



RELATIONSHIP BETWEEN PULSE OXIMETRY RESULTS AND PROGNOSIS OF CHILDREN WITH PNEUMONIA

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ABSTRACT

Introduction: Pulse oximetry is shown to be a reliable indicator of severity of pneumonia in children, and its use is associated with decrease in mortality of pneumonia among children. Also it is a cost-effective tool in management of pneumonia. The general objective of this study is to determine the relationship between pulse oximetry results and prognosis of children with pneumonia.

Methods: This cross-sectional study was carried out on children with respiratory symptoms aged 1 month to 5 years old referring to Bandar Abbas Pediatric Hospital, Iran between January and March 2016. Convenience sampling was used to select the study participants. According to the clinical signs and symptoms, as well as chest radiography, patients were allocated to one of the groups of Pneumonia or Non-Pneumonia. O₂ saturation was measured at baseline, using pulse oximetry. The patients were assessed for condition at discharge, oxygen-delivery device, and duration of hospitalization. Independent samples t-test, one-way analysis of variance (ANOVA) and Pearson Correlation were used for data analysis via IBM SPSS version 23.0 software. A p-value less than 0.05 was considered as significant.

Results: In total, 299 patients with a mean age of 14.3 ± 9.83 years were studied in two groups of Pneumonia (n=149) and Control (n=150). Of the two groups, 178 (59.5%) were male and 121 (40.5%) were female. Baseline mean O₂ saturation was 97.90 ± 4.60 percent in the pneumonia group and 99.95 ± 0.57 percent in the non-pneumonia group ($p < 0.001$). Among pneumonia patients, saturation of O₂ was significantly lower in the group of patients who died, in comparison to children who were discharged by the physician or by parental consent. (83 ± 8.27 versus 98.17 ± 3.69 and 99.16 ± 2.56 ; $p < 0.001$). Results of this study showed that there was significant difference in the saturation of O₂ according to oxygen-delivery devices in pneumonia patients ($p < 0.001$).

Conclusion: Lower initial O₂ saturation is observed in the pneumonia patients in comparison to the control group, in patients with death, in comparison to discharged patients by physician or parental consent. Also, the O₂ saturation was significantly different according the oxygen-delivery devices ($p < 0.001$). Furthermore, lower O₂ saturation was associated with longer duration of hospitalization. Therefore, pulse oximetry has good prognostic role in children with pneumonia. We recommend using pulse oximetry in evaluation of children with pneumonia especially in low resource setting.

KEYWORDS: Pulse oximetry, Pneumonia, Prognosis

1. INTRODUCTION

Acute respiratory tract infections and pneumonia are important causes of mortality and morbidity among children in developing countries (1-6). Hypoxemia is an important factor in pneumonia (7). It can be easily detected using a pulse oximetry (7). It is a safe, non-invasive, inexpensive, and easily available device. Pulse oximetry is shown to be

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a reliable indicator of severity of pneumonia in children, and its use is associated with decrease in mortality of pneumonia among children. Also, it is a cost-effective tool in management of pneumonia (8). Therefore, using pulse oximetry should be trained to physicians and students, and related guidelines should be improved (9). In low resource setting, pulse oximetry can be used as a reliable marker of hypoxemia and severity of pneumonia (10). However, the role of pulse oximetry in exclusion of radiologic pneumonia is limited (11). But, pulse oximetry can predict diagnosis of pneumonia and treatment failure in children with pneumonia (12, 13). Data on the prognostic role of pulse oximetry in children with pneumonia is inadequate More studies are needed in this field. The general objective of this study is to determine the relationship between pulse oximetry results and prognosis of children with pneumonia. The specific objectives include the following: 1) to compare the pulse oximetry results in patients with and without pneumonia, 2) to compare the pulse oximetry results according the patients' condition at discharge, 3) to compare the pulse oximetry results according to situation of oxygenation, 4) to assess the relationship between pulse oximetry results and duration of hospitalization.

2. MATERIAL AND METHODS

2.1. Research design and setting

This cross-sectional study was carried out on children with respiratory symptoms aged 1 month to 5 years old referring to Bandar Abbas Pediatric Hospital, Iran between January and March 2016.

2.2. Sampling

Convenience sampling was used to select the study participants. All patients between 1 month to 5 years old in a period of 3 months who had inclusion criteria of the study, were included in the study. For detection of a difference of 2% in O₂ saturation between two group and considering the confidence interval of 95% and power of 80% and standard deviation of 5% in each group, a sample size of at least 284 were calculated (11). We included 300 patients in the study. Among them, one patient was excluded because of incomplete data.

2.3. Selection criteria

Inclusion criteria included: age between 1 month to 5 years, normal hemoglobin level (10-13 mg/dl), clinical sign and symptoms of pneumonia. The clinical sign and symptoms of pneumonia was defined as cough, findings of lung physical examination (rales), respiratory distress (respiratory rate of >50/min in infants and >40/min in 1-5 years old children) and findings of chest radiography (lobar or interstitial infiltration, hyperinflation, and pleural effusion).

The exclusion criteria included: abnormal movements of extremities which limits using pulse oximetry device, inadequate tissue perfusion, irregular cardiac rhythm, and nail polish.

2.4. Data collection

According to the clinical signs and symptoms as well as chest radiography, patients were allocated to one of the groups of case (patients with diagnosis of pneumonia) or control (patients with diagnosis any respiratory disease rather than pneumonia). All patients underwent O₂ saturation measurement using pulse oximetry. Also, for all the patients, a checklist was completed for demographic information, condition of the patient at discharge, oxygen-delivery devices, and duration of hospitalization.

2.5. Research ethics

A written informed consent was obtained from all parents before inclusion of the patients in the study. It was explained to the parents that they could withdraw consent at any time during the study. The study was approved by the ethics committee of Hormozgan University of Medical Sciences.

2.6. Statistical analyses

For data analysis of the demographic information, mean and standard deviation was used. For the analysis of main study results, Independent Samples T-test, one-way analysis of variance (ANOVA), Pearson Correlation were used. Data was analyzed using IBM SPSS Statistics for Windows (Version 22.0. Armonk, NY: IBM Corp. Released 2013). P-value less than 0.05 was considered as significant.

3. RESULTS

3.1. Demographic findings

In this study, 299 patients were included. Among them 149 (49.8%) were in the case group (patients with pneumonia) and 150 (50.2%) were in the control group. Of the two groups, 178 (59.5%) were male and 121 (40.5%)

were female. Mean age of the participants was 14.3 ± 9.83 and mean O₂ saturation was 98.93 ± 3.42 . Also, the duration of hospitalization was 3.65 ± 2.12 days in study participants.

3.2. Pulse oximetry results in patients with and without pneumonia

Baseline mean O₂ saturation was 97.90 ± 4.60 % in case group and 99.95 ± 0.57 % in control group. The difference was statistically significant ($p < 0.001$).

3.3. Pulse oximetry results according to patients' condition at discharge

In patients with pneumonia, we have compared the O₂ saturation according to patients' condition at discharge. The mean O₂ saturation was 98.17 ± 3.69 percent in children who were discharged by the physician. Mean O₂ saturation was 99.16 ± 2.56 percent in children who were discharged by the consent of their parents before being discharged by the physician. One-way ANOVA test showed significant differences in O₂ saturation based on patients' condition at discharge. Post Hoc analysis using LSD test showed no difference between O₂ saturation of the patients who were discharged by the physician, in comparison to patients who discharged by parental consent before discharge by the physician ($p = 0.163$). However, O₂ saturation were significantly lower in patients who died in comparison to children who were discharged by the physician or their parents' consent ($p < 0.001$).

3.4. Pulse oximetry results according to oxygen-delivery devices

In patients with pneumonia, mean O₂ saturation was 84.83 ± 8.65 percent in intubated patients, 90.80 ± 4.58 percent in children with C-PAP, and 96.88 ± 2.97 in children who were using nasal cannula as oxygen-delivery device. Also O₂ saturation was 99.53 ± 1.57 percent in the group of the patients with no supplementary oxygen. Post Hoc analysis using LSD test showed significant differences between children using nasal cannula for oxygenation and patients without supplementary oxygen at 0.005 level, and significant difference between other groups at <0.001 level.

3.5. Relationship between pulse oximetry results and duration of hospitalization

Pearson correlation test showed that duration of hospitalization was negatively related to O₂ saturation of the patients (Pearson correlation = -0.585 ; $p < 0.001$).

4. DISCUSSION

Patients with pneumonia in our study, had lower saturation of O₂ in comparison to other patients. This finding was acceptable, because in pneumonia, the lung and respiratory tracts are involved. This results in disturbance in the respiratory system. Although, in some cases of pneumonia with mild symptoms, O₂ saturation may be normal, but in more severe cases the O₂ saturation will decrease. Therefore, low O₂ saturation can be used as an index for lung and respiratory tract involvement. As shown in our study, pulse oximetry can distinguish pneumonia patients from other patients without lung and respiratory tract involvement. In patients suspicious to pneumonia, pulse oximetry may provide evidence for respiratory tract and lung involvement, and can help for definite diagnosis (11, 13). Also, response to treatment can be predicted using pulse oximetry (12). One important finding in our study was the fact that the initial pulse oximetry results were lower in patients who died during hospitalization in comparison to patients who were discharged by parental consent or by physician decision. Other studies have confirmed the role of pulse oximetry in prediction of adverse outcomes in pneumonia (8, 14). We observed lower saturations of O₂ in patients who required oxygenation with intubation, C-PAP, or nasal cannula in comparison to patients who did not require oxygenation. Therefore, in patients with low initial O₂ saturation the physician should be ready for providing a suitable way for oxygenation. Sometimes, intensive care unit admission may be required for providing oxygen via intubation and C-PAP. Patients with lower levels of O₂ saturation had longer duration of hospitalization. Therefore, pulse oximetry is a reliable tool for prediction of duration of hospitalization in pneumonia patients. In this study, we have shown the relationship between O₂ saturation and prognosis of the children with pneumonia. However, these results should be interpreted with caution, because based on our study design, the role of pulse oximetry in prognosis of pneumonia is unclear. To determine the prognostic role of pulse oximetry in children with pneumonia, different studies with different analysis methods are recommended.

5. CONCLUSIONS

Lower initial O₂ saturation is observed in pneumonia patients in comparison to control group. Also, O₂ saturation was lower in patients with death in comparison to discharged patients by physician or parental consent. Also lower O₂ saturation was observed in patients receiving oxygen via intubation, and C-PAP in comparison to patients receiving oxygen via cannula. Also, lower O₂ saturation was associated with longer duration of hospitalization.

Therefore, pulse oximetry has good association with prognosis of children with pneumonia. We recommend using pulse oximetry in evaluation of children with pneumonia.

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CONFLICT OF INTEREST:

There is no conflict of interest to be declared.

AUTHORS' CONTRIBUTIONS:

All authors contributed to this project and article equally. All authors read and approved the final manuscript.

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