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Research Article

Necrotizing Pneumonia in Children, Experience of the Children's Hospital of Rabat

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Received: October 30, 2024; **Published:** December 05, 2024

Abstract

Necrotizing pneumonia (NP) is a rare complication of infectious pneumonia, requiring early diagnosis and multidisciplinary medical and surgical management to improve the immediate and long-term prognosis of patients.

Our work is a descriptive study conducted on 30 cases of necrotizing pneumonia, collected in the Pneumo-Allergology and Pediatric Infectiology Department of the Children's Hospital in Rabat between 2021 and 2024. The aim is to analyze the clinical, biological, and radiological characteristics of necrotizing pneumonia in children. The mean age of the patients was 6 years, with 16 boys and 14 girls, and had no significant medical history (70% of cases). No immunodeficiency or vaccination delays were reported. The mean time between the onset of symptoms and hospitalization was 20 days. A total of 76.6% of our patients received antibiotic therapy, and 73.3% received non-steroidal anti-inflammatory drugs before hospitalization.

At admission, the primary symptoms included fever, cough, dyspnea, hemoptysis, and abdominal pain; respiratory distress and persistent fever were the main reasons for hospitalization. The diagnosis of necrotizing pneumonia was confirmed through computed tomography, which showed pulmonary consolidations predominantly on the right side, as well as pleural effusion in 11 patients.

Laboratory analyses revealed inflammatory anemia in 83.3% of cases, neutrophilic leukocytosis in 80%, and elevated C-reactive protein (CRP) in 93.3% of cases, with a mean level of 182.4 mg/L. Blood cultures isolated a pathogen (*Staphylococcus aureus*) in only one instance, while two cytobacteriological examinations of sputum yielded positive results for *S. aureus* and *Pseudomonas aeruginosa*. No pathogens were identified in pleural fluid cultures.

All patients received intravenous antibiotic therapy, primarily with cephalothin, transitioning to oral antibiotics to complete a total treatment duration of 6 to 8 weeks. In certain cases, second-line therapy (vancomycin, ceftazidime, cefotaxime) was required. Pleural drainage was performed in 5 patients, pneumothorax drainage in 4, and thoracoscopy in 3 children.

Most patients had a favorable outcome. However, nine patients developed complications: one pneumothorax (13.3%), one septic shock with endocarditis and pulmonary embolism (3.3%), and one empyema (13.3%). One death was reported. The average hospital stay was four weeks. A six-month follow-up showed complete resolution of pulmonary and pleural lesions in all patients.

Keywords: *Necrotizing Pneumonia; Child; Antibiotic; Drainage*

Introduction

Necrotizing pneumonia (NP) is one of the most serious complications of community-acquired pneumonia (CAP) in children. Although the number of patients with NP is relatively small, an increasing incidence of this form of pneumonia has been reported in recent decades [17].

Aim of the Study

The aim of this work is to report the experience of the Pneumo-Allergology and Infectiology Department of the Children's Hospital at Ibn Sina University Hospital in Rabat, in terms of NP in children, in order to analyze the clinical, biological, radiological, therapeutic, and evolutionary characteristics of this condition in children, particularly in the Moroccan context.

Materials and Methods

This is a study conducted on all children hospitalized for NP during the period extending from January 2021 to July 2024.

The inclusion criteria are:

- Children aged 1 month to 15 years.
- NP diagnosed based on clinical and radiological data.

Exclusion criteria: Records that do not contain sufficient information to be analyzed.

The records were collected from infectious disease registries.

The following data were recorded for each patient in an Excel spreadsheet: age, sex, medical history, clinical signs, duration of symptoms before hospitalization, results of biological and radiological assessments, bacterial culture results, treatment administered, complications, and length of hospitalization.

Results

During the study period, 30 patients with necrotizing pneumonia were hospitalized in the Pediatric Pulmonology and Infectiology Department of the Rabat Children's Hospital. The sex ratio was 1.1, predominantly male, with a median age of 6 years (ranging from 4 months to 14 years). 70% of patients had no significant medical history. Nine children had a history of otorhinolaryngological infections (ENT) infections (3 cases), iron deficiency anemia (1 case), asthma (1 case), and prematurity (2 cases). All these children were up to date with their vaccinations, and none had a history of immunodeficiency.

The mean time between the onset of symptoms and hospitalization was 20 days. Antibiotic therapy had been initiated prior to outpatient admission in 76.6% of cases (median 5 days) and in 33.3% of cases (median 3 days) via the intravenous route after intra-hospital admission, before being transferred to our Pediatric Pneumo-Allergology and Infectiology Center (using simple or protected amoxicillin, macrolides, co-trimoxazole, and sulfamethoprim). 73.3% of patients had received non-steroidal anti-inflammatory drugs (ibuprofen).

The clinical symptoms at admission (Figure 1) were dominated by fever, cough, respiratory distress, hemoptysis, and abdominal pain, respectively. The primary indication for hospitalization was respiratory distress, followed by prolonged fever.

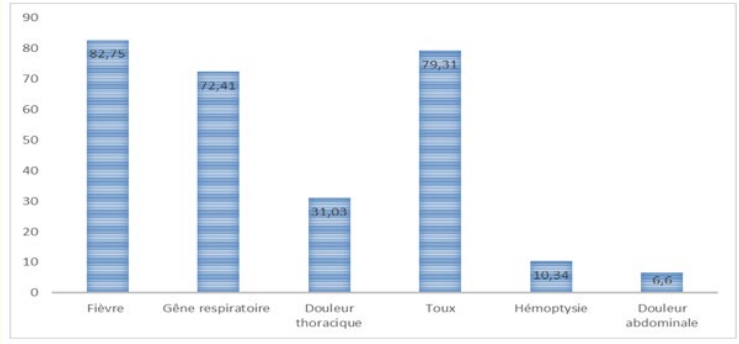

Figure 1: *Clinical symptoms on admission (n: 30 cases).*

The diagnosis of NP was confirmed by chest CT scan, which revealed images of pulmonary consolidation. In 19 and 11 children, the abnormal radiographic appearance was limited to the right and left lungs, respectively. Pleural effusion was identified in 11 patients.

The blood count showed inflammatory anemia in 83.3% of cases, neutrophilic polymorphonuclear leukocytosis in 80%, and normal findings in 13.3% of cases. CRP was elevated in 93.3% of cases, with a mean value of 182.4 mg/L.

Blood culture was positive in only one patient (*Staphylococcus aureus*), and two cases had positive ECBC (cytobacteriological examination of sputum induced by hypertonic serum): one with *Staphylococcus aureus*, and another with *Pseudomonas aeruginosa.* Eight patients underwent pleural puncture, and the fluid was exudative with cellularity rich in neutrophils. Microbiological studies of the pleural fluid were performed, but no cultures were positive.

In the remaining cases, no germs could be identified in the various samples taken, including pleural fluid cultures, sputum cultures, and blood cultures.

Intravenous antibiotic therapy was initiated in all patients. The antibiotic used was a first-generation cephalosporin such as cefalotin. A total of 23.3% of patients required second-line treatment (vancomycin, ceftazidime, cefotaxime). An oral transition (protected amoxicillin, pyostacin) was recommended to complete 6 to 8 weeks of antibiotic treatment.

In addition to medical treatment, pleural drainage was performed in 5 cases, and pneumothorax drainage in 4 cases. Three children required thoracoscopy.

Nine patients developed complications: pneumothorax (4 cases), septic shock with endocarditis and pulmonary embolism (1 case, death), and pleural empyema (4 cases). One death was reported.

The average length of hospitalization was 4 weeks. The outcome was favorable in almost all patients, one death was reported. Chest X-rays at the 6-month follow-up showed complete resolution of pulmonary lesions.

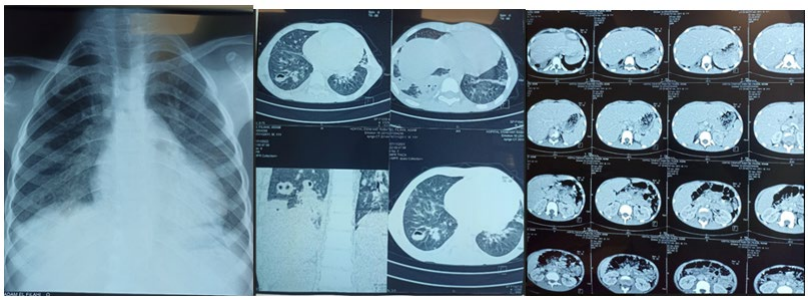

Figure 2 and 3: *Frontal lung X-ray: Right basal cystic image, rounded, fairly well defined, confluent and with thickened walls, the CT complement Cross-sectional image shows rounded lucency at the apical level of the right lung bronchopneumopathy with diffuse excavated pulmonary nodules.*

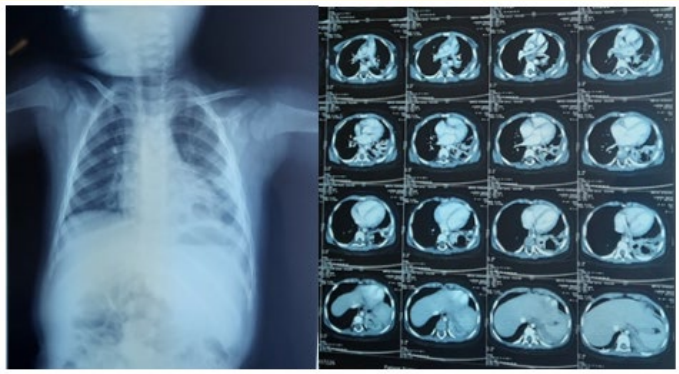

Figure 4: *Left basal alveolar syndrome containing hyperlucency of cystic appearance, the CT scan complement shows the presence of a focus of parenchymal condensation, containing excavations with low abundance pleurisy suggesting pleuropulmonary Staphylococcus.*

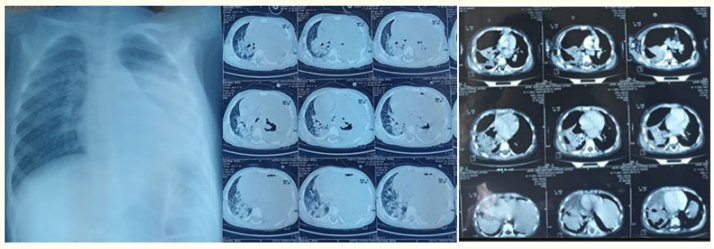

Figure 5: *Frontal chest X-ray: Opacity taking up almost the entire left hemi-pulmonary field with fairly well-limited water density not containing any air bronchogram, Thoracic CT scan in transverse section: Large left pleural effusion, containing a water-air level and air bubbles, responsible for condensation without air bronchogram and cystic images.*

Discussion

Necrotizing pneumonia (NP) is a serious complication of severe pneumonia. It is characterized by areas of pulmonary necrosis with thin-walled cavities. It can affect immunocompetent children without underlying disorders [3]. In our study, only 30% of patients had a medical history (asthma, iron deficiency anemia, ENT infections), and no patient had a history of immune deficiency or underlying chronic pathologies.

The main pathological feature of NP, namely pulmonary necrosis, is caused by toxins produced by invasive bacterial strains [1]. The most frequently involved pathogens are *Staphylococcus aureus*, especially methicillin-resistant strains (MRSA), and *Streptococcus pneumoniae*, although other bacteria and mixed pathogens may also be responsible [2].

Fever and cough are common symptoms, while signs such as hemoptysis and chest pain may indicate a more severe form of necrotizing pneumonia. Abdominal pain may reflect diaphragmatic irritation. The mean time to hospitalization in this series was 20 days, emphasizing the importance of recognizing and treating serious respiratory infections promptly.

The high proportion of patients receiving antibiotics (76.6%) and nonsteroidal anti-inflammatory drugs (73.3%) before hospitalization shows a tendency to initially treat this condition as classic pneumonia. However, the evolution to more severe forms, requiring hospitalization, suggests that these initial treatments may not be sufficient, or that the diagnosis of necrotizing pneumonia is often delayed.

The overuse of non-steroidal anti-inflammatory drugs (NSAIDs), such as ibuprofen, in respiratory infections, including necrotizing pneumonia, is a cause for concern. NSAIDs are known to modulate the inflammatory response by inhibiting cyclooxygenase (COX), which may paralyze some innate immune responses. This is particularly worrisome in the context of severe infections where an adequate immune response is essential to contain the infection [14,15].

Observational studies have shown that patients treated with NSAIDs, particularly in cases of lower respiratory tract infections, are at increased risk of complications such as pneumonia [13]. It has been postulated that NSAIDs, in addition to decreasing inflammation, may actually trigger pro-inflammatory cascades by increasing the migration of leukocytes, particularly neutrophils, into the lungs. This exaggerated response could exacerbate lung injury and promote progression to more severe forms, such as necrotizing pneumonia [10-12].

According to a recently published French study [17], which included 41 children, the pathogen responsible for NP was identified in 51% of cases (21 cases). *Staphylococcus aureus* was the most common (13 cases, 61.9%). Other organisms were also identified, such as *Pseudomonas aeruginosa, Fusobacterium* spp, *Streptococcus pyogenes*, and *Staphylococcus epidermidis* [17]. In our study, the pathogen was identified in only 3 cases, likely due to prior antibiotic therapy before hospitalization.

Chest radiographs rarely reveal signs of necrosis. Contrast-enhanced chest CT scans are more accurate, showing diffuse consolidations, parenchymal destruction, and thin-walled air/fluid-filled cavities, followed by multiple cavities, suggesting pulmonary gangrene or a thick-walled cavity (lung abscess). Pleural effusion may be an early sign.

After treatment, X-rays usually show complete resolution or minimal scarring within 1 to 3 months [4]. MRI, although more sensitive for detecting lesions not visible on a standard X-ray, is not necessary initially. It may be required if initial treatment fails.

Necrotizing pneumonia is associated with a high risk of local complications, such as pneumothorax or pleural empyema [5-7]. In our study, 9 cases (30%) presented complications (4 cases of pneumothorax, 4 cases of empyema, and 1 case of septic shock with endocarditis and pulmonary embolism).

Due to significant variability in the natural course of NP, including its local complications, comparison of the efficacy of different treatment regimens is particularly difficult. Intravenous antibiotics are the cornerstone of effective treatment. The choice of antibiotics should be based on local epidemiological data, although positive microbiological results are observed in only 11 - 51% of patients [17]. These results should guide antibiotic treatment, but no significant differences were found between patients with or without pathogen identification. Prolonged treatment is recommended. In our study, the median duration of antibiotic treatment was 4 weeks. A similar duration has been reported by other authors. Commonly used antibiotics include broad-spectrum penicillins, first-, second-, or third-generation cephalosporins, clindamycin, and vancomycin.

When pleuropulmonary staphylococcal disease is suspected, anti-staphylococcal treatment is initiated immediately. Cefalotin (Keflin) is the reference antibiotic. It is also bactericidal. From a pharmacokinetic point of view, its half-life is short, requiring repeated doses. The dosage in children is 100 - 200 mg/kg [16].

The incidence of pleural effusions reported in other studies was similar and ranged from 63 to 94% [17]. Thus, it can be stated that pleural complications are a typical clinical feature of the disease. In our study, 11 cases had pleural effusion (36.6%). The treatment of pleural effusion associated with NP does not differ from the guidelines on the management of pleural effusion/empyema and includes therapeutic thoracentesis and pleural drainage. The choice between these methods is mainly based on the severity of the disease and local anatomical conditions (pleural fluid volume, its location, presence of adhesions, etc.). However, personal and hospital experience is an important factor affecting the management strategy [1].

Pleural drainage with a chest tube is probably a sufficient therapeutic option for the vast majority of children. This result has been demonstrated in several studies. In our study, pleural drainage was performed in 5/30 patients and was an effective treatment in two of them. Three patients required thoracoscopy.

The presence of necrotizing cavities in complicated pneumonia in children is not an absolute indication for surgical intervention [6-8]. Bronchopleural fistulas and multiloculated empyema are indications for surgical intervention, while patients with small cavities and localized effusions respond well to conservative treatment [2].

Surgical interventions in the management of pediatric NP are indicated in the presence of complications or failure of medical treatment. One study demonstrated that a delay in surgery is associated with an increase in complications, highlighting the importance of early intervention [9]. Furthermore, early thoracoscopy may accelerate recovery and prevent the need for subsequent pulmonary resections [5,8].

Unlike adults, children usually recover without surgery, and in the long term, their radiographic results are normal, without pulmonary sequelae [2]. Despite the severity of the cases, the prognosis is generally good. In our study, only one death was recorded. Favorable results have been reported in three large series that included 80, 41, and 21 patients, respectively [17]. However, cases of death have been reported, emphasizing the severity of NP, especially in children.

Conclusion

Pediatric necrotizing pneumonia presents a diagnostic challenge, requiring rapid and intensive management with prolonged antibiotic treatment and surgical interventions in severe cases. Early diagnosis is essential to limit complications and improve clinical outcomes.

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Volume 8 Issue 1 January 2025