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# Assessment of the impact of anemia on the treatment of acute bronchiolitis cases

Tugrul Donmez[a,b,*], Mehmet Rusen Dundaroz[c]

[a] *Private Clinic, Sakarya, Türkiye*
[b] *Kocaeli Health and Technology University, European Vocational School, Kocaeli, Türkiye*
[c] *Bezmialem Vakıf University, Faculty of Medicine, Department of Pediatrics, Istanbul, Türkiye*

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## Abstract

**Aim:** Acute bronchiolitis is a clinical condition characterized by inflammation of the bronchioles, primarily caused by viral agents in children under two years of age. The cornerstone of treatment includes hydration and oxygenation, while patients should be closely monitored for potential complications. Our objective is to evaluate the impact of anemia on treatment outcomes in children diagnosed with acute bronchiolitis.

**Materials and Methods:** Children aged 1-24 months diagnosed with mild or moderate acute bronchiolitis in a tertiary pediatric health and disease clinic were retrospectively included in the study. Demographic characteristics and bronchiolitis severity (mild/moderate) were recorded. Pre- and post-treatment clinical severity, respiratory rate, heart rate, oxygen saturation levels, and bronchiolitis clinical scores were analyzed. The clinical findings and treatment responses of anemic and non-anemic patients were compared. A p-value of $<0.05$ was considered statistically significant in all analyses.

**Results:** A total of 85 patients with a median age of 5.4 months (52.9% male) were included in the study. Anemia was present in 25.9% of the patients. At admission, the respiratory rate (RR) was significantly lower in anemic patients compared to non-anemic patients (median 37 vs 41, p=0.003). No significant differences were observed between anemic and non-anemic groups for clinical respiratory scores (CRS) (median 4.7 vs 4.7, p=0.721), heart rate (HR) (median 135.6 vs 134.3, p=0.798), or oxygen saturation ($SaO_2$) (median 93.1 vs 93.0, p=0.304) at admission. Post-treatment, both groups demonstrated significant improvements in CRS, HR, and $SaO_2$ ($p<0.05$ for all). However, RR remained lower in the anemic group compared to the non-anemic group (median 32.1 vs 36, p=0.003). The overall change in CRS and other parameters between the anemic and non-anemic groups was not statistically significant ($p>0.05$).

**Conclusion:** Mild anemia does not affect the response to treatment for hypoxia in children with mild to moderate acute bronchiolitis.



## Introduction

Acute bronchiolitis is a condition primarily caused by viral agents in children under the age of two, characterized by tachypnea, retractions, and wheezing [1]. Although its incidence peaks during winter and spring, it varies according to the seasons [2]. The disease is more common and severe in infants aged 1-3 months, with most children under the age of two experiencing acute bronchiolitis [3]. Additionally, it is more frequently seen in males, those who are not breastfed, and those living in crowded conditions [3].

Respiratory syncytial virus (RSV) is responsible for more than 50% of cases diagnosed with acute bronchiolitis [4]. Other common viral agents include Parainfluenza virus (PIV) type 3 and human metapneumovirus (hMPV). Less common agents are adenovirus, PIV type 1-2, Rhinovirus, Influenza virus, and Mycoplasma pneumoniae [5]. The diagnosis of acute bronchiolitis is made clinically; routine testing is not recommended except in cases of severe bronchiolitis or unexpected clinical course [6]. The treatment of acute bronchiolitis is supportive and includes ensuring the patient's hydration and oxygenation while closely monitoring for complications. Treatment of moderate to severe acute bronchiolitis usually requires hospitalization [7, 8].

Anemia is defined as a condition where the hemoglobin (Hb) and/or hematocrit levels in the blood are lower than the accepted reference values, or there is a reduction in the red blood cell mass [9]. The prevalence of anemia varies

*Corresponding author:
*Email address:* drtugruldonmez@gmail.com (Tugrul Donmez)

according to the child's age, gender, socioeconomic status, and geographic location, with a prevalence of 4-20% in children in developed countries and 70-80% in children in developing countries [10]. Anemia leads to a reduction in the oxygen-carrying capacity of the blood due to the decreased number of red blood cells, constituting the primary physiological pathology. Additionally, mild to moderate impairments in leukocyte and lymphocyte functions due to iron deficiency anemia have been reported to result in more frequent and/or severe infections in anemic children [11-13].

This study examined the impact of concomitant anemia on the treatment response in children diagnosed with mild to moderate acute bronchiolitis.

## Materials and Methods

Patient Selection Children aged 1-24 months who presented to the emergency department with complaints of cough, wheezing, and dyspnea and were diagnosed with mild or moderate acute bronchiolitis at a tertiary pediatric health clinic were retrospectively included in the study. Patients with bronchopulmonary dysplasia, congenital heart disease, immune deficiency, or those who received ventilator support during the neonatal period were excluded from the study. Ethical approval was obtained from the scientific research ethics committee of the medical faculty (Bezmialem Vakıf University Clinical Research Ethics Committee, decision no: 22/12).

An a priori power analysis was conducted using G*Power version 3.1.9.7 to determine the minimum sample size required to test the study hypothesis. Results indicated the required sample size to achieve 80% power for detecting a medium effect, at a significance criterion of $\alpha = .05$, was $N = 46$ for independent samples t test. Thus, the obtained sample size of $N = 46$ is adequate to test the study hypothesis.

### *Data collection and Patient evaluation*

The demographic characteristics (age, gender), complaints, and severity of bronchiolitis (mild/moderate) of the included patients were recorded. A scoring system considering general condition, respiratory rate, wheezing, and retractions was used to evaluate the severity of the disease and the effectiveness of treatment approaches (Table 1) [14]. The treatment methods received by the patients and the clinical severity, respiratory rate, heart rate, oxygen saturation [$SaO_2$ (%)] and bronchiolitis clinical scores before and after treatment were analyzed. The Hb and hematocrit levels of the patients were also recorded. The clinical findings and treatment responses of anemic and non-anemic patients were compared post-treatment.

### *Statistical analysis*

Data were analyzed using the SPSS 16.0 (IBM, Armonk, NY: IBM Corp.) software program. The Kolmogorov-Smirnov test and box plot graphs were used to assess the study data's conformity to the normal distribution of the variables. Continuous variables that did not show a normal distribution were presented as median and interquartile range. and categorical variables as count and percentage. As continuous variables were non-normally distributed, non-parametric tests were applied. Mann-Whitney U test was used to compare pre-treatment and post-treatment values between anemia and non-anemia groups, while Wilcoxon signed-rank test was employed for within-group comparisons. Statistical significance was defined as $p < 0.05$.

## Results

The median age of the patients included in the study was 5.4 (min 1, max 20) months. 52.9% (n=45) of the patients were male. While 74.1% (n=63) of the patients were found not to have anemia, only 25.9% (n=22) had anemia (Table 2).

When the results at admission were analyzed, there was no significant difference between the clinical respiratory score (CRS) of the group with anemia and the group without anemia (median 4.7 vs 4.7, p=0.721). There were also no statistically significant differences in heart rate (HR) (median 135.6 vs 134.3) and oxygen saturation ($SaO_2$) (median 93.1 vs 93.9) between the groups (p=0.798, p=0.304, respectively). However, respiratory rate (RR) was significantly lower in the anemic group compared to the non-anemic group (median 37 vs 41, p=0.003).

In the post-treatment results, there was no significant difference in CRS (median 2.5 vs 2.6), HR (median 133 vs 133) and $SaO_2$ (median 97.2 vs 97.2) between the anemic group and the non-anemic group (p=0.213, p=0.707, p=0.527, respectively). However, RR was significantly lower in the anemic group compared to the non-anemic group (median 32.1 vs 36, p=0.003).

CRS and RR decreased significantly and $SaO_2$ increased in the anemic group (p<0.001, p<0.001, p=0.003, respectively). On the other hand, there was no significant change in HR (p=0.935). Similar results were obtained in the group without anemia. CRS and RR decreased significantly and $SaO_2$ increased (p<0.001, p=0.001, p<0.001, p<0.001, respectively). However, there was no significant change in HR (p=0.075) (Table 3).

## Discussion

Acute bronchiolitis is typically a self-limiting disease [15-17]. Most children who do not require hospitalization recover within 28 days; however, the duration of the disease varies depending on age, disease severity, the presence of chronic disease, and the etiological agent [15-18]. This study aimed to examine the impact of concomitant anemia on the treatment response in children diagnosed with acute bronchiolitis.

The primary treatment of acute bronchiolitis is supportive, involving hydration and oxygenation regulation, and close monitoring for complications. High morbidity due to the possibility of hospitalization, prolonged symptoms, feeding problems, and predisposition to secondary bacterial infections highlights the importance of the disease [7, 19, 20].

Acute bronchiolitis cases are more frequent in males due to the narrower bronchial diameters compared to females [3]. Similarly, in our study, more than half of the cases were male. While bronchiolitis cases can occur up to 24 months

**Table 1.** Clinical Scoring in Bronchiolitis [18].

| | 0 | 1 | 2 | 3 |
|---|---|---|---|---|
| RR | <30 | 30-45 | 45-60 | >60 |
| Wheezing | No | In expiration (With stethoscope) | In expiration (without stethoscope) | Inspiration and Expiration |
| Retraction | No | Intercostal | Tracheosternal | Nose wing |
| General condition | Normal | Slightly restless | Restless, decreased feeding | Altered consciousness, malnutrition |

RR: Respiratory rate.

**Table 2.** Demographic characteristics of patients and anemia prevalence rates.

| | | |
|---|---|---|
| Age | Median (IQR) | 5.4 (1.9-8.9) |
| Gender | Male n (%) | 45 (52.9) |
| | Female n (%) | 40 (47.1) |
| Disease Severity | Mild | 27 (31.7) |
| | Moderate | 58 (68.3) |
| Anemia | Yes | 22 (25.9) |
| | No | 63 (74.1) |

M: male, F: female, min: minimum, max: maximum, IQR: Interquartile range.

**Table 3.** Comparison of clinical findings at presentation and after treatment in patient groups with and without anemia.

| Clinical Findings | | Anemia | | p |
|---|---|---|---|---|
| | | Yes | No | |
| At admission | CRS (Median (IQR)) | 4.7 (3.8-6) | 4.7 (4-5.5) | 0.721 |
| | HR (Median (IQR)) | 135.6 (120.8-155.5) | 134.3 (124.9-149.5) | 0.798 |
| | RR (Median (IQR)) | 37 (34.8-40.3) | 41 (31.6-49.4) | 0.003 |
| | $SaO_2$ (Median (IQR)) | 93.1 (91.2-96.5) | 93.9 (92.6-95.7) | 0.304 |
| After treatment | CRS (Median (IQR)) | 2.5 (1.8-2.9) | 2.6 (2.2-3.1) | 0.213 |
| | HR (Median (IQR)) | 133 (121.5-145.2) | 133 (121.4-143) | 0.707 |
| | RR (Median (IQR)) | 32.1 (31.5-33.5) | 36 (30.9-40.1) | 0.003 |
| | $SaO_2$ (Median (IQR)) | 97.2 (95.7-98.5) | 97.2 (95.8-98.3) | 0.527 |

RR: respiratory rate, CRS: clinical respiratory score, HR: heart rate, $SaO_2$: oxygen saturation, IQR: Interquartile range.

of age, the highest hospitalization rate is observed in the 2-6 month age group [21, 22]. In our study, the average age of patients hospitalized due to acute bronchiolitis was found to be 5.4 months, consistent with the literature.

In respiratory physiology, oxygen reaching the alveoli is transported to the tissues bound to Hb in the blood. A decrease in the Hb level in the blood leads to a reduction in the amount of oxygen delivered to the tissues [23, 24]. In children with acute bronchiolitis, hypoxemia and hypercapnia occur due to the disruption of the alveolar ventilation-perfusion balance in the advanced stages of the disease [2,3,25]. The literature indicates that in children with moderate to severe anemia, respiratory and cardiac pathologies such as tachypnea and tachycardia persist longer and normalize later despite treatment [26-29]. Furthermore, a study by Tourniaire G. et al. suggested that anemia could affect the clinical course in children with acute bronchiolitis [30]. In our study, however, no significant difference was found in clinical improvement between anemic and non-anemic patients post-treatment. We believe that the mild anemia in our study population did not result in a clinical difference.

The limitations of the study are as follows: [1] The single-center and retrospective nature of our study poses significant limitations in generalizing the results; [2] The inclusion of patients with mild anemia may have influenced the clinical response.

## Conclusion

The hypoxia observed in mild and moderate acute bronchiolitis cases responds to treatment similarly in mildly anemic and non-anemic patients. Further prospective studies in this area are recommended.

*Ethical approval*

Ethical approval was obtained for this study from the Bezmialem Vakıf University Clinical Research Ethics Committee (Date: 17.12.2024, Decision no: 22/12).

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