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Evaluation of the Management of Infant Respiratory Distress at the CNHU-HKM Pediatric Emergency Department

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Abstract

Introduction: Respiratory distress (RD) is a major emergency to which infants are particularly vulnerable. It can lead to neurological sequelae and even death when treatment is not adequate and rapid. **Objective:** To evaluate the management of RD in infants at the CNHU-HKM in Cotonou. **Methods:** The study was of a transversal and analytical nature and took place over a period of 06 months, from 1st January to 30th June 2015. Included in the study were all infants hospitalised for DR. The therapeutic modalities were analysed according to the recommendations of the World Health Organization. **Results:** A total of 96 infants were included. The hospital frequency of DR was 38%. The average age was 12 months. One in 3 infants had SaO_2 less than 90% on admission, and in 58.3% of cases, the infant showed at least 3 signs of struggle. The initial assessment was as recommended. The systematic use of oxygenrequires a revision of the criteria for oxygentherapy in the unit. The three main causes were severe pneumonia (31.3%), severe malaria (18.8%) and bronchiolitis (15.6%), and their treatment was correct. However, none of the infants had been able to benefit from ventilatory support. Mortality was high (31.2%) linked to the intensity of DR ($p = 0.04$) and sepsis ($p = 0.006$). **Conclusion:** The procedures for the diagnosis and treatment of RD in infants at the CNHU are fairly consistent with WHO guidelines. Ventilatory support is necessary for some children with severe RD.

Keywords

Respiratory Distress, Infant, Oxygen, Benin

1. Introduction

Respiratory distress (RD) is common in pediatric medical practice. It performs an emergency that can be life-threatening. This is a clinical condition followed by an increase respiratory work, with the involvement of accessory respiratory muscles to ensure normal arterial oxygenation without hypoxemia [1]. It is different from respiratory failure which is the inability of the respiratory system to maintain normal blood levels of O_2 and more or less CO_2, with constant hypoxemia [1]. The anatomical and physiological peculiarities of the infant such as the immaturity of the respiratory muscles, the flexibility of the rib cage, the incomplete alveolarization, make the latter more vulnerable to attack respiratory tract [2]. In France, RD represents 36% of the reasons for pediatric intensive care [1]. In the West African region, its hospital frequency is from 22.5% to 30.2% [3] [4]. The most common causes in these regions are severe malaria, acute respiratory infections (ARI), particularly pneumonia, and sepsis [3] [4]. Mortality from respiratory distress there is still above 20% [4]. To reduce child mortality in developing countries, the World Health Organization (WHO), has proposed in 2013, the guidelines inspired by those of "Advanced Pediatric Life Support" [5]. These recommendations include those relating to respiratory distress and oxygen therapy in children, in which there is triage, rapid recognition of hypoxemia, use of oxygen therapy, etiological treatment, and care for associated morbid conditions [5]. This work aims at studying on the one hand the clinical and evolutionary aspect of RD from infants in the pediatric emergency unit at CNHU, and on the other hand, assessing the therapeutic indications following WHO recommendations.

2. Methods

The study was cross-sectional from January 1 to June 30, 2015, lasting 6 months. All infants aged 1 month to 30 months admitted for RD and whose parents had given their consent were involved. Children who died before any treatment were excluded. In this study, RD was defined as the existence of polypnea or bradypnea associated with at least one of the following: a sign of respiratory struggle, hypoxemia, and/or cyanosis. Polypnea was defined as respiratory frequency > 50 cycles/minute in infants from 1 to 12 months, and greater than 40 cycles/minute beyond. Bradypnea was defined as a respiratory frequency < 20 cycles/minute regardless of age [6].

The signs of severe distress were noseflaring, grunting, retractions (suprasternal, intercostal, subcostal, sternum collapsing, see-sawbreathing). The presence of at least three signs of struggle helped define severe RD in this study. According to the WHO, hypoxemia was defined as oxygen saturation in ambient air, less than 90% [5]. Cyanosis was defined as a gray-bluish coloration of integuments related to decreased oxygenation of tissues (reduce hemoglobin > 5 g/dl). The infants were consecutively involved after admission to the emergency room. Then, an investigating doctor, different from the healthcare team, filled out a pre-established investigation form. This investigator made inquiries relating to the identity of

the infant, an initial assessment made by the healthcare team, diagnosis mentioned, treatment prescribed/administered to the infant. This form was daily updated until the end of the infant's stay. Thus, the variables collected were focused on socio-demographic, clinic, therapeutic and progressive factors. The care of each infant, including its assessment and the various treatments received, were analyzed taking into account the WHO recommendations. Data were presented, coded, and analyzed using epi data 3.1 software. The calculation of simple frequencies was used for sampling description. Association between variables was determined by crossing them using Pearson's Chi-square test at a 5% significance level.

3. Results

3.1. Hospital Frequency of DR

A total of 1424 children were hospitalized during the period, including 253 infants. Among these, 96 had presented an RD corresponding to a hospital frequency of 38%.

3.2. Clinical Characteristics of Infants Involved

All children with RD were put on the urgent list regardless of their order of arrival. The average age was 12.6 months ± 8.6, 50 children were male, the majority (82.3%) had been ill for at least 48 hours before admission. Treatment with quinine and/or amoxicillin was given to 85.4% of infants before admission. The vaccines of the Expanded Programme of Immunisation (PEV) recommanded in Benin were correctly given to approximately 95% of infants. At the initial assessment, 1 over 3 infants had a saturation < 90%, and the majority (58.3%) had at least 3 signs of struggle, reflecting severe RD. The pulse oximeter was only used to measure saturation. Table 1 summarizes the characteristics of infants.

3.3. Etiologies

The most common etiologies were severe pneumonia, severe malaria, bronchiolitis, and sepsis. The main severity criterion for malaria was non tolerated anaemia. The children with sepsis were all severely ill with fever and clinically evident infection. In all cases, post-feeding pneumopathy was related to the administration of slurry.

Table 2 summarizes the main etiologies found in the infants involved.

3.4. Therapeutic Modalities

Nasopharyngeal desobstruction (DRP) was performed by soft aspiration of secretions or by washing the nasal cavities with saline serum. All children with SaO_2 < 95% had received oxygen therapy. Oxygen was delivered by gas cylinders or oxygen concentrators and administered only through a simple nasal cannula suitable for the infant. The flow was variable from 1 to 5 l/min, regulated by a manometer, to achieve the therapeutic target set at ≥ 95% in the department.

Table 1. Socio-demographic characteristics and clinical signs of 96 infants with respiratory distress admitted at pediatric emergency department of CNHU from January 1 to June 31, 2015.

	Number	Percentage %
Age		
≤6 months	27	28.1
6 - 12 months	28	29.2
>12 months	41	42.7
Admission		
Direct	41	42.8
Reference	55	57.2
PEV vaccination Status		
complete PEV	91	94.8
Incomplete PEV	5	
Antecedents		
familial Asthma	17	17.8
parental passive Smoking	1	-
Bronchiolitis	2	-
Pneumonia	1	-
Nutritional Status		
Normal	93	96.9
moderate undernutrition	2	-
Severe undernutrition	1	-
Number of Struggle signs on admission		
<3	40	41.7
≥3	56	58.3
Temperature		
<38˚C	31	32.2
≥38˚C	65	67.8
Respiratory Frequency		
Polypnea (FR > 50)	65	67.8
Bradypnea (FR < 20)	1	-
Normal (FR 20 - 50)	30	31.2
OxygenSaturation in % on admission		
<90	32	33.3
90 - 94	64	66.7
≥95	0	-
Cyanosis		
Yes	3	-
No	93	96.9

Table 2. Summary of etiologies of respiratory distress from 96 infants involved in pediatric emergency department from June 1 to 31, 2015.

Etiologies	Number	Percentage (%)
Severe Pneumonia	33	31.3
Severe malaria	18	18.8
Bronchiolitis	15	15.6
Sepsis	12	12.5
SPP	6	6.3
Gavage inhalation pneumonia	5	5.2
Congenital heart disease	4	4.2
Other*	3	3.1
Total	96	100

*Other etiologies are: inhalation of strange substance (1/96), infant asthma (1/96), acute laryngitis (1/96).

Oxygen therapy was stopped when the infant was able to maintain its ambient air saturation at least equal to this value without major signs of struggle regardless of the pathology involved (apart from cyanogenic heart disease). Humidification was systematic regardless of the flow. No child had received ventilatory support, whether invasive or not, in the unit.

Nebulization of salbutamol 2.5 mg was performed in major cases of bronchiolitis. The frequency of administration was variable, on average every 6 hours initially and then every 8 hours when improvement was noted, till the disappearance of wheezing. In infants under 6 months, nebulization was done with oxygen. Corticosteroid therapy based on betamethasone at a rate of 0.5 mg/kg intravenously over 48 hours was administered in cases of bronchiolitis, inhalation pneumopathy, and laryngitis. An oral relay was then made for a total of 5 days of corticosteroid therapy.

Pleural drainage was performed in two cases of the pleuropulmonary staphylococcal disease with abundant pleurisy. A transfusion of red blood cells at a rate of 10 ml/kg from 1 hour and a half to 2 hours was performed in cases of poorly tolerated anemia. The etiological treatments depended on the pathology. Severe malaria was treated with injectable artesunate. Broad-spectrum antibiotic therapy was given for pneumonia. Initially probabilistic, it is readjusted according to bacteriological examinations and or clinical evolution. Amoxicillin and gentamicin combination was foremost used.

The adjuvant treatments administered are: antipyretic for fever above 38.5˚C with paracetamol at a rate of 15 mg/kg every six hours; normal hydration at a rate of 80 to 100 ml/kg/day by IV way or per os depending on the condition of an infant; continuation of feeding as soon as the clinical condition of the infant improved; physiotherapy with an acceleration of the expiratory flow in infants with bronchiolitis with significant congestion. This physiotherapy was provided by a physiotherapist doctor. **Table 3** summarizes the distribution of infants following the treatments administered.

Table 3. Summary of the therapeutic modalities of respiratory distress from 96 infants involved at the pediatric emergency department of CNHU from June 1 to 31, 2015.

Modalities	Number	Percentage (%)
Symptomatic treatment		
Nasopharyngeal clearence	70	73
Oxygen therapy	96	100
Nebulization salbutamol	10	-
Corticosteroid	19	-
Pleural drainage	2	-
Physiotherapy	4	-
Etiological treatment		
Antimalarial	18	-
Antibiotic	74	77
Extraction of strange substance	1	-

3.5. Evolution

Monitoring of infants was based on respiratory and heart frequency, a progression of struggle signs, cyanosis, neurological status, food intake, pulse oximetry. The average duration of RD was 3.6 days ± 2.9. The average length of stay was 5.2 days. Mortality was 31.2% (30/96), the majority within 48 hours after admission (22/30). Factors related to death were the severity of RD including the presence of at least 3 signs of struggle (Chi2 = 8.4281, p = 0.004), and sepsis (Chi2 = 21.3204, p = 0.006).

4. Discussion

The hospital frequency of respiratory distress found in this study is high, 38%, that is, almost one over three infants admitted to the unit. In 1992, Dan *et al.* in a study within the same unit had reported a frequency of 22.5%, all ages category but with 86% of infants [3]. This confirms the infant's vulnerability to infectious processes in general and particularly those reaching the respiratory tract. The majority of infants in this study (58.3%) showed severe respiratory distress, with at least three struggle signs. Systematic screening on admission, based on the ABCD method recommended by the WHO, with systematic measures of saturation, enabled early diagnosis [6]. We can therefore say that a correct initial assessment was done in all children following the WHO recommendations [5] [6]. Once evaluated, all infants had received oxygen therapy although the majority 64% had a saturation between 90% and 94%. There is no universal consensus on the saturation limit for starting oxygen therapy. The practices vary according to medical teams and the pathology involved. Referring to the WHO guidelines, hypoxemia is defined as saturation below 90% in ambient air [5]. In children with respiratory pathology without any other morbid state, oxygenation should

therefore start below this threshold. However, in severely ill children with other urgent signs such as anemia, coma, state of shock, severe dehydration, etc., oxygenation is recommended for SaO_2 < 94% [5]. In infant bronchiolitis, for example, the American Academy of Pediatrics recommends oxygen therapy when saturation is below 90% [7]. Meanwhile, Aubertin *et al.* propose a limit of 92% for starting oxygenation in the absence of other urgent signs, and 95% in the opposite case. The attitude in the department is broader, leading to systematic oxygen therapy as soon as saturation is <95%. Probably, the fact that one over two children showed at least three struggle signs, and that continuous monitoring is difficult to deal in the unit. We think that, re-evaluation of criteria for initiating and stopping oxygen therapy is desirable to rationalize its use. Although the majority of infants in this study had a significant respiratory problem, no ventilatory support was available to decrease the respiratory process. CIPAP with the nasal interface, already used in neonatology at the same hospital, could be sometimes an interesting and feasible alternative to pediatric emergencies [8]. Nevertheless, its implementation would require staff training and maintenance, and a sterilization plan for the devices. The use of a high-flow nasal cannula (HFNC) is also described to improve the fraction of inspired oxygen (FiO_2) delivered to the patient [9].

The main etiologies found are pneumonia, severe malaria, bronchiolitis, sepsis. They are similar to those reported by Sagbo *et al.* in Porto-Novo [10]. The majority of infants in this study had been vaccinated from Expanded Program on vaccination (PEV). But one third presented severe pneumonia, whereby the etiology could not be specified due to lack of accessible viro-bacteriological tests. It could be viral pneumonia. Guittet *et al.* in 2003, had reported 29% of RD related to rhinovirus infection in 211 hospitalized children [11]. The role of bacterial strains uncovered by PEV cannot be neglected. Hence, the importance of hygienic measures and family awareness for other vaccines recommended for children. In addition, anaemia due to martial deficiency, which is frequent in this age group, is said to be a factor in the severity and seriousness of acute low respiratory infections [12] [13]. Some etiologies of DR, such as post-gavage pneumonia, are completely preventable through continuous awareness-raising for behavior change within communities. This study showed the adequation of etiologic treatments despite the inefficiency of some like nebulization of salbutamol and administration of corticosteroids from bronchiolitis [7] [14]. The corticosteroid is still very important in the treatment of laryngitis or asthma [15]. Significant use of antibiotics is found in this study, in which 77% of children were put on antibiotics. In developed countries, health workers have initiated antibiotic therapy, without bacteriological evidence for fear of facing a severe bacterial infection in children. This boosts the use of antibiotics and increases the resistance of bacteria to common anti-infectives. It would be ideal to alleviate the cost of biological tests or free care for infants.

Despite the adequation of prescribed therapy, the mortality from RD is high

(31.2%). This rate is similar to that found in Porto-Novo [10]. It is noted that a time limit is often observed in the initiation of care and parents have to honor the prescriptions. There is therefore a gap between medical prescriptions and their executive reality within the required deadlines, which could have contributed to this unfavorable evolution. However, it appears that some children probably require ventilatory support apart from oxygenation.

5. Limits

The minimum time needed to start the various treatments was not indicated on the investigation form. Indeed, the initiation of etiological treatments was often conditioned by the purchase of prescriptions from the families, which delays the care process.

6. Conclusion

The WHO recommendations in terms of initial assessment are followed within the unit. The use of oxygen is systematic, requiring updating of decision criteria. Nebulization of salbutamol in cases of bronchiolitis should be avoided. Due to high mortality, related to the severity of DR, there is a need for ventilatory support in some children with severe distress. Since this study, collaboration with the adult intensive care unit has been strengthened for these children. And high concentrated masks have become a common practice among children with a significant respiratory problem. Their therapeutic efficacy needs to be determined.

Conflicts of Interest

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

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