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Original Article

Application value of high-quality nursing in patients with severe pneumonia under the treatment of extra corporeal membrane oxygenation

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Abstract: Objective: To explore the application value of high-quality nursing in patients with severe pneumonia under the treatment of extracorporeal membrane oxygenation (ECMO). Methods: A total of 100 patients with severe pneumonia admitted to our hospital within five years were selected, and assigned to a study group (n=52) and a control group (n=48). The control group was nursed under a routine nursing mode when treated with ECMO, while the study group was nursed under a high-quality nursing mode when treated with ECMO. The following aspects of the two groups were evaluated and recorded: Clinical indexes and blood gas analysis indexes before and after nursing intervention and complication rates after treatment. The anxiety and depression of the two groups were assessed using the self-rating anxiety scale (SAS) and self-rating depression scale (SDS), respectively; and their pulmonary infection and prognosis were assessed based on clinical pulmonary infection score (CPIS) and Acute Physiology and Chronic Health Evaluation II (APACHE II), respectively. In addition, the nursing satisfaction of patients was assessed using a self-made *Nursing Satisfaction Questionnaire* from our hospital, and life quality of patients was assessed by referring to the EORTC Quality of Life Questionnaire (QLQ-C30). Results: After nursing, the control group performed significantly better than the control group in clinical indexes and blood gas indexes (all $P<0.05$). The study group had significantly lower CPIS, APACHE II, SAS and SDS scores, and significantly higher life quality scores than the control group (all $P<0.05$). Furthermore, after nursing, the study group showed significantly higher nursing satisfaction and significantly lower overall complication rates than the control group (all $P<0.05$). Conclusion: High-quality nursing is effective for patients with severe pneumonia under the treatment of ECMO, because it can effectively, reduce complications during treatment, and stabilize vital signs of patients.

Keywords: High-quality nursing, ECMO treatment, severe pneumonia, application value

Introduction

Pneumonia is a disease with inflammation of lung tissues caused by different pathogens [1], which usually occurs acutely in winter and spring, with complex clinical manifestations and usually involves the circulation, nervous system, and digestive system [2]. Severe pneumonia causes extremely high clinical mortality and heavy medical expenses [3, 4], and it often causes various complications in intensive care units due to the invasive ventilation measures [5]. Therefore, effective treatment methods are extremely limited in clinical practice. In recent years, with the development of mechanical circulatory support, extracorporeal membrane oxygenation (ECMO) is employed for life-threatening lung or heart failure disease when there is no other treatment choice or no effective treatment methods [6].

ECMO is a resource-intensive and highly complex intervention measure [7], which is an alternative for lung support in severe patients [8]. However, patients treated with ECMO are mostly in a severe situation with weak consciousness, so they not only require timely treatment, but also require nursing, and nursing quality affects their treatment outcome and prognosis [9]. Basic routine nursing may bring the risk of increased patient dependence on nursing [10], while patient-centered high-quality nursing can improve the clinical outcome of patients, and elevate the overall nursing service level, and

can provide targeted nursing intervention for patients from psychological and physiological perspectives [11-14]. A study conducted by Tsai et al. concluded that nursing satisfaction of patients was related to the efficiency and quality of surgical nursing, and high nursing satisfaction contributed to reduction of the readmission rate and mortality of patients [15].

At present, there are few studies on high-quality nursing in patients with severe pneumonia under the treatment of ECMO, so this study explored the application value of it in in patients with severe pneumonia under the treatment of ECMO by employing it in such patients, so as to provide feasible nursing intervention measures for them.

Materials and methods

General data

A total of 100 patients with severe pneumonia admitted to our hospital within five years were selected, and assigned to a study group (n=52) and a control group (n=48). The control group was nursed under a routine nursing mode when treated with ECMO, while the study group was nursed under a high-quality nursing mode when treated with ECMO. The study group consisted of 32 males and 20 females between 36 and 81 years old, with an average age of (57.31±11.83) years, and the control group consisted of 33 males and 15 females between 35 and 80 years old, with an average age of (57.14±12.55) years.

Inclusion and exclusion criteria

Inclusion criteria of the patients were as follows: Patients meeting the diagnostic criteria for severe pneumonia and patients with stable vital signs and detailed general clinical data [16]; patients with capacity for independent thinking and patients with expected survival ≥1 year. This study was approved by the Ethics Committee of our hospital, and the study subjects and their family members signed informed consent forms after understanding the study. Exclusion criteria of the patients were as follows: Patients with end-stage diseases, multiple organ dysfunction syndromes, severe pulmonary hypertension, central nervous system injury, mental disease or family history of psychosis or those in shock or heart failure.

Nursing methods

Patients in the control group were nursed under a routine nursing mode as follows: They were nursed with measures for mechanical ventilation, and arranged to study basic health knowledge; nursing staff was reasonably arranged to monitor their vital signs regularly and perform sputum aspiration and oral nursing to them. In addition, preventive nursing against complications were provided before treatment, and a good ward environment was also provided for them.

Patients in the study group were nursed under a high-quality nursing mode as follows: (1) Nursing and preparation for ECMO before treatment: Nursing staff was arranged to regularly check catheters and oxygenators to keep connections between systems and power connectors, and prepare emergency power. In the meantime, the staff was required to observe the puncture sites of ECMO catheters, change dressing regularly, observe whether the wound of patients oozed blood, and protect catheters from accidental extubation. In addition, the staff was prohibited from performing any operation to catheters to avoid air embolism caused by air in them. (2) Ward environment nursing: Each patient was treated with an individual nursing scheme during treatment to prevent cross infection. Strict aseptic operation, regular ventilation and disinfection for wards were performed, and visiting family members of the patients were required to wear isolation clothes and caps before visiting. In addition, each patient was offered special inspection equipment and facilities, and the equipment and facilities were disinfected before and after use to avoid infection. (3) Psychological intervention: Nursing staff was required to strengthen communication with the patients in a targeted communication way to establish a trusting relationship between them, so as to help the patients alleviate psychological pressure, anxiety, fear, and other negative emotions. In addition, the staff was required to help the patients hold a positive attitude toward their diseases and tell them the significance of positive a mentality in overcoming diseases. Furthermore, family members of the patients were required to give the patients encouragement, comfort and spiritual support when visiting them. (4) Respiratory tract nursing: A high-quality ventilator and sputum elimination machine was

employed for each patient to prevent the patient from being infected with respiratory-related pneumonia. The parameters of each ventilator were set to values of low-pressure ventilation mode for the sake of the lung. Secretions in the respiratory tract of each patient were observed regularly, and the respiratory track was further soothed. In addition, nursing staff was arranged to regularly perform aseptic operations to suck sputum for patients regularly. (5) Nursing against complications: In terms of bleeding, nursing staff was required to always observe and record the catheters of the patients, and immediately treat their bleeding if found, and perform pressure bandaging at puncture sites of them. After bandaging, the staff was arranged to observe whether there was hematoma or oozing of blood in the puncture sites. Invasive operation should be avoided or reduced as much as possible, and if invasive operation was performed, pressing on puncture sites should be prolonged to reduce complications. In terms of infection, antibiotics were used prudently, and the body temperature of each patient was measured and recorded hourly to prevent catheter-related bloodstream infection. Medical staff was required to strengthen treatment to the patients in terms of sputum suction, turning over, and back patting. In terms of hemolysis, the staff was arranged to closely observe the skin temperature and color of the patient's lower limbs, and evaluate and record the urine color and urine volume of the patients. In case of soy urine, it should be reported to the doctor in time for treatment.

Observation indexes

(1) Appetite, sleep quality, hospitalization time, complication rate, and blood gas indexes of the patients after treatment were evaluated and recorded. The blood gas indexes included arterial blood pH, partial pressure of carbon dioxide (PCO_2), oxygen partial pressure (PO_2), and oxygenation index (PFR). (2) The clinical pulmonary infection score (CPIS) was used to assess pulmonary infection of the patients. CPIS covers seven indexes, with the maximum score of 12 points. Lower score indicates more remission of the disease, and higher score indicates severer disease. (3) Acute Physiology and Chronic Health Evaluation II (APACHE II) was used to assess prognosis of the patients. It covers three indexes, with a total score of 71 points. High score indicates severer disease. (4) The self-rating anxiety scale (SAS) was employed for anxiety evaluation of the patients. The scale has the maximum score of 100 points and indicates mild anxiety with 50-70 points, moderate anxiety with 71-90 points, and severe anxiety with more than 90 points. Higher score signifies more severe anxiety. (5) The self-rating depression scale (SDS) was employed for depression evaluation of the patients. The scale has the maximum score of 100 points and indicates mild depression with 50-70 points, moderate depression with 71-90 points, and severe depression with more than 90 points. Higher score indicates more severe depression. (6) The measuring scale of quality of life was used to assess the life quality of the two groups. The scale covers body function, cognitive function, emotion function, role function, and social function, 100 points for each item. Higher score indicates better life quality. (7) The self-made *Nursing Satisfaction Questionnaire* of our hospital was used to evaluate nursing satisfaction of the patients, which mainly covered attitude, character, wearing, and operation proficiency. The questionnaire consisted of 20 questions, and each question was worth 5 points. The score <70 points indicated dissatisfaction; score between 70 and 89 indicated basic satisfaction, and score ≥90 points indicated satisfaction. Satisfaction = (the number of patients satisfied with nursing + the number of patients basically satisfied with nursing)/the total number of patients ×100%.

Statistical analysis

In this study, the data were statistically analyzed using SPSS 20.0 (IBM Corp, Armonk, NY, United States), and made into figures using GraphPad Prism 7. Enumeration data were represented by [n (%)], and comparison between groups was analyzed using chi-square test. Measurement data were represented by mean ± standard deviation (x ± sd), and comparison between groups in measurement data was analyzed using independent-samples T test. Comparison of the same group before and after nursing was analyzed using paired t test. $P<0.05$ indicated a significant difference.

Results

General data

There were no significant differences between the two groups in general clinical baseline data including sex, age, body mass index (BMI), place of residence, nationality, education back-

Table 1. Comparison between the two groups in general data [n (%)] (x ± sd)

Items	Study group (n=52)	Control group (n=48)	t/X^2 value	*P* value
Sex			0.571	0.450
Male	32 (61.54)	33 (68.75)		
Female	20 (38.46)	15 (31.25)		
Age (Y)	56.75±11.83	56.14±12.55	0.069	0.945
BMI (kg/m^2)	23.8±3.6	22.9±3.5	0.250	0.803
Place of residence			0.904	0.342
Urban area	31 (59.62)	33 (68.75)		
Rural area	21 (40.38)	15 (31.25)		
Nationality			0.244	0.622
Han nationality	36 (69.23)	31 (64.58)		
Minority nationality	16 (30.77)	17 (35.42)		
Education background			0.013	0.909
≥ senior high school	32 (61.54)	29 (60.42)		
<senior high school	20 (38.46)	19 (39.58)		
Smoking history			0.048	0.823
Yes	38 (73.08)	36 (75.00)		
None	14 (26.92)	12 (25.00)		
Drinking history			0.014	0.907
Yes	33 (63.46)	31 (64.58)		
None	19 (36.54)	17 (35.42)		
Diabetes history			0.002	0.961
Yes	29 (55.77)	27 (56.25)		
None	23 (44.23)	21 (43.75)		
Clinical symptoms			0.582	0.748
Expectoration	21 (40.38)	23 (47.92)		
Fever	17 (32.69)	14 (29.17)		
Chest pain	14 (26.92)	11 (22.92)		

Table 2. Comparison between the two groups in hospitalization time, appetite, and sleep quality after nursing (x ± sd)

Groups	n	Hospitalization time (d)	Appetite	Sleep quality
Study group	52	24.17±4.56	2.92±0.61	3.34±0.51
Control group	48	36.24±6.21	2.37±0.41	2.78±0.29
T		11.140	5.247	6.675
P		<0.001	<0.001	<0.001

ground, smoking history, drinking history, diabetes history and clinical symptoms (all P> 0.05). See **Table 1**.

Basic clinical conditions of the two groups after nursing

There were differences between the two groups in basic clinical data after nursing (all P<0.05). The study group performed significantly better than the control group in hospitalization time, appetite, and sleep quality after nursing (all P<0.05). See **Table 2**.

Blood gas indexes of the two groups before and after nursing

Before nursing, there were no significant differences between the two groups in blood gas indexes (all P>0.05), while after nursing, both groups showed significantly better blood gas indexes, and the study group performed significantly better than the control group in terms of blood gas indexes (all P<0.05). See **Table 3**.

CPIS and APACHE II score of the two groups before and after nursing

Before nursing, there were no significant differences between the two groups in CPIS and APACHE II score (both P>0.05), while after nursing, both groups had significantly lower CPIS and APACHE II scores, and the study group had significantly lower CPIS and APACHE II scores than the control group (all P<0.05). See **Figure 1**.

SAS score and SDS score of the two groups before and after nursing

Before nursing, no significant difference was observed between the two groups in SAS score and SDS score (both P>0.05), while after nursing, both groups had significantly lower SAS score and SDS score, and the study group had significantly lower SAS score and SDS score than the control group (all P<0.05). See **Figure 2**.

Life quality score of the two groups after nursing

There were differences between the two groups in life quality scores after nursing (all P<0.05). The study group had higher scores in life quali-

Table 3. Blood gas indexes of the two groups before and after nursing (x ± sd)

Groups	N	PH		PCO_2/mmHg		PO_2/mmHg		PFR/mmHg	
		Before nursing	After nursing	Before nursing	After nursing	Before nursing	After nursing	Before nursing	After nursing
Study group	52	7.34±0.1	7.54±0.2	53.41±25.3	36.21±8.9	54.81±18.2	75.31±17.3	49.31±16.3	137.42±55.3
Control group	48	7.35±0.2	7.41±0.1	54.29±25.4	39.57±7.4	55.11±18.1	68.41±15.3	48.21±16.1	114.01±55.4
t		0.319	4.058	0.173	2.043	0.083	2.116	0.339	2.113
P		0.749	<0.001	0.863	0.044	0.934	0.037	0.735	0.037

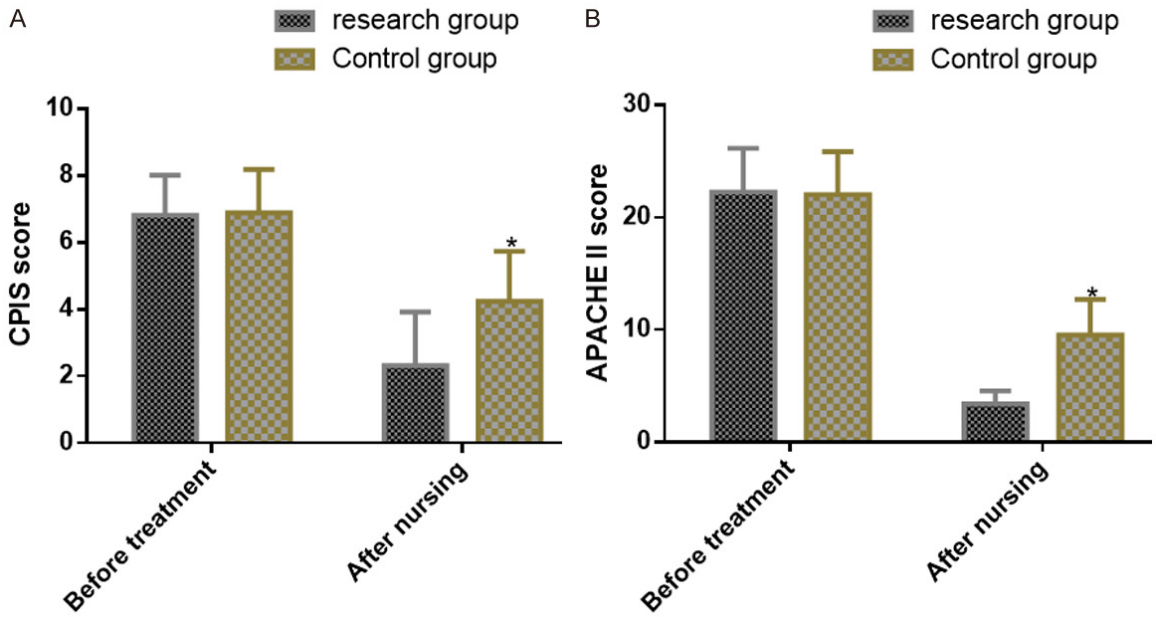

Figure 1. CPIS score and APACHE II score of the two groups before and after nursing. Before nursing, there were no significant differences between the two groups in CPIS and APACHE II score (both P>0.05), while after nursing, both groups had significantly lower CPIS and APACHE II scores, and the study group had significantly lower CPIS and APACHE II scores than the control group (all P<0.05). Note: * indicates that in comparison with the control group after nursing, P<0.05.

ty, body function, emotion function, role function, and social function than the control group after nursing (P<0.05). See **Table 4**.

Nursing satisfaction of the two groups after nursing

The study group showed a nursing satisfaction of 94.23%, with 31 patients very satisfied with nursing (59.62%), 18 patients satisfied with nursing (34.62%), and 3 patients dissatisfied with nursing (5.77%); and the control group showed a nursing satisfaction of 77.08%, with 16 patients very satisfied with nursing (33.33%), 21 patients satisfied with nursing (43.75%), and 11 patients dissatisfied with nursing (22.92%). It was apparent that the nursing satisfaction of the study group was significantly higher than that of the control group after nursing (P<0.05). See **Table 5**.

Complication rate of the two groups after nursing

The study group showed an overall complication rate of 9.62%, with infection in 1 patient (1.92%), hemorrhage in 2 patients (3.85%), embolization in 1 patient (1.92%), and hypotension in 1 patient (1.92%); and the control group showed an overall complication rate of 25.00%, with infection in 4 patients (8.33%), hemorrhage in 3 patients (6.25%), embolization in 2 patients (4.17%), and hypotension in 3 patients (6.25%). It was apparent that the overall complication rate of the study group was significantly

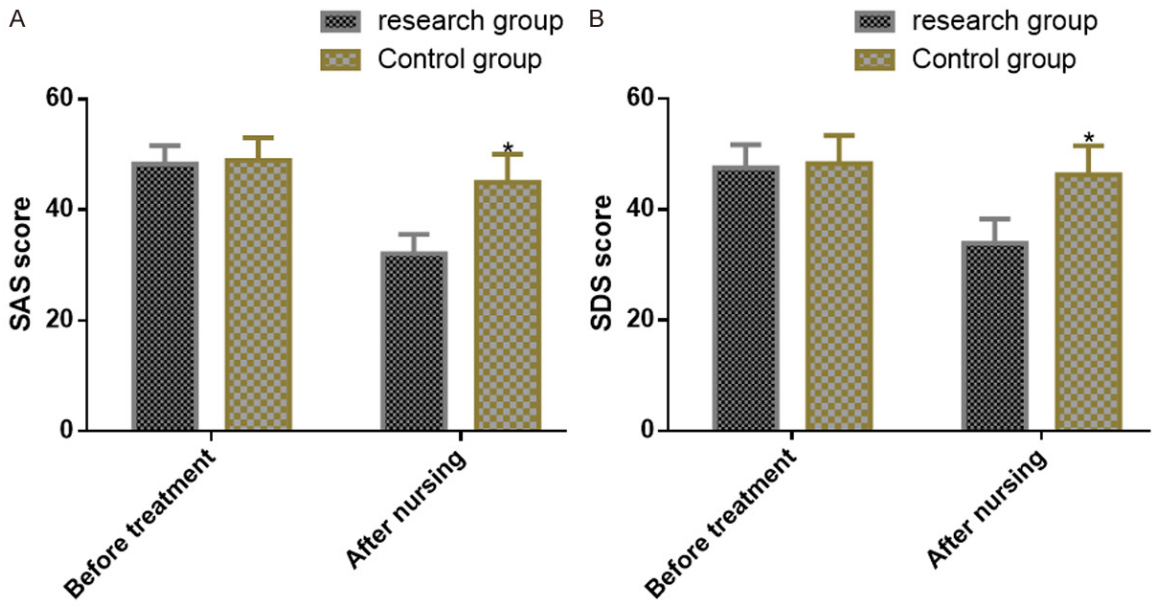

Figure 2. SAS score and SDS score of the two groups before and after nursing. Before nursing, there were no significant differences between the two groups in SAS and SDS scores (both P>0.05), while after nursing, both groups had significantly lower SAS and SDS scores, and the study group had significantly lower SAS and SDS scores than the control group (all P<0.05). Note: * indicates that in comparison with the control group after nursing, P<0.05.

Table 4. Comparison between the two groups in life quality score after nursing (x ± sd)

Life quality score	Study group (n=52)	Control group (n=48)	t value	*P* value
Life quality	78.13±5.12	63.93±3.56	2.666	0.009
Body function	73.87±3.94	60.21±4.40	16.380	<0.001
Emotion function	74.81±6.71	61.89±4.56	11.170	<0.001
Role function	78.33±7.68	59.97±8.75	11.170	<0.001
Social function	78.63±8.33	64.43±9.40	8.008	<0.001

Table 5. Nursing satisfaction of the two groups after nursing [n (%)]

Items	Study group (n=52)	Control group (n=48)	X^2 value	*P* value
Very satisfied	31 (59.62)	16 (33.33)	-	-
Satisfied	18 (34.62)	21 (43.75)	-	-
Dissatisfied	3 (5.77)	11 (22.92)	-	-
Nursing satisfaction	49 (94.23)	37 (77.08)	6.096	0.014

lower than that of the control group after nursing (P<0.05). See **Table 6**.

Discussion

Pneumonia shows an increasing annual mortality, which is related to the increase of elderly patients [17]. Mainly caused by streptococcus pneumoniae and respiratory syncytial virus, pneumonia usually occurs acutely with a variety of severe complications such as acute respiratory distress syndrome, septic shock and respiratory failure [18-20]. In clinical practice, normal hemoperfusion is usually ensured by timely correcting hypoxia and improving systemic oxygen delivery [21], ECMO, as a potential treatment method, is being used more and more in clinical treatment [22].

In this study, we adopted high-quality nursing to nurse patients with severe pneumonia under the treatment of ECMO, finding that the nursed patients have clear improvement. Under the high-quality nursing mode, each patient was nursed comprehensively and in a targeted manner [23, 24]. A study by Redaelli et al. supported that daily nursing was feasible and safe for patients under the treatment of venovenous extracorporeal membrane oxygenation, and could change important parameters [25]. This study revealed that the study group performed significantly better than the control group in hospitalization time, appetite and sleep quality, which indicat-

Table 6. Complication rate of the two groups after nursing [n (%)]

Groups	n	Infection	Hemorrhage	Embolization	Hypotension	Overall rate
Study group	52	1 (1.92)	2 (3.85)	1 (1.92)	1 (1.92)	5 (9.62)
Control group	48	4 (8.33)	3 (6.25)	2 (4.17)	3 (6.25)	12 (25.00)
X^2 value	-	2.159	0.304	0.432	1.217	4.187
P value	-	0.142	0.582	0.511	0.279	0.041

ed that targeted high-quality nursing could improve appetite and sleep quality of the patients, contribute to recovery of them after treatment, and shorten their hospitalization time. In addition, the study group showed a more significant improvement in blood gas indexes than the control group, and also showed a significantly lower complication rate than the control group, which suggested that high-quality nursing could improve hemodynamics indexes and lower the complication rate caused by ECMO in patients. Furthermore, the study group performed significantly better than the control group in CPIS, APACHE II score, SAS score and SDS score, which indicated that high-quality nursing could effectively improve respiratory function of the patients and better relieve their disease. It was also found that psychological intervention on patients could effectively alleviate psychological emotions of the patients.

Life quality reflects the recovery of patients after surgery or treatment [26]. A study pointed out that patients with acute respiratory distress syndrome showed good physical function and social function after being treated with ECMO, but they usually suffered pulmonary fibrosis and abnormal pulmonary function after ECMO [27]. In this study, after high-quality nursing, the patients with severe pneumonia under the treatment of ECMO showed improved life quality, experienced improved clinical efficacy, and suffered no pulmonary fibrosis or abnormal pulmonary function cited in the above study.

To sum up, high-quality nursing is effective for patients with severe pneumonia under the treatment of ECMO, because it can effectively improve life quality, reduce complications and negative emotions during treatment, and stabilize vital signs.

Disclosure of conflict of interest

None.

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