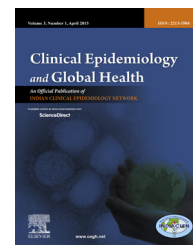


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Original Article

Malnutrition and anaemia associated with hypoxia among hospitalized children with community-acquired pneumonia in North India

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ARTICLE INFO

Article history:

Received 21 July 2016

Accepted 30 August 2016

Available online 1 November 2016

Keywords:

Community-acquired pneumonia

Hypoxia

Malnutrition

Anaemia

North India

ABSTRACT

Objectives: To assess the prevalence and explore the risk factors for hypoxia (SpO₂ levels <92%) in ambient air in children hospitalized with community-acquired pneumonia (CAP).
Methods: This was an observational study, conducted in a tertiary care teaching hospital in north India. Included were children aged 1 month to 5 years having pneumonia with lower chest indrawing (LCI) or severe pneumonia. Excluded were those on oxygen supplementation at time of hospitalization, patients in shock, those with cyanotic congenital heart disease and where parental consent was not obtained. World Health Organization criteria were used for assessing the severity of CAP. Anaemia and moderate malnutrition were defined as haemoglobin <10 g/dl and weight/height <−2 SD, respectively. Peripheral oxygen saturation was measured using a single, portable, battery-powered pulse oximeter at the time of admission and a cut-off of <92% was used to define hypoxia. Haemoglobin was measured by cyanmethemoglobin method.

Results: From July 2013 to June 2014, 165 patients with CAP were admitted, of which 135 patients were eligible for inclusion, and of them, 74.8% (n = 101) had pneumonia with LCI and 25.2% (n = 34) had severe pneumonia. Hypoxia was found in 40% (n = 54/135) of the patients, and of them, 37% (n = 20/54) had pneumonia with LCI and 63% (n = 34/54) had severe pneumonia. Hypoxia was associated with severity of pneumonia (p value <0.001). In the unconditional logistic model, adjusted risk of hypoxia with malnutrition was 12.1 (95% CI) 5.0–29.4, p value <0.001 and with anaemia was 4.5 (95% CI) 1.8–11.2, p value 0.001.

Conclusion: Since a substantial proportion of CAP had hypoxia at hospitalization, prompt detection at admission is essential especially in children with anaemia and malnutrition. Moreover, primary prevention of malnutrition and anaemia in children less than 5 years would contribute significantly in reducing prevalence of hypoxia and thus CAP-related mortality.

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1. Introduction

World Health Organization in November 2015 estimated that 0.92 million children under the age of 5 years die of pneumonia, accounting for 15% of total number of deaths in this age group worldwide. In India, during the year 2011, pneumonia was responsible for about 18% of all deaths of children under 5 years of age.¹

In patients with pneumonia, hypoxia is a predictor of severe disease and has been shown to be a risk factor for death.^{2,3} There is no doubt that detection of hypoxia presents a challenge in resource-limited health facilities. Many studies have demonstrated a low predictive value of clinical signs of hypoxia.^{4–7} Hence, there is a need to objectively monitor hypoxia among children presenting to health care facilities. There is also lack of information in the medical literature on risk factors of hypoxia in children with community-acquired pneumonia (CAP). Therefore, the aim of our study was to explore the risk factor of hypoxia in patients of CAP and to assess the prevalence of hypoxia, which we defined as SpO₂ levels <92% in ambient air⁸ in children hospitalized with CAP. Having knowledge of these risk factors and their optimum management, we would be able to reduce morbidity and mortality due to severe hypoxia in patients of CAP.

2. Materials and methods

This prospective, observational study was conducted for 1 year (July 2013–June 2014) at the Department of Paediatrics, King George's Medical University, Lucknow (26°55' N, 80°59' E), a tertiary care, referral teaching hospital at an altitude of 252 m.

The study was conducted after approval from the institutional ethics committee. Included were children aged 1 month to 5 years with CAP after obtaining written informed parental consent. Excluded were patients on oxygen supplementation at the time of hospitalization, patients in shock, defined as blood pressure below 5th percentile for age and sex, or if not recordable, capillary refill time >3 s, known cases of congenital cyanotic heart disease and cases where consent was not obtained from parents. WHO criteria were used for assessing the severity of CAP defined as no pneumonia, pneumonia with lower chest indrawing (LCI) and severe pneumonia.⁹ WHO criteria were also used for assessing anaemia¹⁰ and malnutrition¹¹ in children. Primary outcome measure was hypoxia defined as SpO₂ < 92% in ambient air.⁸

Any patient with history of fever, cough and difficulty in breathing was screened by an emergency team doctor on duty. As a part of screening, respiratory rate was counted and simultaneously nasal flaring, LCI and cyanosis were ascertained. Respiratory rate was counted for 1 min twice. Haemodynamic stability was assessed by measuring blood pressure and capillary refill time. All patients of pneumonia with LCI and severe pneumonia were admitted. A pulse oximeter was used to measure SpO₂ at the time the patient was admitted by a resident doctor on duty, who was trained in using pulse oximeter by T.N. SpO₂ was recorded using a single, portable, battery-powered pulse oximeter (Finger Pulse Oximeter Model No. SHO 3002, Harsons, India) with the sensor device placed

over the finger (index or middle) or the big toe. The emitting and receiving diodes were carefully opposed. Once a stable plethysmograph waveform was obtained, the saturation reading was watched over at least 30 s and a value was recorded. Hypoxia was defined as SpO₂ < 92% in ambient air.⁸ All patients of pneumonia with LCI not having hypoxia were discharged within 24 h on oral antibiotics.

Venous blood (3 ml) of patients enrolled was withdrawn with full aseptic precautions for routine investigations, and determining C-reactive protein and serum albumin. Haemoglobin was measured by cyanmethemoglobin method. Serum C-reactive protein levels were detected by the Vitros 250 Chemistry System by ELISA method (Ortho-Clinical Diagnostics, Inc., Johnson & Johnson Co., USA). Digital chest radiograph posterior–anterior view was done. All X-rays were read by one clinician. Chest X-ray findings were grouped in categories such as endpoint consolidation, non-endpoint infiltrate and pleural effusion according to WHO criteria.¹²

Data were collected in preformed questionnaires on demographic variables including age, sex, number of siblings, birth order, vaccination status, any co-morbidity, parent education and socio-economic status and household. Height (in cm) was measured by stadiometer for children ≥2 years of age and length by infantometer for younger children; weight was measured in kg; mid arm circumference (in cm) was obtained by measuring tape. Clinical variables included respiratory rate, heart rate, difficulty in breathing, wheeze, fever, cough, inability to feed, chest indrawing, cyanosis, blood pressure and capillary refill time.

Sample size for the study was determined by raosoft online sample size calculator.¹³ Assuming that 50% of the participants will be having hypoxia (as this will give the largest sample size), then to estimate this with a 10% precision and 95% confidence level, we required to recruit a minimum of 96 cases. Data were entered in MS Excel and SPSS software version 15 was used. Univariate analysis was done to assess the distribution of baseline variables by computing frequency, percentages and mean with standard deviation. Thereafter, chi-square test was used for analyzing difference in proportion for different categories. The Student t test was used to analyze difference between two groups for continuous variables. The data were confirmed as significant if *p* value obtained was <0.05. The odd's ratio with 95% confidence limit was also calculated to assess the association of various risk factors with hypoxia. We also calculated and reported the sensitivity and specificity of clinical features for predicting hypoxia. Unconditioned logistic regression was done to find predictors of hypoxia from among those that had univariate association with it using a two-tailed distribution.

3. Results

The study was conducted from July 2013 to June 2014. Total number of cases of CAP reporting to our facility was 165, out of which 135 were enrolled in the study. The reason for cases not recruited is given in Fig. 1. Among those enrolled, there were 74.8% (*n* = 101) cases of pneumonia with LCI and 25.2% (*n* = 34) cases of severe pneumonia. Hypoxia defined as SpO₂ < 92% was found in 54/135 (40%) patients of CAP. Among patients of

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