

Management of Childhood Empyema as a Complication of Community Acquired Pneumonia

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Abstract

Background: Pneumonia is one of the most common reasons for hospitalization in childhood. Although most bacterial pneumonia will resolve with treatment of the underlying infection, some cases will be complicated by the development of an empyema.

Aim of Study: To assess the degree of agreement of the lines of diagnosis and treatment of patients with complicated pneumonia and empyema with the European guidelines for management of childhood empyema.

Patients and Methods: This study is a prospective analysis of 60 patients of empyema that were diagnosed and managed at Assiut University Children Hospital over 12 months from 1st March 2016-28th February 2017.

Results: History of prolonged pneumonic illness (>15 days) and pleuritic pain were checked in 100% and 86.7% respectively. History of the cardinal signs (cough, fever and respiratory distress) and investigations as CXR, WBC count, blood culture, CRP and ESR of community acquired pneumonia was taken in 100%, 100%, 100%, 75%, 41.7% and 41.7% respectively. ELISA test and procalcitonin were not done in any of our patients. History of the lines of management of community acquired pneumonia was taken in 60% of patients. Investigations of empyema as CXR, chest CT scan, analysis of pleural fluid, chest ultrasound, sputum culture were done in 100%, 100%, 75%, 21.7, 8.3% successively. Eighty five % were treated correctly by antibiotics and 65% operated on by chest tube drainage and 1.6% was operated upon by open thoracotomy with decortications. Fibrinolytic therapy was not done in any of our patients.

Conclusion: Empyema is still a respiratory problem in pediatrics. Evaluation of the studied patients were done perfectly except for some history points and some laboratory investigations that showed some defects. Management was perfectly done except for fibrinolytic therapy.

Key Words: *Chest tube drainage – Empyema thoracis – Fibrinolytic agents – Open decortications – Thoracocentesis – Video-assisted thoracoscopic surgery.*

Introduction

EMPYEMA is the most frequent suppurative complication of bacterial pneumonia in childhood. As parapneumonic effusion progresses, fibrin and cellular detritus accumulate, the purulent fluid becomes septated, and a thick peel forms over the visceral and parietal pleura. Parapneumonic pleural effusion is thus classified into 3 stages of progression: Exudative (stage 1), fibrinopurulent (stage 2), and organizational (stage 3) [1].

An estimated 0.6% to 2% of pneumonia cases in children are complicated by empyema. Since the 1990s, there has been a considerable worldwide increase in the incidence of empyema, with rates reaching 28.3% to 53% of all patients hospitalized for pneumonia [2].

The therapeutic management of Pediatric Parapneumonic Effusions and Empyema (PPE/PE) and the impact of initial therapeutic interventions on clinical outcome are the subject of controversial discussions. A recent study from central Europe demonstrated a striking lack of consensus on the treatment of this disease [3].

Although it has been reported that more than half of the children with parapneumonic effusion or pleural empyema can be managed successfully with antibiotics alone [4], there is some evidence that early invasive draining procedures including video-assisted thoracoscopic surgery or intrapleural fibrinolytic therapy could reduce the length of hospital stay [5].

In some studies, chemical debridement with intrapleural fibrinolytic therapy has been shown to reduce length of hospital stay compared to pleural draining catheter alone [6]. Recent recommendations consider antibiotic therapy alone to be

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a reasonable first line treatment option for complication-free small pleural effusions, and pleural drainage alone or with additional fibrinolytic therapy for treatment of children with moderate to large parapneumonic effusion or pleural empyema [7].

Aim of work:

The aim of this study is to assess the degree of agreement of the lines of management of our patients suffering from complicated pneumonia and empyema with the European guidelines for treatment of childhood empyema [8].

Patients and Methods

Our study was done on 60 children (age from 1.2-15 years) with pleural effusion admitted to Assiut University Children Hospital over 12 months from 1st of March 2016 till 28th of February 2017 (prospective audit study).

Research design:

Cases of pleural effusion and empyema were diagnosed and managed at Assiut University Children Hospital over one year. The lines of management were compared with the European guidelines [8] for treatment of childhood empyema and the results were recorded.

The patients with history of community acquired pneumonia were classified into mild, moderate and severe degree according to the: General condition, respiratory rate, presence or absence of cyanosis, O₂ saturation, presence or absence of circulatory failure, artificial respiratory management [8].

Approach to the research:

History:

Personal history: Name, age, sex, residence.

Complaint and its duration:

Present history:

- Toxic appearance.
- Shortness of breath.
- Fever.
- Cough.
- Pleuritic chest pain.
- Malaise.

Chest examination:

- Decreased chest expansion.
- Dullness to percussion of the affected side.

- Decreased breath sounds and/or pleural rub.
- Egophony (patient voices the letter "e", but when listening (auscultation) it sounds like "a").

Investigations of community acquired pneumonia:

- *CXR:*
 - Perihilar changes.
 - Lobar consolidation.
 - Patchy pneumonia.
- *Blood culture:*
 - No growth/Bacterial growth.
- *White blood cells count:*
 - Leukocytosis/normal.
- *CRP:*
 - Positive/negative.
- *ESR:*
 - 1st hour/2nd hour.

Management of community acquired pneumonia:

• *Age from 1.2Y to 5Y:*

Mild disease: Amoxicillin 45-50mg/kg (max. 1 gm) orally/12h for 7 days.

Cefdinir 7mg/kg orally 12h for 5 days.

Cefuroxime 15mg/kg orally 12h for 5 days.

Moderate disease (lobar or lobular effusion): Benzyl penicillin 30 (50.000)/kg IV 6 hourly for 5 days plus azithromycin 10mg/kg orally daily for 5 days.

Benzyl penicillin 30 (50.000)/kg IV 6 hourly for 5 days plus roxithromycin 4mg/kg orally 12 hourly for 7 days.

Severe disease (large pleural effusion, systemic toxicity and/or oxygen dependence): Cefotaxime 25mg/kg IV 8 hourly for 7 days plus azithromycin 10mg/kg orally daily for 5 days.

• *Age from 5 years to 15 years:*

Mild disease: Amoxicillin 45-50mg/kg orally 12 hourly for 7 days plus azithromycin 10mg/kg orally daily for 5 days.

Amoxicillin 45-50mg/kg orally 12 hourly for 7 days plus clarithromycin 7.5mg/kg orally 12 hourly for 7 days.

Serious disease: Amoxicillin 45-50mg/kg orally 12 hourly for 7 days plus azithromycin 10mg/kg orally daily for 5 days.

Amoxicillin 45-50mg/kg orally 12 hourly for 7 days plus clarithromycin 7.5mg/kg orally 12 hourly for 7 days.

Investigations of pleural empyema:

- CXR.

Chest ultrasound scans:

- Chest CT scans.

Analysis of pleural fluid:

- Sputum culture.

Management of pleural empyema:

Antibiotics:

- Cefuroxime/cefotaxime 50mg/kg IV 8 hourly.
- Clindamycin 10mg/kg IV 8 his added when MR-SA is suspected.
- For patients with anaphylactic penicillin allergy and severely ill patients: Vancomycin:
 - <12 year: 30mg/kg (max 1g) IV, 12 hourly.
 - >12 year: 25mg/kg (max 1g) IV 12 hourly plus cefotaxime/ceftriaxone.
 - 50mg/kg (max 2g) IV 8h.

Operative therapy:

- Chest tube drainage.
- Thoracotomy with decortication.
- Immediate surgery using video-assisted thoracoscopic surgery (VATS).
- Chest tube drainage with fibrinolytic agent.

Fibrinolytic therapy:

- (Streptokinase or urokinase).

Results

Our study was done on 60 children (1.2 to 15 years) with empyema admitted to Assiut University Children Hospital over 12 months from 1st of March 2016 till 28th of February 2017 (prospective studies).

Table (1) shows that 100% and 83.3% of patients were examined for respiratory distress and toxic appearance respectively. Respiratory distress and toxicity were present in 70% and 83.3% respectively.

Table (2) shows that history of the cardinal signs of community acquired pneumonia were taken in all patients (100%), the most presenting complaint were cough (100%), fever (80%) and respiratory distress (70%).

Table (3) shows that all patients were checked for history of prolonged pneumonic illness (>15 days) which was present in 45% of patients and 86.7% of patients were checked for history of pleuritic pain and it was present in 7.7% of cases.

Table (4) show that chest X-ray, white blood cell count, blood culture, CRP and ESR were done in 100%, 100%, 75%, 41.7% and 41.7% respectively. ELISA test and procalcitonin were recommended, but were not done.

There were no patients recorded at age 2-4 months in our study.

Table (5) shows the history taken about the management of community acquired pneumonia in the studied patients age from 1.2 years to 5 years (no=36). Eighteen out of 36 patients (50%) were considered mild disease according to history taken, nine of them (50%) received amoxicillin either in inadequate dose [3 cases (16.6%)] or inadequate duration [6 cases (10%)] and 5/18 (27.7%) received cefuroxime either in inadequate dose [2 cases (11%)] or inadequate duration [3 cases (16.6%)]. Ten cases (27.7%) were considered moderate disease, seven of them (70%) received Benzyl penicillin plus azithromycin either in inadequate dose [5 cases (50%)] or inadequate duration [2 cases (20%)]. Eight cases (22.3%) were considered severe disease, five of them (62.5%) received cefotaxime plus azithromycin in inadequate dose [2 cases (25%)] or inadequate duration [3 cases (37.5%)].

Table (6) shows evaluation of investigations of pleural empyema that were done in the studied patients. Chest radiographs, chest CT scan, analysis of pleural fluid, chest ultrasound, sputum culture were done in 100%, 100%, 75%, 21.7, 8.3% successively.

Table (7) shows the evaluation of lines of management of pleural empyema in the studied patients. Out of sixty patients, 51 cases (85%) were treated correctly by antibiotics and 39 cases (65%) operated on upon chest tube drainage and one case (1.6%) was operated by open thoracotomy with decortications.

Table (1): Number of cases with toxic appearance and respiratory distress.

| | Checked | Not checked | Present | Absent |
|------------------------------|---------|-------------|---------|--------|
| <i>Respiratory distress:</i> | | | | |
| No | 60/60 | 0/60 | 42/60 | 18/60 |
| % | 100% | 0% | 70% | 30% |
| <i>Toxicity:</i> | | | | |
| No | 50/60 | No | 50/60 | No |
| % | 83.3% | % | 83.3% | % |

Table (2): History of the cardinal signs of community acquired pneumonia.

| Patients history | Taken | Not taken | No. of cases |
|------------------------------|-------|-----------|--------------|
| <i>Fever:</i> | | | |
| No. | 60/60 | 0/60 | 48/60 |
| % | 100% | 0% | 80% |
| <i>Cough:</i> | | | |
| No. | 60/60 | 0/60 | 60/60 |
| % | 100% | 0% | 100% |
| <i>Respiratory distress:</i> | | | |
| No. | 60/60 | 0/60 | 42/60 |
| % | 100% | 0% | 70% |

Table (3): History checked for prolonged pneumonic illness and presence of pleuritic chest pain.

| History | Checked | Not checked | Present |
|-------------------------------|----------------|---------------|--------------|
| • Prolonged pneumonic illness | 60/60 100% | 0/60 0% | 27/60 45% |
| • Presence of pleuritic pain | 52/60 86.7% | 8/60 13.3% | 4/52 7.7% |

Table (4): Evaluation of investigations of community acquired pneumonia that were done in the studied patients.

| Investigation | | | | |
|-------------------------|----------------|------------------|---------------------|-------------------|
| CXR | | Findings | | |
| Done | Not done | Patchy pneumonia | Lobar consolidation | Perihilar changes |
| 60/60 100% | 0/60 0% | 22/60 36.7% | 21/60 35% | 17/60 28.3% |
| White blood cells count | | Results | | |
| Done | Not done | Leukocytosis | Normal | |
| 60/60 100% | 0/60 0% | 40/60 66.7% | 20/60 33.3% | |
| Blood culture | | Results | | |
| Done | Not done | Bacterial growth | No growth | |
| 45/60 75% | 15/60 25% | 25/45 55.6% | 20/45 44.4% | |
| CRP | | Results | | |
| Done | Not done | Positive | Negative | |
| 25/60 41.7% | 35/60 58.3% | 18/25 72% | 7/25 28% | |
| ESR | | Results | | |
| 1st hour | | Abnormal | Normal | |
| Done | Not done | 18/25 72% | 7/25 28% | |
| 25/60 41.7% | 35/60 58.3% | 18/25 72% | 7/25 28% | |
| 2nd hour | | Abnormal | Normal | |
| Done | Not done | 18/25 72% | 7/25 28% | |
| 25/60 41.7% | 35/60 58.3% | 18/25 72% | 7/25 28% | |

Table (5): History taken about the management of community acquired pneumonia in the studied patients aged from 1.2 years to 5 years (no=36 cases).

| Severity of the disease | Treatment | | | | |
|---|-----------|-----------------|-----------|-----------|--------------------|
| | Correct | Received (n=14) | | | Not received (n=4) |
| Dose | | Duration | Total | | |
| Mild disease (n=18) | | | | | |
| Amoxicillin 45-50mg/kg (max.1gm) orally 12 hourly for 7 days | Zero | 3 (16.6%) | 6 (33.3%) | 9 (50%) | 4 (22.2%) |
| Cefdinir 7mg/kg orally 12 hourly for 5 days | Zero | Zero | Zero | Zero | Zero |
| Cefuroxime 15mg/kg orally 12 hourly for 5 days | Zero | 2 (11.1%) | 3 (16.6%) | 5 (27.7%) | Zero |
| Moderate disease (lobar orlobular effusion) (n=10) | | | | | |
| • Benzyl penicillin 30 (50.000)/kg IV 6 hourly for 5 days plus azithromycin 10mg/kg orally daily for 5 days | Zero | 5 (50%) | 2 (20%) | 7 (70%) | 3 (30%) |
| • Benzyl penicillin 30 (50.000)/kg IV 6 hourly for 5 days plus roxithromycin 4mg/kg orally 12 hourly for 7 days | Zero | Zero | Zero | Zero | Zero |
| Severe disease (large pleural effusion, systemic toxicity and/or oxygen dependence) (n=8) | | | | | |
| • Cefotaxime 25mg/kg IV 8 hourly for 7 days plus azithromycin 10mg/kg orally daily for 5 days | Zero | 2 (25%) | 3 (37.5%) | 5 (62.5%) | 3 (37.5%) |

Table (6): Evaluation of investigations of pleural empyema done in the studied patients.

| Investigation | | Findings | |
|---------------------------|----------------|----------------|----------------|
| CXR | | Rt effusion | Lt effusion |
| Done | Not done | | |
| 60/60 100% | 0/60 0% | 29/60 48.3% | 31/60 51.7% |
| Chest CT scan | | Findings | |
| Done | Not done | Positive | Negative |
| 60/60 100% | 0/60 0% | 60/60 100% | Zero Zero |
| Analysis of pleural fluid | | Results | |
| Done | Not done | Positive | Negative |
| 45/60 75% | 15/60 25% | 19/45 42.2% | 26/45 57.8% |
| Chest ultrasound | | Findings | |
| Done | Not done | Positive | Negative |
| 13/60 21.7% | 47/60 78.3% | 13/13 100% | Zero Zero |
| Sputum culture | | Results | |
| Done | Not done | Positive | Negative |
| 5/60 8.3% | 55/60 91.7% | 3/5 60% | 2/5 40% |

Table (7): Evaluation of lines of management of pleural empyema in the studied patients (n=60).

| Antibiotics treatment | Received | | Not received |
|---|--------------|-----------|---------------|
| | Correct | Incorrect | |
| • Cefuroxime/Cefotaxime 50mg/kg IV 8 hourly | Zero | Zero | 60/60 100% |
| • Clindamycin 10mg/kg IV 8 hourly is added if MRSA is suspected | Zero | Zero | 60/60 100% |
| • For patients with anaphylactic penicillin allergy and severely ill patients: Vancomycin | 51/60 85% | Zero | 9/60 15% |
| <12 year: 30mg/kg (max 1g) IV, 12 hourly. | | | |
| >12 year: 25mg/kg (max 1g) IV, 12 hourly plus cefotaxime/ceftriaxone 50mg/kg (max 2g)IV, 8h | | | |
| | Done | Not done | |
| <i>Operative therapy:</i> | 39/60 | 21 /60 | |
| • Chest tube drainage | 65% | 35% | |
| | 1/60 | 59/60 | |
| • Thoracotomy with decortication | 1.6% | 98.4% | |
| | Zero | 60/60 | |
| • Immediate surgery using video-assisted thoracoscopic surgery (VATS) | 0% | 100% | |
| | Zero | 60/60 | |
| • Chest tube drainage with fibrinolytic agent | 0% | 100% | |
| <i>Fibrinolytic therapy:</i> | Zero | 60/60 | |
| (Streptokinase or urokinase) | 0% | 100% | |

Discussion

Our study revealed that all the patients whom suspected to have pleural effusion were admitted, diagnosed and treated in Assuit University Children Hospital. This is in agreement with Buckingham et al., and Schultz et al., who reported that empyema is one of the most common reasons for hospitalization in childhood [9,10]. In this study we noticed that the most common presenting complaint that enforce the patients to seek medical advice and accept hospital admission was cough in 100% of cases associated with fever in 80% and/or respiratory distress in 70% of them. Similarly Ferrer et al., mentioned that most patients with empyema presented with clinical manifestations of bacterial pneumonia, acute febrile response, pleuritic chest pain, cough, dyspnea, and, possibly, cyanosis [11].

In the present study some points were missed during history taking such as history of pleuritic chest pain and the relatives may give some inaccurate history due to defects in diagnosing previous period of illness.

The following investigations were done in all patients (100%), white blood cell count (leukocytosis in 66.6%), chest X-ray that showed patchy pneumonic changes, lobar consolidation, perihilar changes, right pleural effusion and left pleural effusion in 36.66%, 35%, 28.3%, 48.3%, 51.6% respectively. Chest CT scans were also done in 100% of patients to identify the underlying consolidated lung or fibrinous septations [12].

On the other hand some missed investigations were detected as:

1- *Blood culture:* That was done in 75% of cases, either because it was not recommended or the patients already started antibiotics at the emergency department. In pediatric patients, in whom sputum production is uncommon, identifying the cause of the pulmonary symptoms early in the course of a pulmonary infection is difficult. However, with parapneumonic effusions, the patient may become bacteremic as the organism invades into the pleural space, and a blood culture may reveal the organism [13].

2- *Analysis of pleural fluid:* Was done in 75% of patients due to missed sample in emergency department. Analysis of the pleural fluid pH, LDH, and glucose levels in parapneumonic effusions is potentially useful in diagnosing empyema and guiding decisions on the need for drainage [14].

- 3- *ESR and CRP*: Were done only in 41.6% of patients due to either it was not recommended or it was missed in Emergency Department.
- 4- Chest ultrasound was done in 21.6% of patients, and it is useful in diagnosing the underlying chest etiology of undifferentiated dyspnea and can identify loculated fluid collections [15].
- 5- *Sputum culture*: Was done in 8.3% of patients because it is difficult to be obtained in children at that age.
- 6- ELISA, Procalcitonin, Pleural fluid Polymerase Chain Reaction (PCR), latex agglutination tests were deficient, due to non recommendation or unavailability in our hospital. These tests could be helpful if the cause of the infection cannot be ascertained from stain or culture [16].

Out of sixty patients, 44 (73.3%) of them had a history of receiving improper antibiotics either with inadequate dose or inadequate duration. Patients may present with complicated pneumonia or an initially uncomplicated pneumonia that is poorly responsive to antibiotics (persistent fever after 48h to 72h of antibiotics without clinical improvement, persistent or worsening respiratory distress and/or hypoxia, or new clinical findings of a pleural effusion) [17].

However 85% of our cases received the recommended antibiotics treatment of empyema with no evidence of using fibrinolytic therapy numerous studies have documented the effectiveness of intrapleural fibrinolytics to treat obstructed thoracostomy tubes, increase drainage in multiloculated effusions, and to lyse adhesions [18]. On the other hand 65% were subjected to empyema drainage with intercostal tube. Kirsch et al., reported patients who fail to respond to intravenous antibiotics and improving pulmonary symptoms, are those in whom pleural fluid does not aspirate with needle or tube thoracostomy, or present with Empyema Severity Scores (ESS) of 2 or greater that responded more quickly with earlier decortication [19]. Finally in our study only one case was advised for surgical treatment in the form of open thoracotomy with decortication.

Conclusion:

Empyema is still a problematic chest diseases in pediatrics. Evaluation of the studied patients were done perfectly except for some history points and laboratory investigations that showed some defects. Management was perfectly done except for fibrinolytic therapy.

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التدقيق على تشخيص وعلاج الإلتهاب الصديدي البللورى المكتسب من المجتمع بمستشفى الأطفال الجامعى بأسيوط

إن الإلتهاب الرئوى يعد واحدا من الأسباب الرئيسية للعلاج فى المستشفيات وخاصة فى فترة الطفولة.

على الرغم من أن معظم الإلتهاب الرئوى البكتيرى ينتهى فقط بعلاج الميكروب المسبب للمرض (العدوى الكامنة) إلا إن بعض الحالات تتطور إلى الإلتهاب الصديدي البللورى والذي يعرف بأنه تجمع صديدي داخل الغشاء البللورى أو إنصباب تحت البللورى (المرحلة الأولى) والذي من الممكن أن يتطور ليقى نو مسكن (المرحلة الثانية) أو أن يتطور ليكون قشر الفيبرينى (المرحلة الثالثة).

وهناك مضاعفات أخرى للإلتهاب الرئوى مثل خراج بالرئة والرئة النخرية.

معظم الدراسات الحديثة تسجل إرتفاعا ملحوظا فى عدد الحالات التى تتطور من الإلتهاب الرئوى إلى الإلتهاب الصديدي البللورى.

تم تصميم البحث على الأطفال الذين تم دخولهم إلى مستشفى الأطفال الجامعى بأسيوط فى خلال سنة من بداية مارس ٢٠١٦ وحتى نهاية فبراير ٢٠١٧. والذين يعانون من مضاعفات الإلتهاب الرئوى.

هو دراسة درجة التوافق بين خطة العلاج للمرضى الذين يعانون من الإلتهاب الصديدي البللورى الناتج عن الإلتهاب الرئوى مع القواعد العلاجية الأوربية الموضوعة للإلتهاب الصديدي البللورى.

١- مزعة الدم: تم إجراؤها فى ٧٥٪ من الحالات.

٢- عد كرات الدم البيضاء: تم إجراؤها فى ١٠٠٪ من الحالات.

٣- سرعة الترسيب وبروتين سى الحساس: تم إجراؤها فى ٦٦.٦٪ من الحالات.

٤- اليزا وبروكالسيتونين: لم يتم إجراؤها.

٥- مزعة البصاق: تم إجراؤها فى ٨.٣٪ من الحالات.

٦- تحليل السائل البللورى: تم إجراؤها فى ٧٥٪ من الحالات.

١- أشعة عادية على الصدر: تم إجراؤها فى ١٠٠٪ من الحالات.

٢- أشعة تليفزيونية على الصدر: تم إجراؤها فى ٢١.٧٪ من الحالات.

١- أشعة مقطعية على الصدر: تم إجراؤها فى ١٠٠٪ من الحالات.

• إن الإلتهاب الصديدي البللورى يعد من المشاكل الصعبة فى الأطفال.

• تقييم كل المرضى جاء كاملا ما عدا فى بعض النقاط فى التاريخ المرضى والفحوصات والعلاج.