

## **Efficacy of pulmonary surfactant in the treatment of adult respiratory distress syndrome (ARDS).**

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### **Abstract**

**Objective:** To investigate efficacy of pulmonary surfactant in the treatment of Adult Respiratory Distress Syndrome (ARDS).

**Methods:** From April 21, 2016 to April 21, 2017 100 cases of adult respiratory distress syndrome treated in our hospital were divided into the observation group and the control group with 50 cases in each. Patients in the control group were treated with conventional mechanical ventilation while those in the observation group were given pulmonary surfactant.

**Results:** Compared with the control group, the observation group has better performance in terms of PaO<sub>2</sub>/FiO<sub>2</sub> (115.68 ± 13.48), PaCO<sub>2</sub> (40.63 ± 11.58), PaO<sub>2</sub> (64.23 ± 5.69), time span of oxygenation (102.48 ± 12.69 h), high concentration oxygen duration (3.45 ± 0.22 h), mechanical ventilation time (82.36 ± 3.47 h), total incidence of complications (2%) and total effective rate (98%) of statistical significance, (P<0.05).

**Conclusion:** Pulmonary surfactant is effective and safe in the treatment of adult respiratory distress syndrome.

**Keywords:** Pulmonary surfactant, Respiratory distress syndrome, Curative effect.

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### **Introduction**

Respiratory distress syndrome has main clinical features of respiratory failure, inspiratory three depressions sign, cyanosis, progressive dyspnea, likely to fall on patients of various types. It's mainly because immature development of pulmonary surfactant and lungs causes lesions of permeation and leachability between pulmonary alveolar capillary and lung, liquid transport barriers and atelectasis with the characteristics of onset occult, atypical symptoms and long duration [1]. At present, respiratory ventilators are often used for the treatment but its long term use can lead to severe complications and compliance. For this reason, researchers have carried out thorough studies on treatment plan of respiratory distress syndrome [2]. The purpose of this study is to analyse the clinical significance of pulmonary surfactant in treatment of adults with respiratory distress syndrome as described below.

### **Materials and Methods**

#### **Materials**

In this study a total of 100 patients with adult respiratory distress syndrome who were admitted during April 21, 2016 to April 21, 2017 were selected as the objects and randomly divided into observation group (50 cases) and control group (50 cases). Inclusion criteria: (1) patients meeting clinical diagnostic criteria of respiratory distress syndrome (including

cyanosis, dyspnea and three depressions sign) and patients with the X-ray examination result that showed large shadows with diffuse small patchy infiltration and a white lung like glass; (2) patients voluntary to take part in the experiment with informed consent. Exclusion criteria: (1) patients with poor compliance; (2) patients with severe cardiac insufficiency; (3) patients unable to receive ventilator treatment; (4) patients with family history of psychosis; (5) patients with language disorder or communication barriers.

Patients in the observation group weighted 59.68 ± 2.53 kg and aged 35.69 ± 2.69 on average including 29 males and 21 females in which there were 19 cases of pneumonia, 15 cases of asphyxia and 16 cases of sepsis.

Patients in the control group weighted 59.52 ± 2.69 kg and aged 35.41 ± 2.77 on average including 28 males and 22 females in which there were 20 cases of pneumonia, 13 cases of asphyxia and 17 cases of sepsis. There was no significant difference in basic data of the patients with adult's respiratory distress syndrome in two groups (P>0.05).

#### **Methods**

The control group was treated with conventional mechanical ventilation. First, acid-base balance treatment was applied to ensure the balance of water and electrolyte. Mechanical ventilation was conducted mainly in the form of positive pressure ventilation through the nose and corresponding

parameters were adjusted according to the results. Under normal circumstances, the positive pressure ventilation value is more than 0.195 kpa with PaO<sub>2</sub> ranging from 62 to 86 mmHg and face mask can be administered when necessary.

The observation group was immediately given pulmonary surfactant therapy as soon as they were diagnosed. Poractant Alfa Injection (provided by the Italy CHIESI FARMACEUTIC SPA) was applied with a daily dose of 100 mg/kg and meanwhile the liquid temperature was ensured to maintain at 37°C before injection. Before the treatment the patients were guided to take supine to clean oral and nasal secretions followed by tracheal intubation to facilitate entrance of medicine liquid into the body. The pressure ventilation was conducted for the patients 3~5 min after inhaling the medicine to ensure that the liquid can be uniformly distributed in the lung of the patients. Then trachea was pulled out to perform positive airway pressure as a support of breathing. The patients with serious respiratory obstruction could not be immediately treated, instead firstly endotracheal suction was conducted or the patients were told to turn over to pat on their backs.

### Observation index

The PaO<sub>2</sub>/FiO<sub>2</sub>, PaCO<sub>2</sub>, PaO<sub>2</sub>, time span of oxygenation, high concentration oxygen duration, mechanical ventilation time, total incidence of complications and total effective rate were compared between the two groups.

The total effective rate was divided into rate of significant effect, effective rate and invalid rate. Invalid: patients still had symptoms of cyanosis, three depressions sign and dyspnea even with worse conditions among some patients; effective: The symptoms of cyanosis and three depressions sign gradually improved and the condition has taken a turn for the better; significant effect: the complexion of the patients

returned to normal along with disappearance of symptoms like dyspnea and cyanosis.

### Statistical processing

SPSS20.0 software was used for statistical analysis. Chi square test was applied to detect total incidence of complications as well as total effective rate and t-test was adopted to test PaO<sub>2</sub>/FiO<sub>2</sub>, PaCO<sub>2</sub>, PaO<sub>2</sub>, time span of oxygenation, high concentration oxygen duration and mechanical ventilation time.  $p < 0.05$  suggested that the difference had statistical significance.

### Results

With the pulmonary surfactant therapy, time span of oxygenation, high concentration oxygen duration and mechanical ventilation time were shortened of statistical significance (Table 1).

The treatment safety of the observation group was higher than that of the control group with the complication rate lower than that of the control group of statistical significance (Table 2).

After the treatment, the overall curative effect of the observation group was higher than that of the control group of statistical significance (Table 3).

Before the treatment there was no significant difference in blood gas between the two groups of patients ( $P > 0.05$ ) which may be improved to a certain extent through the implementation of the treatment, but in comparison of the results of the two groups after treatment, the recovery of PaO<sub>2</sub>/FiO<sub>2</sub>, PaCO<sub>2</sub> and PaO<sub>2</sub> of the observation group was better than that of the control group of statistical significance (Table 4).

**Table 1.** Comparison of curative effect between two groups.

Group	Case (n)	High concentration oxygen duration (h)	Time span of oxygenation (h)	Mechanical ventilation time (h)
Observation	50	3.45 ± 0.22	102.48 ± 12.69	82.36 ± 3.47
Control	50	9.86 ± 1.32	126.92 ± 15.44	105.48 ± 4.58

**Table 2.** Comparison of total complication rate between two groups.

Group	Case (n)	Sepsis (n, %)	Pulmonal hemorrhage (n, %)	Infection (n, %)	Total complication rate (n, %)
Observation	50	0 (0.00%)	0 (0.00%)	1 (2.00%)	1 (2.00%)
Control	50	2 (4.00%)	3 (6.00%)	6 (12.00%)	11 (22.00%)

**Table 3.** Comparison of total effective rate between two groups

Group	Case (n)	Significant effect (n, %)	Effective (n, %)	Invalid (n, %)	Total effective rate (n, %)
Observation	50	37 (74.00%)	12 (24.00%)	1 (2.00%)	49 (98.00%)

Control	50	20 (40.00%)	13 (26.00%)	17 (34.00%)	33 (66.00%)
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**Table 4.** Comparison of blood gas between two groups.

Group	Time	PaO <sub>2</sub> /FiO <sub>2</sub>	PaCO <sub>2</sub>	PaO <sub>2</sub>
Observation	Before treatment	70.42 ± 10.69	49.21 ± 10.36	46.37 ± 8.63
	After treatment	115.68 ± 13.48	40.63 ± 11.58	64.23 ± 5.69
Control	Before treatment	70.61 ± 10.54	49.74 ± 10.75	46.31 ± 8.10
	After treatment	102.36 ± 6.74	43.56 ± 10.42	51.06 ± 6.82

### Discussion

Respiratory distress syndrome belongs to hypoxic respiratory failure with such main pathological changes as injury of alveolar capillary endothelial cell and alveolar epithelial cell and positive cell infiltration [3]. Under normal circumstances, patients with respiratory distress syndrome are subject to the decrease the pulmonary surfactant which is unable to be reused, resulting in insufficient surfactant followed by the manifestation of lower lung compliance, respiratory distress and refractory hypoxemia [4]. Therefore, the principle of treating respiratory distress syndrome is to reduce pulmonary hypertension, correct the symptoms of ischemic hypoxia and treat primary diseases to control risk factors and decrease clinical mortality rate [5,6].

The current treatment options for patients with respiratory distress syndrome have not been unified and mechanical ventilation is most commonly used for the treatment in the early which can correct symptoms of hypoxia in the lung and improve pulmonary compliance to promote recovery of respiratory frequency. Despite these good effects a long time of high pressure treatment may lead to oxygen poisoning and lung volume damage, which aggravates the illness of respiratory distress syndrome to eventually form a vicious spiral [7,8]. In addition, the rising of the mechanical ventilation pressure gradually increases lung injury, resulting in complications like gas leakage, pulmonary bleeding [9,10]. Considering the deficiencies of conventional mechanical ventilation, we implemented the therapy of pulmonary surfactant in this study, which can reduce clinical mortality and control progression of the disease, inhibit pulmonary surfactant, prevent the formation of inflammatory mediators and plasma protein and lower pulmonary pressure [11,12]. What's more, pulmonary surfactant is also able to lower pulmonary vascular resistance and relieve dyspnea as well as cyanosis, improve alveolar ability, reduce the incidence of complications, make up for the deficiencies of mechanical ventilation and reduce the damage caused by ventilator [13,14].

Pulmonary surfactant can promote the synthesis and secretion in the treatment of respiratory distress syndrome. With the function of facilitating the synthesis of pulmonary surfactant

[15,16], it enables to improve pulmonary function and PaO<sub>2</sub>/FiO<sub>2</sub>, raise the success rate of treatment, increase the number of lamellar bodies, accelerate the differentiation of lung cells, improve the positive pressure ventilation, prevent alveolar atrophy and better function of the materials at lung surfaces [17,18]. Four kinds of surfactant currently used in clinical trials are respectively recombinant surfactant, artificial preparation, modified natural preparation and natural extracts. Reasonable selection of surfactant can reduce alveolar epithelial injury, prolong survival time for the patients, improve the function and compliance of lung and enhance overall efficacy [19,20].

In short, in the treatment of patients with adult respiratory distress syndrome, pulmonary surfactant manages to promote the overall efficiency by shortening high concentration oxygen duration and time of mechanical ventilation, reduce incidence of complications and improve ventilation function as well as blood gas index for the patients.

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