OVERVIEW OF CLINICAL FEATURES, DIAGNOSIS AND AETIOLOGY OF PARAPNEUMONIC EFFUSION AND EMPYEMA IN CHILDREN

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Abstract

The incidence of empyema and Parapneumonic effusion in children in Romania is still high. A retrospective study was undertaken to investigate the clinical features and etiology of cases if empyema and Parapneumonic effusion admitted in department of Pediatric Surgery, Emergency`s Children Hospital, Cluj-Napoca.

Keywords: empyema, children, pneumonia

Introduction

Parapneumonic effusion occurs in approximatively 3 per 100 000 children per year; it occurs more frequently in pre-school children and more commonly in winter and spring and boys. Empyema is defined as the presence of pus in the pleural space. Childhood empyema is an important complication of bacterial pneumonia. It is considered that small pleural effusion may be present in up to 40% of bacterial pneumonias. Parapneumonic effusion (PPE) and empyema (E) lie on continuum: the stage of the effusion is best assessed using chest ultrasound [1]. E and complex PPE effusion represent parts of a spectrum of disease, with three stages of progression being recognized:

- Stage 1 ("exudative"): clear, sterile fluid accumulation within the pleural cavity without the presence of loculations (PPE)
- Stage 2 ("fibrinopurulent"): fibrin deposition within the pleural space giving rise to loculations; presence of pus (complicated PPE or E); it is usually accompanied by bacterial invasion
- Stage 3 ("organisational"): organized multiloculated empyema with lung entrapment and pleural rind formation, functionally impair gas exchange; this is the stage with complications, as chronic empyema, bronchopleural fistula, lung abcess or spontaneous perforation through the chest wall [2].

The etiology of empyema is closely related with that of community-acquired pneumonia[3]. The majority of PPE are due to Streptococcus pneumonia. Staphylococcus aures is the leading cause of E in developing countries and in children from families with low social economic status; it occurs more frequently in young infants and in summer months when skin infections are more prevalent.

Haemophilus influenzae type b is now an unusual cause of empyema in countries where the Hib vaccine has been introduced into the routine immunization schedule. Anaerobic infections are rare, but may occur in children with neurological disorders at risk of aspiration pneumonia. Mycoplasma pneumoniae is reported to be a common cause of PPE but rarely of E, also Mycobacterium tuberculosis [4].

Children usually present with a severe pneumonia, or a pneumonia that not respond well to initial therapy. Empyema should be suspected in a child with pneumonia who remains persistently febrile despite adequate antibiotic treatment. The clinical features are usually that of pneumonia and accompanying PPE, such as fever, tachipneea, respiratory distress, decrease or absence of breath sounds and dullness on percussion. Severe cases may present with sepsis, dehydration or respiratory failure. Large pleural effusions that cause mediastinal shift will displace the trachea and cardiac apex from the affected side. Pleuretic chest pain or referred abdominal pain may be reported in older children. Tuberculosis pleural effusion may complicate 2-30% of cases of childhood tuberculosis and must be differentiated from PPE or E. A history of persistent cough, weight loss and a household tuberculosis contact is suggestive of childhood tuberculosis. In primary TB, a unilateral PE develops 6 to 12 weeks after infection. It represents a hypersensitivity reaction and is associated with a positive tuberculin skin test (TST) in over 90% of well-nourished immunocompetent children. Tuberculosis alone is a rare cause of empyema and bacterial co-infection is a more likely scenario. Further history and examination should note any evidence of systemic illness that may cause pleural effusion and include congestive heart failure, edema and hypoalbuminemia (as in nephritic syndrome), malignancy, post-streptococcal glomerulonephritis and connective tissue disorders. Questioning and looking for a HIV infection could be important in patients presenting with immunodeficiency.

An anteroposterior chest X-Ray (CXR) should be done in all children with suspected empyema or PPE. Obliteration of the costophrenic angle indicates a fluid collection within the pleural space. Complete "white-out" of the affected hemithorax with mediastinal shift to the contralateral side is seen in large fluid collections.

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Radiological evidence of pneumonia is usually found and the presence of pneumothorax, pneumatoceles or lung cavities suggests Staphylococcus aureus as etiology, or rarely complicated hydatid cysts. Ultrasound is useful to differentiate the pleural fluid, and also is helpful in identifying pleural thickening and loculations, to guide chest drain insertion and perform follow-up. A computed tomography (CT) scan is usually recommended in suspected complicated cases (lung abcess< parenchymal lung abnormalities, mediastinal associated pathology). Further investigations are aimed at identifying an etiological agent. Analysis of pleural fluid using Gram stain and bacterial culture will help diagnosis. Blood culture is very important and may be positive in 10-15% of empyema cases. In cases when TB infection is suspected, microscopy and culture of sputum or gastric lavage and TST are indicated. Acute-phase reactants including white cell count (WCL), CPR and ESR (erythrocyte sedimentation rate) and procalcitonine may have a role in monitoring clinical progress and response treatment.

Most children with PPE and E can be managed by chest tube drainage; still some children may require a thoracotomy and further surgical procedures (debridement, resection of necrotic tissue, closure of fistulas) [5]. Small effusions that are not associated with significant respiratory distress (no need for oxygen therapy, the child does not have high fever and is not in pain) may be managed conservatively. Small effusions may be regarded as being less than 1 cm for children under 2 years of age and under 2 cm for older children. All children with pleural effusion should be initially treated with intravenous antibiotics, and those should be continued after the chest drain has been removed. Oral antibiotics should be given at discharge for 2 weeks (up to 4 weeks in some cases), depend on culture results. Intrapeural fibrinolysis and video-assisted thoracoscopic surgery (VATS) are modern interventions widely used in high-income countries, but most unavailable in our medical society [6], [7]. In the organized stage the goal standard for surgical treatment remains thoracotomy and decortications. Through pleural debridement release of encased lung parenchyma by carefully removing the thick pleural peel from the entire lung surface and making the lung expand meticulous closure of all major leaks and excision of necrotic lung tissue.

Purpose

The aim of this study is to evaluate clinical presentation and etiology of parapneumonic effusion and empyema in children with complicated pneumonia, who required surgical treatment and to identify risk factors for this.

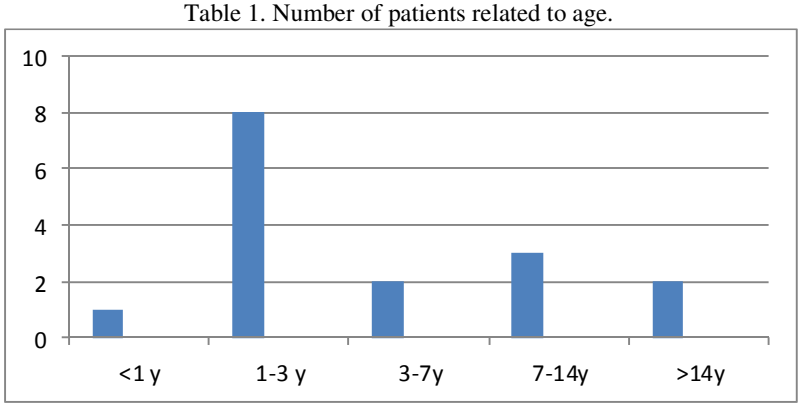
Materials and Methods

Children with empyema were retrospectively recruited over 3 year's period from January 2009 to December 2011 (included). A case of childhood pleural effusion was defined by the investigators as the presence of fluid inside the pleural cavity in a child with respiratory symptoms, fever and raised serologic inflammatory markers, and the presence of pleural collection was confirmed using chest X-Ray (CXR), ultrasound (US) or computed tomography scan (CT). Presence of pus cells in the pleural fluid was defined as empyema. Clinical data collected included: age, sex, area of residence, risk factors (including chronic illness and other predisposing conditions), clinical presentation, diagnosis tool, stage of inflammation, etiology. We excluded from our study pleural collections due to other causes (accidental chest injuries, postthoracotomy, and perforations of esophagus). A total of 16 patients with empyema were evaluated in this study.

Results

Our study included 16 children, 10 girls and 6 boys, age between 5 months to 17 years. The average age of the 16 patients was 5.15 years (Table 1).

Table 1. Number of patients related to age.

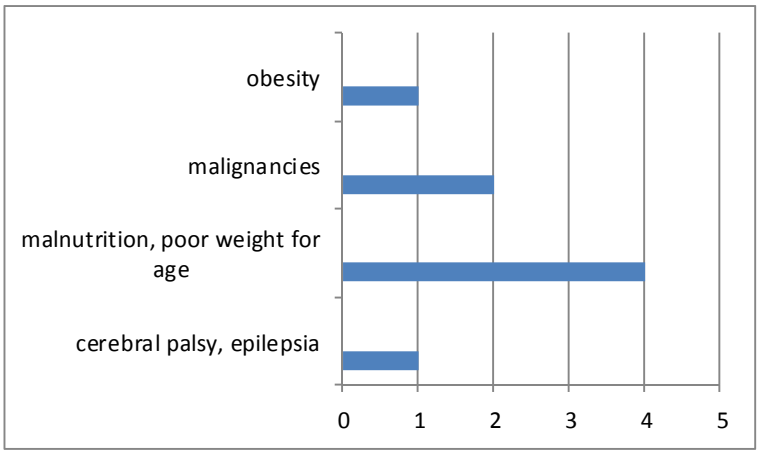


Majority of patients are included in preschool-age (before 7) (68.75%).

Risk factors were identified as in the following chart: poor nutritional status was the most frequent condition, as

25%; two patients had immunosuppressive treatment for leukemia and Hodgkin disease (12.5%), one patient presented with cerebral palsy and conditions for aspirating pneumonia, and one had obesity (6.25% each) (Table 2).

Table 2. Risk factors for developing a complication of pneumonia.



Clinical symptoms were related to pneumonia: chills, fever, dyspneea, chest pain, malaise, cough, increased sputum production, in all 16 cases, the median duration of symptoms prior to admission was 7.32days , (range 3 to 14). Fever, respiratory distress and cough were the main presenting complaints. Aerobic pneumonic infections will tend to present with an acute febrile illness, localized pleuritic chest pain, sputum production and leukocytosis. Infectious with anaerobes tend to lead a more insidious clinical course with less pronounced fever and more generalized systemic symptoms, such as poor appetite and weight loss.

Our patients presented in three different stages of disease (Chart 1):

- Stage 1 (exudative): 2 (14.84%)
- Stage 2 (fibrinopurulent): 8 (50%)
- Stage 3 (organizational): 6 (37.5%)

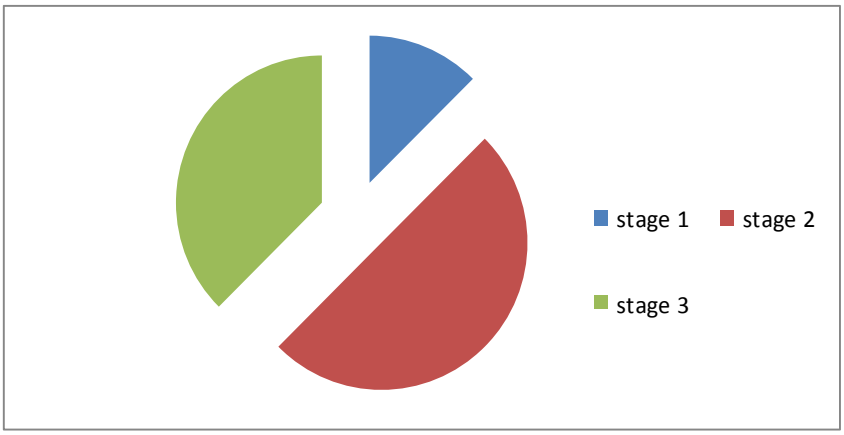


Chart 1. Stages of presentation of pleural effusion.

Diagnosis imaging tools used were: chest-X Ray (CXR), chest ultrasound (US), CT scan. CXR was used as a modality of diagnosis in all 16 patients (100%)m ultrasound was used in 8 patients (50%), especially for follow-up and trying to avoid irradiation in children, and CT scan provided further informations for 6 patients, those who had complications in 3rd stage as fistulas, pneumothorax, lung abscess (37.5%).

All these patients had history of intake of broad spectrum antibiotics and for that, etiological diagnosis was difficult.

Needle aspiration of pleural space was performed in every case and pus was sent for culture and sensitivity. Identification of the causative agent in children with empyema is often difficult, necessitating the use of empiric rather than specific therapy.

Etiology was: MRAS 1 case, Staphylococcus aures 1 case, Streptococcus pneumoniae 1 case, tuberculosis 2 cases and remained unknown for other 11 cases, due to previously mentioned antibiotic treatment.

Right side was involved in 6 cases (37.5%), and left side in 10 cases (62.5%).

Acute-phase reactants were at high levels in all cases, as in following table (Table 3):

Table 3. Acute-phase reactants in patients with pleural effusion.

Case no	White blood cell count x10^3	Neutrophilia	PCR mg/dl	ESR mg%
1	19000	91%	40.8	
2	18900		26.4	
3	24100	75.4%	15.1	**20**
4	12200	72%	18.7	**73**
5	20500	63%	16.6	**110**
6	16700	69.5%	19.8	**75**
7	20800	71%	5.6	**75**
8	18300		36.5	
9	47000	76%		
10	18500		42	**55**
11	12000	56%	12	**26**
12	18600	64%	17.6	**70**
13	21200	54%	17.5	**95**
14	14500		4.7	
15	6700	63%		**45**
16	18000		21	**40**

Discussions

Empyema is usually the result of infected pleural effusion that is associated with ongoing, uncontrolled, pulmonary sepsis or pneumonia. Age plays an important role in the development of empyema. Small children and infants are more commonly affected than older children.

The identification of causative agents in children with empyema can be achieved by culturing blood or pleural fluid. Poor socioeconomic groups with pneumonia are more predisposed to progress to empyema.

Pleural infection should be suspected in all patients with pneumonia, in particular those who fail to respond to appropriate antibiotic therapy, as defined by persistent fever, leukocytosis, and raised inflammatory markers such as CPR. Immunosupressed hosts and infants can present with disproportionately mild symptoms – relative to the severity of the pleural infection). The size of pleural effusion varies, and cannot be used to predict infective etiology.

Any patients presenting with pneumonic symptoms or those who are failing to respond to appropriate therapy and/or who have a pleural-based opacity on CXR that obscures the diaphragm, should be considered for further imaging and investigations.

US of the thoracic cavity can reliably demonstrate loculations and septations and increase the success rate and reduces the complications of thoracocentesis. As a result, we suggest that in the pediatric population US should be routinely used, and CT only in special circumstances, when the diagnosis is in doubt and to provide informations on underlying associated abnormalities such as pulmonary abscesses.

Despite the advances in the diagnosis facilities and early referral, empyema is still one of the most serious chest surgical problems in childhood.

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