



Clinical Observation on Remedial Less Invasive Surfactant Administration Technique Under Duo Positive Airway Pressure Ventilation in Treating Preterm Infants with Respiratory Distress Syndrome

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Abstract

Objectives: The aims of this study were to assess the efficacy of less invasive surfactant administration technique in different times under duo positive airway pressure ventilation in preterm infants born at 28 to 34 weeks.

Methods: A total of 58 preterm infants with gestational ages between 28 to 34 weeks diagnosed with NRDS in Zhengzhou People's Hospital, from June 2017 to June 2018 were randomly divided into early LISA Group (30 cases) and a Remedial Group (28 cases) by adopting random number table method. In the early LISA group, the infants were treated with immediately duo positive airway pressure ventilation and a thin stomach tube was inserted through the vocal cords then infused Pulmonary Surfactant (PS) into the lung. In the remedial LISA group, the infants were treated with immediately duo positive airway pressure ventilation and, when they were progressive exacerbation of dyspnea, then a thin stomach tube was inserted through the vocal cords then infused Pulmonary Surfactant (PS) into the lung. Comparisons were made between the two groups as for the proportions of mechanical ventilation, length of hospital stay, hospitalization expenses, pneumothorax, pneumonia, Bronchial Pulmonary Dysplasia (BPD), and the incidence of Intracranial Hemorrhage (ICH).

Results: Compared with the differences between the 2 groups in the need of mechanical ventilation, length of hospital stay, and complications such as pneumothorax, pneumonia, BPD and ICH, there were no statistical differences (all $P > 0.05$). The hospitalization expenses of the remedial group were significantly lower than those of the early application group ($P < 0.05$).

Conclusion: LISA remedial application technology on therapy RDS is feasible and can significantly reduce the hospitalization expenses. LISA remedial application technology does not increase the proportions of mechanical ventilation, pneumothorax, pneumonia, BPD and ICH.

Keywords: Less invasive surfactant administration; Respiratory distress syndrome; Premature

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Introduction

Neonatal Respiratory Distress Syndrome (NRDS) is due to the lack of primary Pulmonary Surfactant (PS) caused severe illness and high mortality. Exogenous PS is currently recognized as the most effective drugs for treatment of RDS. Studies have shown that, PS reduces alveolar surface tension, improve oxygenation, reducing gas leakage and the like, has become a routine treatment of NRDS [1,2]. As usual with tracheal intubation-pulmonary surfactant- after extubation technique (intubation-surfactant-extubation, InSurE) [3], i.e. to intubation, the tracheal intubation PS infused into the lungs, the trachea removed completed injection intubation, instead Continuous Positive Airway Pressure (CPAP) ventilation. Although this method is effective, but only because the application needs PS endotracheal intubation, increased pain in children; and some children use the cannula cannot be scheduled after extubation PS, still invasive mechanical ventilation [4]. In recent years, it has been proposed "LISA Technology" Less Invasive Surfactant Administration (LISA) [5], i.e., given at birth noninvasive ventilation, in such laryngoscope fine catheter tube, catheter or the like into a blood vessel within the trachea, ventilation in the PS injection, while medication side noninvasive mechanical ventilation. Studies suggest that, LISA technology can

reduce preterm child mortality and long-term incidence of BPD [6]. "2015 American Academy of Pediatrics Neonatal Resuscitation Guidelines" recommended for spontaneously breathing preterm respiratory distress, but the presence of children, first of all give non-invasive mechanical ventilation, endotracheal intubation rather than positive pressure ventilation [7]. But some families cannot afford the conditions and the high cost of the PS, thus abandoning the treatment of premature children. So in the early RDS on the application of PS, PS or application after application of noninvasive ventilation ineffective rescue again when it? Overseas studies results show that the two methods in the need for mechanical ventilation, mortality, Broncho Pulmonary Dysplasia (BPD) no significant difference in the incidence. Therefore, foreign scholars to support the latter [8], but the current domestic research on this are still very small. The results of this research group in previous studies show [9], LISA technology can guarantee the accuracy of the dose of PS; can effectively improve the patient's oxygenation, reducing the rate of mechanical ventilation, avoiding intubation lung injury. Therefore, this study on the basis of previous studies, treatment with RDS in premature children nasal BiPAP LISA technology remedial binding, i.e. administered BiPAP (duo positive airway pressure immediately after birth, DUOPAP) Assisted breathing, according to the situation of children under laryngoscope into the endotracheal tube, into the PS, while the application of noninvasive mechanical ventilation, non-invasive injection to continue after completion of mechanical ventilation, and achieved satisfactory results. It is reported below.

Materials and Methods

General information

Select from June 2017 to June 2018 our department treated a total of 58 cases of children with NRDS. According to the order of admission, divided into 28 cases and 30 cases of early LISA remedial group by random number table. Inclusion criteria: gestational age 28 to 34 weeks; hospitalization in 2 h after birth; not administered pulmonary surfactant treatment before admission, breathing spontaneously, without mechanical ventilation of premature children; NRDS meet diagnostic criteria [10], shortly after birth i.e. respiratory distress clinical manifestations progressive increase groan, foaming at the mouth, dyspnea, cyanosis, X-ray examination showed compliance NRDS I stage to II stage. Exclusion criteria [11]:

1. Gestational age <28 weeks or birth weight <1000 g.
2. Born heart rate <100 beats/min, weak spontaneous breathing, or obvious distress required endotracheal intubation, with mechanical ventilation exclusion.
3. Admission X-ray examination showed NRDS III Grade to IV Grade.
4. Combining complete transposition of great arteries, tetralogy of serious disorders such cyanotic heart disease, diaphragmatic hernia, congenital deformities and other laryngeal web pulmonary function.
5. Severe intracranial hemorrhage (III Stage has occurred or IV Stage).
6. Has air leak (including pneumothorax, pneumomediastinum, etc.).

Two groups of children the same care methods. This study has Zhengzhou People's Hospital Medical Ethics Committee approval, parents of children signed informed consent.

Methods

Treatment: LISA early after birth administered group BiPAP (DUOPAP) Assisted breathing tube into the trachea, the PS was slowly injected through the tube, while the side of the injection DUOPAP assisted breathing, pull out the tube after the injection is completed, continue DUOPAP Assisted breathing. LISA remedial group of children given birth BiPAP (DUOPAP) assisted breathing, such as occurs progressive increase of respiratory distress and/or respiratory distress cannot be relieved, and then into the endotracheal tube, the remedial PS was slowly injected through the tube, the injection after completion of the pull out the tube continues DUOPAP assisted breathing. In children with the above non-invasive ventilator as in any case considered treatment failures requiring mechanical ventilation therapy:

1. The frequent occurrence of apnea, apnea i.e. > (3 to 4) times/h.
2. Inhaled oxygen concentration >0.4, the oxygen saturation pulse duration in children <85%.
3. Arterial blood gas analysis showed arterial oxygen >8.5 KPa and pH <7.25.
4. With disease progression sudden pulse oximetry decreased significantly, the need for oxygen mask pressure. Mechanical ventilation evacuation indication [12].

When the peak inspiratory pressure ≤ 1.0 Kpa to 1.5 Kpa, PEEP=0.2 Kpa to 0.4 Kpa, frequency ≤ 10 times/min, the oxygen concentration ≤ 0.4 , as a result of normal arterial blood gas, into DUOPAP. PS this study is Curosurf (Casey pharmaceutical company in Italy, approval number: H20161201) the first dose of 200 mg/kg, and thereafter according to clinical manifestations in children chest X-ray results, considering whether the required second agent, the second agent is 100 mg/kg.

Outcome measures

1. Comparison 2 group of children born for domestic mechanical ventilation 3D.
2. Compare the two groups of children of hospital stay, hospital costs, pneumothorax, pneumonia, when corrected 36 weeks of gestation Broncho Pulmonary Dysplasia (BPD) and intracranial hemorrhage (Intracranial hemorrhage ICH) incidence.

Statistical methods

Application SPSS 20.0 statistical software, measurement data \pm S that the groups were compared using t test; count data rate and the number of cases that the groups were compared using chi-square test. $P < 0.05$ was considered statistically significant differences.

Results

General information

The 30 cases of early LISA group, 18 males and 12 females; 28 cases remedial LISA Group, including 17 males and 11 females. Children with gender, gestational age, birth weight, prenatal hormone utilization, hospitalization days and RDS stage the difference was not statistically significant ($P > 0.05$), comparable shown in Table 1.

Comparison of treatment outcomes between the two groups

Comparison of mechanical ventilation requirements and

Table 1: Data were compared between the two groups of children.

		Early LISA (n=30)	Remedial LISA (n=28)	P
Gestational age/week		29.7	30.2	>0.05
Mean birth weight/g		1589	1613	>0.05
Gender: Male Female)		18/12	17/11	> 0.05
Prenatal hormone usage (Example (%))		23 (76.7)	24 (85.7)	>0.05
Admission days/hours		0.9	0.85	>0.05
NRDS stage (Example (%))	Phase I	13 (43.3)	12 (42.9)	>0.05
	Phase II	17 (56.7)	16 (57.1)	>0.05

Table 2: Comparison of mechanical ventilation requirements related complications and early LISA group 2 and group remedial RDS in preterm children LISA (example (%)).

Group	Number of cases	Number of mechanical ventilation cases	Pneumothorax	Pneumonia	BPD	ICH
Early LISA group	30	3 (10.0%)	1 (3.3%)	3 (10.0%)	2 (6.7%)	5 (16.6%)
Remedial LISA group	20	4 (14.3%)	2 (7.1%)	3 (7.1%)	1 (3.6%)	4 (14.3%)
X2 or t		1.52	1.36	2.45	0.96	0.87
P		>0.05	>0.05	>0.05	>0.05	>0.05

Table 3: Early LISA Group and remedial LISA Non-invasive ventilation time, hospital stay, Comparison of hospitalization expenses.

Group	Number of cases	Non-invasive ventilation time	Residence time	Hospital costs
		(d, $\bar{x} \pm S$)	(d, $\bar{x} \pm S$)	(Ten thousand yuan, $\bar{x} \pm S$)
Early LISA group	30	32.6 \pm 14.5	32.6 \pm 14.5	6.9 \pm 2.6
Remedial LISA group	28	4.4 \pm 2.9	33.8 \pm 15.2	5.1 \pm 2.8
X2 or t		0.857	1.364	4.457
P		>0.05	>0.05	<0.05

related complications in children with early LISA and salvage LISA:

Early LISA group and remedial group of patients during mechanical ventilation requirements, gas chest, pneumonia, BPD With and ICH hair students rate wait square surface ratio relatively difference different all no Commission meter learns meaning Righteousness ($P>0.05$). The results are shown in Table 2.

Comparison of children with early LISA groups and remedial groups: In non-invasive ventilation time, hospital stay, hospital costs Early LISA Group and remedial group noninvasive ventilation in children with time, live hospital Time Ratio between Relatively No significant difference($P>0.05$), LISA early remedial group hospitalization costs than Group LISA ($t=4.457$, $P<0.05$). The results are shown in Table 3.

Discussion

Respiratory distress syndrome in premature children and more by the lack of primary PS due. In recent years, with the increase in exogenous PS treatment of RDS, greatly improve the survival rate of preterm children. PS is a milestone in the treatment of RDS, RDS PS therapy can effectively reduce complications (e.g. pneumothorax, the BPD) and mortality rate, but the optimum time of administration and continues to explore the way. Some studies show that, PS application sooner the better [3]. Foreign clinical trials 26 weeks to 29 weeks of gestational age preterm children were randomly divided into 3 groups, namely prophylactic PS combined continuous mechanical ventilation group, model group and the INSURE to CPAP (with sub-PS) group. The results are shown CPAP not require intubation group 48%, 53% without the use of PS. Conclusion of the study, immediately after birth in preterm children given nasal CPAP can reduce the use of mechanical ventilation and PS. In recent years, domestic and foreign

RDS Guide [13,14] recommends a spontaneously breathing preterm child after birth, immediately to Nasal Continuous Positive Airway Pressure (NCPAP) therapy, noninvasive mechanical ventilation ineffective application of pulmonary surfactant can be a low-invasive or minimally invasive treatment PS treatment.

DUOPAP [15,16] is based on CPAP, the pressure generating intermittent increased pharynx, larynx so that expansion intermittent stimulation respiratory motion, can produce an average higher than the CPAP airway pressure, tidal volume and increased minute ventilation. Compared with CPAP, DUOPAP can significantly reduce the chance of intubation and mechanical ventilation, extubation increase the success rate. Clinical trials showed that domestic research [17] DUOPAP for NRDS initial treatment of respiratory support, can effectively improve compared with CPAP oxygenation, reducing the carbon dioxide retention, and reduce the use of exogenous pulmonary surfactant without increasing complications.

LISA Technology is a hot technology of the present study, first reported by the German scholar [18], nearly 10 years LISA Technology developed gradually in many NICU Europe. The main object of the LISA Technology under spontaneous breathing PS injected through a fine tube and to reduce damage to the cannula to reduce the need for mechanical ventilation. Embodiment LISA Technology may be administered in a non-invasive ventilator, administered administration more conducive than positive pressure ventilation spontaneous breathing PS uniform distribution and improved lung compliance lungs. In reducing ventilatory demand and reducing the incidence of BPD, LISA technique is superior to the cannula or INSURE [19]. RDS 2019 European guidelines recommend spontaneously breathing may use LISA MIST technology or

alternative INSURE technology [20]. Under the premise of this study DUOPAP respiratory support, early application LISA Technology and remedial applications LISA groups were compared, both in terms of complications of mechanical ventilation requirements, length of stay, pneumothorax, BPD and ICH, etc. were not statistically different. Remedial treatment costs LISA group earlier application LISA set low, reducing the cost of PS generated by the application.

Conclusion

The results of this study show that for gestational age 28 to 34 weeks diagnosed with RDS and does not require mechanical ventilation in premature children, as soon as possible after birth using nasal BiPAP binding remedial applications LISA technology, with respect to the earlier applications LISA technology, demand for mechanical ventilation, pneumothorax, Pneumonia, BPD and related complications such as ICH was not statistically significant. In terms of the cost of treatment, remedial application group was significantly lower than the early application group, the difference was statistically significant. So for respiratory distress syndrome in premature children, remedial application LISA technology may be appropriate to reduce health care costs, reduce hospital costs, reduce the economic burden on families and society in children, without increasing the incidence of complications of pneumothorax, BPD, mechanical ventilation demand, Worthy of clinical application. But because this study is the small sample size of a single-center, multi-center trial of its effectiveness and safety still need large sample further verification.

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