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Application of Mind Mapping Nursing Model in Clinical Efficacy of NRDS

Huiyuan Liu [1,*], Yanwen Wang[1]

[1.] Neonatal Intensive Care Unit, Hangzhou Obstetrics and Gynecology Hospital, Hangzhou, 310008 Zhejiang, China

Keywords

Mind mapping nursing model

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* **Correspondence**

Huiyuan Liu

Neonatal Intensive Care Unit, Hangzhou Obstetrics and Gynecology Hospital, Hangzhou, 310008 Zhejiang, China

E-mail: hzsfckyylhy@163.com

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Abstract

Objective: To investigate the clinical effect of mind mapping nursing model in neonatal respiratory distress syndrome (NRDS). **Methods:** A total of 80 child patients with NRDS admitted to Hangzhou Obstetrics and Gynecology Hospital from March 2020 to March 2022 were selected and randomly divided into control group and observation group, with 40 cases respectively. The control group was given routine intervention, and the observation group was given mind mapping nursing model on this basis. The rehabilitation process, the level of arterial blood gas index, complication and satisfaction degree of family members were compared between the both groups. **Results:** The pediatric critical illness score (PCIS), arterial blood pondus hydrogenii (pH), arterial oxygen saturation (SaO_2) and arterial partial pressure of oxygen (PaO_2) levels of both groups after intervention were distinctly elevated in contrast to before intervention ($p < 0.05$), the pediatric risk of mortality Ⅲ score (PRISM Ⅲ) and arterial partial pressure of carbon dioxide ($PaCO_2$) level were distinctly decreased in contrast to before intervention ($p < 0.05$), and the improvement effect of observation group were distinctly better in contrast to the control group ($p < 0.05$). The application times of pulmonary surfactant (PS), mechanical ventilation time and hospital stay of observation group were distinctly less in contrast to the control group ($p < 0.05$), the total incidence rate of complication was distinctly lower in contrast to the control group ($p < 0.05$), and the total satisfaction rate of family members was distinctly higher in contrast to the control group ($p < 0.05$). **Conclusion:** The intervention of mind mapping nursing model in child patient with NRDS has obvious effects in accelerating the rehabilitation process, improving the arterial blood gas index level, family satisfaction and reducing the incidence of complications.

1 Introduction

Neonatal respiratory distress syndrome (NRDS) is a clinical syndrome characterized by respiratory distress and failure occurring within 4-12 hours after birth, featuring rapid progression, severe manifestations, and poor prognosis, representing a leading cause of neonatal mortality [1,2]. While mechanical ventilation remains the primary treatment, the underdeveloped organs and relatively low immunity of neonates often lead to treatment-associated complications including respiratory system injuries and infections, potentially compromising therapeutic outcomes. Previous studies have demonstrated that effective nursing interventions can significantly enhance treatment efficacy and facilitate recovery in NRDS patients [3]. As an efficient cognitive tool utilizing visual elements (images, flowcharts, and symbols) to organize information, mind mapping has shown promising applications in clinical nursing practice [4]. This study implemented a mind mapping-based nursing protocol for NRDS management, aiming to establish a referential framework for clinical care of affected neonates, with detailed methodology and results presented below.

2 Materials and methods

2.1 General information

A total of 80 neonates with NRDS admitted to Hangzhou Obstetrics and Gynecology Hospital between March 2020 and March 2022 were enrolled and randomly allocated to either the control group or the observation group (n = 40 each). There was no significant difference in the general information of the two groups ($p > 0.05$, Table 1), and this study protocol was approved by the institutional ethics committee.

Table 1 Comparison of general information between the two groups.

Group	Cases	Gender (cases)		Gestational age (weeks)	Body mass (g)
		Male	Female		
Observation group	40	23	17	32.53 ± 2.17	1426.35 ± 104.11
Control group	40	21	19	33.06 ± 2.64	1457.68 ± 116.23
χ^2/t		0.202		-0.981	-1.270
p		0.653		0.330	0.208

2.2 Inclusion and exclusion criteria

2.2.1 Inclusion criteria

Adhere to the diagnostic criteria of NRDS [5]; child patient without contraindications to mechanical ventilation; complete clinical data.

2.2.2 Exclusion criteria

Exclusion criteria comprised neonates with severe cardiac, hepatic or renal dysfunction; autoimmune disorders; severe asphyxia or thoracic deformities; concurrent septic shock; or respiratory distress attributable to meconium aspiration syndrome or wet lung disease.

2.3 Methods

2.3.1 Control group

The control group received conventional interventions: Endotracheal suctioning performed by inserting the catheter until resistance was encountered followed by 0.8 cm withdrawal; The nursing staff performed the single-person turning method and gently patted the child's back. When patting the back, the five fingers should be together and the palm should be in the shape of an empty cup, and oral care administered

with saline-moistened cotton swabs.

2.3.2 Observation group

On the basis of the control group, the observation group was given mind mapping nursing mode:

The mind map was constructed by a multidisciplinary care team comprising attending physicians, head nurses, and staff nurses, with NRDS management as the central theme. Primary branches represented pre-treatment, treatment, and post-treatment phases, while secondary branches detailed risk factors and corresponding interventions for each stage. The diagram radiated outward from the central concept using color-coded hierarchical relationships, ultimately forming a comprehensive tree-structured visualization that was printed on A4 paper for clinical reference.

Implementation involved strategically positioning the mind maps on bedside nursing carts and in treatment rooms while distributing personal copies to all nursing staff. The head nurse conducted comprehensive training sessions to explain the mind map contents, facilitating active group discussions and analyses to ensure proper understanding of corresponding intervention protocols. Staff members participated in simulated scenarios through randomized group assignments, followed by systematic debriefings to identify and address performance gaps. Competency assessments were conducted biweekly to evaluate practical application skills and reinforce protocol adherence.

The mind map was distributed to the family members of the child patient, and the nursing staff carried out health education to the family members of the child patient based on the mind map, with nurses utilizing these visual aids to explain care protocols, key considerations, and critical points in layman's terms while maintaining open communication channels for timely clarification of any queries through thorough, patient-centered explanations.

The mind map-guided protocol was implemented as follows: Pretreatment phase included intravenous parenteral nutrition administration and infrared incubator maintenance with temperature monitored every 2 hours (target auricular temperature 36.5-37.4 ℃), where humidity was adjusted according to gestational age, body weight, and postnatal age to prevent ventilation risks from thermal discomfort, while strict aseptic techniques prevented infections until stable conditions permitted incubator weaning. During the treatment process: When performing ventilation therapy, strictly measure the distance between the trachea and the incisors of the child patient. When resting, place a soft pad under the child patient's neck, tilt the head downward, open the trachea, and use hydrocolloid dressings to relieve the skin pressure on the child patient. Change the position regularly. If the child patient continues to struggle, sedatives can be used to prevent damage to the mouth and throat. Regularly remove oral secretions to ensure smooth breathing through the mouth and nose. To prevent the occurrence of complications such as ventilator-associated pneumonia (VAP) and frequent hemorrhoid. The two-person cooperative turning method was applied. One person helped to turn over, and the other person fixed the tracheal intubation and the ventilator tube to maintain the continuity of ventilator ventilation. After treatment: The child patient was still given parenteral nutrition by intravenous injection. After the condition stabilized, it was changed to nasogastric feeding. During the feeding period, attention should be paid to the drip feeding speed and the eating process of the child patient should be monitored. The mind map is shown in Figure 1.

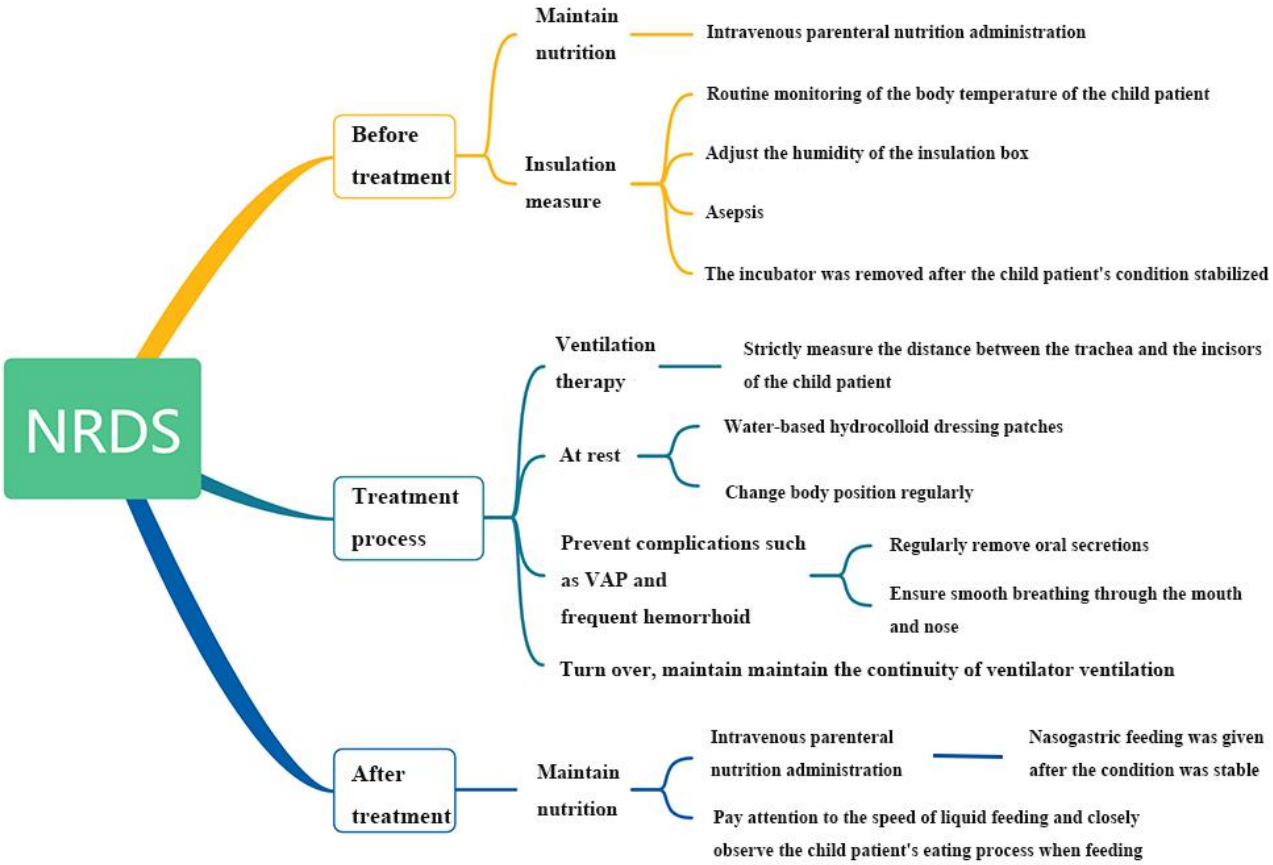

Figure 1 NRDS mind map. NRDS: neonatal respiratory distress syndrome; VAP: ventilator-associated pneumonia.

2.4 Observing indicators

Rehabilitation progress was assessed using both the Pediatric Critical Illness Score (PCIS) [6] and Pediatric Risk of Mortality III (PRISM III) [6] to evaluate disease severity and mortality risk, respectively. The PCIS comprises 11 parameters with scores > 80 indicating non-critical status, 71-80 denoting critical illness, and ⩽ 70 representing extreme criticality (lower scores correlating with worse prognosis). The PRISM III evaluates 16 variables, where higher scores indicate greater mortality risk. Clinical outcomes including pulmonary surfactant (PS) administration frequency, duration of mechanical ventilation, and length of hospital stay were recorded and compared between groups.

Arterial blood gas parameters, including pH, arterial oxygen saturation (SaO_2), arterial partial pressure of oxygen (PaO_2), and arterial partial pressure of carbon dioxide ($PaCO_2$), were measured in both groups before and after intervention using a blood gas analyzer.

Complications: The occurrence of complications such as infection, VAP, ventosity and frequent hemorrhoid in the two groups of child patient were observed and compared.

Caregiver satisfaction was assessed using a self-designed evaluation scale (total score = 100 points), with scores > 90 classified as "great satisfaction," 60-90 as "satisfaction," and < 60 as "dissatisfaction." The overall satisfaction rate was calculated as: (number of great satisfied + number of satisfied cases)/total cases × 100%.

2.5 Statistical analysis

Statistical analysis was performed by SPSS 20.0, and the χ^2 test was used to compare the count data, and the mean ± standard deviation was used to express the measurement data. The t-test was used for comparison, and $p < 0.05$ was considered statistically

significant.

3 Results

3.1 Comparison of rehabilitation process between the two groups

Before intervention, there was no significant differences were observed between groups PCIS or PRISM III scores (Figures 2a-2b, $p > 0.05$). After intervention, both groups showed significant improvements compared to before intervention, with increased PCIS scores (Figure 2a, $p < 0.05$) and decreased PRISM III scores (Figure 2b, $p < 0.05$). Notably, the observation group demonstrated superior outcomes versus controls, exhibiting significantly higher PCIS scores ($p < 0.05$), lower PRISM III scores ($p < 0.05$), reduced PS administrations, shorter mechanical ventilation duration, and decreased hospitalization length (Figure 2c, $p < 0.05$, Table 2).

Table 2 Comparison of rehabilitation process between the two groups (mean ± standard deviation).

Group	Cases	PCIS scores (points)		PRISM Ⅲ scores (points)		Number of PS applications (times)	Time on mechanical ventilation (d)	Length of stay (d)
		Before intervention	After intervention	Before intervention	After intervention			
Observation group	40	75.02 ± 4.17	83.45 ± 5.53 *	16.64 ± 1.36	5.71 ± 0.75 *	1.33 ± 0.67	4.37 ± 0.38	16.35 ± 3.67
Control group	40	74.93±4.66	78.65 ± 5.84 *	16.39 ± 1.75	6.23 ± 0.83 *	2.36 ± 0.42	8.48 ± 0.92	23.39 ± 4.36
t		0.091	3.775	0.713	-2.940	-8.238	-26.114	-7.813
p		0.928	0.000	0.478	0.004	0.000	0.000	0.000

Note: * indicates $p < 0.05$ compared with before intervention.

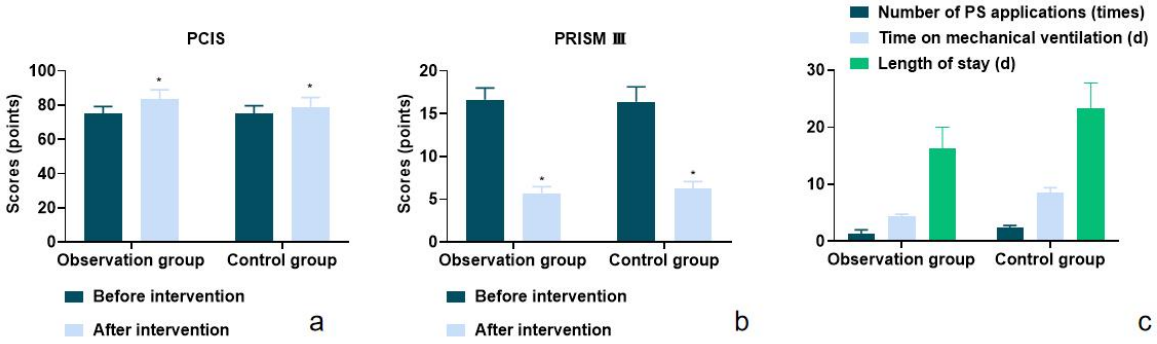

Figure 2 Comparison of rehabilitation process between the two groups. PCIS: pediatric critical illness score; PRISM Ⅲ: third-generation pediatric mortality risk score; PS: pulmonary surfactant. * indicates $p < 0.05$ compared with before intervention.

3.2 Comparison of arterial blood gas index levels in two groups

Before intervention, there was no significant difference in pH, SaO_2, PaO_2, and $PaCO_2$ levels between the two groups of child patient (Figures 3, $p > 0.05$). After intervention comparisons revealed significant improvements in both groups versus before intervention, with elevated pH, SaO_2 and PaO_2 levels (Figures 3a-3c, $p < 0.05$) and reduced $PaCO_2$ (Figure

3d, $p < 0.05$). The observation group demonstrated superior oxygenation outcomes compared to controls, exhibiting significantly higher pH, SaO_2, and PaO_2 values ($p < 0.05$) alongside lower $PaCO_2$ levels ($p < 0.05$, Table 3).

Table 3 Comparison of arterial blood gas index levels between the two groups (mean ± standard deviation).

Group	Cases	pH		SaO_2 (%)		PaO_2 (mmHg)		$PaCO_2$ (mmHg)	
		Before intervention	After intervention	Before intervention	After intervention	Before intervention	After intervention	Before intervention	After intervention
Observation group	40	7.22 ± 0.11	7.42 ± 0.19 *	89.94 ± 6.28	98.47 ± 8.25 *	52.57 ± 9.38	83.32 ± 10.75 *	64.77 ± 7.63	40.52 ± 5.94 *
Control group	40	7.19 ± 0.06	7.30 ± 0.14 *	90.17 ± 6.93	93.75 ± 7.83 *	54.39 ± 10.42	74.26 ± 11.40 *	63.26 ± 7.27	49.23 ± 6.32 *
t		1.154	3.216	-0.156	2.625	-0.821	3.657	0.906	-6.351
p		0.134	0.002	0.877	0.010	0.414	0.000	0.368	0.000

Note: * indicates $p < 0.05$ compared with before intervention.

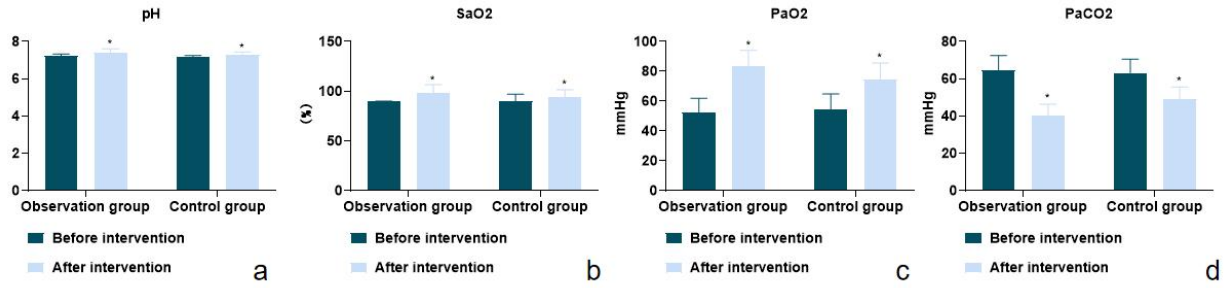

Figure 3 Comparison of arterial blood gas index levels in two groups. pH: arterial blood pH; SaO_2: arterial blood oxygen saturation; PaO_2: arterial blood oxygen partial pressure; $PaCO_2$: arterial blood carbon dioxide partial pressure. * indicates that compared with the before intervention, $p < 0.05$.

3.3 Comparison of complications between the two groups

The total incidence of complications in the observation group was significantly lower than that in the control group ($p < 0.05$), as shown in Figure 4a and Table 4.

Table 4 Comparison of complications between the two groups [Examples (%)].

Group	Cases	Infection	VAP	Ventosity	Frequent hemorrhoid	Overall incidence
Observation group	40	0	1	1	0	2 (5.00)
Control group	40	4	1	3	2	10 (25.00)
χ^2						6.275
p						0.012

3.4 Comparison of family satisfaction between the two groups

The total satisfaction rate of the families in the observation group was significantly higher than that in the control group ($p < 0.05$), as shown in Figure 4b and Table 5.

Table 5 Comparison of family satisfaction between the two groups [example (%)].

Group	Cases	Great satisfaction	Satisfaction	Dissatisfaction	Total satisfaction rate
Observation group	40	19	18	3	37 (92.50)
Control group	40	11	15	14	26 (65.00)
χ^2					9.038
p					0.003

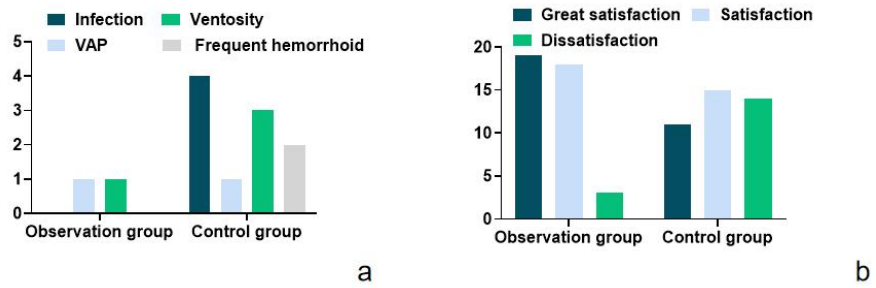

Figure 4 Comparison of complications and family satisfaction between the two groups. VAP: ventilator-associated pneumonia.

4 Discussion

The exact pathogenesis of NRDS remains unclear, though current evidence suggests the following mechanism: acute diffuse alveolar-capillary damage increases pulmonary capillary permeability, causing alveolar and interstitial edema that injures type II pneumocytes, reducing pulmonary surfactant (PS) production. This decreases alveolar surface tension, promotes alveolar collapse, and disrupts ventilation-perfusion ratios, ultimately leading to severe hypoxemia [7]. Given NRDS's rapid progression and potentially fatal outcomes without prompt treatment, timely therapeutic and nursing interventions are critical for improving prognosis. First developed in the 1960s by British psychologist and educator Tony Buzan, mind mapping represents an integrative teaching-learning methodology that has gained clinical nursing applications [8]. Cheng et al [9] demonstrated its efficacy in health education for pediatric inpatients with enteritis. In this study, the control group was given routine intervention and the observation group was given mind mapping nursing mode. The results showed that the latter had a better effect in NRDS child patient.

The results demonstrated that both groups showed improved PCIS scores and reduced PRISM III scores post-intervention, with the observation group exhibiting significantly greater improvements than controls, along with fewer PS administrations, shorter mechanical ventilation duration, reduced hospitalization, and lower complication rates - indicating that the mind mapping nursing model

effectively alleviates NRDS severity and accelerates recovery while minimizing complications. This model's efficacy stems from its multidisciplinary care team (physicians, head nurses, and staff nurses) receiving specialized mind mapping training to master its applications and construction methods. By integrating theory with practice through hierarchically structured visual tools, the approach clarifies complex nursing protocols, facilitates team discussions, and guides targeted interventions, thereby enhancing nursing competency and delivering superior care that promotes recovery and reduces hospitalization [10,11]. The model's color-coded tree diagrams organize nursing information for family education, improving disease knowledge retention, treatment adherence, and complication prevention awareness. Concurrently, nurses' timely clearance of oral secretions maintains airway patency, preventing respiratory compromise and reducing complications. Furthermore, the visual transformation of textual information into graphic formats emphasizes continuous vital sign monitoring and ventilator parameter adjustments to maintain physiological oxygenation, ultimately decreasing both mechanical ventilation duration and PS requirements [12].

NRDS results from pulmonary surfactant (PS) deficiency, which increases alveolar surface tension and leads to progressive alveolar collapse, atelectasis, decreased lung compliance, and impaired gas exchange [13]. Arterial blood gas parameters (pH, SaO_2, PaO_2, $PaCO_2$) serve as critical indicators of pulmonary ventilation and oxygenation, with their dysregulation signifying hypoxic states and acid-base imbalances. This study revealed significant post-intervention improvements in all these parameters for both groups, with the observation group demonstrating superior outcomes versus controls (elevated pH, SaO_2, PaO_2; reduced $PaCO_2$) alongside higher family satisfaction rates-collectively indicating that the mind mapping nursing model effectively optimizes oxygenation parameters while enhancing family satisfaction. In the mind mapping nursing model, by applying mind maps and using the two-person cooperative turning method to turn child patient with NRDS over, the position exchange can have a changing effect on the bilateral imbalanced exudate in the lungs of the child patient, reduce the difference in pressure between the dorsal and ventral pleural cavities, ensure pulmonary ventilation function, reduce alveolar overinflation and alveolar collapse, and thereby improve pulmonary ventilation and oxygenation [14,15]. In addition, in the mind mapping nursing intervention, the attending physician, head nurse and nurses form a nursing team, and jointly compile a mind map for the care of child patient with NRDS. The nursing content is displayed in multiple forms such as pictures, key words, colors and lines. Meanwhile, the family members of the child patient can directly participate in the entire nursing process, and if they have any questions, they can consult the nursing staff for timely solutions. Promote the communication between nursing staff and family members, thereby improving the satisfaction of family members [16].

In summary, the mind mapping-based nursing intervention demonstrates significant clinical benefits for NRDS patients, including accelerated recovery, improved arterial blood gas parameters, enhanced family satisfaction, and reduced complication rates.

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Not applicable.

Conflicts of Interest

All authors declare that the research was conducted in the absence of any commercial or fnancial relationships that could be construed as a potential confict of interest.

Author Contributions

Conceptualization, H.L.; Data curation, Y.W.; Formal analysis, Y.W.; Methodology, H.L.; Writing-original draft, H.L.; Writing-review and editing, Z.S.; All authors have read and agreed to the published version of the manuscript.

Ethics Approval and Consent to Participate

This study was approved by the hospital ethics committee.

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Availability of Data and Materials

The original contributions presented in the study are included in the article, further inquiries can be directed to the corresponding authors.

Supplementary Materials

Not applicable.

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