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Original Research Article

Comparative evaluation of high flow oxygen therapy versus low flow oxygen therapy in the management of acute moderate bronchiolitis

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ABSTRACT

Background: Acute bronchiolitis is the most common respiratory tract infection in young children. Despite the high prevalence, no consensus exists on management. Hence the present study was conducted to find out the efficacy of high flow oxygen therapy (HFNC) versus low flow oxygen therapy in the management of acute moderate bronchiolitis.
Methods: Prospective randomized controlled study of 100 children aged between 2 months to 24 months with signs and symptoms of acute moderate bronchiolitis were admitted to Indira Gandhi Institute of Child Health, Bangalore from January 2018 to June 2019 formed the study group, they were randomised into 2 groups, group A received high flow oxygen therapy and group B received low flow oxygen therapy.
Results: Out of 100 children enrolled in the study, 50 children (group A) received high flow oxygen therapy and 50 children (group B) received low flow oxygen therapy. At 24 hours the mean severity score for group A was 0.46±077 and group B was 1.86±0.86 ($p<0.001$). Maximum improvement in O_2 saturation was observed in group A compared to group B. The duration of hospital stay was shorter (2-3 days) in group A with a mean of 2.20 days and was longer (4-5 days) in group B with a mean value of 3.84 days which was statistically significant ($p<0.001$).
Conclusions: Children with acute bronchiolitis treated with heated humidified high flow oxygen (HFNC) had early improvement in the clinical severity score, reduced duration of oxygen requirement and decrease in the length of hospital stay. Hence heated humidified high flow oxygen (HFNC) is an effective and safe modality of treatment for children with acute moderate bronchiolitis compared to low flow oxygen therapy ($p<0.0001$).

Keywords: Bronchiolitis, HFNC, Low flow oxygen therapy

INTRODUCTION

Bronchiolitis is one of the most common and serious lower respiratory tract infections in infants. It is the major cause of morbidity and leading cause of hospitalization with annual hospitalization rates of 17 per 1000 children under 6 months of age and 3 per 1000 under 2 years of age.[1] It is an acute inflammatory injury of bronchioles, most common viral aetiology include respiratory syncytial virus (>50%), influenza virus, parainfluenza virus, adenovirus, corona viruses and human metapneumovirus.[2]

The current treatment of acute bronchiolitis is supportive care mainly in the form of supplemental oxygen, fluid therapy, and hypertonic saline nebulization. Traditionally oxygen is provided via low flow nasal prongs. However, the recent few studies have revealed that oxygen therapy via heated, humidified, high flow nasal cannula (HFNC) allows the delivery of high inspired gas flow which have better efficacy and outcome compared to traditional low flow oxygen therapy. The inspired oxygen concentration (FiO_2) can be varied from 21% to 100%. Hence the present study was undertaken to establish the efficacy of

HFNC oxygen therapy in the management of acute bronchiolitis.[5]

METHODS

A prospective randomized controlled study was carried out for a period of 12 months from January 2018 to June 2019. The study protocol was approved by the Institutional Ethical Committee. One hundred children between the age group of 2 months to 24 months with signs and symptoms of acute bronchiolitis admitted to Indira Gandhi Institute of Child Health, Bangalore formed the study group.

Informed written consent was obtained from parents of each patient before enrollment. Detailed clinical history and examination findings were recorded in a standard predesigned proforma. Assessment of patient's clinical severity score (CSS) and SpO_2 readings by pulse-oximeter were done at admission, 30 minutes for the first 2 hours, 4th hourly and then every 6th hourly until discharge. The sum of the CSS scores ranged from 0-12, and accordingly classified in to mild, moderate and severe bronchiolitis as per Wang et al.[6]

These children were subjected to the need-based investigations including complete blood count (CBC), chest X-ray (CXR) and arterial blood gas analysis (ABG).

All children with moderate bronchiolitis were started on standard treatment protocol with oxygen therapy, saturation monitoring, fluid and electrolyte management. They were randomized using custom random number generator into two groups: group A: received high flow oxygen therapy; group B: received low flow oxygen therapy.

They were reassessed every 30 min, clinical response was determined by improvement in CSS score, improvement in O_2 saturation, duration of oxygen requirement and duration of hospital stay.

Inclusion criteria

All children aged between 2 months to 24 months with acute moderate bronchiolitis were included in the study.

Exclusion criteria

All children with acute mild bronchiolitis, and those who received treatment outside for acute bronchiolitis; those with congenital heart disease; those with congenital malformation of lung were excluded.

Statistical analysis

Statistical analysis was performed by STATA 11.2 (College Station TX USA). Shapiro Wilk test had been used to check the normality. Students t test was used to find the significance between the CSS and duration of hospital stay with the treatment groups (high flow oxygen therapy, low flow oxygen therapy) and these were expressed as mean and standard deviation. Chi square test was used to measure the association between the age groups, symptoms, investigations and CSS score with treatment groups (high flow oxygen therapy, low flow oxygen therapy) and these were expressed as frequency and percentage and was considered as statistically significant when $p<0.05$.

RESULTS

The following were the results of 100 children with signs and groups of acute moderate bronchiolitis.

Majority of the children were between the age group of 2 months to 6 months (55%; n=100) as shown in Table 1.

Boys were predominantly affected than girls in the ratio of 1.7:1. Fast breathing was predominant symptom followed by chest in drawing (84%).

Improvement in CSS was seen with high flow oxygen therapy group in first 24 hours which was statistically significant ($p<0.001$) as shown in Figure 1.

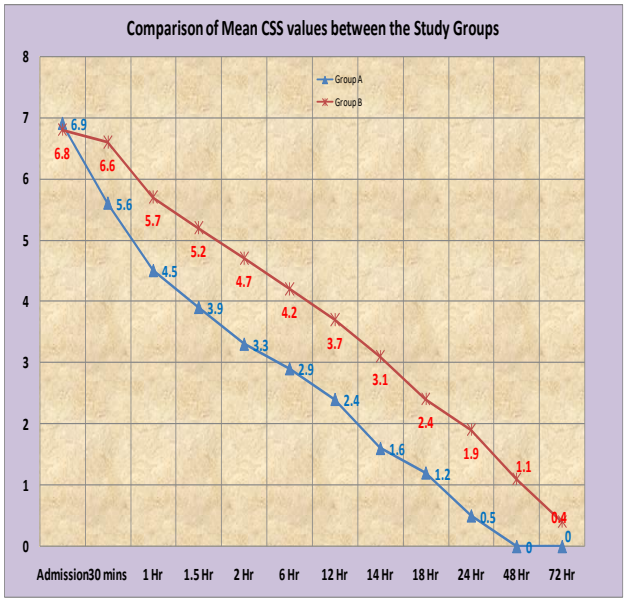

Figure 1: Improvement in CSS.

Improvement in oxygen saturation was observed in high flow oxygen therapy group maximum in the first 24 hours of starting treatment which was statistically significant ($p=0.001$) as shown in Table 2.

The mean duration of hospital stay was shorter in high flow oxygen therapy group, 2.2±0.517 days while compared to 3.8±0.840 days in low flow oxygen therapy group which was statistically significant ($p<0.001$) as shown in Table 3.

Table 1: Age distribution of children with acute bronchiolitis.

Age (in months)	Group A	Group B	Total
	N (%)	N (%)	N (%)
2-6	24 (48.0)	31 (62.0)	55 (55.0)
6-12	18 (36.0)	13 (26)	31 (31.0)
12-18	6 (12.0)	5 (10)	11 (11.0)
18-24	2 (4)	1 (2)	3 (3.0)
Total	50	50	100

Table 2: Improvement in O_2 saturation.

Hours	Group A	Group B	P value
	N (%)	N (%)	
<24	32 (64)	12 (24)	0.001
24-48	14 (28)	26 (52)	
48-72	4 (8)	9 (18)	
>72	0 (0)	3 (6)	

Table 3: Duration of hospital stay.

Duration of stay (days)	Group A (n=50)	Group B (n=50)	P value
	Mean±SD	Mean±SD	
Discharged after	2.2±0.517	3.8±0.840	<0.001
Range	2-3	4-5	

Table 4: Duration of oxygen requirement in comparison with other studies.

Study	Group A (days)	Group B (days)	P value
Ahmed et al[1] (n=100)	3.1	1.4	<0.01
Milani et al[5] (n=40)	4	6	0.006
Franklin et al[7] (n=1400)	1.87	1.81	0.61
Present study (n=100)	2.4	1.3	<0.001

Table 5: Duration of hospital stay in comparison with other studies.

Study	Group A (days)	Group B (days)	P value
Ahmed et al[1] (n=100)	7	4	<0.001
Milani et al[5] (n=40)	9	6	0.002
Franklin et al[7] (n=1400)	3.1	2.9	0.19
Present study (n=100)	3.8	2.2	<0.001

DISCUSSION

Bronchiolitis is the most common lower respiratory tract viral infection in children. Across various studies worldwide, it has been observed that high flow oxygen therapy is effective in treating acute bronchiolitis.

Table 1 shows the comparison of total number of cases studied with the distribution of age, with other studies. In the present study the most common age group of children with acute moderate bronchiolitis affected belongs to 2 months to 6 months. Similar observation was observed by Ahmed et al and Milani et al.[1,5] Infants younger than six months were most severely affected, owing to smaller, more easily obstructed airways and a decreased ability to clear secretions.

Table 4 shows the duration of oxygen requirement, which was less in high flow oxygen therapy group. This observation was similar to studies done by Ahmed et al and Milani et al.[1,5] These results can be explained by the fact that, the use of heated, humidified HFNC therapy enabled delivery of higher inspired gas flow of air/oxygen blend, up to 10-30 l/min. It also provided continuous positive airway pressure thus keeping the child's small airways open and improving the ventilation. Warmed and humidified oxygen might also thinned out the secretions and reduce mucus plugging. Use of HFNC also resulted in washout of nasopharyngeal dead space

and reduction in upper airway resistance, thus resulting in alveolar ventilation as a greater fraction of minute ventilation. These factors likely to improve respiratory gas exchange. Hence there was an early improvement in CSS, lesser duration of oxygen supplementation and decrease in length of hospital stay in children managed with high flow oxygen therapy when compared to conventional low flow oxygen therapy.

Table 5 showed the duration of hospital stay which was shorter (2 to 3 days) in high flow oxygen therapy group with a mean value of 2.2 days and was longer (4 to 5 days) in low flow oxygen therapy group with a mean value of 3.8 days which was statistically significant ($p<0.001$), was comparable with study done by Ahmed et al and Milani et al.[1,5]

Limitation of the study

The viral etiology could not be established due to logistic reasons. Sample size was too small to conclude. Further studies are required on a larger scale.

CONCLUSION

In acute moderate bronchiolitis use of high flow oxygen therapy significantly improved the clinical severity score, reduced the duration of oxygen requirement and length of hospital stay compared to conventional low flow oxygen therapy. Therefore, heated humidified high flow oxygen therapy is an effective and safe treatment for children with acute moderate bronchiolitis.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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