Epidemiological, Etiological, Clinical, and Therapeutic Aspects of Pleural Effusion in Children at the Pediatric Department of Libreville University Hospital

ABSTRACT

Objective:
this study aimed to improve the management of pediatric pleural effusion at libreville university hospital by identifying primary etiologies and proposing effective diagnostic and therapeutic strategies.

Methods
a retrospective, descriptive, and analytical study was conducted from january 2017 to april 2020, including 59 children aged 1 month to 16 years hospitalized for pleural effusion. Data were analyzed using epi-info 7 software. Incomplete records and non-pleural effusion cases were excluded.

Results
the prevalence of pediatric pleural effusion was 0.47%, with a male predominance (54.2%) and a peak age range of 1–5 years (50.8%). Common symptoms included fever, cough, and respiratory distress. The most frequent etiologies were *staphylococcus aureus* (26%) and pleuropulmonary tuberculosis confirmed by genexpert (13.6%). Chest radiographs showed unilateral effusion in 89.7% of cases, while pleural ultrasounds, performed in 62.7% of patients, confirmed effusion in 60.5%. Empirical antibiotic therapy was administered initially and later adjusted based on antibiograms. Patients diagnosed with tuberculosis received a standard antitubercular regimen, including rifampicin, isoniazid, pyrazinamide, and ethambutol. The average hospital stay was 21.6 days, and outcomes were generally favorable.

Conclusion
pediatric pleural effusion is uncommon in gabon, but pleuropulmonary tuberculosis remains a significant cause. Early diagnosis and prompt treatment, including appropriate antimicrobial therapy and standardized antitubercular regimens, are essential to improving outcomes.

Keywords: pleural effusion, Staphylococcus aureus, tuberculosis, diagnosis, treatment, drainage

1. INTRODUCTION

Pleural effusion, the accumulation of fluid in the pleural cavity, is a significant pediatric condition associated with considerable morbidity and mortality [1, 2]. In sub-Saharan Africa, its increasing prevalence is linked to factors such as

antibiotic resistance and limited access to healthcare [3, 4]. Despite advancements in diagnostic and therapeutic methods, data specific to Gabon remain sparse, making studies necessary to guide evidence-based management.
The objective of this study was to improve the management of pediatric pleural effusion cases at Libreville University Hospital by identifying common etiologies and proposing effective strategies.

1.Objective

To contribute to improving the management of children hospitalized for pleurisy at the University Hospital Center of Libreville (CHUL).

2. MATERIAL AND METHODS

This study was conducted at the Centre Hospitalier Universitaire de Libreville (CHUL), located in the heart of Gabon's capital city.

The pediatric department of CHUL served as the study site. This department includes an outpatient consultation unit and two care and hospitalization units, with a total capacity of 52 beds, including 12 for pediatric emergencies and 40 for hospitalization. An archiving unit has been in place since 2017.

Type and Study Period

This is a retrospective, descriptive, and analytical study conducted between January 2017 and April 2020.

Study Population

The source population consisted of all children seen in the pediatric department since the establishment of the archiving unit.

Inclusion Criteria

We included records of children aged 1 month to 16 years hospitalized for pleural effusion diagnosed based on clinical criteria (pleural effusion syndrome), radiological criteria (pleural detachment on chest X-ray and/or ultrasound), and biological criteria (leukocytosis on complete blood count (CBC), positive C-reactive protein). Patients with comorbidities (renal failure, heart failure, HIV infection) were also included.

Exclusion Criteria

Incomplete records (absence of clinical and paraclinical evidence), children hospitalized for conditions other than pleurisy, and children younger than one month or older than 16 years were excluded.

Study Procedure

This retrospective study was conducted using the department’s archives, retaining only records that met the inclusion criteria. The analyzed parameters included:At the interview: identity, medical history, vaccination status, lifestyle. At clinical examination: general condition, temperature, pleuropulmonary examination. At paraclinical examination: CBC, CRP, chest X-ray, chest ultrasound, chest CT scan, pleural fluid analysis (cytology, biochemistry, bacterial culture, GeneXpert, tuberculin skin test, blood culture).

The data were recorded on a collection form.

Statistical Analysis

Data were entered and analyzed using Epi-info 7. Percentages were used for qualitative variables, and means were used for quantitative variables. Proportion comparisons were performed using Pearson’s Chi-square test. Mean comparisons were performed using Student’s t-test. The significance threshold was set at $p < 0.05$.

3. RESULTS AND DISCUSSION

1.1 Results

During the study period, 12,520 patients were hospitalized, including 59 cases of pleurisy, representing a prevalence of 0.47%. The male-to-female ratio was 1.2, with 54.2% of the cases being male. The mean age of the patients was 56.4 months (± 56.9 months), with the age group 1 to 5 years representing 50.8% of the cases. In 42.9% of the cases, the parents were unemployed.

Table 1: Patient Distribution by Age and Gender

Age Group (Years)	Male (%)	Female (%)	Total (%)
1-5	30 (50,8)	20 (33,9)	50 (84,7)
6-10	5 (8,5)	2 (3,4)	7(11,9)
11-16	1 (1,7)	1 (1,7)	2 (3,4)

The main presenting symptoms were fever (93.2%), cough (66.1%), and respiratory distress (33.9%). There was an association between pleural effusion syndrome and respiratory distress in 44.1% of the cases. Chest radiographs were performed in 98.3% of the cases, revealing unilateral pleural effusion in 89.7%. Most effusions were of moderate volume (51.7%). Pleural ultrasound was performed in 37 patients (62.7%), revealing pleurisy in 60.5% of the cases, with unilateral effusion in 52.6%.

Thoracentesis was performed in 40.7% of the cases, revealing purulent fluid in 62.5% of the cases. Cytological analysis of the pleural fluid showed lymphocyte predominance (53.3%), followed by neutrophils (33.3%).

The identified etiologies accounted for 69% of the cases, including *Staphylococcus aureus* (26%), pleuropulmonary tuberculosis (13.6%), and bacteremia (6.8%) with pathogens such as *Burkholderia cepacia*, *Pantoa spp. 1*, *Serratia odorifera*, *Serratia ficaria*, and *Haemophilus influenzae* associated with *Escherichia coli* (1.7%). The etiology remained unknown in 31% of the cases.

Table 2: Main Identified Etiologies

Etiology	Number of Cases (%)
Staphylococcus aureus	15 (26%)
Pleuro-pulmonary tuberculosis	8 (13.6%)
Bacteremia	4 (6.8%)
Unknown etiology	18 (31%)

All patients received medical treatment. The initial antibiotic therapy was adjusted based on antibiograms. The first-line antibiotics included amoxicillin-clavulanate, ceftriaxone, and gentamicin. Second-line treatment included ciprofloxacin, lincomycin, levofloxacin, ceftazidime, amikacin, and flucloxacillin.

Antitubercular therapy was initiated for 8 patients with pleuropulmonary tuberculosis, including a four-drug regimen of rifampin, isoniazid, pyrazinamide, and ethambutol for 2 months, followed by a two-drug regimen for an additional 4 months. One patient received corticosteroid treatment.

Thoracic drainage was performed in 22.4% of patients, with the duration of drainage ranging from 3 to 13 days. One child underwent evacuative thoracocentesis, and two others required surgical intervention for encapsulated pleurisy.

Oxygen therapy was prescribed for 45.76% of the patients, and respiratory physiotherapy was used in 1.69%. Antipyretics, bronchial mucolytics, and nasal decongestants were primarily used to treat cough and fever in infants. Three patients (5.08%) required admission to the intensive care unit for an average of 6 days.

Table 3: Main Administered Treatments

Treatment	Number of Cases (%)
First-line antibiotics	59 (100%)
Thoracic drainage	13 (22.4%)
Anti-tuberculosis treatment	8 (13.6%)

The clinical outcome was favorable for all patients. The hospitalization duration ranged from 2 to 120 days, with an average of 21.6 days. Regular monitoring of complete blood count (CBC) and C-reactive protein (CRP) showed improvement between the 6th and 31st day, with an average of 11.3 days. Radiological improvement was observed between the 11th and 34th day, with an average of 14.7 days. The 8 patients with pleuropulmonary tuberculosis were declared cured after 9 months.

A statistically significant correlation was observed between age and medical history ($p = 0.001$), as well as between age and chest pain ($p = 0.012$). However, no other variable showed a significant relationship with age.

2.2 Discussion

The findings of this study provide important insights into the epidemiology, clinical presentation, and management of pediatric pleural effusion in a resource-limited setting.

The prevalence of pleural effusion (0.47%) observed in this study is consistent with findings from other sub-Saharan studies, although regional variations exist. For example, Mali reports a higher prevalence of 2.5%, likely due to different healthcare-seeking behaviors and diagnostic capabilities [5, 6]. The male predominance is similar to findings in Burkina Faso and other African countries [7].

Fever and respiratory symptoms, particularly cough and distress, were the most frequent clinical presentations, consistent with previous studies highlighting these as characteristic of pediatric pleural effusion [8, 9]. Radiological confirmation remains essential, with chest X-rays providing critical initial diagnostics and ultrasound enhancing effusion characterization, especially in distinguishing exudative from transudative effusions [10].

Bacterial infections, particularly from *Staphylococcus aureus*, emerged as the leading etiology. This underscores the need for vigilance against resistant strains in areas with high antibiotic misuse [11]. The identification of tuberculosis in 13.6% of

cases emphasizes its burden in sub-Saharan Africa and the importance of rapid diagnostic tools like GeneXpert in improving detection rates [12, 13].

Therapeutic strategies showed positive outcomes, emphasizing the importance of tailored antibiotic regimens guided by antibiograms. However, reliance on empirical therapy reflects the diagnostic limitations in low-resource settings [14]. Standardized antitubercular therapy yielded satisfactory results in tuberculosis management, in line with global guidelines [15].

Despite these successes, challenges persist. Delayed presentation due to limited access to healthcare often exacerbates disease severity, prolonging hospital stays. Moreover, the absence of advanced diagnostic tools in many settings necessitates reliance on clinical judgment, which may not always suffice.

To address these gaps, the integration of point-of-care diagnostics and strengthening referral systems are recommended. Enhanced training for healthcare providers in recognizing and managing pleural effusion is also critical. Collaboration with international health organizations could help facilitate resource allocation, ensuring timely and accurate diagnostics.

Conclusion

This study highlights the importance of early diagnosis and tailored management in pediatric pleural effusion cases. While *Staphylococcus aureus* and tuberculosis are the predominant etiologies, resource-limited settings require strategic improvements in diagnostic and therapeutic approaches.

Further research and the development of nationwide databases are essential for refining management protocols and reducing morbidity associated with pleural effusion in children.

Ethical Approval

This study was conducted in compliance with the recommendations of the Declaration of Helsinki. Official authorization was obtained from CHUL. Patient anonymity was ensured by replacing names with file numbers.

Disclaimer (Artificial intelligence)

Option 1:

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

REFERENCES

1. Basille D. Prise en charge des pleurésies infectieuses. Société de Pneumologie de Langue Française, 2024. Disponible sur : https://splf.fr/prise-en-charge-des-pleuresie-infectieuses/
2. Guyon G, et al. Les pleurésies purulentes de l'enfant. EM Consulte, 2005. Disponible sur : https://www.em-consulte.com/article/33067/les-pleuresies-purulentes-de-l-enfant
3. Pédiatrie Pratique. Pleurésies purulentes de l'enfant : Prise en charge actuelle. 2006. Disponible sur : https://www.pediatrie-pratique.com/journal/article/pleuresies-purulentes-de-l-enfant-prise-en-charge-actuelle
4. Adjoh K, et al. Pleurésies tuberculeuses : aspects épidémiologiques. Rev Mal Respir, 2015. Disponible sur : https://www.em-consulte.com/article/1023271

5. Moral L, Toral T. Population-based cohort of children with parapneumonic effusion and empyema managed with low rates of pleural drainage. Front Pediatr. 2021;9:621943. Disponible sur : https://www.frontiersin.org/journals/pediatrics/articles/10.3389/fped.2021.621943/full
6. Kwarteng Owusu S, Addo-Yobo EO, et al. Empyema in hospitalized children in Ghana. JPATS, 2024. Disponible sur : https://www.ajol.info/index.php/jpats/article/view/263711
7. Grobler L, et al. Strengthening tuberculosis services. Pathogens, 2022. Disponible sur : https://www.mdpi.com/2076-0817/11/2/158
8. Kirkpatrick BV, Kao SC. Pleural Effusions and Pneumothoraces. Pediatrics in Review, 2017. Disponible sur : https://publications.aap.org/pediatricsinreview/article-abstract/38/4/170/35019/Pleural-Effusions-and-Pneumothoraces?redirectedFrom=fulltext
9. Zhang L, et al. Concise etiology of pleural effusion in children. Int J Surg Gastroenterol, 2021. Disponible sur : https://journals.lww.com/ijsgh/fulltext/2021/05010/analysis_of_the_concise_etiology_of_pleural.2.aspx
10. Al-Tawfiq JA, Al-Omari A, Al-Zahrani A, et al. Clinical features, management, and outcomes of empyema in children: A retrospective study. J Asthma Allergy. 2020;13:331-338. Disponible sur : https://journals.lww.com/joad/fulltext/2020/09060/clinical_features%2C_management_and_outcomes_of.4.aspx
11. Moral L, Toral T. Population-based cohort of children with parapneumonic effusion and empyema managed with low rates of pleural drainage. Front Pediatr. 2021;9:621943. Disponible sur : https://www.frontiersin.org/articles/10.3389/fped.2021.621943/full
12. Zaki HA, Albaroudi B. Clinical features, management, and outcomes of empyema in children: A retrospective study. BMC Pulm Med. 2023;23(1):56. Disponible sur : https://link.springer.com/article/10.1186/s13089-023-00356-z
13. Griffith D, et al. Evolution of empyema management. J Pediatr Surg, 2018. Disponible sur : https://pubmed.ncbi.nlm.nih.gov/28781127/
14. Marais BJ, Schaaf HS. Childhood tuberculosis challenges. Infect Dis Clin N Am, 2010. Disponible sur : https://pubmed.ncbi.nlm.nih.gov/20674801/
15. Maphalle LN, Michniak-Kohn BB, Ogunrom MO. *Pediatric Tuberculosis Management: A Global Challenge or Breakthrough?*. *Frontiers in Pediatrics*. 2021;9:676004. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC9406656/