A Retrospective Analysis of the Six-year Data of Respiratory Distress Syndrome of Premature Infants

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Abstract. Objective: To retrospectively analysis the clinical data of preterm infants diagnosed neonatal respiratory distress syndrome(NRDS) of our hospital in 2004-2009,and observe the efficacy of pulmonary surfactant(PS). Methods Systematically review the medical records. Result: 257 cases preterm infants diagnosed NRDS in 2004 -2009 , The incidence of hospitalized NRDS no more change. The survival rate and PS applications rate increased. Gestational age and birth weight were negatively correlated with NRDS, asphyxia, pneumonia, CLD ,PDA, intracranial hemorrhage were positively correlated with NRDS. 113 cases used PS, 77cases survival (68.14%), 144 cases did not use PS, 73 cases survival (50.69%). Conclusion: Gestational age and birth weight were negatively correlated with NRDS, and asphyxia, pneumonia, CLD, PDA, intracranial hemorrhage were positively correlated with NRDS. There is an increase trend on the survival rate of NRDS. PS application could increase the survival rate of NRDS in preterm infant.

Keywords. Newborn Baby; Respiratory Distress Syndrome; Systems Review; Pulmonary Surfactant

One of the most common complications for premature infants is neonatal respiratory distress syndrome (NRDS) that can be caused by many pathogeneses, among which pulmonary surfactant deficiency is the most important cause. NRDS occupies a large proportion in curable respiratory system diseases and also is the common cause for the death of premature infants, which occupies 30% of death causes of newborn babies and 50.7% [1] of the death causes of premature infants. Pulmonary surfactant is extensively applied in clinic, which enhances the success rate of the treatments on premature infants. In this research, retrospective analysis is conducted on the 3256 cases of premature infants in our hospital and research is also made on the correlation between neonatal respiratory distress syndrome and other common complications of premature infants and the effects of the application of exogenous pulmonary surfactant.

1 Objects and Methods

1.1 Research Objects:

3468 cases of premature infants who were in the NICU of newborn department in our hospital between Jan. 1st, 2004 and Dec. 31st, 2009 and the third edition of Practice of Neonatology was selected as the diagnostic criteria of premature infants, namely, gestational age < 37weeks (for the patient whose gestational age was unknown when admitting, subject to the assessment of gestational age), the cases whose age in days was more than 28 days when admitting to hospital and the ones lacking of clinical data were rejected.

1.2 Data Collection:

"the survey schedule of the data of premature infants in NICU of ×× hospital" was formulated and the major investigation items contained: (l) General cases: birth date, age in days, gender, gestational age. (2) Common complications of premature infants: asphyxia, NRDS, pneumonia, CLD, PDA, jaundice, bacterial meningitis, septicemia, NEC, intracranial hemorrhage, ROP. Diagnosis was made by two senior doctors (one professor and one attending physician) by referring to clinical diagnostic criteria of Practice of Neonatology. (3) Treatment: PS application condition. (4) Prognosis: survival condition. The electronical medical records of ×× hospital between 2004 and 2009 were consulted to fill the data in "the survey schedule of the data of premature infants in NICU of ×× hospital".

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1.3 Statistic Method and Analysis:

After the survey schedule was sorted, the data file was built on Excel through all the acquired data and SPSS 13.5 statistic software was applied to process: all the measurement data should be expressed by mean ± standard deviation ($x \pm s$); $\chi 2$test should be applied for enumeration data and variance test should be applied for measurement data and Kendall correlation analysis should be applied for correlative study; if $P<0.05$, then it is significant.

2 Results

2.1 General information:

3468 cases of children patients were diagnosed as premature infants between 2000 and 2009 with 3256 cases satisfying the inclusion criteria; the average gestational age is 33.36±2.39 weeks and the average birth weight is 2004.47±556.32g; the male female ratio is 1.77:1. Among them, 257 cases were diagnosed as NRDS; the average gestational age is 31.92±1.05weeks and the average birth weight is1569±421.32g; among all the cases, 175 are male and 82 are female.

2.2 NRDS case number, incidence rate and survival rate:

The annual incidence case number, survival case number and PS application case number of NRDS between 2004 and 2009 were sorted respectively and the incidence rate (percentage in the hospitalized premature infants in the same year), survival rate and PS application ratio were calculated respectively; the survival rate of NRDS and PS application ratio tend to increase year by year, which is shown in Table1.

Table 1. Case number, incidence rate and survival rate of NRDS between 2004 and 2009

Year	Case Number of NRDS (incidence rate %)	Survival Case Number of NRDS (survival rate %)	Application Case Number of PS (%)
2004	15/184(8.15)	4/15(26.67)	1/15(6.67)
2005	20/248(8.06)	9/20(45.00)	6/20(30.00)
2006	18/323(5.57)	12/18(66.67)	7/18(38.89)
2007	58/622(9.32)	32/58(55.17)	20/58(34.48)
2008	61/857(7.12)	35/61(57.38)	32/61(52.46)
2009	85/1022(8.32)	58/85(68.24)	50/85(58.82)
Total	257/3256(7.89)	150/257(58.37)	113/257(43.97)

2.3 Correlation Analysis on NRDS and Birth Weight, Gestational Age and Other Complications of Premature Infants:

As is shown in table 2, the correlation of NRDS incidence of premature infants and gestational age, birth weight and asphyxia, pneumonia, CLD, PDA, jaundice, bacterial meningitis, septicemia, NEC, intracranial hemorrhage, ROP incidence among the six years are calculated respectively. If $P<0.05$, the correlation is significant. The gestational age, birth weight and NRDS incidence are negatively correlated; asphyxia, pneumonia, CLD, PDA, intracranial hemorrhage and NRDS incidence are positively correlated; the correlation of jaundice, bacterial meningitis, septicemia, NEC and ROP and NRDS incidence is not significant.

Table 2. Correlation comparisons on NRDS and birth weight, gestational age and other complications

	r	P
Gestational Age	-0.252	.000
Birth Weight	-0.160	.000
Asphyxia	0.090	.000

Pneumonia	0.103	.000
CLD	0.067**	.000
PDA	0.070**	.000
Intracranial Hemorrhage	0.142**	.000
Jaundice	-0.022	.210
Bacterial Meningitis	-0.016	.373
Septicemia	0.020	.262
NEC	-0.002	.926
ROP	-0.011	.514

2.4 Comparison on the Influence of PS Application on the Survival Rate of NRDS

Among all the 257 cases of patients who were diagnosed as NRDS, PS was applied on 113 cases and 77 cases survive with the survival rate of 68.14%; for the 144 cases that did not apply PS, 73 cases survive with the survival rate of 50.69%; the survival rate of NRDS can be increased by applying PS and the difference is significant ($P<0.05$). See Table 3.

Table 3. Comparison between PS application and NRDS survival rate

	Survival (n)	Not Survival (n)	Total(n)	Survival Rate%
Applying PS(n)	77	36	113	68.14
Not Applying PS(n)	73	71	144	50.69
Total(n)	150	107	257	58.37
$\chi 2$		9.24		
P		0.0024		

3 Discussion

NRDS is a series of respiratory symptoms caused by PS deficiency which can be caused by various pathogenesis, its clinical manifestations are progressive dyspnea and respiratory failure shortly after birth, the major patients are premature infants, its mortality is high and also it is the main cause for the death of premature infants. Along with the increment of the case number of premature infants admitted in our department, the case number of NRDS also increases year by year, however, incidence rate does not change obviously with the average rate of 7.89%; although the number of premature infants whose gestational age is less than 34 weeks in our center tends to increase year after year (the data has not be published), the incidence rate of NRDS does not increase, indicating that in fact the incidence rate of NRDS reduces gradually, which should be related with the wide application of prenatal progestational hormone and PS prevention and early application [2].

Besides its own hazard, other complications can also be caused by NRDS and it is shown by the research that the gestational age, birth weight and NRDS incidence are

negatively correlated; asphyxia, pneumonia, CLD, PDA, intracranial hemorrhage and NRDS incidence are positively correlated; the correlation of jaundice, bacterial meningitis, septicemia, NEC and ROP and NRDS incidence is not significant; the specific analysis is as follows: when gestational age is younger, the birth weight is lighter and the incidence rate of NRDS is higher, which is related with the gradual increment of PS synthesis following the increment of gestational age, therefore, for the prevention of NRDS, the application of antenatal glucocorticoids and the prevention and early application of PS on the premature infant whose gestational age is young should be strengthened and simultaneously the gestational health care should be strengthened and the incidence of premature infants should be reduced. Due to the antenatal or intrapartum hypoxia-ischemia of asphyxiant children patients, anaerobic metabolism of organism is increased and ATP synthesis is reduced and the merged hyoxemia, hypoglycemia and acidosis all influence PS synthesis; in addition, pulmonary endothelium is damaged after hypoxic injury and consequently the capillary permeability is increased and plasma components is penetrated into pulmonary alveoli and the formation of pulmonary hyaline membrane is increased and thus the incidence rate of NRDS is increased, therefore, another key aspect of NRDS prevention is to promote the recovery of newborn babies and reduce the incidence of birth asphyxia. The positive correlation between pneumonia and NRDS is owing to two reasons; on the one hand, type II alveolar cell is injured when suffering from pneumonia and PS synthesis is decreased; on the other hand, respirator are needed by children patients of NRDS to assist respiration, which increases the incidence rate of ventilator-associated pneumonia. Furthermore, due to the application of respirator, the respirator parameter should be high, especially for children patients without PS treatment and thus the pressure injury, capacity injury, cleavage injury and hyperoxic lung injury are increased and in the meantime, the incidence rate of lung inflammation is also high, which are the reasons for the increment of the incidence rate of CLD of children patients of NRDS. Due to the organism hypoxia and acidosis when suffering from NRDS, the postnatal kininogenase -bradykinin system activation generated by the stimulation of normal hyperoxia is restrained, and the synthesis inhibition of prostaglandin is reduced and thus the contraction of arterial duct is influenced; moreover, owing to the reduction of pulmonary vasculature pressure during the NRDS improvement process, the left-to-right shunt is added and then the blood flow of pulmonary circulation is increased and thus pulmonary edema is caused; in the mean time, blood flow of systemic circulation is reduced and blood supply of brain tissue is insufficient, which causes the increment of incidence rate of intracranial hemorrhage of premature infants.

The research shows that the survival rate and PS application ratio of children patients who suffer from NRDS in our department increase gradually. There is evidence showing that [3] antenatal glucocorticoids and postpartum PS application have synergistic effect and the demand of PS dosage are reduced by antenatal glucocorticoids. At present, the best solution [4] for NRDS prevention of ELBWI is antenatal glucocorticoids+intrapartum intratracheal injection of PS+ nasal continuous positive airway pressure (nasal continuous positive airway pressure, nCPAP). Besides, mechanical ventilation [5] can be avoided through "INSURE" technology (tracheal intubation-surface-active substance- extubation with CPAP), thereby, the incidence of mechanical ventilation-associated complications of premature infants are reduced. 35% of NRDS morbidity and 50% of air leakage [6-8] can be reduced by applying PS and the multiple application effects are due to single dose [9]. It is recommended by the guideline [10] (2010) for respiratory distress syndrome of newborn baby in Europe: ① for the child patient who has suffered from respiratory distress syndrome or has high risk factors, pulmonary surfactant should be applied, which is testified to be able to reduce mortality and incidence of pulmonary gas leakage (A) . ② for the premature infant whose gestational age is less than 27 weeks, pulmonary surfactant should be applied prophylactically within 15 minutes after birth. For the premature infant whose gestational age is 26 weeks and 30 weeks, pulmonary surfactant (A) can also be applied prophylactically if cannula is needed in delivery room or hormone is not used by the mother antenatally. ③for the child patient without treatment, oxygen progressive increment is needed and pulmonary surfactant(A) should be used as early as possible if evidence of respiratory distress syndrome appears clinically. ④ if there is evidence showing the process of respiratory distress syndrome, mechanical ventilation is needed if oxygen is needed continuously; for the patient whose oxygen concentration is more than 50% under continuous positive airway pressure of 6 cm H2O pressure, the second or the third dose of pulmonary surfactant should be used to reduce pneumothorax and mortality(A).

However, due to the non-unified cognition of doctors in newborn department on PS and the economy, the wide application of PS is limited in China, especially in the underdeveloped areas; it is worth noting that the incidence of NRDS can be decreased by the early application of PS and the incidence of related diseases of NRDS can also be reduced, such as ventilator-associated pneumonia, CLD, PDA and intracranial hemorrhage and consequently the

survival rate and life quality of premature infant are enhanced and the hospital stays are shortened and the hospitalization expenses are reduced; therefore, the prevention and early application of PS on NRDS of premature infants should be further promoted.

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