

Infantile Whooping Cough at CHNEAR: Epidemiological, Clinical, Paraclinical, Therapeutic, and Evolutionary Aspects

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Abstract

Whooping cough is a respiratory infection that can occur at any age. It is more common and more likely to be fatal in young children, especially infants. The aim of the study was to define the characteristics of whooping cough in infants hospitalized at the Albert Royer Children's Hospital in Dakar. We conducted a retrospective, descriptive, and analytical study at the Albert Royer National Children's Hospital in Dakar over a period of two and a half years. All infants under three months of age hospitalized for suspected pertussis confirmed by PCR were included. During the study period, 12 infants were included. The mean age was 55.9 ± 15.7 days, with a male predominance (8/12). Fever was reported in 9 infants at presentation. Half of the patients had not received any pertussis vaccination, and none of the mothers had received a pertussis booster. Paroxysmal cough and respiratory distress were the most frequent presenting symptoms, observed in 11 and 10 infants, respectively. Most patients were admitted between 4 and 7 days after symptom onset. Hypoxemia was present in 10 infants. Hyperleukocytosis was observed in more than two-thirds of cases (10/12), with a predominantly lymphocytic profile in 75% of patients on the initial complete blood count. PCR testing for *Bordetella pertussis* was positive in all cases. The mean duration of oxygen therapy was 10.8 ± 7.1 days. All infants required respiratory support, most commonly nebulization with 3% hypertonic saline and salbutamol. Macrolide-based antibiotic therapy was administered to 10 infants. Complications occurred in 3 cases. The outcome was favorable in 11 infants. However, more than two-thirds of patients (10/12) had a persistent cough lasting more than three weeks after

hospital discharge. This study clearly shows that whooping cough has become rare but is still present, especially in developing countries. It has a greater impact on young infants due to their immature immune system. It can be prevented through a vaccination strategy called cocooning, which aims to protect the youngest infants in particular.

Keywords

Whooping Cough, *Bordetella pertussis*, Infant

1. Introduction

Pertussis is a re-emerging, neglected, and highly contagious bacterial respiratory infection. It is caused by the strictly aerobic Gram-negative bacillus *Bordetella pertussis* and, to a lesser extent, *Bordetella parapertussis* [1] [2]. The bacteria adhere to the respiratory epithelium, multiply extracellularly, and release several toxins that exert both local and systemic effects on the host [3] [4]. Although pertussis can affect individuals of all ages, young infants are particularly vulnerable due to immune immaturity and the risk of severe complications [5].

The incidence of pertussis in infants younger than 2 - 3 months is high in all countries for which data are available, exceeding 1000 cases per 100,000 population during epidemic periods [6]. According to the European Centre for Disease Prevention and Control, there were 25 130 cases of pertussis reported between 1 January 2023 and 31 December 2023, and an additional 32 037 cases reported between 1 January and 31 March 2024 [7]. In Senegal, however, epidemiological data on pertussis remain scarce in the medical literature.

Despite the availability of an effective acellular pertussis vaccine included in the Expanded Programme on Immunization (EPI) [8], and the demonstrated effectiveness of maternal vaccination during the third trimester of pregnancy, pertussis remains endemic, particularly in developing countries.

The overall objective of this study was to describe the epidemiological, clinical, paraclinical, therapeutic, and outcome characteristics of pertussis in infants hospitalized at the Albert Royer Children's Hospital in Dakar. The specific objectives were to assess pertussis-related morbidity in hospitalized infants, identify factors contributing to the occurrence of pertussis in this population, describe their management, and evaluate clinical outcomes.

2. Patients and Methods

This was a retrospective, descriptive, and analytical study conducted at the Albert Royer National Children's Hospital over a period spanning from January 2022 to June 2024 (2 years and 6 months).

A convenience sample was performed. All patients hospitalized with suspected pertussis and having bacteriological confirmation were included. Patients with in-

complete or unusable medical records were excluded.

Data were collected from patients' medical records using a standardized data collection form validated.

The variables studied included socio-epidemiological data (age at diagnosis, sex, and geographic origin), clinical data (medical history, underlying conditions and/or comorbidities, clinical signs), paraclinical data (complete blood count, chest X-ray, bacteriological findings), therapeutic management (oxygen therapy, aerosol therapy, antibiotic therapy, corticosteroid therapy), and outcome variables (length of hospital stay, complications, favorable outcome, and mortality).

Data entry and statistical analysis were performed using Epi Info software. Qualitative variables were expressed as frequencies and percentages, while quantitative variables were described using means with standard deviations, medians, and ranges.

3. Results

During the study period, 15 infants were suspected of having pertussis. Among them, one patient could not undergo PCR testing, and two had negative PCR results. A total of 12 patients were included. The mean age was 55.92 days \pm 15.72, with a median age of 59 days and extremes ranging from 30 to 90 days. There was a predominance of males: 8 boys and 4 girls. Seven (07) of the 12 infants were from downtown Dakar. Nine patients were born to mothers who had had multiple pregnancies and multiple births. The average maternal age was 29.14 years \pm 5.2, with a minimum of 22 years and a maximum of 37 years.

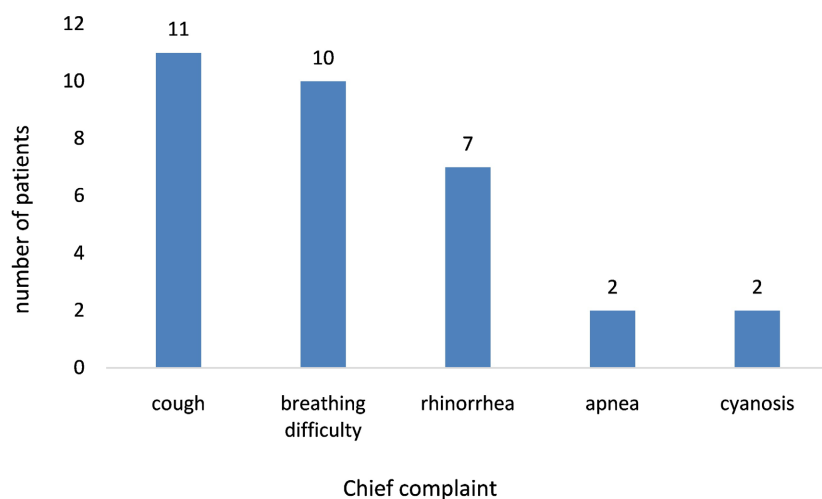


Figure 1. Distribution of patients according to reason for consultation.

A notion of familial respiratory infection was noted in 3 patients. Regarding vaccination status, half of the patients ($n = 6$) had not received any doses of the pertussis vaccine, including two infants who were not yet eligible for vaccination and four who had missed their scheduled immunizations. None of the mothers had received a pertussis booster shot. Five (05) patients were born prematurely.

Coughing paroxysms and respiratory distress were the most frequent reasons for consultation, reported in 11 and 10 infants, respectively (**Figure 1**). The majority of patients were admitted between 4 and 7 days after symptom onset.

Paroxysmal cough associated with apnea and cyanosis was observed in four children. At admission, polypnea was present in 8 of the 12 patients, fever in 9 patients, and tachycardia in 7 patients. Hypoxemia was identified in 10 patients, with oxygen saturation levels below 90% in five cases. Clinical examination revealed a condensation syndrome and bronchial obstructive syndrome in five patients, while stridor was noted in one patient.

Laboratory findings showed hyperleukocytosis in nine patients, with a predominantly lymphocytic profile in 75% of cases on the initial complete blood count. C-reactive protein (CRP) levels were positive in half of the patients. All patients tested positive for *Bordetella pertussis* by polymerase chain reaction (PCR). Co-infections with other pathogens were identified, the most frequent being rhinovirus (two cases) and *Klebsiella pneumoniae* (two cases) (**Figure 2**). Chest radiography revealed bronchial syndrome in six infants and poorly defined pulmonary opacities in seven cases, while only one patient had a normal chest X-ray.

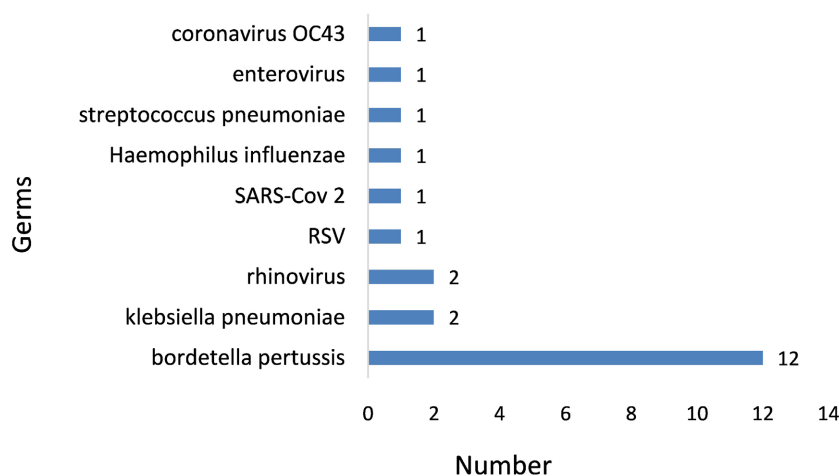


Figure 2. Distribution according to the germs found by PCR.

The mean duration of oxygen therapy was 10.75 ± 7.11 days, with a range of 2 to 24 days. All patients required respiratory support, including two infants who received invasive ventilatory support. Nebulization with 3% hypertonic saline was administered to eight patients, and salbutamol to four patients. The majority of infants (10 out of 12) received macrolide-based antibiotic therapy. Intravenous corticosteroid therapy was administered to nine patients, including betamethasone in eight patients and hydrocortisone in one patient.

In the study population, some infants had complications such as hypoglycemia (2 cases), nosocomial infection (1 case), and seizures (3 cases). The outcome was favorable in 11 out of 12 patients, and one death was noted following intracranial hypertension leading to brain death. After discharge from hospital, infants were

reviewed at the outpatient clinic after one week and then after four weeks for re-assessment and persistent coughing lasting more than 3 weeks was noted in 10 patients. The average length of hospital stay was 18.5 days \pm 13.74. The median length was 13.5 days, with extremes of 5 and 49 days. The most common length of hospital stay was 15 days (Table 1).

Table 1. Distribution of patients according to length of hospital stay.

Length of stay	Frequency
5 - 10 days	3
11 - 15 days	6
>15 days	3
Total	12

4. Discussion

The small sample size ($n = 12$) in this 2.5-year study may be explained by the fact that PCR testing is usually performed in hospitalized patients in routine clinical practice; consequently, cases managed on an outpatient basis may have been underdiagnosed. The average age in our study was 55.92 days \pm 15.72, which is similar to that of Slaoui [9], conducted in Casablanca from 2012 to 2019, which found that 75% of the population was under 3 months old, and Kafty, which found that 87% of infants were under 2 months old [10]. Infants under 3 months of age are more vulnerable to pertussis [11] [12]. This could be explained either by the fact that this population was too young to be vaccinated, as pertussis vaccination schedules begin at one and a half months of age, or even two months in some countries, or by the fact that they had not yet achieved complete immune protection [6]. This was the case in our study, where half of the patients had not received any vaccines and no infants were fully vaccinated. Furthermore, within the study population, no mothers had received a pertussis booster vaccination. Vaccinating mothers during the third trimester of pregnancy should be considered the best strategy for protecting children against pertussis, particularly during the first three months of life [8] [13] [14]. Amirthalingam *et al.*, in a case-control study conducted in England and Wales, demonstrated that vaccination against pertussis during pregnancy, at least 7 days before delivery, could prevent up to 91% of pertussis cases in infants under 3 months of age [15].

Family contacts represent one of the main sources of pertussis infection during the first year of life, a period when infants are not yet fully immunized [10] [16]-[18]. In our study, a probable source of infection was identified as a sibling or the mother in three of the twelve cases.

A male predominance was observed, with 8 out of 12 infants affected, corresponding to a sex ratio of 2. Similar findings were reported by Slaoui, who noted a male predominance of 51.2% [9], and by Zouari, with 55.4% [19]. However, the literature generally indicates no clear association between sex and *Bordetella per-*

tussis infection.

More than half of the patients (n = 7) were from the city center, which may be explained by the central location of the study site in Dakar and the resulting referral pattern.

Paroxysmal cough and respiratory distress were the most common reasons for consultation, reported in 11 and 10 infants, respectively. Comparable findings have been reported in the literature, notably by Slaoui in Morocco, where 99.2% of patients presented with paroxysmal cough [9], by Zouari in Tunisia with a prevalence of 80% [19], and by Kazantzi in Greece, who reported a rate of 87% [20].

In our study, hypoxemia was observed in 10 patients, with oxygen saturation levels below 90% in five cases (41.67%). Lower rates were reported by Slaoui [9] (9.2%) and Zouari [19] (50%). The relatively high proportion of hypoxemic infants in our series may be explained by the presence of associated pulmonary abnormalities, including condensation syndrome and bronchial obstructive syndrome, as only one patient had a normal pulmonary examination.

Hyperleukocytosis was observed in nine patients, with a predominantly lymphocytic profile in 75% of cases on the initial complete blood count. Numerous studies have clearly demonstrated that the toxin produced by *Bordetella pertussis* plays a key role in the development of leukocytosis and in the formation of leukocyte aggregates within the arterioles, veins, and pulmonary lymphatics of lung tissue [21]-[23]. A strong association has been established between elevated circulating white blood cell counts and the severity of pertussis, as hyperleukocytosis is linked to an increased risk of mortality [3] [4].

All patients in our study tested positive for *Bordetella pertussis* by PCR. Co-infections with other pathogens were also identified, most commonly rhinovirus (two cases) and *Klebsiella pneumoniae* (two cases). In Morocco, Kafty *et al.* reported that direct detection of bacterial DNA using PCR techniques, particularly RT-PCR, was more sensitive than culture [24]. Molecular diagnostic methods appear to be faster, more sensitive, and more reliable than conventional microbiological techniques, providing earlier and more accurate diagnosis. Indeed, culture-based methods generally require 5 - 7 days, while serological assays may take 7 - 14 days to yield results [25] [26].

Co-infection with rhinovirus was frequently isolated. Di Camillo *et al.* in Italy noted a viral co-infection with rhinovirus in 26.15% of cases [13].

The results of chest X-rays were consistent with those of the pulmonary examination, in which only one infant had no pulmonary lesions.

The mean duration of oxygen therapy was 10.75 ± 7.11 days, with a range of 2 to 24 days. All patients required respiratory support, including two infants who received invasive ventilatory support. This high requirement for respiratory assistance can be reasonably explained by the clinical severity at admission, as the majority of hospitalized infants presented with respiratory distress (10 out of 12 cases) and hypoxemia (10 out of 12 cases). In France, Mathilde *et al.* reported that

61% of patients required oxygen therapy [3]. In contrast, Di Camillo *et al.* observed that only a small proportion of patients (10 out of 195; 5%) required respiratory support in their series [13].

Most infants in our study (10 out of 12) received macrolide-based antibiotic therapy. Consistent with current recommendations and published data, macrolides were the first-line treatment in several reported series, including those by Mathilde *et al.* in France [3], Di Camillo *et al.* in Italy [13], and Slaoui *et al.* in Morocco [9], where all patients received macrolide therapy.

Regarding inhalation therapy for *Bordetella pertussis* infection, nebulized 3% NaCl was administered to eight patients, while salbutamol was given to four patients in our series. Similarly, intravenous corticosteroid therapy was administered to nine patients. Current literature provides no clear evidence supporting the indication or efficacy of nebulized adrenaline, salbutamol, corticosteroids, or hypertonic saline in this context. A meta-analysis included in a Cochrane review by Wang demonstrated that the use of betamethasone and salbutamol did not result in a significant reduction in hospital length of stay or in the frequency of coughing episodes per day [27].

Corticosteroid therapy was administered to nine patients, including betamethasone in eight patients and hydrocortisone in one patient. It was initiated in these patients because they were initially considered to have acute bronchiolitis prior to PCR confirmation of pertussis. In addition, at the time of management, there was no standardized consensus regarding the treatment of acute bronchiolitis in infants, as a treatment protocol was only implemented in 2023.

Progressive Aspects

Whooping cough can be particularly severe in young infants. In our study, only one infant died due to serious complications, including encephalopathy and intracranial hemorrhage, which led to intracranial hypertension and ultimately brain death after 15 days of hospitalization. The outcome was favorable in all other cases.

The mean length of hospital stay was 18.5 ± 13.74 days, with a median of 13.5 days and extremes ranging from 5 to 49 days. In comparison, Di Camillo reported a mean hospital stay of 8.4 ± 6.7 days [13]. In De Greeff's series, the median hospital stay was 8 days (range: 0 - 80 days) [16], whereas in Lobzin's series, it was 12 days (range: 1 - 46 days) [28].

5. Conclusion

Whooping cough (pertussis) is a highly contagious respiratory infection that, although rare, continues to persist. It predominantly affects young infants due to their immature immune systems. Prevention is primarily achieved through a vaccination strategy, including the cocooning approach, which is specifically designed to protect the most vulnerable infants.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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