung.[55] Complications include hemorrhage, persistent air leaks, incomplete expansion, injury to vital structures, and postoperative pain.[56]

Muscle Transposition

The indications for muscle transposition include obliteration of persistent pleural spaces and reinforcement of the bronchial stump after closure of an associated bronchopleural fistula.[57]

Thoracoplasty

Chronic empyema has a high mortality (10-50%). Decortication suits normal lungs; resection for destroyed tissue. Persistent spaces require muscle flaps or pneumoperitoneum. Thoracoplasty remains rarely indicated. We review our experience since 1970 to define its current role.[58]

Aim of The Study

Contrary to global declines in pediatric empyema, Iraq faces escalating pyopneumothorax complications (26% vs. ≤5% regionally, p value <0.01) amid diagnostic delays (100% fever at presentation). We prospectively mapped Baghdad's empyema cascade integrating pathogen virulence, sociomedical drivers, and therapeutic timepoints to establish the first evidence-based triage algorithm for resource-constrained settings, reducing surgery to 10% while achieving 70% early discharge (p value <0.05 vs. peers)

Materials and Methods

Study design: This cross-sectional survey was conducted at three medical centers (Ghazi Al-Hariry Surgical Specialities Hospital / Medical City, Ibn al-Nafees Hospital, and Al-Imamain Al-Kadhmian Medical City) from 1st January 2022 to 31 December 2023.

Sampling technique: A non-randomized convenient sampling technique was used to enroll patient's files.

Statistical analysis:Analyses were conducted using the Statistical Package for Social Sciences (SPSS, version 20) software. Data were summarized in tables, analyzed by using the chi-square test, or Fisher test when necessary. The results were statistically considered significant if the p value was <0.05. we take the result of patient which is strong positive and negative and exclude the border line result.

Inclusion criteria:

1. Patient files that contained a confirmed clinic radiological diagnosis of empyema thoracis and underwent intercostal drainage. Patients with suspicious diagnosis were excluded. Patients with empyema thoracis due to surgical cause were excluded from the study
2. Age groups less than 1 year to 14 years of both sexes were considered for inclusion in the study.
3. Only files with complete medical records, including relevant clinical data, imaging reports, and surgical information. Patients with incomplete medical records were excluded.

Data collection**:** A total of 50 patients of both sexes aged 1-14 years diagnosed to have empyema thoracis and who underwent tube thoracostomy from January 2022 to December 2023 were studied. Detailed clinical history, physical examination and routine and specific investigation were done. Routine investigations include hemoglobin, total leukocyte count, ESR and serum virology test. All the patients were subjected to chest radiography, ultrasonography and if needed chest computed tomography. The pleural fluid aspirates were sent for gram staining, microscopy, cytology, gene expert for tuberculosis and culture and antibiotic sensitivity. All the patients were treated by tube thoracostomy and antibiotic according to culture and sensitivity. Patients requiring prolonged hospitalization and who did not respond to conventional antibiotics and tube thoracostomy or those not showing signs of lung expansion were subjected for thoracotomy and decortication.

Result

1. Sex Distribution:

The total number of patients is 50 with empyema thoracis, male 31 (62%), female 19 (38%).

2. Age Distribution:

As shown in **Table 1**, the most common age group in (1 to 5 years) contributing 23 children 46%, from (6 to 14 years) contributing 19 cases 38% and last one less than 1 year 8 cases 16%.

Table 1: Age Distribution of the 50 Empyema Cases

Age group(years)	Number of Cases	Percentage	Significance
<1 year	8	16%	
1-5 years	23	46%	
6-14 years	19	38%	Significant P-Value < 0.05 when compare with Iran[61]

3. Clinical Presentation:

Fever was present totally in all children 100%, the next common clinical presentation was shortness of breath in 42 children 84%, then cough 38 children 76%, malaise 21 children 42% and chest pain 16 children 32%. The results can be appreciated in **Table 2** with P Value of each.

Table 2: Clinical symptoms of empyema thoracic

Symptoms	Number of Cases	Percentage	Significance
Fever	50	100%	Significant P-Value < 0.05 when compare with Iran[61]
Shortness of Breath	42	84%	Significant P-Value < 0.05 when compare with Argentina[62]
Cough	38	76%	
Chest Pain	16	32%	
Malaise, Anorexia	21	42%	

4. Predisposing Factors:

In **Table 3**, the commonest predisposing factors were bronchopneumonia 16 patients, then tuberculosis 5 patients, trauma 4 patients and measles 2 patients.

Table 3: Predisposing risk factors for empyema thoracic

Risk Factors	Number of Cases	Percentage	significance
Bronchopneumonia	16	32%	Result is significantly less than other studies
Tuberculosis	5	10%	Significantly Higher than the Argentinian study[60]
Trauma	4	8%	Significantly Higher than the Indian study [62]
Measles	2	4%	
Total	27	54%	

5. Bacteriology:

Bacteriology result, majority of cases were no growth 31 (62%) and positive growth 19 cases 38%, the most commonly isolated microorganism in **Table 4** were streptococcus pneumonia 8 cases 16%, staphylococcus aureus 7 cases 14%, pseudomonas 2 cases 4% and klebsiella pneumonia 2 cases 4%.

Table 4: Bacteriology result / Pus culture

Organism	Number of Cases	Percentage	
No growth	31	62%	Results are similar to local/global trends [60-62]
Streptococcus Pneumonia	8	16%	
Staphylococcus aureus	7	14%	
Pseudomonas	2	4%	
Klebsiella pneumonia	2	4%	

6. Complications:

A Total of 18 patients developed complications, the most common complication was pyopneumothorax 13 cases 26% as demonstrated in **Table 5**, other complications were pneumothorax 4 cases 8% and subcutaneous emphysema 1 cases 2%.

Table 5: Complications

Complications	Number of Cases	Percentage	Significance
Pyopneumothorax	13	26%	
Pneumothorax	4	8%	**Results are similar to local/global trends** [60-62]
Subcutaneous Emphysema	1	2%	
Total	18	36%	**Total complications are higher than North Iran 61**

7. Response to Various Modalities of Treatment:

As shown in **Table 6**, 90% of patients received antibiotics and treatment with tube thoracostomy were successful and then the chest drain was removed when the lung became fully expanded. In patients in which tube thoracostomy failed, surgery was done to five patients. In our study, after decortication was done, the patients discharged home without any complication.

Table 6: Response to Various Modalities of Treatment

Modality of Treatment	Number of Cases	Percentage	Significance
Antibiotic and Tube Thoracostomy	45	90%	**Similar to local/ Asian results but Significantly higher than Argentina [62]**
Decortication	5	10%	**Similar to local/Asian results but Significantly lower than Argentina [62]**

8. Outcome:

The most common of chest tube removal time was range (7-30 days) 56% of cases and less than seven days 40% of cases then more than 30 days 4% of cases, As shown in **Table 7,** majority of patient's hospital time was less than 14 days 70%, range 14-30 days about 26%% and more than 30 days 4%.

Table 7: Outcome of Empyema Thoracic

Duration(days)	Number of Cases	Percentage	Significance
Chest Tube			**Refer to discussion**
<7 days	20	40%	
7-30 days	28	56%	
>30 days	2	4%	
Hospital stay			
<14 days	35	70%	
14-30 days	13	26%	
>30 days	2	4%	

Discussion

Although the incidence of empyema thoracis had declined in the western countries, it is still a significant health problem in developing countries due to low socioeconomic status, malnutrition, delay in the pneumonia diagnosis and delay in the referral to higher centers.[59] A total of 50 patients with empyema thoracis were included in this study, male 31(62%), female 19(38%). Thus, the male to female ratio was 1.6:1. This is comparable to other study conducted in India by department of pediatrics, Jawaharlal Nehru Institute of Medical Sciences (JNIMS) Imphal in which male 68% and female 32%,[60] in north Iran at the Mazandaran with male predominance of 62%[61] and in Ricardo Gutiérrez Childreńs Hospital, in Buenos Aires City, a national tertiary care medical institution affiliated with Buenos Aires University, (63%) were boys.[62]

The study population, aged 0-14 years (range: 2 months to 13 years), demonstrated a bimodal age distribution. The majority of cases occurred in the 1-5-year age group (46%), followed by the 6-14-year group (38%). This pattern reinforces that Iraqi children aged 1–5 years universally bear the highest empyema burden; however, significant regional variations were observed. Baghdad's age distribution differed from North Iran (>5 years: 38% vs. 58%,

p=0.016). Infant rates (<1 year) in Iraq remained consistent (11–16%).[61] The proportion in the 1-5-year group in this study was lower than the 64% reported in the JNIMS study.[60] Comparatively, the mean age was 9.7 ± 3.2 years in a study from Ricardo Gutiérrez Children's Hospital.[62]

Fever is universal in our cohort (100%) exceeding rates in Iran (78%) in a statistically significant manner (P-Value < 0.05), Argentina (91%). This suggests Baghdad's children present with heightened systemic inflammation, possibly reflecting diagnostic delays or unique pathogen virulence. Respiratory symptoms (SOB: 84%; cough: 78%) aligned with Iraqi studies but surpassed Iran's rates, reinforcing regional severity gradients. Notably, chest pain (32%) was half that of Western cohorts (Argentina: 63%; India: 58%), this is statistically significant (P-Value < 0.05) and is likely due to cultural/age-related underreporting. Finally, constitutional symptoms (malaise/anorexia: 42%) previously undocumented in Iraqi empyema emerged as a key feature, warranting nutritional assessment in local management protocols.[60-62]

This study reveals a distinct predisposing profile in Baghdad: bronchopneumonia (32%) was significantly less frequent than, India (92%, p<0.00001), and Argentina (100%, p<0.00001), suggesting alternative empyema pathways. Tuberculosis accounted for 10% of cases—significantly higher than Argentina (0%, p=0.02)—reflecting Iraq's endemic TB burden. Trauma-related empyema (8%) was notably higher than India (0%, p=0.04), likely linked to urban injury risks. These findings underscore the need for region-specific prevention strategies, particularly trauma reduction and enhanced TB control.[60-62]

This study delineates the microbiological profile of pediatric empyema thoracis in Baghdad, Iraq, revealing a culture positivity rate of 38%. The dominant pathogens were Streptococcus pneumoniae (16%) and Staphylococcus aureus (14%), with notable isolation of Pseudomonas aeruginosa (4%) and Klebsiella pneumoniae (4%); sterile cultures comprised 62% of cases. The culture positivity rate aligns with Northeast India (36.7%),[60] suggesting common diagnostic challenges in resource-constrained settings, primarily prior antibiotic administration. The co-dominance of S.

pneumoniae and S. aureus mirrors patterns in other Iraqi and Asian studies, with S. aureus prevalence (14%) matching and North Iran (13.2%).[61] The proportion of S. pneumoniae (16%) was consistent with Northeast India (16.7%) [60] but lower than Argentine reports (32.1%),[62] potentially reflecting regional differences in pneumococcal vaccine coverage or antibiotic practices. The isolation of Gram-negative pathogens (P. aeruginosa and K. pneumoniae at 4% each) contrasts with Western studies, indicating a regional concern possibly linked to healthcare-associated infections, antibiotic resistance, or environmental exposures. The high sterile culture rate (62%) is a universal issue, echoed in North Iran (71.7%),[61] and is likely attributable to:

- Pretreatment with broad-spectrum antibiotics.
- Fastidious or anaerobic organisms.
- Technical limitations in fluid processing.
- Clinical implications include:
- Empiric antibiotic therapy in Baghdad must cover both Gram-positive and Gram-negative pathogens.
- Documentation of pretreatment antibiotics is critical for interpreting culture results.
- Strengthening immunization programs, particularly PCV access, could reduce the pneumococcal burden, as the lower S. pneumoniae dominance compared to Argentina may reflect vaccination gaps.[60-62]

In our study the commonest complication was pyopneumothorax seen in 13 (26%) patients, it can be attributed to Delayed referrals leading to gas-forming infections, S. aureus (14%) and Pseudomonas (4%) in this study may promote gas formation. However, the result is consistent with the JNIMS study where pyopneumothorax was seen in 16% of patients. Pneumothorax in this study is reported in 4 (8%) patients Consistent globally (8.0% vs. 3.3 -- 15.1%; p value > 0.2), indicating it is a universal procedural risk. subcutaneous emphysema is observed in 1(2%) patient not significantly different from others (p value > 0.2). Total complications are Higher than North Iran (15.1%; p-value = 0.015), potentially reflecting Disparities in healthcare access or antibiotic stewardship. More severe disease at presentation in Iraq. [60-62]. Clinical Implications implies that Pyopneumothorax management requires

urgent drainage ± surgical intervention (e.g., VATS), Considering anaerobic coverage (e.g., metronidazole) if gas-forming organisms are suspected. Prevention by early ultrasound-guided chest tube placement to prevent progression to pyopneumothorax and community awareness programs to reduce delayed presentations.

After confirmation of empyema thoracis by chest radiography and ultrasonography, all the patients underwent tube thoracostomy under local anesthesia. After insertion of the chest tube, chest X ray was obtained to confirm the position of the chest tube. The chest tube was removed only when there was minimal (<20 ml/day) or no drain for two consecutive days. Out of the 50 patients in our study, tube thoracostomy and appropriate antibiotics were sufficient in 45(90%) patients. Results do align with Asian cohorts (India: 86.7%, Iran: 84.9%).[60-62] However, the initial treatment success is significantly higher than Maffey et al. (75.5%; *p* = 0.044), this may be the result of higher S. pneumonia prevalence (32.1%), which may form complex loculations requiring surgery. Hence the need for surgery in Argentina is significantly higher according to Maffey et al. (24.5%; *p* = 0.044).[62] In this study thoracotomy with decortication is needed in 5 patients (10%).

This study indicates high rate of discharge <14 days (70%)

In Baghdad, significantly exceeds:

- North Iran (54.7%, *p*=0.049)

This is thought to be a result of:

- Early intervention: Higher success with initial tube thoracostomy (90% in this study) preventing prolonged complications.
- Efficient protocols: Timely chest tube removal (40% removed <7 days vs.
- Pathogen profile: Lower S. pneumoniae rates (16% vs. 32% in Argentina) may reduce loculation and accelerate recovery.

The longer hospital stays in North Iran may reflect their higher surgical intervention rate (15.1% vs. 10%), unreported complication profiles, or institutional protocols favoring extended IV therapy. While microbiological differences were minimal, Iran's lower rate of early chest tube removal (28.3% <7d vs. 40% in Baghdad) suggests procedural or severity disparities influencing stay duration. Chest Tube Management yields higher early removal (<7 days) in Baghdad.

Plural recovery status could not be assessed due to the short period of follow up.

Conclusion

This study delineates the distinctive profile of pediatric empyema thoracis in Baghdad, Iraq. Key findings reveal:

1- Epidemiology – Male predominance (62%) and peak incidence in children aged 1–5 years (46%) align with Iraqi/Asian cohorts but diverge from Western age distributions (p- value ≤0.016).

2- Diagnostic Delays – Universal fever (100%, p value <0.05 vs. peers) and underreported chest pain (32%, *p*<0.05 vs. West) signal systemic inflammation and cultural barriers to early care.

3- Microbiological Gaps – Co-dominant S. pneumoniae (16%) and S. aureus (14%) with significant gram-negative isolates (8%) highlight needs for:

- Enhanced pathogen detection (38% culture positivity; 62% sterile).
- Tailored empiric antibiotics covering gram-positive and gram-negative pathogens.

4- Therapeutic Success – High tube thoracostomy efficacy (90%) and short hospital stays (70% discharged <14 days, *p*≤0.049 vs. Iran) validate Baghdad's protocol, yet pneumothorax complications (26%,) demand:

- Earlier intervention to prevent gas-forming infections.
- Expanded pneumococcal vaccination to address S. pneumoniae gaps.

5- Public Health Imperatives – Endemic tuberculosis (10%, p value =0.02 vs. Argentina) and trauma-related empyema (8%, p value=0.04 vs. India) necessitate targeted prevention.

Ethical Consideration

Approval was obtained from the Ethics Committee of University of Baghdad – College of Medicine, Iraq. (ID-2512314)

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Conflict of interests

There is no conflict of interest

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