# MANAGEMENT OF COMPLICATED PARAPNEUMONIC EFFUSION AND EMPYEMA THORACIS IN CHILDREN AT THE UNIVERSITY TEACHING HOSPITAL OF KIGALI IN RWANDA: A CASE STUDY

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## ABSTRACT

**Objective:** To describe the management options of Parapneumonic effusion and empyema thoracis in the department of Pediatrics at the University Teaching Hospital of Kigali (CHUK).

**Methods:** A retrospective descriptive study was conducted in 52 children with parapneumonic effusion (PPE) and empyema thoracis in the department of Pediatrics at CHUK for 3 years. The data collected included demographic information, clinical presentation, laboratory investigations and hospital length of stay (LOS).

**Results:** The study involved 52 patients with whom 25 were males (48.1%) and 27 females (51.9%). The age-interval was between 5 to 144 months (12years) old and the mean age was 37.67 months (3years and 1 month). The mean hospital LOS was 26.53 days, and those who spent more than 30 days were considered to have a prolonged hospital LOS. The disease-related hospital mortality rate was 11.5% (6 cases) and all were under 4 years-old. Almost all patients were treated medically with chest tube drainage and antibiotics; only 1 case required thoracotomy and pleural decortication. Chest tube lasted 1-10 days in 63.5%. Cephalosporins (3rd generation) were the cornerstone of intravenous antibiotics and their mean treatment duration time was 17.23 days.

**Conclusion**: PPE and empyema thoracis are severe complications of pneumonia. The study intended to describe the overview of hospital prevalence of the conditions. The mortality rate remains high in the subgroup of under 4 years-old; though many children responded well to the intravenous antibiotics and chest tube drainage.

**Keywords:** Parapneumonic effusion, empyema thoracis, chest tube thoracostomy.

## INTRODUCTION

Empyema thoracis is defined as pus in the pleural space, although most clinical trials use the term pleural infection to encompass both empyema thoracis and complicated parapneumonic effusions [1]. It has been recognized since the time of Hippocrates; and historically it has been associated with high mortality ranging between 6-24% [2].

The disease occurs most commonly as the result of bacterial
pneumonia, but other etiologies include esophageal rupture, mediastinal or subdiaphragmatic disease, neoplasm, bacteremia, pancreatitis, chest trauma, and thoracic surgery [3]. In most series of patients with community acquired empyema thoracis, aerobic bacteria predominate. These include Streptococcus pneumoniae and Staphylococcus aureus [4], but Communityassociated methicillin-resistant Staphylococcus aureus is
an increasingly common cause of both parapneumonic effusion and empyema thoracis [5].
The natural course of empyema thoracis has 3 stages: the exudative, the fibrinopurulent, and the organizing phases. These stages are a continuum process; and the development of empyema thoracis in association with pneumonia goes through a progressive course that starts as simple parapneumonic exudation and develops into the organizing phase [4,6,7,8]. The two last stages are called complicated parapneumonic effusions and spontaneous healing may occur or a chronic empyema thoracis may develop.

The clinical presentation of the child with parapneumonic effusion or empyema thoracis depends on the waiting period before medical consultation. Some children present with symptoms related to empyema thoracis whereas others have been seen earlier in the course and appropriately treated for pneumonia, but fail to respond. Therefore, any child who remains febrile or unwell 48 hours after initiation of antibiotic therapy for pneumonia should be reevaluated for potential complications with repeat examination and chest radiograph [8,9].

The management option for empyema thoracis depends on the phase of the disease. It is either medical with antibiotics, therapeutic thoracentesis, tube thoracostomy and fibrinolytics, or a surgical procedure with video-assisted thoracoscopy (VATS), minithoracotomy and decortication; though antibiotics and intercostal drainage (ICD) remains the mainstay of the treatment[10].

Algorithmic approaches to management of parapneumonic effusion and empyema thoracis have been developed by the British Thoracic Society (BTS), the American Pediatric Surgical Association (APSA), and the Pediatric Infectious Diseases Society (PIS)[8,11,12]. These approaches are similar, and reports the treatment of simple effusions with drainage and antibiotics; and complicated effusions with either early surgical drainage (VATS or mini-thoracotomy) or fibrinolysis and chest tube drainage.

Whether surgery considered the initial treatment of choice or reserved for failed medical management; there are no evidences supported its use as first-choice treatment [8]. A systematic review of 67 studies published between 1981 and 2004 regarding the treatment of empyema thoracis in children aggregated the data according to the mode of therapy (nonoperative versus primary operative) [13].

Treatment with antibiotics and tube thoracostomy was successful in 76%.. However, avoidance of surgery appears to occur at the expense of an increased duration of chest tube (10.6 versus 4.4 days), hospital stay (20 versus 10.8 days), antibiotic therapy (21.3 versus 12.8 days) and mortality (3.3 versus 0 percent).

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In institutions where a pediatric surgeon is not readily available, fibrinolytic therapy is an acceptable alternative to VATS regarded there is no difference in clinical outcome between intrapleural fibrinolysis and VATS for the treatment of childhood empyema thoracis; herein intrapleural fibrinolyis has proven to be a more economic treatment option compared to VATS and should be the first choice treatment in children [4,14].

Despite the marked abnormalities at the time of presentation and the variety of treatment approaches, the majority of children make a complete recovery. Most children improve with antibiotic therapy and simple drainage. However, early active therapy (ie, chest tube placement with or without fibrinolytic therapy, or VATS) may result in shorter duration of illness and length of hospital stay. Complications such as bronchopleural fistula, tension pneumothorax and perforation through the chest wall (empyema necessitatis) are rare; but if they occur, the recovery is prolonged [13].

As most cases of PPE and empyema thoracis complicate from pneumonia, it is not rare to see those complications while pneumonia is the first leading cause of under-five mortality in Rwanda [16, 17]. The diagnostic tools are currently available and continuously improved; but still the management of empyema thoracis in children at CHUK remains challenging for medical staff provided the limitations in treatment options (VATS or fibrinolytics).

This study aims to determine the treatment options of PPE and empyema thoracis in the department of pediatrics at CHUK; and describe the burden of related complications on the follow-up of such highly prevalent disease.

### Objectives:

- To describe the therapeutic tools commonly used in the management of parapneumonic effusion and empyema thoracis

- To determine the type and duration of the commonly used antibiotics for the management of PPE and empyema thoracis in children at CHUK

## METHODS

A descriptive and retrospective study using quantitative approach was conducted during a period of three years. The study included 52 children aged between 1 month and 14 years who have been admitted in pediatric department from 1st January 2009 to 31stDecember 2012 for complicated PPE and empyema thoracis. Data were collected from hospital medical records in the department of pediatric. The data entry and analysis tools were EpiInfo 7.2 and Stata 11. Age, sex, cultured germs (blood and pleura), length of chest tube drainage, type of antibiotics and duration of intravenous and oral antibiotics were analyzed as dependant and moderating variables to the endpoint outcome. The inclusion criteria were based on: frank purulent collection drained from either pleural tap and/or chesttube insertion, the presence of pleural effusion on chest radiography, or the presence of loculated fluids on chest ultrasound.

However, were excluded in the study children under 1 month-old, or children with empyema thoracis without evidence of prior pneumonia causes. The hospital ethical clearance was received before the conduction of the study.

## RESULTS

Among 52 children studied with PPE and empyema thoracis, 25 were male (48.1%) while 27 were female (51.9%) The patients involved were aged between 5 and 144 months (12years) and the mean age was 37.67 months (3years and 1 month) [table 1].

**Table 1: Mean age of patient population studied with PPE and empyema thoracis**

**CHUK Jan 2009-Dec 2012**

| | |
|---|---|
| Age (months) | 52 |
| Mean (months) | 37.6731 |
| Median (months) | 27.0000 |
| Mode (months) | 36.00 |
| Std. Deviation | 3.7±1 |

The mean hospital length of stay (LOS) was 26.53 days, and those who spent 30 days or more were considered to have a prolonged LOS (figure 1) The mortality rate was 11.5% (6 cases) and all were under 4 years-old.

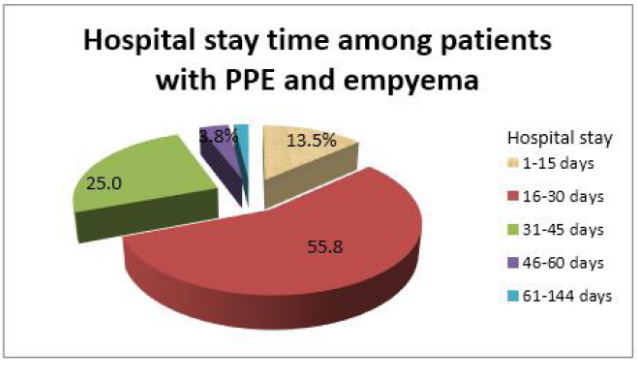


**Figure 1: Hospital stay time of patient of patient population studied with PPE and empyema thoracis, CHUK Jan 2009- Dec 2012.**

The implicated germ was identified in 8 cases only (15.4%) in both pleural fluid and blood specimen in equal frequency. Among them 2 were Staphylococcus aureus, no case of Streptococcus pneumoniae, and the rest were unusual causes of PPE and Empyema thoracis such as Pseudomonas, klebsiella, E.coli, Proteus, and salmonella typhi. All patients were treated medically with chest tube drainage and antibiotics. Chest tube lasted 1-10 days in 63.5 % [table 2], and was accidentally removed by the patients in 36.5%.

**Table 2: Duration of chest tube in patient population studied with PPE and empyema thoracis, CHUK/Pediatrics Jan 2009-Dec 2012.**

| Duration of chest tube | Frequency | Percentage |
|---|---|---|
| < 10 days | 33 | 63.5 |
| 11-20 days | 16 | 30.8 |
| 21-30 days | 2 | 3.8 |
| > 30 days | 1 | 1.9 |
| Total | 52 | 100.0 |

All patients were treated with intravenous antibiotics and the cornerstone was a third generation cephalosporin [table 3]. After completion of intervenous antibiotics, 63.5% received oral antibiotics mainly cloxacillin and metronidazole while 36.5% didn't get any additional oral antibiotics.

**Table 3: Types of intravenous antibiotics received by patient population studied with PPE and empyema thoracis, CHUK/Pediatrics Jan 2009-Dec 2012.**

| IV antibiotics | Frequency | Percent |
|---|---|---|
| 3rd generation cephalosporin | 7 | 13.5 |
| Cloxacillin (alone) | 2 | 3.8 |
| 3rd generation cephalosporin + cloxacillin | 23 | 44.2 |
| Others | 1 | 1.9 |
| 3rdgeneration cephalosporin + cloxacillin + Metronidazole | 19 | 36.5 |
| Total | 52 | 100.0 |

The mean duration of intravenous antibiotics was 17.23 days (figure 3), but they were not specified in time of duration of each oral antibiotics.

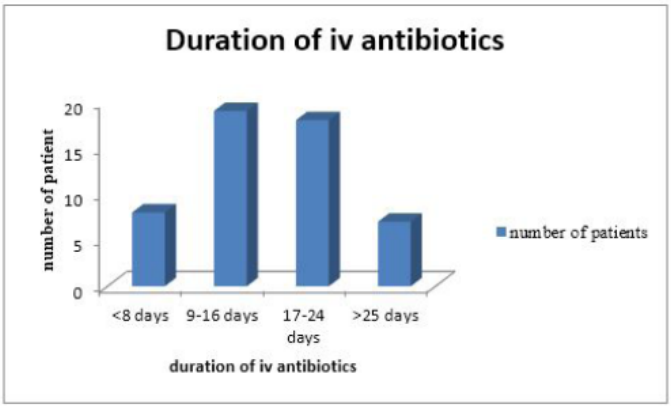


**Figure 3: Duration of intravenous antibiotics in patient population studied with PPE and empyema thoracis, CHUK/Pediatrics Jan 2009-Dec 2012.**

Surgical intervention was carried out in 5 cases (9.6%) and most of interventions were thoracic abscess drainage (4 cases) and thoracotomy and decortication (1 case).

Overall complications occurred in 13 cases (25%) and those complications included bronchopleural fistula (2 cases), empyema necessitates (3 cases), and others -8 cases- (lung atelectasis, pneumothorax, thoracic wall abscess, subcutaneous empysema, rib osteomyelitis)

## DISCUSSION

Regardless of the stage of disease, all patients initially received a medical treatment of intravenous antibiotics and chest tube thoracostomy. The two most common regimens of antibiotics used are cephalosporins of 3rd generation with cloxacillin (44.2%), and cephalosporins of 3rd generation with cloxacillin and metronidazole (36.5%). The mean duration time for intravenous antibiotics was 17.23 days. There are no data from randomized controlled trials on standardized duration of therapy or whether the duration of therapy should vary depending upon the causative organism [8]. Some clinicians continue intravenous antibiotics for 48 hours after the patient becomes afebrile or after the chest drain is removed. Other protocols continue with intravenous therapy up to two weeks [8].

6 cases of death were reported. A good response to medical treatment in terms of cure was achieved; however, only 1 case required surgical treatment with thoracotomy and decortication. Provided the BTS algorithm approaches in management of PPE and empyema thoracis and their indications for surgery [7], 1 case should not have been the only case treated surgically regarded the considerable number of patients with persistent
pleural sepsis despite chest tube drainage and antibiotics coverage. Complications from the disease occurred in 13 cases (25%) and include bronchopleural fistula, empyema necessitatis, lung atelectasis, pneumothorax, thoracic wall abscess, subcutaneous empysema, and rib osteomyelitis.

## DISCUSSION

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