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Study on the Effects of Curosurf Combined with Budesonide on Blood Gas Analysis Indices and Complications in the Treatment of Respiratory Distress Syndrome in Premature Infants

Xiaohui Peng*
The Second Affiliated Hospital of Shaoyang University, Shaoyang 422000, Hunan, China

**Author to whom correspondence should be addressed.*

Abstract: *Objective:* To investigate the effects of Curosurf combined with budesonide on blood gas indices and complications in the treatment of respiratory distress syndrome in premature infants. *Methods:* From October 2021 to October 2023, 60 premature infants with respiratory distress syndrome were selected from our hospital and divided into a control group and an observation group, with 30 infants in each group. The value of the treatment was compared between the two groups. *Results:* The observation group had lower mechanical ventilation time, hospital stay, $PaCO_2$ level, and complications than the control group ($p < 0.05$). The pH, PaO_2, OI index levels, and total effective rate were higher in the observation group than in the control group ($p < 0.05$). *Conclusion:* The combination of Curosurf and budesonide in the treatment of respiratory distress syndrome in premature infants can effectively optimize blood gas analysis indices and improve treatment outcomes. It is worthy of clinical promotion.
Keywords: Respiratory distress syndrome in premature infants; Curosurf; Budesonide; Blood gas analysis indices; Complications

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1. Introduction

Neonatal respiratory distress syndrome is an acute lung disease that frequently occurs in neonates. It is usually caused by various etiologies, leading to respiratory obstruction and failure. The incidence of this disease is closely related to neonatal gestational age, with shorter gestation being more susceptible.

Weight is also a factor, and premature infants with shorter gestation and lower weight are more likely to be diagnosed with respiratory distress syndrome. Prompt and targeted treatment measures must be implemented to improve respiratory status [1,2]. High-frequency oscillatory ventilation combined with conventional ventilation is an effective treatment for severe respiratory distress syndrome, especially suitable for children. However, relying solely on mechanical ventilation to alleviate symptoms cannot fully restore lung function [3]. Budesonide, as an innovative hormone therapy drug, exhibits excellent anti-inflammatory and anti-allergic effects. It can effectively alleviate lung inflammation, reduce airway resistance, and improve respiratory ventilation efficiency [4,5].

Curosurf, as a natural lung surfactant, has the ability to reduce alveolar surface tension, helping to enhance lung function, prevent alveolar collapse, and effectively optimize gas exchange and improve oxygenation [6,7]. Based on this, this article aims to investigate the effects of Curosurf combined with budesonide on blood gas analysis indices and complications in the treatment of respiratory distress syndrome in premature infants.

2. Materials and methods

2.1. General information

From October 2021 to October 2023, 60 premature infants with respiratory distress syndrome were selected from our hospital and divided into a control group and an observation group, with 30 infants in each group. The general information of the two groups was balanced and comparable ($p > 0.05$). See **Table 1**.

Table 1. Comparing the general information of the two groups

General information		Control group (n = 30)	Study group (n = 30)	t/χ^2 value	*p*-value
Gestational age (weeks)		32.50 ± 3.60	32.00 ± 3.20	0.568	0.571
Sex (n)	Male	19	16	0.617	0.432
	Female	11	14		
Weight (kg)		2.35 ± 0.44	2.25 ± 0.40	0.921	0.360
NRDS grade (n)	Grade I	6	7	2.911	0.087
	Grade II	8	10		
	Grade III	16	13		
Delivery mode (n)	Vaginal delivery	17	20	0.634	0.425
	Cesarean section	13	10		

2.1.1. Inclusion criteria

(1) Meet the diagnostic criteria for RDS in premature infants [8];

(2) Family members sign the informed consent form.

2.1.2. Exclusion criteria

(1) Other serious diseases;

(2) Allergy to Curosurf or budesonide;

(3) Unable to complete the treatment cycle;

(4) Withdraw from this study;

(5) Unable to follow up.

2.2. Methods

2.2.1. Control group

Within 2 hours after birth, clean the respiratory tract, place the infant on a warming table, and administer Curosurf (100–200 mg/kg). Adjust the ambient temperature to 37 °C. Subsequently, administer the medication through the trachea, perform pressurized oxygen inhalation for 3–5 minutes, and then provide oxygen through a nasal cannula or hood. The airway is not cleared within 6 hours.

2.2.2. Observation group

Nebulize budesonide suspension (Chengdu Zhengda Tianqing Pharmaceutical Group Co., Ltd., H20203063, 2 mL:1 mg), 0.5 mg each time, twice a day. The treatment method for Curosurf is the same as that for the control group.

2.3. Observation indicators

2.3.1. Comparison of mechanical ventilation time and hospital stay

Observe and record the mechanical ventilation time and hospital stay for both groups.

2.3.2. Comparison of arterial blood gas indicators before and after treatment

Collect approximately 3 mL of fasting venous blood samples from the infants before and after treatment. Use the ST2000 blood gas analyzer (produced by Wuhan Mingde Biotechnology Co., Ltd.) to measure pH, arterial oxygen partial pressure (PaO_2), arterial carbon dioxide partial pressure ($PaCO_2$), and oxygenation index (OI).

2.3.3. Comparison of complication rates

Record the incidence of pneumothorax, ventilator-associated pneumonia, bronchospasm, pulmonary hemorrhage, and pulmonary infection in both groups.

2.3.4. Comparison of clinical treatment effects

Significant effectiveness refers to the obvious relief of symptoms such as dyspnea, chest oppression, and rapid heartbeat, and complete recovery of lung function; effectiveness refers to significant improvement in symptoms and lung function; if there is no improvement in symptoms, it is considered ineffective. Effective rate = significant effectiveness + effectiveness.

2.4. Statistical processing

Statistical analysis was performed using SPSS 24.0 software. Measurement data are expressed as mean ± standard deviation (SD), and the *t*-test was used for comparison. Count data are expressed as percentages, and the χ^2 test was used for comparison. $p < 0.05$ indicates a statistically significant difference.

3. Results

3.1. Comparison of mechanical ventilation time and hospital stay

The mechanical ventilation time and hospital stay in the observation group were lower than those in the control group, with a significant difference ($p < 0.05$). See **Table 2**.

Table 2. Comparison of mechanical ventilation time and hospital stay [($\bar{x} \pm s$), d]

Group	Number of cases	Duration of mechanical ventilation (days)	Hospitalization duration (days)
Control group	30	8.76 ± 0.42	34.16 ± 2.94
Study group	30	6.37 ± 0.58	28.43 ± 5.67
t-value		18.28	4.914
p-value		0.001	0.008

3.2. Comparison of arterial blood gas indicators

After treatment, the observation group had higher pH, PaO_2, and OI values than the control group, while $PaCO_2$ was lower in the observation group. There were significant differences between the two groups ($p < 0.05$). See **Table 3**.

Table 3. Comparison of arterial blood gas indicators

Group	Cases	pH-Value		PaO_2 (mmHg)		PaO_2 (mmHg)		OI (mmHg)	
		Pre-treat	Post-treat	Pre-treat	Post-treat	Pre-treat	Post-treat	Pre-treat	Post-treat
Control group	30	5.39 ± 0.74	6.20 ± 0.95	43.29 ± 6.52	60.38 ± 6.97	61.34 ± 5.27	49.16 ± 4.39	227.42 ± 18.35	342.36 ± 22.54
Observation group	30	5.32 ± 0.70	7.38 ± 1.06	43.20 ± 6.47	71.24 ± 7.48	61.41 ± 5.35	32.60 ± 3.78	227.33 ± 18.27	401.80 ± 25.47
t-value		0.376	4.541	0.053	5.818	0.051	15.660	0.019	9.572
p-value		0.707	0.002	0.957	0.001	0.959	0.001	0.984	0.001

3.3. Comparison of complication rates

The incidence rate in the observation group was lower than that in the control group, but there was no significant difference ($p > 0.05$). See **Table 4.**

Table 4. Comparison of complication rates [n/%]

Group	Cases	Pneumothorax	VAP[1]	Bronchospasm	Pulmonary hemorrhage	Pulmonary infection	Total incidence
Control group	30	2 (6.66)	1 (3.33)	2 (6.66)	0 (0.00)	1 (3.33)	6 (20.00)
Observation group	30	1 (3.33)	0 (0.00)	1 (3.33)	0 (0.00)	1 (3.33)	3 (10.00)
χ^2-value							1.176
p-value							0.278

3.4. Comparison of clinical treatment effects

The total effective rate in the observation group was higher than that in the control group, with significant differences ($p < 0.05$). See **Table 5**.

Table 5. Comparison of clinical treatment effects [n/%]

Group	Cases	Markedly effective	Effective	Ineffective	Total effective rate
Control group	30	12 (40.00)	10 (33.33)	8 (26.66)	22 (73.33)
Observation group	30	17 (56.66)	11 (36.66)	2 (6.66)	28 (93.33)
χ^2-value					4.320
p-value					0.037

4. Discussion

Respiratory distress syndrome (RDS) originates from insufficient or deficient surfactant produced by alveolar type II cells. This condition makes it difficult for alveoli to fully expand, preventing air from normally entering the lungs, which leads to respiratory symptoms caused by an imbalance between ventilation and perfusion. This symptom is particularly common in premature infants, with common manifestations including accelerated breathing and reduced breath sounds in both lungs. In extreme cases, it can cause the lungs to appear pale, resulting in neonatal hypoxemia [9,10]. In the treatment of premature infants with RDS, continuous positive airway pressure ventilation therapy can maintain the normal structure of the respiratory tract, and its application significance cannot be ignored. However, it cannot ensure stable tidal volume and ventilation safety of the airway. Additionally, this therapy may increase the risk of barotrauma to the lung tissue, limiting its clinical application [11].

According to the results of this study, compared to the control group, the observation group treated with RDS in premature infants had higher pH, PaO_2, and OI indicators, and lower $PaCO_2$, indicating that the combination of Curosurf and budesonide can significantly improve blood gas indicators. In addition, the observation group had shorter durations of mechanical ventilation and hospital stays, as well as a lower complication rate. This benefit is attributed to budesonide's ability to quickly stabilize children's lung cell membranes, reduce the production and release of inflammatory mediators, alleviate respiratory mucosal edema, and promote the constriction of respiratory blood vessels. These effects reduce respiratory impedance and enhance the smoothness of lung ventilation function, showing significant efficacy in the treatment of children with such diseases [12,13]. Curosurf, extracted from pig lungs, contains phospholipids such as phosphatidylethanolamine. Supplementing alveolar surfactant can reduce surface tension, maintain alveolar stability, enhance ventilation function, and improve blood gas indicators [14,15].

In summary, the treatment of respiratory distress syndrome in premature infants with Curosurf plus budesonide can optimize blood gas indicators, improve efficacy, and reduce complications. However, due to time constraints and various other factors, the sample size selected in this study was relatively small. The results obtained may vary to some extent. Therefore, in subsequent clinical studies, the sample size needs to be expanded, and patient prognosis should be analyzed. Additional studies are needed to make the results more accurate and provide precise data theoretical support for clinical practice.

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