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Research Article

# Practice of Pleural Drainage in a Pediatric Hospital Over a Three-Year Period in Abidjan, Ivory Coast

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## Abstract

**Introduction:** Complications associated with pleural drainage are the cause of significant morbidity and mortality. The objective of this study was to describe our experience in the practice of pleural drainage in a pediatric hospital setting.

**Methodology:** This was a retrospective, analytical cross-sectional study. We identified the pleuropulmonary conditions for which drainage was performed in the medical pediatrics department of the Cocody University Hospital from January 1, 2020 to December 31, 2022. The Chi 2 test was used to study the statistical significance at an error threshold of 5%.

**Results:** We collected 120 cases of thoracic drainage. The mean age of the patients was 47.66 months. The mean hospital stay was 10.42 days. The main morbid conditions were purulent pleurisy (61.7%), hydropneumothorax (31.7%) and spontaneous pneumothorax (6.7%). The mean time for drain placement was 3.16 days with extremes of 0 and 8 days. The drain site was axillary in all children and the technique used was the mandrel technique with the Joly drain whose size varied according to the patient's age. Complications occurred in 51 patients (42.5%). In 20.8% of cases, transfer to a specialized thoracic surgery department was necessary. The factors associated with this transfer were severe acute malnutrition (p = 0.008) and the long duration of evolution of the signs before drainage (p = 0.017).

**Conclusion:** The pleural drainage efficiency goes through the early conditions' diagnosis requiring the drain placement and the know-how in this therapeutic procedure.

**Keywords:** Child; Lungs; Drain; Ivory Coast

## Introduction

Acute respiratory infections in children (ARI), particularly bacterial pneumonia, are responsible for a high morbidity and mortality in developing countries, including Côte d'Ivoire [1]. Acute community pneumonia (ACP) is a major public health problem; which justifies its inclusion in the Integrated Management of Newborn and Childhood Illness strategy (IMCN). The incidence of ARI in children under 5 years in Côte d'Ivoire was 176 per 1000 cases [2]. They are the second most common reason for consultation and hospitalization in pediatric departments [3]. Failure to comply with acute community pneumonia (ACP) guidelines and the three delays in effective medical management cause severe forms including pleural effusions. They threaten life with the risk of complications, sometimes fatal, and also reflect a new health challenge: antimicrobial resistance.

A study carried out in 2018 in the pediatric department of the Cocody University Hospital, on pleurisy profile, had objectified a hospital prevalence of 6.1% of purulent pleurisy. Percutaneous thoracic drainage was the most used local treatment (62%) [4]. However, in the literature, complications are frequent and of the order of 9-26% depending on the studies [5], hence the interest of our work. The objective was to describe our experience in the practice of pleural drainage in a tropical pediatric hospital environment. It was specifically a question of describing the complications related to thoracic drainage and identifying the factors associated with the transfer of patients to a specialized environment, in particular thoracic surgery, at the Abidjan Institute of Cardiology (ICA).

## Methodology

This was a cross-sectional study, with an analytical aim involving the retrospective children's files analysis for whom the diagnosis of pleuro-pneumonia was retained and a thoracic drainage performed during hospitalization in the medical pediatrics department of the University Hospital Center (CHU) of Cocody. It took place from January 1, 2020 to December 31, 2022, for a period of 3 years. The study population was selected from all children hospitalized in the medical pediatrics department of the Cocody University Hospital during the study period. We chose the CHU of Cocody because it is a level 3 hospital. The medical pediatrics department has two pediatric pneumologists, who are competent to perform diagnostic and therapeutic procedures related to pleural pathology in children. All children from 1 month to 15 years, regardless of gender, in whom a chest tube was inserted for a pleuropulmonary condition diagnosed on admission or during hospitalization based on clinical and paraclinical arguments were included. The children selected underwent a thorough clinical examination. Nutritional status was assessed using anthropometric criteria according to the 2006 WHO growth standards. We were particularly interested in the weight-for-height growth index expressed as a Z-score compared to the reference median. Thus, the children were considered to be:

- Severe acute malnutrition (SAM) if P/T Z-score < -3;
- Moderate acute malnutrition (MAM), if -3 ≤ Z-score P/T < -2;
- Well nourished or normal, if Z-score P/T ≥ -2.

For each patient, the following variables were collected: sociodemographic, clinical, paraclinical data and those relating to thoracic drainage (indications, complications and the resulting course of action), from emergency and hospitalization records.

Medical records of patients not containing an imaging test result were not retained. The data collected were entered into the EPIDA software, analyzed using the Epi info software (version 7.2.2.6). Qualitative variables were expressed as frequencies or proportions and quantitative variables as means and standard deviations. For the comparison of proportions, the interdependence test, the Chi-square was used or the Fisher test if the conditions for using Chi-square were not met. The significance threshold was set at a p value less than 0.05.

The medical and scientific management issued a favorable opinion regarding the conduct of the survey in the medical pediatrics department of the CHU of Cocody, after having taken note of the protocol of this research work.

Patient confidentiality and anonymity were ensured in strict compliance with medical ethics and deontology. The authors declare no conflict of interest.

## Results

Over the study period, 120 medical records of children who had undergone chest drainage were retained.

### Socio-demographic and clinical characteristics of patients

There was a male predominance with a sex ratio of 2. The mean age was 47.66 with extremes of 2 and 180 months. Infants represented 55.8% of the cases. The children were mainly from families with modest socio-economic conditions (57.5%). More than half of the children (50.8%) were brought to consultation beyond 07 days following the onset of the signs. The mean consultation time was 10.42 days with extremes ranging from 4 to 35 days. A quarter of the patients (25%) presented with severe acute malnutrition. Hypoxemia (83.3%), signs of respiratory struggle (95%), fluid pleural effusion syndrome (61.7%), mixed pleural effusion syndrome (31.7) and gas pleural effusion syndrome (6.7%) are the main respiratory physical signs found. Table I summarizes the socio-demographic and clinical characteristics of the patients.

### Paraclinic data (Table II)

Blood cultures were positive in 19 patients or 15.2% of cases. The predominance of *Staphylococcus aureus* was noted in 68.4% of cases. Pleural fluid bacteriology was positive on 22 samples with also a clear predominance of *Staphylococcus aureus* in 77.3% of cases. The main lesions on chest X-ray were dominated by opacities with a watery tone suggestive of pleurisy (Image 1) in 61.7%, followed by images of fluid-air level suggesting a hydropneumothorax (Image 2). The radiological lesions concerned an entire hemithorax in 68.3% of cases and were bilateral in 5% of our patients. Table II summarizes the paraclinical data.

### Chest drainage data

The mean drainage time from admission was 3.16 days with extremes ranging from 0 to 8 days. Thoracic drainage was performed beyond 48 hours in 64.2% cases. The mean drainage duration was 6.03 days with extremes of 0 and 12 days. The drain seat was axil-

**Table I:** Distribution of patients according to socio-demographic and clinical characteristics.

| Socio-demographic characteristics and clinics | Effective (n = 120) | (%) |
|---|---|---|
| Sex | | |
| Male | 80 | 66.7 |
| Female | 40 | 33.3 |
| Children age (months) | | |
| 1-24 | 67 | 55.8 |
| > 24 | 53 | 44.2 |
| Socio-economic condition | | |
| Raised | 15 | 12.5 |
| Average | 36 | 30.0 |
| Weak | 69 | 57.5 |
| Consultation time (days) | | |
| > 7 | 61 | 50.8 |
| ≤ 7 | 59 | 49.2 |
| Nutritional Status | | |
| Normal | 58 | 48.3 |
| MAM | 32 | 26.7 |
| SAM | 30 | 25.0 |
| Pulmonary Signs | | |
| Hypoxemia | 100 | 83.3 |
| Signs of respiratory struggle | 114 | 95.0 |
| Fluid pleural effusion syndrome | 74 | 61.7 |
| Mixed pleural effusion syndrome | 38 | 31.7 |
| Gaseous pleural effusion syndrome | 8 | 6.7 |

**Table II:** Distribution of patients according to paraclinical data.

| Paraclinical data | Effective | % |
|---|---|---|
| Blood culture (n = 120) | | |
| Negative | 101 | 84.2 |
| Positive | 19 | 15.2 |
| Germs identified (n = 19) | | |
| *Staphylococcus aureus* | 13 | 68.4 |
| *Meticillin-resistant staphylococcus* | 3 | 15.8 |
| *Streptococcus pneumoniae* | 3 | 15.8 |
| Bacteriology of pleural fluid (n = 82) | | |
| Negative | 60 | 73.2 |
| Positive | 22 | 26.8 |
| Germs identified (n = 22) | | |
| *Staphylococcus aureus* | 17 | 77.3 |
| *Meticillin-resistant staphylococcus* | 1 | 4.5 |
| *Streptococcus pneumoniae* | 4 | 18.2 |
| Frontal chest X-ray (n = 120) | | |
| Main lesion | | |
| Image suggestive of pleurisy | 74 | 61.6 |

| | | |
|---|---|---|
| Suggestive image of a hydropneumothorax | 38 | 31.7 |
| Suggestive image of a pneumothorax | 8 | 6.7 |
| Location of the main lesion | | |
| Bilateral lesions | 6 | 5.0 |
| Lesion affecting an entire hemithorax | 82 | 68.3 |
| Others | 32 | 26.7 |
| Associated pathological images | | |
| Yes | 27 | 22.5 |
| No | 93 | 77.5 |
| Various associated lesions (n = 27) | | |
| Alveolar opacities | 12 | 44.5 |
| Bubbles | 6 | 22.2 |
| Parenchymal excavations | 9 | 33.3 |

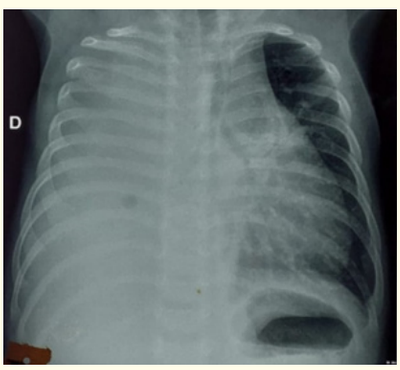


**Image 1:** Radiological image suggestive of a large volume right pleurisy.

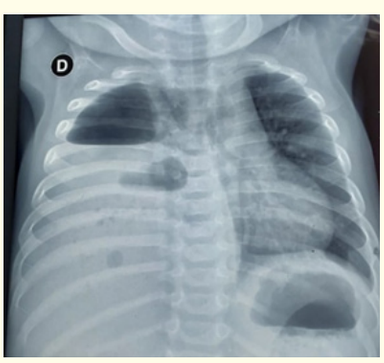


**Image 2:** Radiological image suggestive of a right hydropneumothorax.

**Image 3:** Placement of a thoracic drain via the axilla.

lary in all children (Image 3) and the technique used was the Mandrel technique with the Joly drain, the size of which varied according to the patient's age.

## Complications of chest drainage and management

Complications were observed in 51 patients, or 42.5% of cases. The occurrence of certain adverse events led to the need for transfer to thoracic surgery in 49% of cases. Table III summarizes the complications related to thoracic drainage and the management to be adopted.

## Factors influencing patient transfer in thoracic surgery

Factors associated with transfer to thoracic surgery were severe acute malnutrition (OR = 3,95, IC à 95%:1,54-10,08) and long duration of signs before drainage **(**OR = 3,11, IC à 95%: 1,19-8,14**)**. Table IV summarizes the factors promoting failure of thoracic drainage.

**Table III:** Distribution of patients according to complications and management.

| Complications | Effective | % |
|---|---|---|
| Objective complications (n = 51) | | |
| Iatrogenic pneumothorax | 06 | 11.8 |
| Nosocomial infection | 06 | 11.8 |
| Parietal abscess | 03 | 5.9 |
| Subcutaneous emphysema | 03 | 5.9 |
| Accidental drain removal | 07 | 13.7 |
| Non-return of the lung to the wall | 19 | 37.3 |
| Early recurrence after drain removal | 07 | 13.3 |
| Behavior to adopt in the face of adverse events (n = 51) | | |
| Drainage resumed | 07 | 13.7 |
| Adaptation of the antibiotic | 06 | 11.8 |
| Monitoring | 10 | 19.6 |
| Flattening of the parietal abscess | 03 | 5.9 |
| Transfer to thoracic surgery | 25 | 49.0 |

**Table IV**: Factors influencing the transfer of patients in thoracic surgery.

| | Patients not transferred to thoracic surgery (n = 95) | Patients transferred to thoracic surgery (n = 25) | P | OR [IC] |
|---|---|---|---|---|
| Age group | | | | |
| ≤ 24 months | 52(77.6%) | 15(22.4%) | 0.637 | 0.806 [0.329-1.976] |
| > 24 months | 43(81.1%) | 10(18.9%) | | |
| Duration of evolution of signs in outpatient care | | | | |
| ≤ 7 days | 52 (88.1%) | 7 (11.9%) | 0.017 | 3.11 [1,188-8,138] |
| > 7 days | 43 (70.5%) | 18 (29.5%) | | |
| Nutritional status | | | | |
| Normal +MAS | 77 (85.6%) | 13 (14.4%) | 0.002 | 3.95 [1,54-10,08] |
| MAS | 18 (60.0%) | 12 (40.0%) | | |
| Drainage indication | | | | |
| Pleurisy | 59 (79.7%) | 15 (20.3%) | 0.75 | ------- |
| Hydropneumothorax | 28 (73.7%) | 10 (26.3%) | | |
| Pneumothorax | 08 (100.0%) | 00 (00.0%) | | |
| Associated radiological lesions | | | | |
| Yes | 19 (70.4%) | 8 (29.6%) | 0.201 | 0.531 [0.2-1.414] |
| No | 76 (81.7%) | 17 (18.3%) | | |
| Extent of radiological lesion | | | | |
| The entire hemithorax | 68 (82.9%) | 14 (17.1%) | 0.136 | 1,979 [0.799-4.901] |
| Half of the hemithorax | 27 (71.1%) | 11 (28.9%) | | |

## Discussion

Thoracic drainage is a technical procedure commonly performed in the medical pediatrics department of the Cocody University Hospital. Indeed, a study carried out in 2018 noted an incidence of purulent pleurisy of 6.1%, of which 62% of patients had benefited from thoracic drainage [4]. Since 2016, the pediatrics department has had a pediatric pneumonia unit. Thus, all children with serious respiratory conditions are primarily directed to this unit. The male sex was predominant at 66.7% with a sex ratio of 2. Several studies relating to pleuropulmonary infections show a clear male predominance [6-9]. this male predominance could be explained by the fragility of the little boy in his natural constitution [10].

Infants aged 1 to 24 months accounted for 55.8% of patients. Severe pediatric respiratory infections are common in infants due mainly to their immature immune system [6].

Socioeconomic status plays an important role in the determinism of infectious diseases in general and pleuropulmonary diseases in particular. Literature data show that pleuropulmonary diseases occur more frequently in socially disadvantaged patients [9]. In our study, 57.5% of patients were from a family with an unfavorable socioeconomic status. These data are confirmed by those of Thiam who noted in Senegal that the majority of patients (75.9%) lived in a deprived environment. This study noted that the low socio-economic level would promote delay in consultation and therefore the worsening of community pneumonia with the formation of pleural effusions most often requiring the use of thoracic drainage [11].

Pleuropulmonary diseases occur most often in fragile patients; this underlines the importance of the notion of the terrain [9]. Several factors favoring pleuropulmonary diseases are highlighted in our series, notably hemoglobinopathy (16.5%), HIV immunosuppression (5.0%), congenital heart disease (2.5%).

A favoring terrain and/or an underlying disease are found in 80% of cases in the study of Ferre A., *et al*. [12]. Malnutrition is an important element to take into account, generally in all infectious pathologies [9]. Severe acute malnutrition constitutes a state of immunodepression. In this field, infectious pathologies evolve quietly with a little noisy symptomatology, hence a diagnosis often at the stage of complication making management difficult. In our study, 25% of children presented with severe acute malnutrition. This situation was significantly associated with drainage failure resulting in a transfer to thoracic surgery (OR = 3,95, IC à 95%:1,54-10,08).

The indications for thoracic drainage are dominated by purulent pleurisy (61.1%), hydropneumothorax (31.7%) and pneumothorax (6.7%). For Aguemon AR., *et al*. the indications for thoracic drainage were dominated by spontaneous or traumatic pneumothorax, a serous, sero-haematic or purulent pleurisy and hemothorax [13]. The delay in diagnosis and management of pneumonia at the community level often complicates these infections with the development of purulent pleurisy [14,15].

The mean consultation time was 10.42 days with extremes ranging from 4 to 35 days. Thiam found a time greater than 7 days in 80.6% of patients [11]. The long duration of evolution of the signs before thoracic drainage is a risk factor for drainage failure with transfer to thoracic surgery **(**OR = 3,11, IC à 95% : 1,19-8,14**)**. Indeed, a pleural effusion is at risk of encystment if it has evolved for several days. Surgical treatment is then required in order to restore correct respiratory function [16].

The drain was fitted on average within 3.16 days, with extremes from 0 to 8 days. This result is identical to that of Mathilde [9]. Thoracic drainage was performed after 48 hours in 64.2% of cases, which is a long delay given the urgent nature of this procedure. Indeed, in 68.3% of cases, there was a large effusion, involving almost an entire hemithorax with signs of cardiorespiratory intolerance due to compression of the mediastinal organs. This relatively long delay of 3 days on average could be explained by the difficult socioeconomic conditions of the parents because the equipment for fitting the drain was the responsibility of the parents.

Different techniques are used for chest drainage such as Seldinger technique, pleurocath, mini drain and madrin technique [17]. In our study, thoracic drainage was performed exclusively with Joly drains, the numbers of which varied according to age.

Drain placement is a painful and anxiety-provoking procedure. It requires appropriate pain and anxiety prevention [19]. Premedication with midazolam and local anesthesia with 2% xylocaine were performed in all patients. The drain location was axillary in all children. The drainage site most often reported in the literature is the lateral route, in the safety triangle bordered in front by the lateral edge of the pectoralis major muscle and behind by the lateral

edge of the latissimus dorsi muscle, above by the third intercostal space (EIC) and below by the fifth EIC. The anterior route between the second and third EIC on the midclavicular line is mainly used for drainage of pneumothorax [17,19].

Once the drain is fixed, a frontal chest X-ray can confirm lung re-expansion and the correct position of the drain. Attention should be paid to the absence of a bend in the drain and the intrapleural location of the outermost drainage orifice. The functional drain transmits variations in intrapleural pressure, and we thus observe an oscillation of the drainage fluid synchronous with the respiratory cycles. Pleural lavage in cases of purulent pleurisy was systematic and was done with betadine saline. *Mathilde 's study* noted pleural lavage with saline only in 40% of cases [9].

Complications occurred in 51 patients (42.5%) such as non-return of the lung to the wall (37.3%), accidental removal of the drain (13.7%), early recurrence after removal of the drain (13.7%), iatrogenic pneumothorax (11.8%), nosocomial infection (11.8%), parietal abscess (5.9%) and subcutaneous emphysema (5.9%). In 49% of cases, a transfer to a specialized thoracic surgery department was necessary to manage these complications. A study published in 2019 [20], on the complications of conventional thoracic drainage during spontaneous pneumothorax, had documented 59.8% of complications secondary to drainage such as: moderate to severe chest pain (50%), subcutaneous emphysema (24.3%), bleeding (15.6%), poor positioning of the drain (14.7%), atelectasis (13.7%), infection (5.8%), bronchial congestion (3.9%), exclusion of the drain (2.9%), OAP to vacuo (1.8%) and vagal discomfort following the injection of xylocaine (0.9%).

According to the literature, complications are frequent in the order of 9-26% following thoracic drainage [5]. They are classified into minor complications (bleeding at the insertion site, tube kinking, pain limiting inspiratory movements, subcutaneous emphysema, unsightly scar) and major complications (hemothorax due to injury to the vascular-nervous bundle, leak at the tube insertion site, accidental removal of the drain, perforation of an organ (lung, spleen), local abscess, emphysema, iatrogenic pneumothorax upon removal of the tube, re-expansion pulmonary edema (vacuo -induced pulmonary edema).

The high percentage of these complications in our study could be explained by several elements.

- Thoracic drainage is performed without ultrasound control with a significant risk of trauma to the pulmonary parenchyma that may justify the occurrence of iatrogenic pneumothorax. Knowledge of adhesion of the lung to the chest wall contraindicates the performance of percutaneous pleural drainage. Guidance by ultrasound or videothoracoscopy is necessary [21].
- The technique used in our department is the Mandrel technique with Joly drains whose size varies with age. It is much more invasive than the Seldinger technique which is a simple technique, does not require a large dissection of the intercostal space and has the advantage of a reduction in pain during drain placement, a reduction in the risk of infection and a reduction in unsightly sequelae [5].
- The equipment used for drainage such as the jar, connectors, aspirator and surgical box is not single-use. Multiple use of drainage equipment is a source of nosocomial infection.

## Conclusion

Drainage is a life-saving procedure that allows lung re-expansion. Its effectiveness requires early diagnosis of conditions requiring the placement of a drain and know-how in this therapeutic procedure. Drainage plays an important role in our hospital practice. To minimize complications, attention must be paid to training in this emergency procedure.

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