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Original Research Article

ROLE OF NEBULISED HYPERTONIC SALINE IN THE TREATMENT OF ACUTE BRONCHIOLITIS IN CHILDREN AGED 4 WEEKS TO 2 YEARS

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ABSTRACT

Background: To study the effect of nebulised 3% saline on hospitalized children aged 4weeks to 2 years with acute bronchiolitis with regard to decrease in respiratory distress and duration of hospital stay.

Materials and Methods: This was a hospital based prospective interventional non blinded controlled trial done in the age group of 4 weeks to 2 yrs admitted with acute bronchiolitis with a Respiratory Distress Assessment Instrument (RDAI)score of 4 to 15 [on a scale of 0 (mild) to 17 (severe)] in a teritiary care centre.

Results: The most common presenting complaint in our study was cold which was present in 43 (76.79%) cases followed by cough in 41 (73.21%). This was followed by hurried breathing in 31 (55.36%). Wheeze was present in 29(51.79%) cases and fever in 28 (50%). The two groups were comparable with respect to baseline characteristics. The number of children who improved with treatment in Study group was 19(63.3%) and in control group was 11(36.70%). When compared to control group, there was statistically significant (p=0.015) improvement in the study group. This showed that the nebulised 3% saline nebulisation was useful in symptomatic improvement in the clinical condition of significantly more number of children. There was significant reduction in RDAI scores and improvement in saturation after 6hr, 12hr and 24hrs of initiation of treatment in Study group.

Conclusion: The present study concluded that there was significant decrease in Respiratory rate and RDAI scores with the use of 3% NS nebulisation. The duration of hospital stay was less and the time required for change of treatment was more in Study group, but statistical significance could not be established.

Keywords: Bronchiolities, RDAI Score, NS nebulisation, wheeze.

INTRODUCTION

Acute bronchiolitis is one of the major causes for hospital admissions in children younger than 1 year. It is most common between the ages of 2 and 6 months.[2] Infant characteristically presents with rhinorrhoea, cough and occasionally low-grade fever. Within 1 or 2 days, these symptoms are followed by the onset of rapid respiration, chest retractions and wheezing.

Upto 3% of all children are hospitalized with acute bronchiolitis in their first year of life.3 RSV is responsible for half of the cases. Despite the high prevalence, little consensus exists on the optimal management of the disease.[9]

Management of acute bronchiolitis is mainly supportive. Humidified oxygen is the main stay of treatment. Antibiotics and steroids are generally not helpful. Nebulised bronchodilators, such as salbutamol or ipratropium, though often used, have not been shown to reduce the severity or duration of the illness. Mechanical ventilation may be required in about 2% of infants admitted to hospital.[4]

Various other treatments have been proposed for acute bronchiolitis. They are other bronchodilators like adrenaline, inhaled and systemic steroids, aerosolised human DNAase, ribavirin, antibiotics, leukotriene receptor antagonists, heliox, ventilation, immunoglobulins.10Among them the use of nebulised 3% saline in the treatment of bronchiolitis

in infants is still in controversy. Hence the current study was undertaken to compare the efficacy of nebulized 3% saline given along with supportive treatment to those receiving only supportive treatment, in decreasing the respiratory distress and duration of hospital stay among children with acute bronchiolitis.

Aims and Objectives

To study the effect of nebulised 3% saline on hospitalized children aged 4weeks to 2 years with acute bronchiolitis with regard to decrease in respiratory distress and duration of hospital stay.

MATERIAL AND METHODS

This was a hospital based prospective interventional non blinded controlled trial done in the age group of 4 weeks to 2 yrs admitted with acute bronchiolitis with a Respiratory Distress Assessment Instrument (RDAI)score of 4 to 15 [on a scale of 0 (mild) to 17 (severe)] in a teritiary care centre.

Preterm with corrected age of less than 4 weeks at presentation, children who received oral or inhaled corticosteroids during the preceding 2 weeks, previous episodes of wheezing, known chronic cardiopulmonary disease, immunodeficient children, severe respiratory distress (pulse > 200/min, respiratory rate > 80/min, or RDAI score above 15) or profound lethargy/ altered sensorium, and children who have received any inhaled drug therapy for the current disease were excluded from the study.

Diagnosis was mainly clinical, based on the presence of nasal discharge, wheezy cough, fine inspiratory crackles and/or high pitched expiratory wheeze.

Monitoring was done by measuring the oxygen saturation with pulse oximeter. The clinical status including the RDAI score, saturation was monitored every 2hrs for the first 6 hour and then every 6thhourly during the hospital stay. However, based on the child's condition the frequency of monitoring was increased if necessary.

Chest X-ray, complete blood count and other routine investigations was done as indicated. Supportive treatment like supplemental oxygen, maintenance of hydration, and antipyretics as required. Further each child in the study was grouped into one of the treatment groups. Group 1 was study group who received nebulised 3% saline with supportive treatment. Nebulised 3% saline 3ml per treatment every 2nd hourly for the first 3 doses followed by 4th hourly for 5 doses and then 6th hourly till 6 days or till discharge, whichever is earlier. Group 2 was control group who received only supportive treatment. An Increase in RDAI score by 2 points above the admission score, RDAI score >15 or SpO2 less than 94% despite oxygen therapy was the criteria to start additional treatment at any point of time.

Outcomes were measured in terms of improvement in oxygen saturation, clinical assessment including RDAI score and the duration of hospital stay. The outcomes were assessed based on:

1. The number of subjects who required change of treatment because of their clinical deterioration.
2. Comparison of change in the respiratory rate, RDAI score & saturation among those who responded to treatment in each of the groups.
3. Comparison of the mean duration of hospital stay in both the groups, among those who responded to treatment.
4. Comparison of the mean duration after which treatment was changed in both the groups, among those who did not respond to treatment.

RESULTS

Total number of children who fulfilled the criteria for this study were 57, out of which 28 were allotted to the study group & 29 in the control group. One from the study group left against medical advice and 27 subjects in the study group were assessed. Mean age of presentation in study group was 5.95 months (±2.68 months). Males (n=7; 25.93%) outnumbered females (n=20;74.07%). In control group, males comprised 62%(n=18) whereas females comprised 38%(n=11) of study population. The mean age in control group was 5.65 months (±2. 94 months)

The two groups were comparable with respect to the number of subjects having each of the symptoms except for hurried breathing, which was found to be more in Control group and was statistically significant. [Table 1]

The mean pulse rate at the time of admission in the control group was 143 bpm and study group was 135 bpm and comparable in both the groups (P=0.724). Mean respiratory rate was 66 cycles per minute in control group and 63 cycles per minute in study group and comparable in both groups(P=0.313). [Table 2]

The number of subjects with leukocytosis was more in the control group but the difference between the two groups was not statistically significant.62% children in the control group had leukocytosis compared to 37% children among the study group; however the difference between two groups was not statistically significant (P=0.062). The two groups were comparable (P=0.28) with respect to the number of subjects with chest x-ray changes. [Table 3]

The number of subjects for whom treatment was changed was more in control group when compared to the study group and it was statistically significant.

The mean duration for the change of treatment regimen was more in the study group when compared to the control group but it was not statistically significant (p=0.214).

In subjects of the control group for whom treatment was not changed (n=11) the mean respiratory rates at 0 hrs, 6hrs and 24 hrs after treatment were 66, 57

and 48 respectively showing a statistically significant change in the respiratory rate with treatment (p<0.001). [Table 4]

The difference between the beginning of treatment to 6 & 24 hrs after treatment & of that between 6th and 24thhr after initiation of treatment was statistically significant and the respiratory rate had decreased with treatment.

In subjects of the study group for whom treatment was not changed (n=19) the mean respiratory rates at 0 hrs , 6hrs and 24 hrs after treatment were 63, 58 and 49 respectively showing a statistically significant change in the respiratory rate with treatment (p<0.001). [Table 5]

The difference between the beginning of treatment to 6 & 24 hrs after treatment & of that between 6th and 24thhr after initiation of treatment was statistically significant and the respiratory rate had decreased with treatment.

The study showed that the change in Saturation within the control group at 6 and 24 hours after the treatment initiation was not statistically significant in contrast to the results found in the study group which showed statistically significant improvement in saturation. [Table 6]

The study showed that though the Saturation improved by 6hrs of treatment, the difference in saturation at 6hrs to that at the beginning of treatment was not significant statistically. While the difference between the beginning of treatment to 24 hrs after treatment & of that between 6th and 24thhr after initiation of treatment was statistically significant & had improved. [Table 7]

The changes in respiratory rate at various time intervals were compared between the study group and control group. This showed that the rate of decrease in Respiratory rate in both the groups, among those who responded to treatment, was similar. [Table 8]

The changes in Saturation at various time intervals were compared between the study group and control group among those who responded to treatment and they were similar.

The change RDAI score with treatment within control group at 0, 6 & 24hrs among subjects for whom treatment was not changed (n=11) was not statistically significant though it had decreased with treatment.

The change RDAI scores with treatment in the Study group at 0,6& 24hrs among subjects for whom treatment was not changed (n=19) was statistically significant with p=0.002. [Table 9]

The difference in RDAI scores in the study group from the beginning of the treatment to 6 & 24 hrs after treatment & of that between 6th and 24thhr after the initiation of treatment was statistically significant (p<0.05) and the RDAI score had decreased with treatment. [Table 10]

The mean RDAI score compared at 0hr, 6hr & 24hr after the initiation of treatment showed that the RDAI score has decreased in both the groups with the initiation of treatment and in both the groups, the mean of RDAI score at various time intervals were comparable (p>0.05). [Table 11]

The mean duration of hospital stay was less in Study group compared to Control group among those who responded to treatment, but the difference was not statistically significant (p=0.414). [Table 12]

Table 1: Comparison of both the group with respect to the number of subjects having each symptom (n=56)

Symptoms (n=56)	Control group	%	Study group	%	Total	%	P value
Cold, rhinorrhea	22	75.86	21	77.78	43	76.79	0.8370
Cough	22	75.86	19	70.37	41	73.21	0.5430
Fever	14	48.27	14	51.85	28	50.00	0.3280
Wheeze	13	44.82	16	59.26	29	51.79	0.4770
Fast breathing	20	37.93	11	74.07	31	55.36	0.0130
Chest indrawing	13	44.82	14	51.85	27	48.21	0.6360

Table 2: Comparison of control and Study group with respect to examination findings at the time of admission(n=56)

Clinical signs	Control (%)	Study (%)	P value
Retractions	23 (79.31)	26 (96.30)	0.103
Rhonchi	24 (82.76)	26 (96.30)	0.195
Crepitations	26 (89.65)	23 (85.19)	0.700

Table 3: Children in both the groups were comparable with respect to the number of children having hypoxia at the time of admission

Hypoxia	Study (%)	Control (%)	Total (%)	P value
Absent	26 (92.59)	24 (82.76)	50 (89.29)	0.195
Present	1 (7.41)	5 (17.24)	6 (10.71)	
Total	27 (100)	29 (100)	56 (100)	

Table 4: Comparison of the Study and the Control group with respect to number of subjects requiring change of treatment(n=56)

Group	Treatment not changed (%)	Treatment changed (%)	Total (%)	P value
Control	11 (36.7)	18 (69.2)	29 (51.8)	P=0.015
Study	19 (63.3)	8 (30.8)	27 (48.2)	
Total	30 (100)	26 (100)	56 (100)	

Table 5: Comparison of change in Respiratory rate with treatment in the Control group between various time intervals

Pair	Mean Difference	Std. Error	P value
RR at 0 & 6hr	8.30	2.20	0.008
RR at 0 & 24hr	16.76	3.77	0.002
RR at 6 & 24hr	8.46	2.81	0.033

Table 6: Comparison of change in Respiratory rate with treatment in the Study group between various time intervals

	Mean Difference	Std. Error	P value
RR at 0 & 6hr	5.09	0.9	<0.001
RR at 0 & 24hr	14.18	2.17	<0.001
RR at 6 & 24hr	9.09	1.61	<0.001

Table 7: Comparison of change in saturation with treatment in the Study group between various time intervals

	Mean Difference	Std. Error	P value
Saturation at 0 & 6hr	-0.68	0.35	0.196
Saturation at 0 & 24hr	-1.22	0.41	0.021
Saturation at 6 & 24hr	-0.54	0.17	0.013

Table 8: Comparison of the Study group (n=19) and the Control group (n=11) with respect to changes in Respiratory rate among subjects for whom treatment was not changed

	Group	Mean	Std. Deviation	Unpaired Student t test		
				Mean difference	T value	P value
RR change from 0 to 6hr	Control	6.00	8.07	1.11	0.62	0.533
	Study	4.88	4.55			
RR change from 0 to 6hr	Control	16.76	13.60	2.58	0.64	0.527
	Study	14.18	10.21			
RR change from 0 to 6hr	Control	8.46	10.13	-0.62	-0.21	0.835
	Study	9.09	7.55			

Table 9: Comparison of the Study group and the Control group with respect to changes in Saturation among subjects for whom treatment was not changed (n=30)

	Group	Mean	Std. Deviation	**Student t test**		
				Mean difference	T value	P value
Saturation change from 0 to 6hr	Control	0.31	2.15	0.97	1.84	0.071
	Study	-0.66	1.77			
Saturation change from 6 to 24hr	Control	-0.50	1.95	0.72	1.09	0.279
	Study	-1.22	1.92			
Saturation change from 0 to 24hr	Control	-0.28	0.72	0.25	0.98	0.333
	Study	-0.54	0.80			

Table 10: Comparison of change in RDAI with treatment in the Study group between various time intervals(n=19)

		N	Mean Rank	Sum of Ranks	P value
RDAI score change at 0 & 6hr	Negative Ranks	14	11.32	158.5	0.009
	Positive Ranks	5	6.3	31.5	
	Ties	8			
RDAI score change at 0 & 24hr	Negative Ranks	14	9.64	135	0.005
	Positive Ranks	3	6	18	
	Ties	5			
RDAI score change at 6 & 24 hr	Negative Ranks	9	5.61	50.5	0.013
	Positive Ranks	1	4.5	4.5	
	Ties	12			

Table 11: Comparison of the Study and the Control group with respect to RDAI scores at 0, 6 & 24hrs among subjects for whom treatment was not changed (n=30)

	Group	Mean	Std. Deviation	P value
RDAI score at 0hr	Control	7.27	1.30	0.749
	Study	7.17	0.94	
RDAI score at 6hr	Control	7.13	2.65	0.270
	Study	6.48	1.57	
RDAI score at 24hr	Control	6.07	2.43	0.964
	Study	6.04	1.67	

Table 12: Comparison of the Study and the Control group with respect to the mean duration of hospital stay among subjects for which treatment has not been changed (n=30)

Groups	N	Mean duration (in hrs)	Std. Deviation	Mean Difference	P value
Study group	19	84.63	21.88	5.91	0.414
Control group	11	90.55	11.46		

DISCUSSION

This study was aimed to compare the efficacy of 3% saline nebulization (in addition to supportive treatment), against the use of supportive treatment alone for the management of acute bronchiolitis.

In our study the percentage of males was higher than that of females both in the control and study group. A similar observation was found in AAP guidelines for acute bronchiolitis.

The mean age of presentation in the Control group was 5.65±2.94 months and in study group was 5.95±2.68 months. This is similar to other studies which showed peak between 2-6 months 2 and that of AAP, showing peak incidence at 7 months.[5]

The mean duration of cold, the most common complaint in both the groups, was 4.13±2.14 days in control group and 4.00±2.96 days in study group. This is similar to other studies conducted by Brian A. Kuziket al,[6] and Avigdor Mandelberg.[7] Both the groups were comparable with respect to mean duration of each of the symptom.

Both the groups were comparable with respect to the number of subjects having retractions, rhonchi and crepitation. The mean PR and RR at the time of admission were also comparable between the groups.

At the time of admission 2 (7.41%) patients in study group and 5 (17.24%) patients in control group had hypoxia, but the difference between the two groups was statistically not significant (p=0.195).

The number of subjects who had leucocytosis was comparable between the two groups (p=0.062). Chest X ray findings of hyperinflation was found in 13 (33.34%) subjects in control group and 16 (47.62%) subjects in study group. The difference between the two groups was statistically not significant (p=0.28).

Out of 29 subjects in control group, 18 (69.2%) required change of treatment as per the department protocols, which included use of other nebulised medications and antibiotics. While, only 8 (30.8%) subjects in the Study group required change of treatment. The difference between the two groups was significant (p=0.015) and means that the number of patients who improved by hypertonic saline nebulisations were more when compared to those on supportive treatment alone.

This Study showed that the use of 3% saline nebulisation in addition to supportive treatment is effective in improving the clinical conditions of a child with acute bronchiolitis. The study conducted by Linjie Zhang et al concluded that 3% saline group had a significantly lower post-inhalational clinical score than the 0.9% saline group.[12] This was a meta-analyses which included studies conducted by Mandelberg et al, Sarrell et al which showed the similar results.[7,8] The study conducted by Khalid Al-Ansari et al comparing efficacy and safety of 5%, 3% and 0.9% saline for acute bronchiolitis showed that the decrease in clinical severity score for 3% saline was more than that of 0.9% saline.[9]

In contrast, the study conducted by SimranGrewalet al10comparing nebulised racemic epinephrine in hypertonic saline and normal saline showed that there was no significant clinical improvement with the use of hypertonic saline, compared to normal saline.

The mean duration after which the treatment was changed in Study group was 37.50±14.61 hrs in Study group and 27.00±27.06 hrs in Control group. So, the patients in control group deteriorated faster than those in the Study group, but the difference was not statistically significant (p=0.214), which may be because of the small sample size in our study.

Further analyses of data, from those who had no modifications in the treatment in both study and control group was done. (19 in study group and 11 in control group).

The analysis of both the groups with respect to the changes in RR showed that the decrease in RR in both the study and control group after 6 and 24 hours of initiation of treatment was statistically significant within the group. Then the change in RR with treatment was compared between both the groups, and was found to be not significant (p>0.05).

Assessment of saturation showed that the saturation improved significantly with treatment only in study group and not in control group. Then the change in saturation with treatment was compared between both the groups, and was statistically not significant (p>0.05). This may be because of significantly higher loss of subjects from further analysis in control group due to the need for additional treatment

Assessment of RDAI scores showed that the RDAI score reduced significantly with treatment only in study group and not in control group. Then the change in RDAI score with treatment was compared between both the groups, and was statistically not significant (p>0.05). This may be because of the small sample size in our study.

The study by Susan Wu et al, SimranGrewal et al showed no significant improvement in Clinical severity scores with the use of 3%NS nebulisation. The study conducted by AvigdorMandelberg et al showed that the use of 3% saline nebulisation reduced the clinical severity scores.[11,9,7] The mean duration of hospital stay among those subjects who responded to treatmentinstudy group was 84.63±21.88 hrs while it was 90.55±11.46 hrs in control group with no statistically significant difference (p=0.414). The study conducted by Susan Wu et al comparing the use of 0.9% NS and 3% NS also didn't show any significant difference in the length of the hospital stay, while the meta-analysis done by Zhang L et al showed significant reduction in length of hospital stay. This difference may be because of significant loss of subjects in control group for follow up, who have deteriorated with

supportive treatment alone and have undergone change of treatment.[12,11]

No adverse effects like excessive cough or episodes of bronchospasm while receiving nebulisation was noted in our study. The retrospective study conducted by Shawn Ralston et al, showed that the use of 3% saline without adjunctive bronchodilators had lower rates of adverse effects.[13]

CONCLUSION

The number of children who improved in Study group without requiring additional treatment was significantly more when compared to control group. So, we conclude that use of 3% saline nebulisation, in addition to supportive treatment is useful in reduction of clinical symptoms. There was significant decrease in Respiratory rate and RDAI scores with the use of 3% NS nebulisation. The duration of hospital stay was less and the time required for change of treatment was more in Study group, but statistical significance could not be established.

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