

Risk factors for intensive care need in children with bronchiolitis: A case-control study

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Received: 14th March 2017, Accepted: 23th April 2017

SUMMARY: Coşkun Y, Sağlam F, Mamal-Torun M, Akman İ. Risk factors for intensive care need in children with bronchiolitis: A case-control study. Turk J Pediatr 2017; 59: 520-523.

Bronchiolitis is the most common cause of lower respiratory tract infection and hospitalization in infancy and some of the patients may require admission to Intensive Care Unit (ICU) due to severe form of the disease. The aim of this study was to determine the risk factors for ICU need. The study group was composed of 30 patients admitted to ICU with the diagnosis of bronchiolitis and 30 bronchiolitis patients that were treated in the regular ward at the same period were enrolled to the study as the control group. Clinical characteristics, laboratory and imaging data were collected and compared statistically. The mean age of the patients was 33.6 ± 24.4 days and 202.8 ± 179.8 days in the study and control groups respectively, $p < 0.001$. The presence of tachypnea at admission (96% of patient group and 70% of control group; $p = 0.01$), having oxygen saturation less than 92% (100% of patient group and 27% of control group; $p < 0.001$), having radiological findings of bronchopneumonia and positive result for respiratory syncytial virus were also found to be significantly different in the study and control groups ($p < 0.05$).

Key words: bronchiolitis, risk factors, hospitalization, intensive care unit.

Bronchiolitis is a leading cause of hospitalization of infants. Although most of the children with bronchiolitis can be managed as outpatients, 10-16% of infants younger than 2 years of age are hospitalized with the diagnosis of bronchiolitis and 80% are younger than 6 months of age.¹ In children younger than 1 year of age presenting to emergency department with bronchiolitis, up to 40% are admitted with an average length of stay of 3.3 days.² The risk factors associated with the need for hospitalization are the age younger than 12 weeks, preterm birth and underlying comorbidity such as cardiovascular, pulmonary, neurologic or immunologic disease.³ Young maternal age, low antibody titer to respiratory syncytial virus (RSV), lower socioeconomic status, tobacco smoke exposure, living in crowded surroundings, having older siblings and lack of breastfeeding have also been associated with greater likelihood for severe illness and hospitalization.⁴⁻⁶ Nevertheless, the

most important risk factor for hospitalization is young age.⁷

Some of the hospitalized children need Intensive Care Unit (ICU) admission. Although there are no clear-cut rules that determine the level of care that should be given to bronchiolitis patients, there is a need for evidence based assessment for ICU to triage patients at both referring and receiving hospitals. In the case of respiratory failure that requires mechanical ventilation support, apnea with desaturation and severe impairment of general conditions, the transfer to ICU is recommended.⁸ There are limited resources and availability of pediatric ICU in different geographic locations.

The aim of this study was to determine risk factors related to the need for intensive care for the children hospitalized with the diagnosis of bronchiolitis.

Materials and Methods

We performed a case-control study of 30 bronchiolitis patients who were treated in ICU and 30 time-of-hospital-stay-matched controls who were treated in pediatrics ward with the same diagnosis. Study participants were collected from a single center, Göztepe Medical Park Hospital in Istanbul, Turkey. For each case a matched control was selected from bronchiolitis patients that were hospitalized at ward at the corresponding time period.

Information about demographic factors (i.e. age, sex, birth weight, gestational age, breastfeeding status, number of siblings, smoking exposure, mode of delivery, the presence of multiple pregnancy), clinical and laboratory data (i.e.

symptoms, oxygen saturation, respiratory rate, the co-presence of bronchopneumonia, radiologic findings, complete blood count and CRP values, viral test results) were collected from the hospital information system.

The study was approved by local ethical committee on clinical trials. Informed consent was obtained from all of the subjects included in the study.

Statistical analyses

The data was analyzed by IBM SPSS Ver20; a p value <0.05 was accepted as significant. Simple associations were compared with Chi-square test and Student's t-test as appropriate. Odds ratios with 95% of confidence interval

Table I. The Characteristics of the Patients According to Groups.

| Characteristics | Study group (n=30) | Control group (n=30) | p |
|--|-----------------------|-------------------------|--------|
| Age (days) | 33.6±24.5 | 202.8±179.8 | <0.001 |
| Birth weight (kg) | 3,063.6±708.9 | 3,080±738.9 | 0.93 |
| Gestational age (months) | 37.9±2.9 | 38.2±3.3 | 0.73 |
| Delivery type (normal/Caesarean), n/n | 12/18 | 5/25 | 0.04 |
| Sex (female/male), n/n | 11/19 | 11/19 | 1.0 |
| Multiple pregnancies (Yes), n (%) | 4 (13.3) | 4 (13.3) | 1.0 |
| Respiratory rate | | | |
| ≥60/min, n (%) | 29 (96.6) | 8 (26.7) | 0.01 |
| <60/min, n (%) | 1 (3.4) | 22 (73.3) | |
| Oxygen saturation | | | |
| >95%, n (%) | 0 | 22 (73.3) | <0.001 |
| 92-95%, n(%) | 0 | 8 (26.7) | |
| <92%, n (%) | 30 (100) | 0 | |
| Exposure to tobacco smoke (Yes), n (%) | 17 (56.7) | 15 (50.0) | 0.262 |
| Number of siblings | 2.4±0.9 | 1.9±1.0 | 0.06 |
| ≤2 n(%) | 17 (56.7) | 23 (76.7) | 0.10 |
| >2 n(%) | 13(43.3) | 7 (23.3) | |
| Breast feeding, n (%) | 28 (93.3) | 24 (80.0) | 0.06 |
| Only breast milk, n (%) | 23 (76.7) | 13 (43.3) | 0.03 |
| Breast milk + suppl. food n (%) | 5 (16.6) | 11 (36.7) | |
| Only supplementary food, n(%) | 2 (6.7) | 6 (20.0) | |
| Virology results | | | |
| Respiratory syncytial virus, n(%) | 24 (80) | 15 (50.0) | 0.001 |
| Human rhinovirus, n (%) | 0 | 1 (3.4) | 0.31 |
| Influenza virus, n (%) | 1 (3.4) | 2 (6.8) | 0.55 |
| Parainfluenza virus type IV, n (%) | 0 | 1 (3.4) | 0.31 |
| Positive radiologic findings, n (%) | 21 (70.0) | 11 (36.7) | 0.01 |

(CI) were calculated by risk assessment of chi-square analysis and logistic regression by entry method was performed using variables found to be statistically different between two groups.

Results

The median age of patients was 33.6 days in case group and 202.8 days in control group ($p < 0.001$). In both groups, there were 11 girls and 19 boys; birth weight, gestational age, exposure to tobacco smoke and the presence of multiple pregnancies were similar in both groups. The sibling number was higher in study group but not statistically significant. The most frequently detected virus was RSV and its presence in the study group was significantly higher; influenza virus, parainfluenza virus type 4 and human rhinovirus were also detected. The presence of tachypnea, low oxygen saturation and accompanying bronchopneumonia with positive radiologic findings were significantly higher in the study group. Table I shows the demographic and clinical characteristics of two groups. The odds ratios calculated are presented in Table II.

Logistic regression model did not reveal any statistically significant predictor.

It was seen that all patients of the case group were treated with oxygen with the mean duration of 6.2 days, 8 patients received continuous positive airway pressure (CPAP) and 5 of those also received synchronized intermittent mandatory ventilation (SIMV).

Discussion

In this case-control study, it was demonstrated that the most important risk factors of ICU need in bronchiolitis patients were young patient age and low oxygen saturation. Accompanying bronchopneumonia, the presence of tachypnea and detection of RSV on viral panel were

also found more frequently in the patients who attended ICU. The breastfeeding ratio was found higher in study group, probably because the age of the patients in this group was much younger.

In a large multicenter, prospective cohort study, in which the patients were followed for three years, Hasegawa et al.⁹ found that low birth weight and the presence of tachypnea are the predictors of requiring use of intensive care. In that study, patient age was found as a significant predictor, only when the patients who received mechanical ventilation were included into sensitivity analysis of multivariate logistic regression. Oxygen saturation, although having been found lower in ICU patients was not included in regression analysis. In our study, the birth weight was similar in both groups and the presence of tachypnea was significantly more frequent in case patients but was not found as a significant predictor for ICU need in logistic regression analysis. The data obtained from both studies, although looks like obvious observations, demonstrates that there is a need for new studies that will reveal the risk factors for ICU need in bronchiolitis patients more clearly.

Brooks et al.¹⁰ assessed respiratory rate, oxygen saturation, presence of wheezing and chest radiologic findings in children who admitted to emergency department with bronchiolitis and were proven to be RSV positive. Among those patients, they retrospectively matched children who were transferred to ICU with those who was not and they found that respiratory rate and oxygen saturation were modestly higher in index patients, compared with controls, wheezing and chest radiologic findings were nor different between groups. In our study, the presence of radiologic findings was higher in ICU patients.

Table II. Risk Factors for Intensive Care Unit Need.

| Risk factors | Odds ratio | 95% CI | P |
|--------------------------------|------------|----------|--------|
| Young age | NA | | <0.001 |
| Low oxygen saturation | NA | | <0.001 |
| Positive RSV result | 4.00 | 1.2-12.5 | 0.015 |
| Positive radiological findings | 4.03 | 1.3-11.8 | 0.019 |
| Breast feeding | 0.83 | 0.7-1.05 | 0.254 |
| Tachypnea | 5.11 | 0.8-32.9 | 0.020 |

CI: confidence interval; NA: non-applicable

Young patient age and low oxygen saturation were found as the most important risk factors for prediction of ICU need for bronchiolitis patients; also, tachypnea, RSV positivity and accompanying bronchopneumonia with positive radiologic findings were found significantly higher in ICU patients while gestational age, sex, birth weight and the presence of multiple pregnancies were not found as significant risk factors.

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