

Observation of curative effect of nasal continuous positive airway pressure combined with high-dose ambroxol for neonatal respiratory failure

Zhen Liu^{1,2,3}, Jinghan Chi^{1,2,3} and Zhichun Feng^{1,2,3*}

¹BaYi Children's Hospital, Clinical Medical College in PLA Army General Hospital, Southern Medical University, Beijing, China

²National Engineering Laboratory for Birth Defects Prevention and Control of Key Technology, Beijing, China

³Beijing Key Laboratory of Pediatric Organ Failure, Beijing, China

Abstract: To observe and analyze the effectiveness of nasal continuous positive airway pressure for neonatal respiratory failure. The 200 newborns with respiratory failure treated in our hospital. They were enrolled as study subjects and assigned to study group and reference group with equal number of cases. The study group was treated with continuous positive airway pressure plus high-dose ambroxol, while the reference group only received high-dose ambroxol. The overall treatment effect was compared between the two groups. Observation of the overall treatment efficacy of the study group and the reference group showed that the study group was superior to the reference group, $P < 0.05$; comparison of such treatment indicators as disappearance of shortness of breath, disappearance of cyanosis, disappearance of groaning, assisted ventilation duration, hospital stay showed that the study group was significantly superior to the reference group, $P < 0.05$; comparison of arterial oxygen partial pressure, oxygen saturation, and carbon dioxide partial pressure showed differences between groups, $P < 0.05$. Treatment of neonatal respiratory failure with nasal continuous positive airway pressure plus high-dose ambroxol can achieve good results and reduce hospital stay.

Keywords: Nasal continuous positive airway pressure, high-dose ambroxol, newborn, respiratory failure.

INTRODUCTION

Neonatal respiratory failure as a common complication of neonatal respiratory diseases is a key factor causing neonatal death. There are more susceptibility factors for neonatal respiratory failure (Liu 2014, Fang *et al.*, 2015, Gao and Chen 2015, Sarwar *et al.*, 2017) including: weak respiratory muscles, few fatigue-resistant muscle fibers in the diaphragm in particular. Newborns who need a large amount of oxygen must rely on breathing to promote compensation. With small trachea that means greater resistance, poor cilia motor function, neonates are prone to obstruction of airway secretions, thereby causing ventilation dysfunction (Barkat and Mahmood 2018). Their immature alveolar structure and function means ventilation disorder is possible. With poor immunity, they are prone to lung infection. The various factors cause suffocation, resulting in increased pulmonary vascular resistance and pulmonary hypertension, thereby triggering heart failure and respiratory failure (Huddy *et al.*, 2017, Khan *et al.*, 2017).

In case of neonatal respiratory failure, it is imperative to improve the accuracy of diagnosis, and take effective treatment in a timely manner to improve treatment success rate. It is essential to ensure the best prognosis effect (Farid *et al.*, 2018). The key to the treatment of neonatal respiratory failure lies in hypoxia correction, and

mechanical ventilation and non-invasive ventilation are generally adopted schemes for the disease. This study is to observe and analyze the effect of nasal continuous positive airway pressure plus high-dose ambroxol for neonatal respiratory failure, with specific contents shown as follows.

MATERIALS AND METHODS

The 200 children with neonatal respiratory failure who were treated in our hospital from January 2015 to December 2017, were enrolled as the study subjects. All the patients met clinical diagnostic criteria for neonatal respiratory failure. The children's clinical manifestations included dyspnea, cyanosis, arrhythmia and renal dysfunction. This paper has a rigorous structure, and the conclusion has been approved by relevant ethics and relevant departments..

In this study, the children's family members have signed the formal informed consent. The children were divided into study group and reference group, each having 100 cases. Where, there were 55 male children and 45 female children in the study group, with an average gestational age at (36.29 ± 2.37) weeks and an average body weight at (2.3 ± 0.9) kg. There were 52 male children and 48 female children in the reference group, with an average gestational age of (36.33 ± 2.56) weeks and an average body weight at (2.4 ± 0.5) kg. Comparison of the relevant data of the two group showed comparability, $P > 0.05$.

*Corresponding author: e-mail: zhjfengzc@126.com

Both groups were treated with conventional treatment programs including anti-infection, maintaining electrolyte balance and acid-base balance, fluid infusion etc., to actively maintain steady state of internal environment and improve micro-circulation. Meanwhile, nutritional support and symptomatic treatment initiatives were also implemented. The reference group was only given ambroxol hydrochloride treatment, i.e. intravenous infusion of 7.5 mg ambroxol hydrochloride for four times a day. With 15 minutes or more each time, one course of treatment lasted 5 days. The study group was treated with ambroxol hydrochloride plus nasal continuous positive airway pressure. The initial oxygen flow was 4-6L/min, which can be scientifically adjusted to 2-4L/min if the patient's condition is relatively stable. The oxygen inhale concentration was between 30%-50%, and the nasal continuous positive airway pressure was between 0.39kPa-0.59kPa. According to the monitored clinical symptoms and blood gas analysis results, the positive end-expiratory pressure and oxygen inhale concentration were reasonably adjusted. When the children were in a stable state with condition fully improved, nasal continuous positive airway pressure was appropriately removed.

The overall treatment efficacy of the two groups was observed and compared, including the three criteria of markedly, effective, and invalid. Where, the markedly evaluation criterion is that ventilation is significantly improved after treatment, the machine can be removed without external intervention (Field *et al.*, 2015, Kanwal *et al.*, 2018); the effective evaluation criteria is that children occasionally have tight breath, nasal continuous positive airway pressure can be removed without external assistance in treatment; the invalid criterion is there is no change after treatment or even the condition aggravates.

STATISTICAL ANALYSIS

The statistical analysis software used was SPSS 21.0. Where, the measurement data were expressed as mean \pm average $\bar{x} \pm s$ and t was used for comparison between groups; the count data was expressed using natural numbers (n) and percentages (%), and χ^2 was used for comparison between groups. $P < 0.05$ indicates statistical value.

RESULTS

Comparison of overall treatment efficacy between the two groups

As shown in table 1, comparison of the overall treatment efficacy between the two groups shows that the study group treated with nasal continuous positive airway pressure plus high-dose ambroxol is superior to the reference group, with significant difference from the latter, $P < 0.05$, statistically significant.

Comparison of the disappearance of clinical symptoms and hospital stay between the two groups

As shown in table 2, comparison of disappearance of clinical symptoms and hospital stay in the two groups shows that the study group is superior to the reference group, $P < 0.05$, statistically significant.

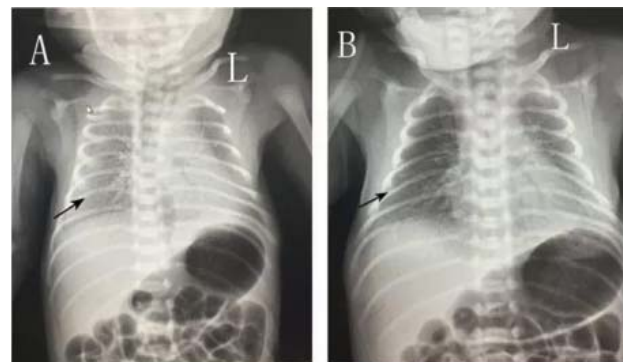


Fig. 1: Comparison of X-ray films before and after treatment of the children in the study group.

Comparison of arterial oxygen partial pressure, oxygen saturation and carbon dioxide partial pressure in the two groups

As shown in the table 3, comparison of the arterial blood oxygen pressure, oxygen saturation, and carbon dioxide partial pressure indicates that the study group is significantly superior to the reference group after treatment, $P < 0.05$, statistically significant.

Comparison of X-ray films before and after treatment of the children in the study group

The Comparison of X-ray films before and after treatment of the children in the study group is shown as fig. 1. From fig. 1, Comparison of X ray film of child patients in research group before and after treatment is shown in fig. 1. It can be seen that the pulmonary manifestation (arrow) is significantly improved, indicating better respiratory conditions of patients.

DISCUSSION

Respiratory failure is respiratory abnormality caused by various factors, which makes normal metabolism of lung gas impossible, reduces blood oxygen concentration and increases blood carbon dioxide concentration (Du *et al.*, 2016). Failure to timely and effectively treat the disease will easily lead to abnormal metabolism in various organ tissues of the body, and will seriously threaten the life safety of children. Currently, widespread clinical treatment program is nasal continuous positive airway pressure plus high-dose ambroxol, and good results are generally achieved (Pang and Li 2017, Rehder *et al.*, 2017). Ambroxol hydrochloride as a medicine for sputum excretion can promote the discharge of respiratory secretions, actively improve respiratory conditions, and promote the growth and secretion of pulmonary

Table 1: Comparison of overall treatment efficacy between the two groups [n(%)]

Group	Case number	Markedly	Effective	Invalid	Total effective rate
Study group	100	68	30	2	98(98.00)
Reference group	100	42	40	18	82(82.00)
χ^2					16.52
P					<0.05

Table 2: Comparison of disappearance of clinical symptoms and hospital stay between two groups ($\bar{x} \pm s$)

Group	Disappearance of shortness of breath (d)	Disappearance of cyanosis (d)	Disappearance of groaning (d)	Assisted ventilation duration (d)	Hospital stay (d)
Study group (n=100)	2.04±0.18	0.93±0.25	1.01±0.36	3.65±1.20	8.60±2.31
Reference group (n=100)	3.18±0.22	1.80±0.33	1.98±0.52	5.48±1.63	10.58±3.26
t	4.38	6.04	5.32	6.16	5.30
P	<0.05	<0.05	<0.05	<0.05	<0.05

Table 3: Comparison of arterial oxygen partial pressure, oxygen saturation and carbon dioxide partial pressure in the two groups

Group	Case number	Arterial oxygen partial pressure (mmHg)	Carbon dioxide partial pressure (mmHg)	Oxygen saturation a (%)
Study group	100	95.28±4.28	35.18±5.08	98.05±5.93
Reference group	100	80.29±6.35	42.19±4.25	90.58±3.17
t		14.08	10.62	9.16
P		<0.05	<0.05	<0.05

surfactant, ultimately achieving rapid growth of lung tissue (Kattan, González, Becker, 2018; Vander, Spoel, Laas, 2016; Maryam *et al.*, 2017). Ambroxol for neonatal respiratory failure can accelerate formation of pulmonary surfactants, and actively improve lung ventilation, thus helping children recover better. In addition, nasal continuous positive airway pressure can enhance respiratory drive, and help reduce the upper airway resistance, promote release while effectively reducing consumption of alveolus pulmonis surfactant, ultimately realizing high-frequency ventilation effect. The combined use of nasal continuous positive airway pressure and high-dose ambroxol treatment can better increase the ventilation of the lungs, improve the ventilation function, help children improve the clinical symptoms, enhance comfort degree and promote prognosis.

This study shows that the study group treated with nasal continuous positive airway pressure plus high-dose ambroxol is superior in terms of total effective rate, with obvious difference from the reference group, $P < 0.05$, statistically significant. Moreover, disappearance time of clinical symptoms and hospital stay are significantly shorter in the study group than the reference group, $P < 0.05$, statistically significant. In addition, the study group is superior in terms of arterial oxygen partial pressure, oxygen saturation, and carbon dioxide partial pressure, $P < 0.05$, and the effect is significant.

CONCLUSION

In summary, treatment of neonatal respiratory failure with nasal continuous positive airway pressure plus high-dose ambroxol can achieve good results as demonstrated in shorter hospital stay and significant application effects.

ACKNOWLEDGEMENTS

The study was supported by the Sanming Project of Medicine in Shenzhen (No. SZSM201606088).

REFERENCES

- Barkat MQ and Mahmood HK (2018). Phytochemical and antioxidant screening of *Zingiber officinale*, *Piper nigrum*, *Rutag raveolanes* and *Carum carvi* and their effect on gastrointestinal tract activity. *Matrix Science Medica*, 2(01): 09-13.
- Du GP, Ren XL and Li H (2016). Clinical analysis of bi-level positive airway pressure for neonatal respiratory failure. *Shenzhen Journal of Integrated Traditional Chinese and Western Medicine*, 26(03): 138-140.
- Fang PC, Yue HZ, Gao LX and Chen YF (2015). Observation of curative effect of nasal continuous positive airway pressure combined with high-dose ambroxol for neonatal respiratory failure. *Chinese Journal of Clinical Rational Drug Use*, 8(04): 112-113.

- Farid A, Khaliq T, Sher HA, Mushtaq A and Abid A (2018). Renal clearance and urinary excretion of moxifloxacin in healthy male volunteers. *Matrix Science Pharma*, **2**(01): 19-22.
- Field D, Elbourne D and Truesdale A (2015). Neonatal ventilation with inhaled nitric oxide versus ventilatory support without inhaled nitric oxide for preterm infants with severe respiratory failure: the INNOVO multicentre randomised controlled trial (ISRCTN 17821339). *Pediatrics: Official Publication of the American Academy of Pediatrics*, **115**(4): 926-936.
- Gao LX and Chen YF (2015). Effects of nasal continuous positive airway pressure on plasma brain natriuretic peptide concentration in neonates with respiratory failure. *Chinese Journal of Clinical Rational Drug Use*, **8**(07): 173-174.
- Huddy CL, Bennett CC and Hardy P (2017). The INNOVO multicentre randomised controlled trial: neonatal ventilation with inhaled nitric oxide versus ventilatory support without nitric oxide for severe respiratory failure in preterm infants: Follow up at 4-5 years. *Archives of disease in childhood. Fetal and Neonatal Edition*, **93**(6): 430-435.
- Kanwal A, Aslam B, Mushtaq A, Anwar H and Ahmed HM (2018). Gastroprotective effect of *Avena sativa* (Oat) seed grains against gastric ulcer induced by indomethacin in healthy adult male albino rabbits. *Matrix Science Pharma*, **2**(01): 14-18.
- Kattan J, González A and Becker P (2018). Survival of newborn infants with severe respiratory failure before and after establishing an extracorporeal membrane oxygenation program. *Pediatric Critical Care Medicine* (A journal of the Society of Critical Care Medicine and the World Federation of Pediatric Intensive and Critical Care Societies), **14**(9): 876-883.
- Liu ZM (2014). Observation of clinical efficacy of ambroxol combined with nasal continuous positive airway pressure in the treatment of neonatal hyaline membrane disease. *Journal of Clinical Medical Literature*, **1**(09):1547.
- Maryam A, Aslam S, Saif S, Aslam T, Tusleem K, ul Qamar MT, Abdullah I, Mushtaq A, Khalid RR and Siddiqi AR (2017). Statistical analysis of risk factors affecting the prognosis of biliary atresia in infants. *Matrix Science Pharma*, **1**(02): 20-24.
- Pang JZ and Li Y (2017). Study on the effect of nasal continuous positive airway pressure on neonatal ventilation function. *World Latest Medicine Information*, **17**(14): 67-74.
- Raza A, Qamar AG, Manzoor A, Ijaz M, Hayat K, Rehmanand T and Muhammad G (2017). Detection of biofilm production by *Staphylococcus aureus* and in-vitro inhibition of biofilm using serum antibodies. *Matrix Science Medica*, **1**(02): 07-10.
- Rehder KJ, Turner DA and Cheifetz IM (2017). Extracorporeal membrane oxygenation for neonatal and pediatric respiratory failure: An evidence-based review of the past decade (2002-2012). *Pediatric Critical Care Medicine: A journal of the Society of Critical Care Medicine and the World Federation of Pediatric Intensive and Critical Care Societies*, **14**(9): 851-861.
- Sarwar MS, Subhani Z, Bilal M and Nazir QA (2017). Medicinal efficacy of antihypertensive agents for acute inflammation; an associated risk factor of hypertension. *Matrix Science Medica*, **1**(02): 13-15.
- Vander CZ, Spoel M and Laas R (2016). Exercise capacity, daily activity and severity of fatigue in term born young adults after neonatal respiratory failure. *Scandinavian Journal of Medicine and Science in Sports*, **24**(1): 144-151.