

Original Article

The effect of EBN combined with integrated hierarchical accountability nursing on patients with severe pneumonia

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Received January 28, 2021; Accepted February 23, 2021; Epub May 15, 2021; Published May 30, 2021

Abstract: Objective To explore the effects of evidence-based nursing (EBN) combined with integrated hierarchical accountability nursing on patients with severe pneumonia (SP). Methods: 72 SP patients admitted to our hospital from March 2019 to March 2020 were recruited as the study cohort and randomly divided into control group (36 patients) or research group (36 patients). The control group underwent conventional nursing, and the research group underwent EBN combined with integrated hierarchical accountability nursing plus. The patients' respiratory function, inflammatory factor levels, hospital stay durations, mechanical ventilation times, complication rates, and nursing satisfaction levels were compared between the two groups. Results: Before the nursing, there were no significant differences in the FVC, TLC, MVV, or VC levels between the two groups ($P>0.05$). After the nursing, the FVC, TLC, MVV, and VC levels in the research group were all lower than they were in the control group (all $P<0.05$). Before the nursing, the WBC, CRP, and PCT levels in the two groups were similar ($P>0.05$). After the nursing, the WBC, CRP, and PCT levels in the research group were significantly lower than they were in the control group ($P<0.05$). The hospital stay durations and mechanical ventilation times in the research group were shorter than they were in the control group ($P<0.05$). The complication rate in the research group was lower than it was in the control group (5.56% vs. 27.78% $P<0.05$). The nursing satisfaction level in the research group was higher than it was in the control group (97.22% vs. 77.78% $P<0.05$). Conclusion: EBN combined with integrated hierarchical accountability nursing has a good application effect on patients with SP. It can significantly improve patients' respiratory function and inflammatory factor levels, reduce the duration of patient hospital stays, reduce their mechanical ventilation times, and complication rate, and enhance their satisfaction with the nursing. Thus, it is worthy of further promotion.

Keywords: Evidence-based nursing, integrated hierarchical accountability nursing, severe pneumonia, respiratory function

Introduction

Severe pneumonia (SP) is a common critical illness seen in the ICU. Its clinical features mainly include a prolonged fever, and the main clinical manifestations include dyspnea, high fever, multiple organ dysfunction, etc. Some patients show dysphoria, narcolepsy, coma, and even death [1]. Most patients with SP in the ICU need to be mechanically ventilated, and, in extreme cases, a tracheotomy is required. The severity depends on the respiratory function, the systemic inflammatory response, etc. [2]. It is now well established in a variety of studies that during the mechanical

ventilation treatment in the ICU, scientific and practical nursing measures can help patients with SP effectively improve their respiratory function and prevent complications [3]. Evidence-based nursing (EBN) is a new nursing model [4]. Compared with conventional nursing, it is more time-sensitive and scientific, and it can improve patients' comfort and promote their recovery and prognosis. Integrated hierarchical accountability nursing is an innovation of the nursing model, which can join nurses and doctors together and then assign work according to their seniority and positions, so it fundamentally promote nurses' enthusiasm and further improve the quality of the nursing [5, 6].

This study provides new insights into EBN combined with integrated hierarchical accountability nursing. In this study, 72 SP patients were recruited to explore the effects of EBN combined with integrated hierarchical accountability nursing on the respiratory function, the inflammatory factor levels, the hospital stay durations, and other indicators in patients with severe pneumonia.

Materials and methods

General materials

72 SP patients admitted to our hospital from March 2019 to March 2020 were recruited as the study cohort. Inclusion criteria: (1) Patients who met the criteria established in "Guidelines for the Diagnosis and Treatment of Acquired Pneumonia" [7] and were diagnosed with SP in a clinical exam; (2) Patients who had no communication or mental disorders; (3) Patients with no immune system disorders; (4) Patients or their families who signed the informed consent forms. Exclusion criteria: (1) Patients with liver, kidney, or other vital organs diseases; (2) Patients with cardiovascular disease; (3) Patients with unstable vital signs; (4) Patients with cancer. This study was approved by our hospitals' ethics committee.

The patients in the study cohort were divided into a control group and a research group, with 36 patients in each group. In the control group, there were 20 males and 16 females ranging in age from 43 to 75 years old, with an average age of (64.62±9.73). In the research group, there were 22 males and 14 females ranging in age from 43 to 75 years with an average age of (64.62±9.73). There were no statistically significant differences between the two groups in terms of their general clinical data, such as gender, age, etc. ($P>0.05$), so they were comparable.

Methods

The control group underwent conventional nursing. After they were hospitalized, the nurses provided mechanical ventilation care, airway management, condition monitoring, nutritional support, etc. And each patient's vital signs and respiratory function were closely monitored in order to early detect respiratory failure and other complications. Once an abnormal emergency occurred, it was reported promptly.

In addition to the conventional nursing the control group underwent, the research group also underwent EBN combined with integrated hierarchical accountability nursing. The content was as follows.

EBN: (1) We established an EBN team and we conducted training based on the concepts, development, and nursing significance of EBN; (2) We raised questions, comprehensively evaluated the patient's nursing content, including their complications after surgery, their psychological conditions, nutrition, etc., and classified and structured the problems to be well prepared for the evidence-based nursing; (3) Based on the materials and literature related to the inpatients and the actual clinical nursing experience in our hospital, we made a scientific EBN plan and then implemented it.

Integrated hierarchical accountability nursing: (1) We implemented integrated hierarchical accountability nursing. The medical staff in the department were divided into several integrated medical staff accountability teams. Each consisted of a resident physician, an attending physician, a first-level primary nurse, a second-level primary nurse, and a nursing assistant. (2) We developed a nursing plan. The responsibilities of each member were made clear. When a patient was diagnosed and treated, the team members needed to evaluate, negotiate according to each patient's condition, and make a diagnosis and treatment plan that met each patient's actual situation. (3) Cooperative work. We established an integrated system to manage the rounds and the duty shifts. A second-level primary nurse and a nursing assistant made rounds at least twice a day. The attending doctor and the first-level primary nurse made rounds at least twice a week. And then, they evaluated the treatment efficacy and the nursing. (4) Reasonable run sheet. When the run sheet was drawn up, the team gave full consideration to the seniority and clinical experience of the doctors and primary nurses. They reasonably assigned the experienced and the new personnel to ensure that a correct response was made in the event of a medical event. (5) Regular summary. The resident doctors and the primary nurses needed to regularly check the teamwork once a week, including random inspections, supervision, and teamwork guidance. An academic seminar or a medical staff discussion was held

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Table 1. Comparison of the respiratory function before and after the nursing ($\bar{x} \pm s, L$)

	FVC		TLC		MVV		VC	
	Before nursing	After nursing	Before nursing	After nursing	Before nursing	After nursing	Before nursing	After nursing
Research Group (n=36)	6.88±2.07	2.40±0.40*	108.37±2.70	98.74±2.01*	5.55±1.60	2.67±0.84*	6.67±1.92	4.18±0.88*
Control Group (n=36)	6.74±2.11	4.41±1.21*	108.42±2.64	106.30±2.15*	5.49±1.56	3.98±1.08*	6.64±1.95	5.41±1.19*
t	0.284	9.463	0.079	15.410	0.161	5.745	0.066	4.986
P	0.777	<0.001	0.937	<0.001	0.872	<0.001	0.948	<0.001

Note: * means a comparison with the data before the nursing, P<0.05.

once a month to summarize and discuss the difficulties encountered in work and to actively solve them.

Observation indexes and evaluation criteria

(1) Comparison of the respiratory function before and after the nursing in the two groups. A Japanese MINATO pulmonary function tester AS-507 (Jinan OLABO Science Instruments Co., Ltd.) was used to measure the patients' vital capacity (FVC). Normal range: male (3.20±0.13) L; female (2.30±0.05) L; normal range of total lung capacity (TLC): male (5.38±0.73) L, female (4.37±0.66) L; normal range of maximum ventilatory volume per minute (MVV): male (105.34±2.70) L, female (92.52±2.10) L; normal range of vital capacity (VC): male (3.49±0.83) L, female (2.50±0.64) L. The closer the value was to the normal range, the better the respiratory function was; (2) Comparison of the inflammatory factor levels before and after the nursing in the two groups. We took 5 ml blood from each patient's cubital vein in the early morning on an empty stomach. Then the blood was anticoagulated with EDTA and centrifuged at 3,000 rpm. The serum was separated and stored in a freezer at -20°C for later inspection. The chemiluminescence method was used to measure the enumeration levels of the white blood cells (WBC), and the enzyme-linked immunosorbent method was used to measure the serum C-reactive protein (CRP) and the procalcitonin (PCT) levels. (3) Comparison of the hospital stay durations and mechanical ventilation times; (4) Comparison of the complications rates between the two groups. (5) Comparison of the nursing satisfaction levels. A nursing satisfaction questionnaire was used to determine the nursing satisfaction levels. The total possible score was 100 points, 85-100 points indicated satisfied; 60-84 points indicated basi-

cally satisfied; ≤ 59 points indicated dissatisfied. Nursing satisfaction = (basically satisfied + satisfied + very satisfied)/total number of cases × 100%.

Statistical methods

GraphPad Prism version 8.0 and SPSS version 21 were used. The quantitative data were expressed as ($\bar{x} \pm s$), and were compared between groups using independent sample t tests, while the comparisons in a group were tested using independent paired t-tests. The enumeration data were described as n (%), using chi-square χ^2 tests. P<0.05 indicated statistical significance.

Results

Comparison of the respiratory function before and after the nursing

Before the nursing, there were no significant differences in the FVC, TLC, MVV, or VC levels between the two groups [(6.88±2.07) vs. (6.74±2.11); (108.37±2.70) vs. (108.42±2.64); (5.55±1.60) vs. (5.49±1.56); (6.67±1.92) vs. (6.64±1.95); all P>0.05]; after the nursing, the FVC, TLC, MVV, and VC levels in the research group were all lower than they were in the control group [(2.40±0.40) vs. (4.41±1.21); (98.74±2.01) vs. (106.30±2.15); (2.67±0.84) vs. (3.98±1.08); (4.18±0.88) vs. (5.41±1.19*); all P<0.05]. See **Table 1**.

Comparison of the inflammatory factor levels before and after the nursing

Before the nursing, the WBC, CRP, and PCT levels in the two groups showed no significant differences [(19.33±4.40) vs. (19.28±4.37); (142.09±28.35) vs. (141.95±28.40); (18.39±3.78) vs. (18.90±3.81); all P>0.05]; after the nursing, the WBC, CRP, and PCT levels in the

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Table 2. Comparison of the inflammatory factor levels before and after the nursing ($\bar{x} \pm s$)

Groups	WBC ($\times 10^9/L$)		CRP (mg/L)		PCT (ng/ml)	
	Before nursing	After nursing	Before nursing	After nursing	Before nursing	After nursing
Research Group (n=36)	19.33±4.40	11.07±3.07**	142.09±28.35	72.38±23.04**	18.39±3.78	9.52±2.24**
Control Group (n=36)	19.28±4.37	14.26±3.9**	141.95±28.40	94.64±26.81**	18.90±3.81	15.37±3.41**
t	0.048	3.856	0.021	3.776	0.570	8.603
P	0.962	<0.001	0.983	<0.001	0.570	<0.001

Note: **means a comparison with the data before the nursing, $P < 0.05$.

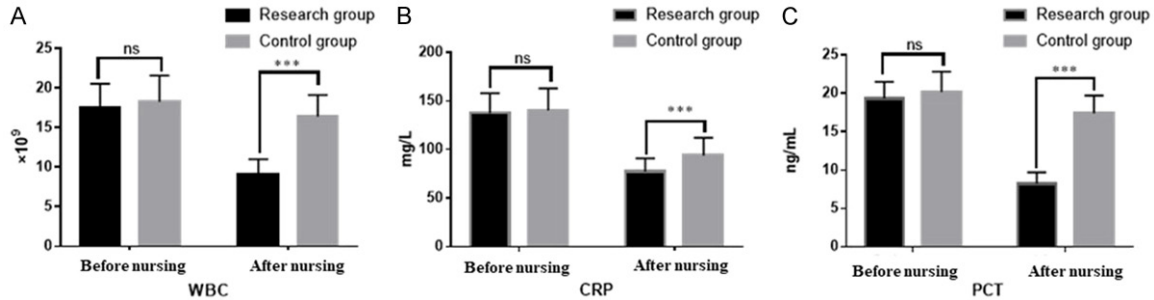


Figure 1. Comparison of the inflammatory factor levels before and after the nursing.

Table 3. Comparisons of the hospital stay durations and the mechanical ventilation times ($\bar{x} \pm s$, d)

Group	Hospital stay	Mechanical ventilation time
Research Group (n=36)	15.32±2.70	20.42±4.17
Control Group (n=36)	18.37±3.42	27.05±5.45
t	4.200	5.797
P	<0.001	<0.001

research group were significantly lower than they were in the control group [(11.07±3.07) vs. (14.26±3.9); (15.32±2.70) vs. (18.37±3.42); (20.42±4.17) vs. (27.05±5.45); all $P < 0.05$]. See **Table 2** and **Figure 1**.

Comparison of the hospital stays and mechanical ventilation times

The hospital stays and the mechanical ventilation times in the research group were shorter than they were in the control group [(11.07±3.07) vs. (14.26±3.9); (72.38±23.04) vs. (94.64±26.81); all $P < 0.05$]. See **Table 3**.

Comparison of the complications

The incidence of complications in the research group was 5.56%, lower than the 27.78% in the control group ($P < 0.05$). See **Table 4**.

Comparison of the nursing satisfaction

The nursing satisfaction in the research group was 97.22%, higher than the 77.78% in the control group ($P < 0.05$). See **Table 5**.

Discussion

SP, a common clinical infectious disease, is characterized by its severity, complexity, rapid development, etc. [8]. There is a growing body of literature [9, 10] that recognizes that SP is a progressive disease, and it originates in the lungs, and it can rapidly develop into respiratory failure. If no effective measures are taken in time, it can cause a systemic inflammatory syndrome, such as respiratory failure, multiple organ failure, cross-infection, etc., and even death in severe cases. In light of the recent events in SP, some scholars proposed [11] that SP patients treated with customized nursing could effectively improve in terms of their clinical symptoms and quality of life, thus reducing their complications and decreasing the death rate. Previous conventional SP nursing models no longer meet the needs of patients with this disease, and the models were used for a long time but showed a low effect on patients' quality of life or on a decline in their complication rates. EBN, a new type of nursing model [12] as a branch of evidence-based medicine, can accurately provide

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Table 4. Comparisons of the infection rates and death rates [n, (%)]

Group	Pulmonary edema	Atelectasis	Respiratory failure	Heart failure	Total incidence
Research Group (n=36)	1 (2.78)	1 (2.78)	0 (0.00)	0 (0.00)	2 (5.56)
Control Group (n=36)	2 (5.56)	3 (8.33)	3 (8.33)	2 (5.56)	10 (27.78)
χ^2					6.400
P					0.011

Table 5. Comparison of the nursing satisfaction levels [n, (%)]

Group	Satisfied	Basically satisfied	Dissatisfied	Satisfaction
Research Group (n=36)	22 (61.11)	13 (36.11)	1 (2.78)	35 (97.22)
Control Group (n=36)	13 (36.11)	15 (41.67)	8 (22.22)	28 (77.78)
χ^2				6.222
P				0.013

patients with guidance, strengthen the consistency of the nursing and medical treatment so as to make the patients have higher quality care, and then promote the body's recovery and improve respiratory function. The main focus of EBN is to master relevant knowledge and consult the research literature and provide treatment information, combined with the individual patients, to ensure an orderly and feasible nursing intervention [13].

The integrated hierarchical accountability nursing model involved doctors, chief nurses, and nurses in the department being divided into groups according to the hierarchical principle to ensure that the patients were under the charge of the medical staff in the same group during the treatment [14]. This model emphasized the service concept of "patient-centered". In the management process, it insisted on meeting the practical needs of patients so that patients could enjoy high-quality nursing services in the hospital. The nursing plan, accomplished jointly by doctors and nurses, clearly determined the responsibilities of the doctors and the nurses with a reasonable allocation to help the patients overcome the disease and to create a high-quality care model [12-15]. The study demonstrated that implementing an integrated hierarchical accountability nursing model for patients with severe pneumonia can effectively shorten the patients' recovery times, reduce their incidence of complications and death rates, and then ensure their medical safety [16]. However, few clinical studies have paid attention to EBN combined with integrated

hierarchical accountability nursing. Therefore, this study aimed to explore the effect of EBN combined with integrated hierarchical accountability nursing on the respiratory function, the inflammatory factor levels, the hospital stay durations, and

other indicators in patients with severe pneumonia. The nursing effect was significant. The results of this study showed that the FVC, TLC, MVV, and VC levels in the research group after the nursing were all lower than they were in the control group, suggesting that the EBN combined with integrated hierarchical accountability nursing for SP patients can effectively improve the respiratory function, halt the progress of the disease and promote the patients' recovery. A possible explanation for this might be that a lack of understanding of SP prevented the patients from receiving better care, resulting in a weak respiratory function and a worsening of the disease, thus affecting the prognosis. This finding is consistent with a previous investigation that found that SP is closely related to the inflammatory immune response [17, 18]. Pathogenic infections play a vital role in the pathogenesis of SP, such that local inflammation can lead to a systemic inflammatory response, not the toxin damage and the simple pathogenic bacterium. One interesting finding is that after the nursing, the WBC, CRP, and PCT levels in the research group were significantly lower, suggesting that EBN combined with integrated hierarchical accountability nursing can reduce the inflammatory levels in patients with severe pneumonia and improve their prognoses and rehabilitation. CRP, an acute-phase protein, was able to enhance the phagocytic ability of the phagocytes. PCT is a protein that reflects the active degree of inflammation in a patient's body. When its concentration in the body is increased, it means that the body is severely infected [19].

In this study, the hospital stay durations and the mechanical ventilation times in the research group were shorter than they were in the control group, and the nursing satisfaction in the research group was higher than it was in the control group. These results support evidence from previous observations that a model of care specific to the disease can improve patients' clinical symptoms, improve patients' quality of life, reduce patients' incidence of complications, and improve the nursing satisfaction levels in order to reduce patient mortality [20].

This study has the following limitations: (1) The sample size was insufficient; (2) The follow-up was not sufficiently long; (3) It was not a multicenter study.

In summary, EBN combined with integrated hierarchical accountability nursing has a significant effect on patients with severe pneumonia, as it significantly improves the patients' respiratory function and inflammatory factor levels, reduced their hospital stay durations and mechanical ventilation times, and it reduces their incidence of complications, and increases their satisfaction levels with the nursing.

Disclosure of conflict of interest

None.

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