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Analysis of Perioperative Respiratory Care Methods and their Application Value in Children with Congenital Heart Disease

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Abstract: *Objective*: To analyze the perioperative respiratory care methods and application value in children with congenital heart disease. *Methods*: 60 children with congenital heart disease (treated from January 2021 to October 2023) were screened and divided into two groups randomly. Each group consisted of 30 cases. The perioperative routine was used in the control group. The observation group underwent the perioperative routine along with better respiratory care. Oxygenation indicators, surgical complications, and family satisfaction levels of the groups were compared. *Results*: There was no significant difference in the oxygenation index between the two groups of children at admission ($P > 0.05$). At discharge, the oxygenation indicators in the observation group were better than those of the control group, and the incidence of surgical complications was lower than that of the control group. The total satisfaction of family members in the observation group was higher than that of the control group ($P < 0.05$). *Conclusion*: During the perioperative period for children with congenital heart disease, the implementation of respiratory care, which mainly involves symptomatic care, catheter care, sputum suction care, etc., can actively improve the oxygenation indicators, reduce surgical complications, and promote faster and better recovery, of children with congenital heart disease.

Keywords: Congenital heart disease; Perioperative respiratory care; Nursing methods and value

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1. Introduction

According to statistics, about 150,000 to 200,000 newborns born in China every year have congenital heart disease [1]. This disease can be life–threatening to newborns and causes a burden to their families and society. Currently, congenital heart disease can only be treated by surgery. With the development of medical technology, the success rate of congenital heart surgery and the prognosis of the patients have improved significantly, with more affected children receiving surgical treatment. In addition to surgical treatment, perioperative care is crucial, especially respiratory care. If respiratory care is insufficient, complications such as pulmonary infection and atelectasis may occur. In addition, the patient's lung compliance may be reduced, which could lead to lung disease. Impairment of ventilatory function will increase the need for assisted ventilation post-surgery [2,3],

which will hinder the overall recovery of the children. By keeping this in mind, it is necessary to strengthen perioperative respiratory care for children with congenital heart disease. This study explored the methods and values of perioperative respiratory care for children with congenital heart disease. A total of 60 children were included as research subjects.

2. Materials and methods

2.1. Information

60 children with congenital heart disease were selected as the subjects for this study (admission period: January 2021 to October 2023). They were divided into a control group and an observation group of 30 cases each randomly.

The control group consisted of 18 males and 12 females, aged 1 to 8 years old (mean: 4.01 ± 0.69 years old), including 12 cases of patent ductus arteriosus, 11 cases of atrial septal defect, 4 cases of tetralogy of Fallot, and 3 cases of other defects. In the observation group, there were 19 males and 11 females. The oldest was seven years old, and the youngest was 1 year old. The average age was 4.22 ± 0.58 years old. The patient with patent ductus arteriosus was 13 years old. The observation group also included 10 cases of atrial septal defect, 5 cases of tetralogy of Fallot, and 2 cases of other defects.

Inclusion criteria: (1) Patients who were diagnosed with congenital heart disease through chest X-rays, echocardiography, and other examinations; (2) patients who met the criteria for surgical treatment; (3) patients whose families who were informed about the surgical plan and consented to the study; (4) patients with complete information.

Exclusion criteria: (1) Patients with severe organic lesions, heart, liver, and kidney diseases; (2) patients with other types of congenital heart disease; (3) patients with immune system and blood system diseases.

2.2. Method

The control group was subjected to routine perioperative care. Preoperative preparations were made and the operation was carried out according to standardized procedures. Vital signs of the child after the operation were monitored closely, essential management of the respiratory tract was performed, tubes were fixed, the respiratory tract was kept open, and the instructions on posture, diet, activities, and precautions were explained clearly.

The observation group was subjected to routine care along with increased respiratory care during the perioperative period, which consisted of six aspects. (1) Symptomatic care: After the child was admitted to the hospital, a chest X-ray examination was performed and the results of lung auscultation were analyzed. If the child had a lung infection, antibiotics were given, and aerosol inhalation therapy was performed until the infection completely subsided before surgery. The saturation of the child's blood oxygen was tested. If the child was cyanotic or had pulmonary hypertension, low-flow oxygen inhalation was required, 3 times/day, 2h/time. (2) Catheter care: After intubation, the catheter was marked and taped using two butterfly-shaped tapes to prevent it from falling off or shifting in place. Agitated children were restrained after obtaining consent from their families. Straps were used to restrain the limbs to prevent accidental extubation. The condition of the catheter was monitored every hour to ensure the catheter was not blocked or twisted and to deal with any adverse conditions promptly. If the child was conscious, could breathe independently, and showed acceptable cough reflex, stable hemodynamics, and his/her blood gas analysis indicators were all normal, then the child could be deemed for extubation. Rescue supplies were used to remove all secretions in the trachea and the oral and nasal cavities. After extubation, respiratory sounds, blood oxygen saturation, and other indicators were monitored

and the complexion was observed. Once the child was found to have difficulty breathing, or if there were signs of hypoxia, it was addressed immediately. The location of the sputum sounds and breathing conditions were determined, and the child's back was tapped lightly from top to bottom while holding hands to facilitate sputum expulsion. If the child's sputum had a relatively high viscosity, ultrasonic atomization inhalation therapy was used in adjunction. (3) Sputum suction care: Sputum suction was performed based on the child's condition. For children of < 1 year old, a 6F sputum suction tube was used. For children of ≥ 1 year old, an 8F sputum suction tube was used, and the negative pressure was controlled at < 15kPa. Sputum suction was performed by two nurses. One was responsible for separating the ventilator and tracheal intubation, providing oxygen support through the breathing bag, and performing lung expansion operations during the interval between sputum suction; the other one was responsible for clearing the secretions. (4) Ventilator care: The parameters of the ventilator were reasonably set. The ventilation mode used was synchronized intermittent mandatory ventilation (SIMV) + pressure–regulated volume control (PRVC) + pressure support ventilation (PSV). The positive end-expiratory pressure, number of breaths, and tidal volume were set to 3–5 cm H_2O, 25–35 times/min, and 10 ml/kg, respectively. If the blood gas analysis was normal, medium-high flow oxygen inhalation for half an hour with tracheal intubation was utilized along with the administration of dexamethasone. After sputum suction, the tube was removed and oxygen inhalation was carried out using a mask or bilateral nasal cannula. (5) Chest physical therapy care: Chest physical therapy was performed 1 hour after extubation, once every two hours, for 5 to 10 minutes each session. Before physical therapy, the child's breathing condition was evaluated to understand the specific location of the sputum sound. To expel phlegm, the child's back was tapped and the suprasternal fossa was pressed to stimulate coughing, while a sputum suction tube was used to remove the phlegm. If the sputum was viscous, a mixture of 0.3 g of atomized acetylcysteine solution + 2 ml normal saline solution was inhaled three times a day. After each inhalation, the chest and back were tapped. The vibration generated when tapping facilitates sputum discharge. (6) Rehabilitation care: Before removing the drainage tube, the child was instructed to move his limbs in bed three times a day, 5–10 minutes each time. After removing the drainage tube, the child was required to start walking in moderation that day while slowly increasing activity over time.

2.3. Observation indicators

(1) The oxygenation indicators of the two groups of children on admission and discharge were compared. Blood gas analysis was carried out, accompanied by the examination of inspired oxygen concentration, arterial oxygen partial pressure, and oxygenation index by collecting 1ml of femoral artery blood.

(2) The surgical complications between the two groups, including any signs of pneumothorax, atelectasis, and respiratory tract infection were compared.

(3) The satisfaction of family members of the two groups was compared. The satisfaction of the family members was evaluated using the hospital's self-made nursing satisfaction questionnaire The questionnaire was filled out by the main caregiver. The score ranged from 0 to 100, with 90 to 100 indicating "very satisfied," 70 to 89 indicating "relatively satisfied," 60 to 69 indicating "satisfied," and < 60 indicating "unsatisfied." The total satisfaction (%) = very satisfied + relatively satisfied + satisfied.

2.4. Statistical methods

Based on SPSS 25.0 for Windows software, the observed data were compared normatively. The measurement data were expressed as mean ± standard deviation, and the data were compared using a *t*-test; the count data were expressed as percentages and compared using the chi-square (χ^2) test. $P < 0.05$ indicates a statistically

significant difference.

3. Results

3.1. Oxygenation indicators

As shown in **Table 1**, there were no significant differences in the oxygenation indicators between the two groups of children on admission, $P > 0.05$. At discharge, the inhaled oxygen concentration, arterial oxygen partial pressure, and oxygenation index of the children in the observation group were higher than those in the control group at $P < 0.05$.

Table 1. Oxygenation indicators (mean ± standard deviation)

Group name	Number of examples (*n*)	Inhaled oxygen concentration (%)		Arterial partial pressure of oxygen (mmHg)		Oxygenation index (mmHg)	
		On admission	Upon discharge	On admission	Upon discharge	On admission	Upon discharge
Control group	30	35.15 ± 7.26	40.52 ± 6.37	102.65 ± 13.35	110.15 ± 11.18	299.58 ± 25.46	410.65 ± 31.19
Observation group	30	35.26 ± 7.18	45.58 ± 7.23	102.51 ± 14.17	118.96 ± 12.37	299.40 ± 26.18	428.65 ± 30.26
t	-	0.059	2.876	0.039	2.894	0.027	2.269
P	-	0.953	0.000	0.969	0.005	0.979	0.027

3.2. Surgical complications

As shown in **Table 2**, the incidence of surgical complications in the observation group was lower than that of the control group, $P < 0.05$.

Table 2. Surgical complications (*n* [%])

Group name	Number of cases (*n*)	Pneumothorax	Atelectasis	Respiratory tract infection	Total
Control group	30	1 (3.33)	2 (6.67)	3 (10.00)	6 (20.00)
Observation group	30	0 (0.00)	0 (0.00)	1 (3.33)	1 (3.33)
χ^2	-	-	-	-	4.043
P	-	-	-	-	0.044

3.3. Family satisfaction

As shown in **Table 3**, the overall satisfaction of the family members of the observation group with the nursing care provided was higher than that of the control group ($P < 0.05$).

Table 3. Family satisfaction (*n* [%])

Group name	Number of cases (*n*)	Very satisfied	Relatively satisfied	Satisfied	Unsatisfied	Overall satisfaction
Control group	30	8(26.67)	10 (33.33)	6 (20.00)	6 (20.00)	24 (80.00)
Observation group	30	14 (46.67)	10 (33.33)	5 (16.67)	1 (3.33)	29 (96.67)
χ^2	-	-	-	-	-	4.043
P	-	-	-	-	-	0.044

4. Discussion

Congenital heart disease is the most common type of heart disease in children. It refers to problems in the heart development process of children, and the exact cause is unclear. This disease may be related to viral infection or genetic defects. Symptoms may differ between patients. Common symptoms include difficulty in breathing, fatigue, and edema [4]. There may be no symptoms at birth, but they may gradually appear as the child ages. As the organs and tissues of children are not fully matured, there will be higher risks during surgery [5]. Cardiopulmonary dysfunction, infection, and other problems can occur during extracorporeal circulation surgery. If the airway is not cared for properly, airway phlegm blockage and other adverse effects may occur. This incident requires increased attention and strengthening of perioperative respiratory care.

The perioperative nursing care for children with congenital heart disease should focus on respiratory tract care. In this study, 30 children in the observation group were provided with symptomatic care, catheter care, sputum suction care, ventilator care, chest physical therapy care, and rehabilitation care. Symptomatic care improves the pre-operative physical condition of children, reduces adverse factors, and promotes smooth operation. Catheter care ensures smooth operation of the catheter, strictly controls the indications for extubation, and reduces complications. Sputum suction care promotes the patency of the respiratory tract [6-8] in conjunction with ventilator care to improve the oxygenation indicators of the child. Chest physical therapy care enables smoother breathing and rehabilitation care restores the child's bodily functions gradually [9-11]. The results and data in this study showed that the inhaled oxygen concentration, arterial oxygen partial pressure, and oxygenation index of the children in the observation group upon discharge from the hospital were all higher than those in the control group. The incidence of surgical complications in the observation group was lower than that of the control group, indicating that perioperative respiratory care can improve the child's oxygenation indicators and reduce complications. This is because respiratory care focuses on ensuring the smooth operation of catheters, sputum suction, and ventilators. All these can help children smoothly discharge sputum, improve breathing, and prevent surgical complications [12,13]. Comparing the nursing satisfaction of the two groups of family members, the observation group was higher, which showed that the observation group was more satisfied with the nursing method.

5. Conclusion

Providing perioperative respiratory care, such as symptomatic care and catheter care, to children with congenital heart disease can help reduce complications and promote recovery after surgery.

Disclosure statement

The author declares no conflict of interest.

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