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Efficacy of budesonide combined with cefoperazone sodium and sulbactam sodium in the treatment of neonatal pneumonia and its influence on serum inflammatory factors

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Abstract: To analyze the efficacy of budesonide combined with cefoperazone sodium and sulbactam sodium in neonatal pneumonia, and observe its effect on serum inflammatory indicators. 96 patients with neonatal pneumonia admitted to our hospital from January 2023 to January 2024 were selected as the research objects, and they were divided into a control group and an observation group using random number table method, with 48 cases in each group. The control group was treated with speridone and sulbactam, and the observation group was treated with budesonide on the basis of the control group. The clinical efficacy, lung function indicators [peak volume ratio (VPEF/VE), peak expiratory flow (TPEF/TE)], and serum inflammatory factors [C-reactive protein (CRP), interleukin-6 (IL-6), matrix metalloproteinase 9 (MMP-9) and leukotriene B4 (LTB4)] levels were compared between the two groups. Compared the clinical efficacy of the two groups, the levels of VPEF/VE, TPEF/TE and PEF in the observation group were higher than those in the control group (P <0.05); after treatment, the levels of VPEF/VE, TPEF/TE and PEF in the study group were higher than those in the control group (P<0.05); after treatment, the levels of CRP, IL-6, MMP-9 and LTB4 in the observation group were significantly lower than those in the control group (P<0.05). Budesonide combined with cefoperazone sodium and sulbactam sodium in the treatment of neonatal pneumonia can improve clinical efficacy, improve lung function, and reduce serum inflammatory factor levels.

Keywords: Neonatal Pneumonia; Budesonide; Cefoperazone Sodium and Sulbactam Sodium; Lung Function; Inflammatory Factors

Neonatal pneumonia is a common and serious respiratory disease, known for its high incidence and life-threatening [1].According to statistics from the World Health Organization, approximately 1.5 million newborns worldwide die from pneumonia every year, making pneumonia one of the key factors in death among children under the age of five [2-3].In China, neonatal pneumonia is also a key factor in neonatal death, especially in premature births and low-weight newborns [4].At present, the treatment methods for neonatal pneumonia mainly include anti-infectious antibiotic treatment, comprehensive supportive therapy and oxygen therapy [5].Cefoperazone sodium and sulbactam sodium are a widely used antibiotic. Although often used to treat this disease, the effect is not always satisfactory when used alone [6].Glucocorticoids, especially the inhaled glucocorticoid budesonide, have attracted increasing attention for their role in the treatment of pneumonia due to their anti-inflammatory, reduced fluid exudation and improved respiratory function. The purpose of this study is to evaluate the effect of budesonide combined with cefoperazone sodium and sulbactam sodium in the treatment of neonatal pneumonia, and to explore its effect on serum inflammatory factor levels, in order to provide an innovative perspective and scientific basis for the clinical treatment of neonatal pneumonia.

1. Data and methods

1.1 General data

96 patients with neonatal pneumonia admitted to our hospital from January 2023 to January 2024 were selected as the research objects, and they were divided into a control group and an observation group using random number table method, with 48 patients in each group. In the control group, there were 27 males and 21 females respectively; the age was 10 - 28 days, with an average age of (18.42±1.96) days; the course of disease was 1 - 6 days, with an average of (3.62±0.75) days. In the observation group, there were 29 males and 19 females respectively; the age was 10 - 29 days, with an average age of (18.72±2.04) days; the course of disease was 1 - 6 days, with an average of (3.77±0.81)

days. The two sets of general data were compared (P>0.05) and were comparable.

Inclusion criteria: ① Meet the diagnostic criteria for neonatal pneumonia [7]; ② Have different degrees of dyspnea symptoms; ③ The patient and his family sign the informed consent form.

Exclusion criteria: ① Complications such as congenital heart disease and respiratory failure; ② abnormal liver function; ③ neonatal jaundice; ④ Allergy to the drug in this study.

1.2 Treatment methods

Children in the control group received intravenous injection of cefoperazone and sulbactam (Sinopharm Xingsha Pharmaceutical (Xiamen) Co., Ltd., Chinese Medicine Approval Zi: H20041485) twice a day at a dose of 30mg/kg each time.

In addition to the control group, the observation group received nebulized inhalation treatment with budesonide (Shanghai Shangyao Xinyi Pharmaceutical Factory Co., Ltd., Chinese Medicine Approval Zi: H20010552), also twice a day, 1mg each time. The course of treatment for children in both groups was 7 days.

1.3 Observation indicators

Clinical efficacy [8]:The temperature recovery time, cough disappearance time, lung moist rales disappearance time, and shortness of breath disappearance time were compared between the two groups before and after treatment. Significantly effective: Clinical symptoms completely disappeared, X-ray examination showed no patchy shadows on the chest, and wet sounds in the lungs disappeared; Effective: Clinical symptoms were significantly improved, X-ray examination showed that the density of patchy shadows on the chest decreased, and wet rales in the lungs were reduced; Invalid: Clinical symptoms, X-ray examination, and wet rales in the lungs did not improve or worsen. Total effective rate =(effective + effective) number of cases/total number of cases ×100%.

Lung function indicators: To compare the lung function indicators between the two groups before and after treatment, we used the MasterScreenPaed lung function instrument produced by Jaeger Company to monitor the following indicators:Peak volume ratio（Volume of Expiratory Flow at Peak Expiratory Flow Ratio,VPEF/VE）、peak time（Time to Reach Peak Expiratory Flow,TPEF/TE）、peak expiratory flow（Peak Expiratory Flow,PEF）.

Serum inflammatory factors: Before the start of treatment and after 7 days of treatment, 3 milliliters of venous blood were collected under fasting conditions in the morning, centrifuged at a speed of 3000 revolutions per minute for 10 minutes, and stored at-20 ℃ for testing. Using the A4500 microplate reader produced by Shanghai Xinhua Taikang Biotechnology Co., Ltd., the serum levels of inflammatory mediators in the two groups of children, including C-reactive protein, were compared by enzyme-linked immunosorbent assay (ELISA) method (C-Reactive Protein (CRP), interleukin-6 (IL-6), matrix metalloproteinase-9 (MMP-9), and leukotriene B4 (LTB4).

1.4 Statistical methods

All data were input into SPSS22.0 software, and the counting and measurement data were expressed respectively using “[n (%)]” and “($\bar{x} \pm s$)”, and the corresponding inter-group tests were carried out using “χ2’”and” t “. The grade data were expressed as”[n (%)]”, and the rank sum test was performed. P<0.05 indicated that the difference was statistically significant.

2. Results

2.1 Clinical efficacy

Compared the clinical efficacy of the two groups, the observation group was higher than that of the control group (P<0.05), as shown in Table 1.

Table1 Comparison of clinical efficacy between the two groups [n(%)]

Group	Number	Excellence	Effective	Invalid	Total Effective Rate
Control Group	48	25(52.08)	11(22.92)	12(25.00)	36(75.00)
Observation Group	48	39(81.25)	7(14.58)	2(4.17)	46(95.83)
$\chi 2$					8.362
P					0.004

2.2 Lung function indicators

After treatment, the levels of VPEF/VE, TPEF/TE and PEF in both groups were increased ($P < 0.05$), and the levels of VPEF/VE, TPEF/TE and PEF in the study group were increased.TPEF/TE and PEF levels were higher than those in the control group ($P < 0.05$), as shown in Table 2.

Table2 Comparison of pulmonary function indicators between the two groups before and after treatment($\overline{x} \pm s$)

Group	Number	VPEF/VE（%）		TPEF/TE（%）		TPEF/TE（%）	
		Before Treatment	After Treatment	Before Treatment	After Treatment	Before Treatment	After Treatment
Control Group	48	29.59±4.17	33.83±3.96*	29.76±5.53	34.47±5.84*	57.38±14.18	63.13±12.87*
Observation Group	48	29.67±4.56	37.61±4.12*	29.17±5.31	39.65±6.18*	57.13±15.97	75.56±16.16*
t		0.090	4.583	0.533	4.221	0.081	4.169
P		0.929	＜0.001	0.595	＜0.001	0.936	＜0.001

Note:Compared with the same group before treatment, *P<0.05

2.3 Serum inflammatory factors

After treatment, the levels of CRP, IL-6, MMP-9 and LTB4 in the observation group were significantly lower than those in the control group (P<0.05), as shown in Table 3.

Table3 Comparison of serum inflammatory factors between the two groups before and after treatment ($\overline{x} \pm s$)

Group	Number	CRP（mg/L）		IL-6（ng/L）		MMP-9(ng/mL)		LTB4(μg/L)	
		Before Treatment	After Treatment	Before Treatment	After Treatment	Before Treatment	After Treatment	Before Treatment	After Treatment
Control Group	48	20.45±3.78	10.73±2.36*	572.26±37.43	211.79±24.02*	235.26±40.85	171.28±16.35*	6.12±1.34	2.25±0.69
Observation Group	48	21.06±4.19	7.34±2.01*	571.49±36.32	165.32±23.24*	234.28±37.12	149.61±15.43*	5.96±1.27	1.43±0.38
t		0.749	7.576	0.102	9.633	0.123	6.678	0.600	7.212
P		0.456	＜0.001	0.919	＜0.001	0.902	＜0.001	0.550	＜0.001

Note: Compared with the same group before treatment, *P<0.05

3. Discussion

Neonatal pneumonia poses a serious threat to neonatal health, and its treatment is quite challenging [9].Although antibiotic treatment, especially the use of cefoperazone sodium and sulbactam sodium, is currently the main means of treating neonatal pneumonia, which kills bacteria by inhibiting the synthesis of bacterial cell walls, the use of antibiotics alone may lead to a prolonged course of treatment, increased side effects, and has limited effect in some severe cases [10].In view of the limitations of single antibiotic treatment, this study aimed to investigate the efficacy of budesonide combined with cefoperazone sodium and sulbactam sodium in the treatment of neonatal pneumonia, and analyze its impact on serum inflammatory factor levels in order to find a more effective clinical treatment plan.

The results of this study showed that the clinical efficacy of the observation group was significantly higher than that of the control

group. The total effective rate in the observation group was 95.83%, while that in the control group was 75.00%. This difference suggests that budesonide combination therapy has significant advantages in improving the treatment effect of neonatal pneumonia. The possible explanation is that budesonide, as an inhaled glucocorticoid, can effectively reduce pulmonary inflammation and promote the alleviation of clinical symptoms. This finding is consistent with the findings of UrsRC[11] et al., who pointed out that inhaled glucocorticoids can improve clinical outcomes in children with pneumonia. In terms of lung function indicators, VPEF/VE, TPEF/TE and PEF levels in both groups increased after treatment, but the improvement in the observation group was significantly better than that in the control group. This suggests that combination treatment with budesonide can more effectively improve lung function in children. The anti-inflammatory effect of budesonide may reduce airway resistance and improve airway patency, thereby improving lung function indicators. This conclusion is consistent with the study by YangX[12] et al., who found that inhaled glucocorticoid treatment can significantly improve lung function in children with pneumonia. In terms of serum inflammatory factor levels, the levels of CRP, IL-6, MMP-9 and LTB4 in the observation group were significantly lower than those in the control group after treatment. These results suggest that budesonide combination therapy has a significant effect in reducing levels of inflammatory factors. The decrease in CRP and IL-6 levels reflects the role of budesonide in reducing systemic inflammatory responses, while the decrease in MMP-9 and LTB4 may be related to budesonide's inhibition of airway remodeling and infiltration of inflammatory cells. These findings are consistent with research by XuXJ[13] et al., who demonstrated that inhaled glucocorticoids can reduce the production of inflammatory mediators, thereby reducing the inflammatory state.

In summary, budesonide combined with cefoperazone sodium and sulbactam sodium in the treatment of neonatal pneumonia can improve clinical efficacy, improve lung function, and reduce serum inflammatory factor levels. It is an effective treatment option. However, this study still needs to further expand the sample size and conduct long-term follow-up to verify its long-term efficacy and safety.

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