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Original Article

Effect of all-in-one nursing model on ICU ventilator-associated pneumonia

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Abstract: Objective: To study the effect of an all-in-one nursing model on ICU ventilator-associated pneumonia (VAP). Methods: A total of 100 ICU patients needing ventilator assistance who were admitted to our hospital from March 2018 to December 2019 were equally randomized into two groups by a lottery system, with 50 cases in each group. Patients in the control group received routine nursing, and patients in the experimental group received all-in-one nursing. The number of ICU VAP patients, time transferring from ICU to an ordinary ward, hospital stay, mechanical ventilation time, nursing efficiency, and the changes of blood pressure, heart rate and oxygen saturation during nursing was compared between the two groups. Results: Regarding the number of cases of VAP, the length of stay in the ICU, and the length of hospital stay, and the mechanical ventilation time, the experimental group was markedly shorter than that of the control group ($P<0.05$). With respect to the effective rates of nursing care, the experimental group (96%) was better than the control group (80%) ($P<0.05$). When considering the changes of hemodynamic indexes during the nursing process, the two groups exhibited no marked difference ($P>0.05$). After intervention, the control group was inferior in terms of the oxygen partial pressure and carbon dioxide partial pressure compared to the experimental group ($P<0.05$). Conclusion: All-in-one nursing can reduce the incidence of VAP in ICU patients, significantly shorten the length of ICU stay, hospital stay and mechanical ventilation time, thus improving overall nursing efficiency.

Keywords: Integrated medical care, ventilator-associated infectious pneumonia, ICU, nursing effect, application value

Introduction

The Intensive Care Unit (ICU) is a place that provides isolation space and medical equipment for critically ill or unconscious patients. Patients receive intensive treatment and care in the ICU, and all vital signs of patients are closely monitored [1-3]. There are certain differences between the ICU and ordinary wards in terms of manpower, material resources, or technology, and the ICU strives to provide patients with the best treatment and support. Generally, the ICU ward will be equipped with monitors, ventilators, electrocardiographs, defibrillators, pacemakers, tracheal intubation and other daily necessary emergency materials, so as to give first aid to patients in the event of an accident. ICU patients often use ventilators for mechanical ventilation. Excessive mechanical ventilation may cause ventilator-associated pneumonia (VAP), thereby prolonging the patient's stay in the ICU ward, which not only increases the patient's suffering, but also brings economic pressure for family members [4-7]. Consequently, the prevention of VAP in ICU patients is a problem that needs attention in ICU nursing. All-in-one nursing care refers to the collaborative work of the attending doctors and relevant nursing staff to jointly manage the patient's care. It is reported that all-in-one nursing care can significantly improve the efficiency of patient care and shorten the recovery time of patients [8-10]. As a new type of nursing model, all-in-one nursing care, from a comprehensive and holistic perspective, combined with previous clinical work experience, analyzes the psychological and physiological problems of patients, strengthens the evaluation of the condition, and formulates a personalized and targeted nursing program. Over the years, numer-

Table 1. General data comparison ($\bar{x} \pm sd$)

Index	Experimental group	Control group	t/X^2	P
Gender (male/female)	26/24	25/25	0.04	0.84
Age (years)	39.35±6.08	39.77±6.21	0.34	0.73
Height (cm)	168.10±7.36	167.98±7.55	0.08	0.94
Weight (kg)	73.29±2.44	73.61±2.38	0.66	0.51
hypertension (n)	7	9	0.30	0.59
diabetes (n)	5	4	0.12	0.73
hyperlipidemia (n)	3	5	0.54	0.46
Cause of hospitalization				
Severe trauma	21	20	0.04	0.84
coronary heart disease	13	15	0.20	0.66
shock	10	11	0.06	0.81
organ transplantation	6	4	0.44	0.51

ous trials for the prevention and control of VAP have been launched worldwide, but there is a lack of such initiative for ICU patients with VAP. In this regard, this study was designed to study the application value of all-in-one care in ICU patients with VAP by providing different nursing methods and comparing probability of occurrence of VAP, length of hospitalization, stay in the ICU, time of mechanical ventilation, and hemodynamic indicators.

Materials and methods

General information

This was a retrospective study conducted on 100 ICU patients who needed to use ventilators and were admitted to our hospital over a period of March 2018 to December 2019. They were equally randomized into a control group and an experimental group. Patients in the experimental group were 25-50 years old, and patients in the control group were 27-50 years old. The comparison of general data such as gender, age and reason for admission between the two groups was not statistically significant (P>0.05). See **Table 1**.

Inclusion/exclusion criteria

Inclusion criteria: ① Patients who were hospitalized in the ICU of our hospital and used a ventilator for mechanical ventilation; ② Patients who were aged ≥18 years old; ③ No combined diseases; ④ No history of drug allergy, drug abuse, and bad habits; ⑤ This study was approved by the hospital ethics committee, and all patients voluntarily participated in the study and signed an informed consent form.

Exclusion criteria: ① With coagulopathy, or taking anticoagulant drugs; ② Infectious pneumonia occurred recently; ③ Patients who were expected to die within the study period.

Methods

The patients in the control group received conventional nursing methods. The nursing staff regularly check the patients' vital indicators and report to the attending doctor in time when abnormal problems occurred.

Patients in the experimental group received all-in-one medical nursing care. We divided the responsibility area of doctors and nurses according to the beds. Within the scope of responsibility, doctors and nurses needed to cooperate and manage patients. We established a communication platform for medical staff to summarize and communicate with patients within their jurisdiction daily. The nursing staff reported the patient's complains during the nursing process and the patient's or family's demands to the attending doctor. The doctor and nursing staff worked together to develop a care plan for the patient in the next stage. We made sure to round the ward at least once a day to check whether the various instruments are working properly and if the patient's vital signs are stable. We carried out professional training or assessment of medical staff on a regular basis in order to strengthen nursing work [11-13].

Observation indicators

The number of cases of ICU VAP, the time of ICU transfers to the general ward, the length of hospitalization, the time of mechanical ventilation, the effective rate of nursing, and the changes in blood pressure, heart rate, blood oxygen saturation, partial pressure of oxygen and carbon dioxide during the nursing process were compared between the two groups.

Table 2. Comparison of the number of cases of VAP, stay in ICU, hospital stay, and mechanical ventilation time ($\bar{x} \pm sd$)

Groups	VAP (n)	ICU stay (d)	hospital stay (d)	mechanical ventilation time (d)
Experimental group	2	8.62±1.35	22.81±3.36	6.67±1.54
Control group	9	11.50±2.66	26.59±3.99	10.25±2.11
t	5.01	6.83	5.12	9.69
P	0.03	<0.001	<0.001	<0.001

Table 3. Comparison of effective rates

Groups	Markedly effective	Effective	Ineffective	Total effective rate (%)
Experimental group	33	15	2	96%
Control group	13	27	10	80%
X^2				6.06
P				0.01

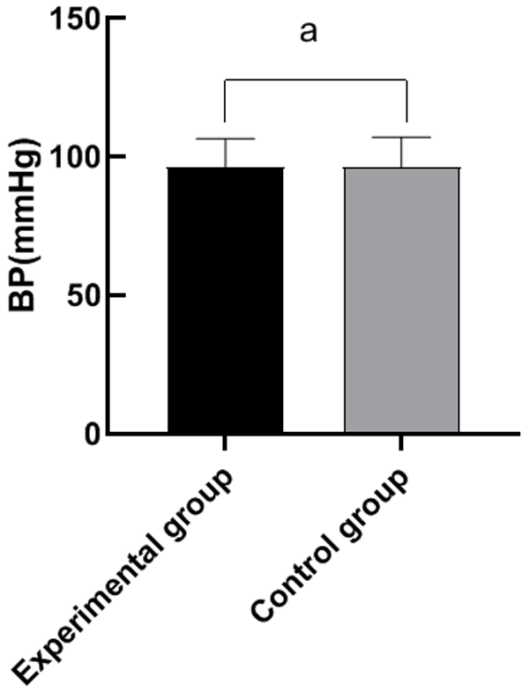

Figure 1. Comparison of blood pressure changes between the two groups. Note: The abscissa represents the experimental group and the control group from left to right, and the ordinate represents blood pressure (BP, mmHg). [a]indicates the comparison of blood pressure of the experimental group (96.35±10.24) mmHg, and the control group (96.28±10.77) mmHg (t=0.03, P=0.97).

Effectiveness of nursing care was graded as follows. Markedly effective: the patient does not exhibit any adverse reactions, and the time from ICU to the general ward is shorter; Effective: the patient shows adverse reactions, and relief without medication, and VAP is not present; Ineffective: VAP occurs.

The normal systolic blood pressure is 90-140 mmHg, and the diastolic blood pressure is 2/3. The normal range of heart rate is 60-80 beats/min. The normal range of blood oxygen saturation is 95-100%.

Statistical analysis

Discrete variables were expressed as counts and percentages, and continuous variables as means and standard deviation (SD); differences between groups were assessed using Chi-square test for categorical variables, and Student *t*-test for continuous variables. The significance level of all the analyses was defined as $P<0.05$. SPSS 20.0 was the software used for the analysis, and GraphPad Prism 7 (GraphPad Software, San Diego, USA) was used to illustrate the figures.

Results

Comparison of the number of cases of VAP, stay in ICU, length of hospitalization, and time of mechanical ventilation

Regarding the number of cases of VAP, the length of stay in ICU, and the length of hospital stay, and the mechanical ventilation time, the experimental group was markedly shorter than that of the control group (P<0.05). The infection rate of VAP is negatively correlated with the time of mechanical ventilation. See **Table 2**.

Comparison of the effectiveness of nursing care

With respect to the effective rates of nursing care, the experimental group (96%) was better than the control group (80%) (P<0.05). See **Table 3**.

Comparison of hemodynamic index changes

When considering the changes of hemodynamic indexes during the nursing process, the two

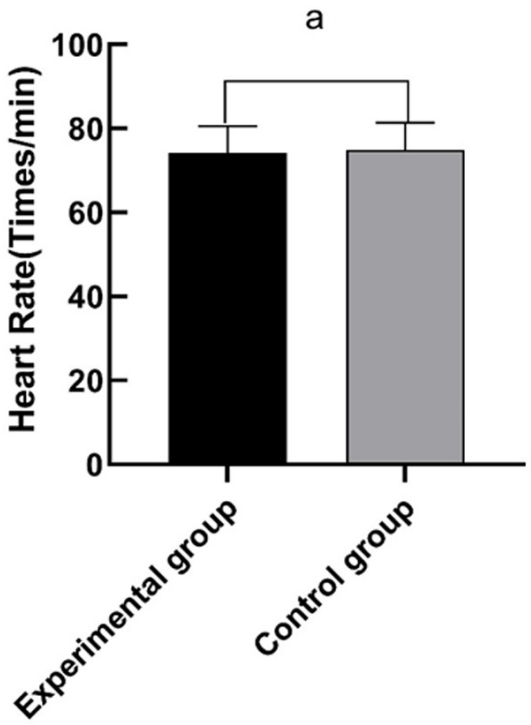

Figure 2. Comparison of heart rate changes between the two groups. Note: The abscissa represents the experimental group and the control group from left to right, and the ordinate represents the heart rate (beats/min). [a]indicates the comparison of heart rate in the experimental group (74.22±6.34) beats/min, and the control group (74.91±6.50) beats/min (t=0.54, P=0.59).

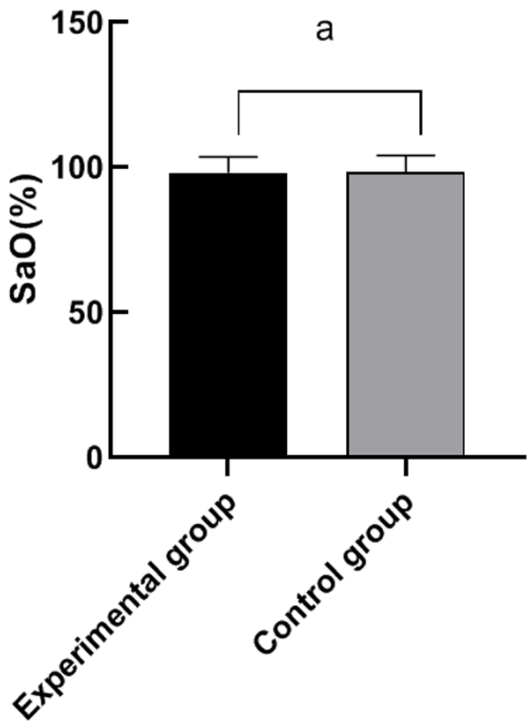

Figure 3. Comparison of changes in blood oxygen saturation between the two Groups. Note: The abscissa represents the experimental group and the control group from left to right, and the ordinate represents the blood oxygen saturation (SaO, %). [a]indicates the comparison of blood oxygen saturation in the experimental group (98.02±5.51)%, and the control group (98.24±5.8)% (P<0.05).

groups exhibited no marked difference (P>0.05). See **Figures 1**-**3**.

Comparison of oxygen partial pressure and carbon dioxide partial pressure

The oxygen partial pressure and carbon dioxide partial pressure of both groups improved after intervention. When compared against the control group, the results of oxygen partial pressure and carbon dioxide partial pressure were significantly in favor of the experimental group (P<0.05). See **Table 4**.

Discussion

ICU patients generally need to use various instruments to maintain their health, and the ventilator is an indispensable machine for patients who require mechanical ventilation [14-16]. However, there is highly-polluted condensed water in the ventilator, and severe pneumonia infectious may develop if the condensed water flows back into the body. In addition, if the ventilator and humidifier tubing are not replaced in time, serious infections may also occur. Therefore, nursing for ICU patients requires more attention [17-19]. All-in-one nursing care refers to the nursing method in which the patient's attending doctor and the nurse cooperate to care for the patient. That is, the medical staff regularly communicates and learns, and formulates corresponding nursing plans according to the specific conditions of the patient. It has been reported that all-in-one medical care can significantly improve the efficiency of nursing care, and help reduce the recovery time of patients, and keep patients with a positive treatment mentality [20-22]. To study the application effect of all-in-one nursing model in ICU patients, and analyze the probability of patients with VAP under the all-in-one nursing model, we mainly selected ICU patients, performed different nursing methods in different groups, and compared the hemodynamic

Table 4. Comparison of oxygen partial pressure and carbon dioxide partial pressure before and after intervention between the two groups (mmHg) ($\bar{x} \pm sd$)

Index	Time	Experimental group	Control group
oxygen partial pressure	before intervention	59.11±3.44	58.99±3.12
	after intervention	97.83±4.29[a,b]	90.83±3.25[a]
carbon dioxide partial pressure	before intervention	45.01±2.75	44.78±2.71
	after intervention	37.21±3.17[a,b]	41.45±2.78[a]

Note: [a]compared with before intervention, P<0.05; [b]compared with control group after intervention, P<0.05.

indexes, nursing effective rate, hospitalization stay, ICU stay, mechanical ventilation time, and the number of VAP cases.

The present study demonstrated that the number of patients with VAP in the experimental group was remarkably smaller. It shows that all-in-one nursing care can dramatically reduce the chance of patients developing VAP, and the shorter mechanical ventilation time of the experimental group contributes to it. The infection rate of infectious pneumonia has a certain correlation with the time of mechanical ventilation, wherein they are positively related. In addition, the experimental group demonstrated a shorter length of stay in ICU and in the length of hospital stay (P<0.05). Zhang et al [23] proposed that all-in-one nursing care can noticeably shorten the hospitalization time and recovery time of patients with severe pneumonia, and that patients with severe pneumonia who receive all-in-one nursing care exhibited shorter cough disappearance time, wheeze disappearance time and shortness of breath remission time. This is in line with the present study, which fully reinforces the reliability of the results of this study. Furthermore, when considering the effective rate of nursing care and general hemodynamic indexes of the two groups of patients, the effective rate of nursing care of the experimental group was markedly higher (P<0.05); the comparison of blood pressure, heart rate, and blood oxygen saturation of the two groups showed no statistical significance (P>0.05). It is revealed that all-in-one care has little effect on the changes of patients' general hemodynamic indexes. After intervention, when compared against the control group, the results of oxygen partial pressure and carbon dioxide partial pressure were significantly in favor of the experimental group. It highlights that all-in-one care plays a vital role in preventing and treating ICU VAP. The findings of the present study may be biased due to the smaller sample size and failure to carry out long-term follow-up. Thus a study with a larger population and longer-term follow-up are needed.

To sum up, all-in-one nursing care can reduce the risk of VAP in ICU patients, significantly shorten the time of staying in the ICU, the length of hospitalization, and the time of mechanical ventilation, thereby improving the efficiency of nursing care.

Disclosure of conflict of interest

None.

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