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*Original Article*

# Effect of care bundles in the nursing of severe pneumonia

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**Abstract:** Objective: To explore the effect of care bundles and analyze the influence of different angles of turning over on the sputum excretion of mechanically ventilated patients with severe pneumonia. Methods: 120 patients with severe pneumonia in our hospital from October 2016 to October 2019 were equally randomized into four groups, each with 30, according to the date of admission. The control group was given conventional nursing and placed in a position of left 30°-half lying-right 30°; the group A was given comprehensive care bundles and placed in a position of left 30°-half lying-right 30°; the group B was given comprehensive care bundles and placed in a position of left 45°-half lying-right 45°, and the group C was given comprehensive care bundles and placed in a position of 60° left-half lying-60° right. The respiratory rates and oxygenation indexes of patients in the three groups (group A, B, C) in lateral position at 2 h and 6 h respectively before and after mechanical ventilation were compared. And we compared the nursing efficiency and satisfaction. Results: The control group showed lower nursing efficiency and satisfaction compared with the group A ($P<0.05$). The group B and C showed higher oxygenation index after six hours of ventilation compared with group A ($P<0.05$). After two hours of mechanical ventilation, the group B and C showed lower respiratory rate and higher oxygenation index compared with the group A, and the respiratory rate and oxygenation index of the group B were closest to the normal range ($P<0.05$). Conclusion: The sputum excretion effect of mechanically ventilated patients with severe pneumonia was the best if they were placed in a position of left 45°-half lying-right 45° and given comprehensive care bundles.

**Keywords:** Comprehensive care bundles, severe pneumonia, turning over angle, mechanical ventilation, sputum excretion effect

## Introduction

Comprehensive care bundles, a new nursing model designed based on the conditions of patients, has gradually been widely applied in clinical nursing [1-3]. Pneumonia, known as a common respiratory disease, is easily to develop into severe pneumonia if not treated timely, which leads to respiratory failure in patients and even threatens their lives [4-6]. Mechanical ventilation is an important part for the treatment of severe pneumonia, and its role is to expel sputum and gas. During mechanical ventilation, patients are placed in a position of 30° sitting and lying to facilitate sputum excretion [7-10], but the mechanical ventilation brings damage to patients to a certain extent, thus affecting their recovery. In order to improve the efficacy of mechanical ventilation and analyze the impact of sitting and lying angles on mechanical ventilation, this study aims to analyze the changes of respiratory rates and oxygenation indexes of patients before and after mechanical ventilation with different sitting and lying angles.

## Materials and methods

### *General information*

120 patients with severe pneumonia in our hospital from October 2016 to October 2019 were randomly selected, and they were separated into a control group (n=30), a control group 2 (group A, n=30), a treatment group (group B, n=30), and a treatment group 2 (group C, n=30) according to the date of admission. There were 14 males and 16 females, with an

age of (56.99±6.97) years old, in the control group; group A consisted of 17 males and 13 females, with an age of (57.34±7.66) years old; group B included 14 males and 16 females, with an age of (55.39±7.34) years old; group C included 15 males and 15 females, with an age of (56.90±7.06) years old. No significant difference in the general data of patients was observed among groups (P>0.05).

### Inclusion/exclusion criteria

*Inclusion criteria*

1) Patients who exhibited signs of patients with severe pneumonia.

2) All patients who underwent invasive mechanical ventilation.

3) Patients without any history of drug allergy, drug abuse and bad habits.

4) The ethics committee of our hospital had given permission and all patients voluntarily participated in the study and signed an informed consent form.

*Exclusion criteria*

1) Patients who had consciousness disorder and couldn't follow the instruction of researchers.

2) Patients who didn't meet the standard of mechanical ventilation in lateral position.

3) Patients who didn't meet the standards for the oronasal sputum suction.

### Methods

*Nursing methods*

Patients in the control group underwent conventional nursing that was to circulate the air in the ward, monitor their temperature, heart rate, etc. and adjust the temperature and humidity in the ward to facilitate the recovery of patients, and then we observed their breathing. If patients showed abnormal breathing, we immediately checked and cleaned their respiratory tract. The group A, B, and C were all given comprehensive care bundles, i.e, 1) We developed a systematic comprehensive care bundles plan based on the conditions of patients; 2) We kept in contact with patients and their families and clarified the individual difference to make a personalized nursing plan; 3) Patients were given respiratory management, ventilator management, nasogastric feeding, etc. First, we cleaned the stomach retention of patients and performed sputum suction within 30 minutes before nasogastric feeding, and then we didn't conduct nasogastric feeding until patients had stable breathing and no coughing. If aspiration occurred during nasogastric feeding, we immediately stopped and waited till their breathing was stable. In severe cases, we immediately informed doctors to make the correct treatment. In addition, we promptly cleaned nasogastric feeding tube and residue in the oral and nasal cavity to prevent blocking after completing nasogastric feeding. Secondly, we timely cleaned the oral and nasal cavity, ventilator pipelines, etc., kept the airbag pressure of ventilator 20~30 cm$H_2$0, and adjusted the state of airbag based on the positions of patients [11, 12]. Thirdly, during sputum suction, we left the oxygen concentration slightly higher than that during non-sucking sputum, and the ventilator was forbidden to remove. Then we cleaned the residues in the respiratory tract, and assisted patients in turning over for postural drainage. Finally, we wholly disinfected the ventilator (Darger NMPA [2013], No.: 3543831). In the meantime, we timely replaced the ventilator pipeline, humidifier, and humidification fluid, and ensured oral and nasal nursing to avoid cross-infection, 3 times/d.

*Mechanical ventilation methods*

Patients in the control group and group A were placed in a position of left 30°-half lying-right 30°; patients in group B were in a position of left 45°-half sitting-right 45°; patients in group C were placed in a position of left 60°-half sitting-right 60°. In other words, all the patients were towards the left during mechanical ventilation, and their upper bodies was respectively at an angle of 30°, 45°, and 60° to the ground. They faced forward in a half lying position after 1.5 hours and then the right after 1.5 hours, and their upper bodies were at an angle of 30°, 45°, and 60° to the ground. We observed the respiratory rates and oxygenation indexes of patients in the control group, the group A and the group B at 2 h and 6 h respectively before and after ventilation, and clarified the influence

**Table 1.** Comparison of nursing effectiveness between control group and group A

| Group | Marked effectiveness | Effectiveness | Ineffectiveness | Overall effectiveness rate (%) |
|---|---|---|---|---|
| Group A | 23 | 5 | 2 | 93% |
| Control group | 13 | 4 | 13 | 57% |
| $X^2$ | | | | 10.76 |
| P | | | | 0.001 |

**Table 2.** Comparison of nursing satisfaction between control group and group A

| Group | Very satisfaction | Satisfaction | Relatively satisfaction | Dissatisfaction | Satisfaction rate (%) |
|---|---|---|---|---|---|
| Group A | 20 | 6 | 4 | 0 | 100% |
| Control group | 9 | 11 | 6 | 4 | 87% |
| $X^2$ | | | | | 4.29 |
| P | | | | | 0.04 |

of different lateral positions on mechanical ventilation.

*Observation indicators*

We compared the nursing efficiency and satisfaction of patients in the control group and the group A, and clarified the nursing effect of the comprehensive care bundles and the conventional nursing in patients with severe pneumonia. The respiratory rates and oxygenation indexes of patients in groups A, B, and C were compared at 2 h before ventilation, at 2 h and 6 h after ventilation to analyze the relationship between different lateral positions and the effect of mechanical ventilation.

*Statistical processing*

Software SPSS21.0 was employed to process and analyze the relevant information and data in this study. Measurement data was represented as (x±s), and performed using t-test for comparison between two groups and one-way analysis of variance for multiple groups, and the count data was represented as [n (%)] using $X^2$ test. $P<0.05$ meant that the difference is statistically significant.

## Results

*Comparison of nursing effectiveness between control group and group A*

Patients in the control group underwent conventional nursing, and patients in the group A underwent the comprehensive care bundles. Group A had higher effectiveness compared with the control group ($P<0.05$), indicating that comprehensive care bundles significantly improves the nursing effectiveness. See **Table 1**.

*Comparison of nursing satisfaction between control group and group A*

The nursing satisfaction of the group A was 100% while the control group was 87%, and the comparison of the two groups was significant ($P<0.05$). See **Table 2**.

*Comparison of respiratory rates at different times in the group A, B and C*

There was no significant difference in the respiratory rates of the three groups before ventilation ($P>0.05$), and the difference in respiratory rates of the three groups after six hours of ventilation was not significant ($P>0.05$). See **Figure 1**.

After two hours of ventilation, group B and C had lower respiratory rate compared with the group A ($P<0.05$), and the respiratory rate of patients in group B was 12-20 breaths/min, indicating that the left 45°-half lying-right 45° position effectively improved the effect of mechanical ventilation and can stabilize their respiratory rate possible. See **Figure 2**.

*Comparison of oxygenation index of group A, B and C at different times*

The comparison of oxygenation index of group A, B and C was not significant at 2 h before ventilation. See **Figure 3**.

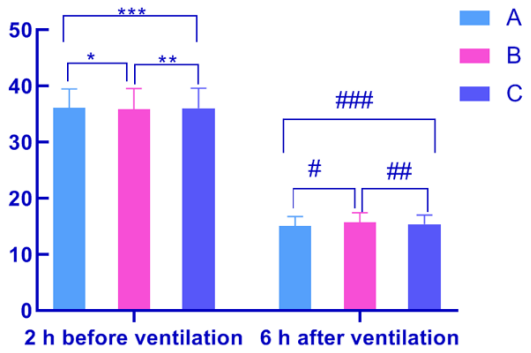


**Figure 1.** Comparison of respiratory rates at 2 h before ventilation and after six hours of ventilation (times/min). Note: The X-axis indicates the respiratory rates of patients in group A, B, and C at 2 h before ventilation and the respiratory rates of patients in group A, B, and C after six hours of ventilation from left to right. The Y-axis represents thee respiratory rate (times/min). At 2 h before ventilation, the respiratory rate of each group is (36.10±3.38) times/min in group A, (35.89±3.67) times/min in group B, and (36.07±3.55) times/min in group C. One-way analysis of variance was performed in the group, and the difference was statistically significant (F=24.38, P<0.01). After six hours of ventilation, the respiratory rate of each group was (15.09±1.66) times/min in group A, (15.68±1.74) times/min in group B, and (15.40±1.62) times/min in group C. One-way analysis of variance was performed in the group, and the difference was statistically significant (F=27.36, P<0.01). *indicates the comparison of the respiratory rate of the group A and B at 2 h before ventilation (t=0.23, P=0.82). ** indicates the comparison of the respiratory rate of group B and C at 2 h before ventilation (t=0.19, P=0.85). *** means the comparison of the respiratory rate of group A and C at 2 h before ventilation (t=0.03, P=0.97). # indicates the comparison of the respiratory rate of group A and B after six hours of ventilation (t=1.34, P=0.18). ## indicates the comparison of the respiratory rate of group B and C after six hours of ventilation (t=0.65, P=0.52). ### indicates the comparison of the respiratory rate of group A and C after six hours of ventilation (t=0.73, P=0.47).

After two hours and six hours of ventilation, group B and C had higher oxygenation index compared to the group A, and the oxygenation index of group B was the first to reach 300 mmHg after two hours of ventilation and 400~500 mmHg after six hours of ventilation. The comparison of oxygenation index among each group was significantly different (P<0.05), indicating that the left 45°-half lying-right 45° position of patients in group B effectively promoted the oxygenation index of patients with severe pneumonia closer to normal. See **Figure 4**.

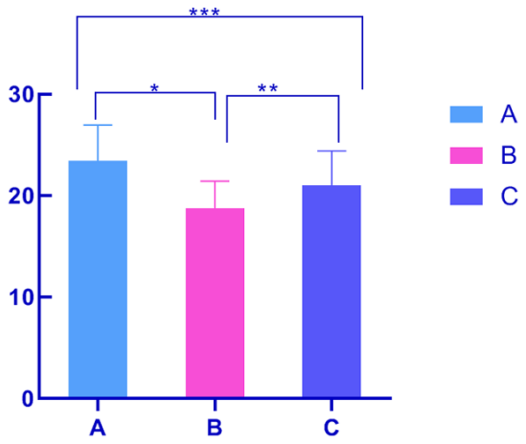


**Figure 2.** Comparison of respiratory rate after two hours of ventilation (times/min). Notes: The X-axis indicates the respiratory rate of patients in group A, B, and C after two hours of ventilation from left to right, and the Y-axis indicates the respiratory rate (times/min). After two hours of ventilation, the respiratory rates of group A, B and C were respectively (23.41±3.55) times/min (18.76±2.68) times/min, and (20.98±3.44) times/min. One-way analysis of variance was performed in the group, and the difference was statistically significant (F=54.89, P<0.01). * indicates the comparison of respiratory rate of group A and B after two hours of ventilation (t=5.73, P<0.001). **indicates the comparison of respiratory rate of group B and C after two hours of ventilation (t=2.79, P=0.007). *** means the comparison of respiratory rate of patients in group A and C after two hours of ventilation (t=2.69, P=0.009).

## Discussion

As the clinical nursing continuously updates and optimizes, comprehensive care bundles have been gradually utilized widespread and become an indispensable and important part of modern medical nursing [13, 14]. As a serious respiratory disease, severe pneumonia often leads to the acceleration of respiratory rate and increase in the oxygenation index, thus affecting the lives of patients. Comprehensive care bundles are a group of personalized nursing plans that combine nasogastric feeding, respiratory tract nursing and ventilator nursing management [15-19]. Patients with severe pneumonia are generally treated with mechanical ventilation [20, 21], and they are usually in a lying position of 30° during mechanical ventilation, but its effect is not significant. In order to analyze the nursing effect of comprehensive care bundles in patients with severe pneumonia and the influence of different positions on the effect of mechanical ventilation,

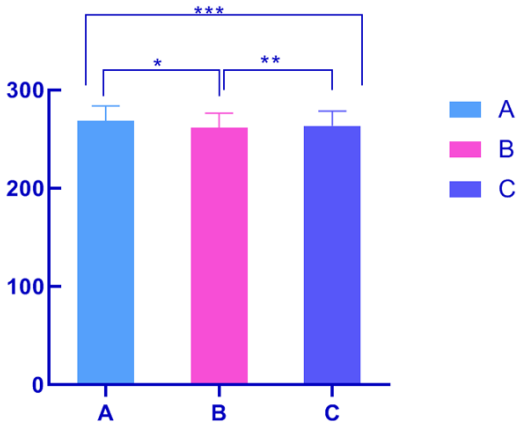


**Figure 3.** Comparison of oxygenation index at 2 h before ventilation (mmHg). Notes: The X-axis represents the oxygenation index of patients in the group A, B, and C at 2 h before ventilation from left to right, and the Y-axis represents the oxygenation index (mmHg). The oxygenation index of group A was (268.44±15.38) mmHg, (261.39±15.00) mmHg for group B, and (263.54±14.97) mmHg for group C. One-way analysis of variance was performed in the group, and the difference was statistically significant (F=31.45, P<0.01). * indicates the comparison of oxygenation index of patients in group A and B at 2 h before ventilation (t=1.80, P=0.08). ** indicates the comparison of oxygenation index of patients in groups B and C at 2 h before ventilation (t=0.56, P=0.58). *** means the comparison of the oxygenation index of group A and C at 2 h before ventilation (t=1.25, P=0.22).

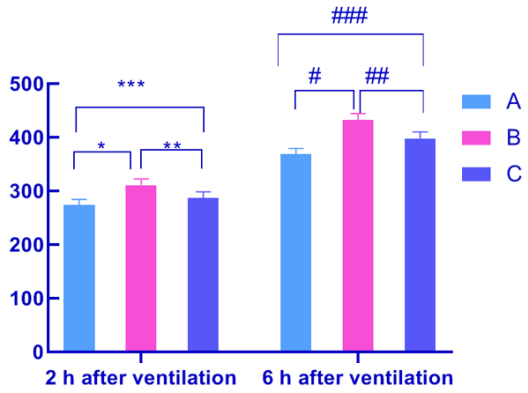


**Figure 4.** Comparison of oxygenation indexes after two hours and six hours of ventilation (mmHg). Notes: From left to right, the X-axis indicates the oxygenation index of patients in the group A, B, and C after two hours of ventilation and the oxygenation index after six hours of ventilation. The Y-axis represents the oxygenation index (mmHg). The oxygenation indexes of the group A, B and C were (273.64±10.58) mmHg, (311.21±11.37) mmHg, and (286.73±11.90) mmHg after two hours of ventilation respectively. One-way analysis of variance was performed in the group, and the difference was statistically significant (F=58.76, P<0.01). The oxygenation indexes of the group A, B and C were (369.37±10.11) mmHg, (432.52±11.67) mmHg, and (398.33±11.76) mmHg after six hours of ventilation respectively. One-way analysis of variance was performed in the group, and the difference was statistically significant (F=61.57, P<0.01). * indicates the comparison of oxygenation index of group A and group B after two hours of ventilation (t=13.25, P<0.001). ** indicates the comparison of oxygenation index of group B and C after two hours of ventilation (t=8.15, P<0.001). *** means the comparison of oxygenation index of group A and C after two hours of ventilation (t=4.50, P<0.001). # indicates the comparison of oxygenation index of group A and B after six hours of ventilation (t=22.40, P<0.001). ## indicates the comparison of oxygenation index of group B and C after six hours of ventilation (t=11.30, P<0.001). ### indicates the comparison of oxygenation index of group A and C after six hours of ventilation (t=10.23, P<0.001).

this study aims to compare the nursing efficiency and satisfaction of comprehensive care bundles and conventional nursing and the effects of mechanical ventilation with different positions to seek for the best.

In this study, the control group was given conventional nursing, and the group A was given comprehensive care bundles. It was seen from the comparison that group A had higher nursing effectiveness and satisfaction compared with the control group (P<0.05). Yang Yuqin et al. [12] proposed that comprehensive care bundles effectively promoted the recovery of neurological function of patients with stroke in and prevented complications, similar to the results of this study.

Patients in groups A, B, and C were placed in a lateral position of 30°, 45° and 60° respectively, and we compared their respiratory rates and oxygenation indexes when they were given mechanical ventilation at different times. The results showed that patients in the group A had higher respiration rate compared with those in the group B and C after two hours of ventilation, and the respiration rate of the group B was 12-20 times/min (P<0.05). There was no significant difference in the respiratory rates of three groups at 2 h before ventilation and after six hours of ventilation. Patients in the group B and C had higher oxygenation indexes compared with those in the group A after 2 h and 6 h of ventilation, and the group B was the only group whose oxygenation index reached the

normal range after six hours of ventilation ($P<0.05$). The results indicated that it was the best for patients with severe pneumonia to be placed in a lateral position of 45° during mechanical ventilation, which helped their respiratory rate and oxygenation index recover to the normal range possible, so 45° is the best lateral angle.

In summary, the comprehensive care bundle is beneficial to the recovery of patients with severe pneumonia and provides more effective nursing. It is beneficial most to patients with severe pneumonia who undergo mechanical ventilation in lateral position of 45°, and its efficacy is significantly better than 30°and 60°. Therefore, it is concluded that the sputum excretion effect of mechanically ventilated patients with severe pneumonia was the best if they were placed in a position of left 45°-half lying-right 45° and given comprehensive care bundles, and this conclusion is worthy of clinical application and promotion. The limitation of the study lies in that the number of people included is relatively small. In the future, it is necessary to expand the number of cases and involve the long-term survival rate and complication rate of patients.

## Disclosure of conflict of interest

None.

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