Childhood Pneumonia: Clinical Aspects Associated with Hospitalization or Death

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***Objective*: To determine which available information at an Emergency Room (ER) consultation is associated with hospitalization or death among children with pneumonia. Design: Prospective cohort study. Setting: The ER of one university and one private hospital. Measurement: Using stepwise logistic regression we analyzed factors that showed a univariate association. Main Results: Of 2,970 cases, the median age was 1.83 years (range 2 days to 14.5 yrs, mean 2.76 ± 2.72 yrs); 25.8% were hospitalized and 0.8% died. Age (2-11 mos, OR 0.4 [0.2-0.6]; 12-59 mos, OR 0.2 [0.1-0.4]; ≥ 5yrs, OR 0.1 [0.08-0.3]), malnutrition (OR 2.0 [1.4-2.7]), underlying chronic illness (OR 1.4 [1.1-1.8]), tachypnea (OR 1.8 [1.4-2.4]), chest indrawing (OR 1.7 [1.4-2.2]), and somnolence (OR 1.8 [1.4-2.4]) were associated with hospitalization and age (2-11 mos, OR 0.3 [0.08-0.8]; ≥ 12 mos, OR 0.06 [0.02-0.2]), malnutrition (OR 3.1 [1.2-7.7]) and underlying chronic illness (OR 4.3 [1.6-11.0]) were associated with death in the multivariate analysis. Conclusions: Several clinical aspects may be used in assessing need for hospitalization (i.e. young age, malnutrition, underlying chronic illness, tachypnea, chest indrawing and somnolence) for children with pneumonia seen at the ER. Individual intrinsic factors such as age, malnutrition and underlying chronic illness were independently associated with death. Pneumonia should be considered a treatable disease and complete recovery can be achieved in the majority of the cases.**

Key Words: Pneumonia, children, clinical signs, hospitalization, mortality, outpatients.

Acute respiratory infection, particularly pneumonia, is a major cause of hospitalization and death during childhood in poor areas of the world [1,2]. In order to reduce the high mortality, the World Health Organization (WHO) has developed a Program for the Control of Respiratory Infections through improved case management for children under five years of age [3]. In the mid 1990s, this program was included as a component of the Integrated Management of Childhood Illness (IMCI) Strategy [4], which is currently being proposed as a single and integrated approach to assess, classify and treat children at first level health facilities. The primary goal is to reduce deaths in children aged < 5 years in the Americas by 100,000, between 1999 and 2002 [5]. By using this approach, pneumonia is diagnosed by the presence of tachypnea defined as: ≥ 60 breaths/minute among children aged < 2 months, ≥ 50 breaths/minute among children aged 2-11 months and ≥ 40 breaths/minute among children aged 12-59 months. The guidelines used to categorize pneumonia severity include the presence of chest indrawing, somnolence, convulsions, grunting

Received on 12 March 2001; revised 5 September 2001.

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This study was supported by the Pan American Health Organization.

The Brazilian Journal of Infectious Diseases 2002;6(1):22-28

1413-8670

when the child is quiet, severe malnutrition and inability to drink, as indicators for hospitalization and parenteral antibiotics [6].

In this study, we sought to evaluate which clinical aspects were associated with hospitalization or death in children with pneumonia at two tertiary health care settings in Salvador, Bahia, Brazil.

Materials and Methods

Study design and population. We attempted to enroll prospectively every child diagnosed with pneumonia, from September, 1997, to October, 1999, at the Emergency Room (ER) of the Professor Hosannah de Oliveira Pediatric Center (PHOPC), a university hospital, and at the Pediatric ER of the Aliança Hospital (AH), a private hospital, in Salvador, Brazil. Data were collected on a standardized data entry form (Figure 1) to extract demographic and clinical information. The diagnosis of pneumonia was based on either a finding of simultaneous cough and tachypnea [3], or radiologically confirmed infiltrate. For children aged five years or older, tachypnea was defined as a respiratory rate $\geq$ 40 breaths/minute. Chest X-ray was read by the pediatrician on duty during the consultation. All patients were treated with antibiotics. All ER records were reviewed once a week, beginning in March,1998, at the PHOPC, and in May,1998, at the AH. The data entry forms of those patients characterized as having pneumonia whose forms were not filled out prospectively by the primary physician, were filled out retrospectively. Admission to the hospital or death were registered after cross-reference with the computer file of the respective hospital and the clinical records of those patients who died were reviewed for the collection of additional data.

Data analysis. Statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS 9.0). Age was categorized into four groups: <2 months, 2-11 months, 12-59 months, $\geq$ 5 years. Malnutrition was defined as weight for age under –2SD using the National Center for Health Statistics (NCHS-USA) pattern.[7] Fever was defined as axillary temperature $> 37.5^{o}$C during the consultation. Association between dependent and independent variables was initially assessed by univariate analysis with the Pearson chi square test or Fisher's exact test as appropriate. The statistical tests were two tailed, with a significance level of 0.05. Independent variables that gave significant results in the univariate analysis were used in the four stepwise multiple logistic regression analysis to determine their independent effect on the dependent variables. Odds ratios and their corresponding 95% confidence intervals were calculated. The study was approved by the institutional review board of each hospital and by the Ethics Committee of the Faculty of Medicine of the Federal University of Bahia.

Results

A total of 2,970 cases were consecutively identified among 2,795 children. The intervals between separate episodes in the patients with more than one infection were, in all instances, longer than 1 month. There were 54.1% males and 45.9% females. The median age was 1.83 years (range 2 days to 14.5 years, mean 2.76 ± 2.72 years). Tachypnea was reported in 62.3% of all cases. Chest X-ray was performed in 96.0% and radiologically confirmed infiltrate was described in 97.9%. Hospitalization occurred in 25.8% of the cases and mortality was 0.8%; death occurred within the first 24 hours of admission in 47.8%. Underlying chronic illness was reported in 31.1% of the cases and the most frequent ones were: asthma/increased bronchial reactivity (55.0%), cardiopathy (13.3%), gastroesophageal reflux (5.9%), anemia (5.2%), neuropathy (3.6%), genetic syndrome (3.1%), chronic liver disease (1.9%). Table 1 shows significant differences in clinical aspects in relation to hospitalization; no significant differences were noticed in the frequency of cough, fever, wheezing, crackles, or in the distribution of gender. Table 2 shows the association of several clinical aspects with death; no significant differences were found in the frequency of

Table 1. Clinical aspects associated with hospitalization in children with pneumonia

	Hospitalization		Univariate		Multivariate	
Characteristic*	**Yes (N=503)**	**No (N=1100)**	**p value**	**OR (CI 95%)**	**p value**	**OR (CI 95%)**
Age						
< 2 mos	49 (9.7)	29 (2.6)				
2 - 11 mos	169 (33.6)	248 (22.6)	0.000	0.4 (0.2-0.7)		0.4 (0.2-0.6)
12 - 59 mos	249 (49.5)	634 (57.6)	0.000	0.2 (0.1-0.4)		0.2 (0.1-0.4)
≥ 5 yrs	36 (7.2)	189 (17.2)	0.000	0.1 (0.06-0.2)	0.000	0.1 (0.08-0.3)
Malnutrition	110 (21.9)	101 (9.2)	0.000	2.8 (2.1-3.7)	0.000	2.0 (1.4-2.7)
Underlying illness (chronic)	183 (36.4)	314 (28.5)	0.002	1.4 (1.1-1.8)	0.01	1.4 (1.1-1.8)
Inability to drink	31 (6.2)	36 (3.3)	0.008	1.9 (1.2-3.2)	0.2	1.5 (0.8-2.6)
Tachypnea	395 (78.5)	647 (58.8)	0.000	2.6 (2.0-3.3)	0.000	1.8 (1.4-2.4)
Chest indrawing	305 (60.6)	440 (40.0)	0.000	2.3 (1.9-2.9)	0.000	1.7 (1.4-2.2)
Somnolence	137 (27.2)	157 (14.3)	0.000	2.2 (1.7-2.9)	0.000	1.8 (1.4-2.4)

*Results are reported in n (%).

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1a.Baseline Data: (to be filled out at the hospital)

Hospital code:_____ Patient code:_____

Patient ID (hospital):_____ Consultation Date :____/_____/____

Patient name:_____

Birth Date___/___/___ Age_____ Sex ___M___F

Telephone: ( ) _____ Doctor_____

Address(district/city)_____

Father profession_____ Mother profession_____ Health insurance_____

Household Smoker _____(Y/N) Attending Day-care center _____(Y/N) Going to school____(Y/N)

Chronic illness_____(Y/N) Did the child take any antimicrobial to treat this illness_____(Y/N)

Which?_____ Which?_____ until when?_____

2.Clinical Data: (to be filled out at the hospital):

Cough____(Y/N) Respiratory rate____ Temp_____ºC Weight____

Ability to drink_____(Y/N) Chest indrawing____(Y/N) Crackles ____(Y/N) Wheezing_____(Y/N)

Somnolence ____(Y/N)

Chest x-ray performance____ (Y/N) Result:

- ❑ 1.Normal
- ❑ 2.Interstitial infiltrate
- ❑ 3.Alveolar infiltrate
- ❑ 4.Interstitial and alveolar infiltrate
- ❑ 5.Pleural efusion

1b. Baseline Data: (to be filled out at the hospital)

Where did the patient present:
❑ 1.Emergency Room ❑ 2.Ambulatory Room ❑ 3.Other (specify)_____
Information Source:
1.Clinical record____(Y/N) 2.Doctor_____(Y/N) 3.Family/patient_____(Y/N)

3.Evolution: (to be filled out at the hospital)

Was the patient admitted to the hospital_____(Y/N)
If hospitalized, what happens after 10 days of admittance:
1.Death____(Y/N) 2.discharge____(Y/N) 3.Still in the hospital___(Y/N) Discharge Date ___/___/___

4.Microbiologic Data: (to be filled out at the laboratory)

Blood culture performance____(Y/N)
Result: ❑ 1.*S. pneumoniae* ❑ 2.*H. influenzae* ❑ 3.Other (specify)_____
Pleural fluid culture performance_____(Y/N)
Result: ❑ 1.*S. pneumoniae* ❑ 2. *H. influenzae* ❑ 3.Other (specify)_____
S. pneumoniae: serotype_____(Adolfo Lutz Institute)
Penicillin resistance_____ MIC_____

Table 2. Clinical aspects associated with death in children with pneumonia

	Death		Univariate		Multivariate	
Characteristic*	Yes (N=22)	No (N=1740)	p value	OR (CI 95%)	p value	OR (CI 95%)
Age						
< 2 mos	5 (22.7)	83 (4.8)				
2-11 mos	11 (50.0)	453 (26.0)	0.1	0.4 (0.1 - 1.2)		0.3 (0.08 – 0.8)
≥ 12 mos¶	6 (27.3)	1204 (69.2)	0.000	0.08 (0.02 - 0.3)	0.0001	0.06 (0.02 – 0.2)
Malnutrition	10 (45.5)	225 (12.9)	0.000	5.6 (2.4 - 13.1)	0.02	3.1 (1.2 - 7.7)
Underlying illness (chronic)	14 (63.6)	532 (30.6)	0.002	4.0 (1.6 - 9.5)	0.002	4.3 (1.6 - 11.0)
Tachypnea	20 (90.9)	1124 (64.6)	0.02	5.5 (1.3 - 23.5)	0.06	3.4 (0.8 - 15.3)
Chest indrawing	15 (68.2)	804 (46.2)	0.05	2.5 (1.0 - 6.1)	0.6	1.3 (0.5 - 3.2)

* Results are reported in n (%)
¶ No death in children ≥ 5 yrs.

cough, inability to drink, fever, crackles, wheezing, somnolence or in the distribution of gender. There were 1,367 and 1,208 cases excluded from the multivariate analysis of hospitalization and death, respectively, due to lack of information of any of the predictor variables. The underlying chronic illness reported by children who died were: cardiopathy (7/14), neuropathy (3/14), asthma (1/14), gastroesophageal reflux (1/14), congenital infection (1/14), hypothyroidism (1/14).

Discussion

This study has several important characteristics: first, there were a great number of patients studied; second, the study was carried out at two hospitals which give tertiary health care; and third, the timing was prospective.

Our data demonstrated that tachypnea, chest indrawing, somnolence, malnutrition, underlying chronic illness, and young age were independently associated with hospitalization for pneumonia (Table 1), suggesting that they may be used in deciding the appropriateness of hospitalization for children with pneumonia. These results are in agreement with previous studies [8-11]. We failed to show an independent association with inability to drink and hospitalization. Although it has been found to be an appropriate criterion for defining very severe disease [11], it may overlap with other clinical aspects.

This study also provided evidence that basic individual intrinsic factors such as age, malnutrition, and underlying chronic illness, are independently associated with death (Table 2). According to the WHO, over 30% of all deaths in children under five years of age in poor countries, occur during the first months of life [12], and 70% those deaths are attributable to pneumonia, diarrhea, measles, or malaria [13]. Recent estimates suggest a strong and consistent relationship between malnutrition (measured as poor anthropometric status) and an increased risk of death from acute respiratory infection [14]. Therefore, preventive strategies like vaccination, which is effective in very young children, and nutrition education programs are remarkably important [15, 16]. We think that further studies are needed to clarify the independent association of tachypnea with death in children with pneumonia, as in this investigation where that association demonstrated a borderline significance.

We included patients diagnosed with pneumonia in accordance with the WHO criteria (i.e. tachypnea) in the analysis [3] because chest X-ray was not feasible in all cases, and tachypnea has been exhaustively demonstrated to be an excellent predictor of radiologically defined pneumonia [8,9,17-25]. The weight for age z-score was not used to evaluate nutritional status because information on the height of each child is not collected during consultations in the ERs. Our results may not be generalized to the industrialized world where malnutrition in children is rare [26, 27].

Our mortality rate (0.8%) was remarkably low. This may be attributable to the fact that this study was conducted at two tertiary health care settings in an urban area. High pneumonia mortality has been reported mainly in rural areas in poor countries because of difficult access to health care [4,6,23].

From the data shown, one can infer that pneumonia may be considered a treatable disease and complete recovery may be achieved in the majority of the cases. However, some patients are prone to fatal outcomes because of several different intrinsic factors (i.e. young age, malnutrition, underlying chronic illness).

Acknowledgments

We thank Maria Regina A. Cardoso, MD, PhD, for her technical assistance in the analysis, and every pediatrician, nurse, and medical student, working in the ERs of the participant hospitals, for collaborating on this study.

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