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Incorporating Self-Efficacy Theory to Awake Prone Positioning in COVID-19 Patients: A Single-Center Perspective Study

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Abstract

Objective: This study sought to examine whether the inclusion of self-efficacy theory could increase the effectiveness of awake prone positioning in COVID-19 patients. **Method:** A total of 80 COVID-19 patients admitted to the respiratory department of our hospital between December 2022 and February 2023 were randomly allocated into either the intervention group (n=40) or the control group (n=40). The control group received routine respiratory medicine treatment and underwent awake prone positioning, whereas the intervention group received additional self-efficacy theory intervention alongside awake prone positioning. The patients' oxygen saturation level (SpO_2) and respiratory rate (RR) were closely monitored at three different time points: before awake prone positioning, 30 minutes and 1 hour after awake prone positioning. Furthermore, the patients' Modified Medical Research Council (mMRC) dyspnea scale and self-efficacy scores were evaluated on the first, second, and third days of awake prone positioning. The cumulative duration of awake prone positioning and patient satisfaction were recorded on the third day of the intervention. **Results:** The data indicate that the intervention group demonstrated significant improvements in both SpO_2 and RR compared to the control group, both at 1 hour and at the end of awake prone positioning (P0.05). Moreover, the intervention group experienced a substantial reduction in the dyspnea index compared to the control group on the second and third day (P0.05). The intervention group also reported higher self-efficacy scores, cumulative duration of awake prone positioning ventilation on the third day, and satisfaction levels compared to the control group on the first, second, and third day (P0.05). **Conclusions:** The incorporation of self-efficacy theory to awake prone positioning improves the short-term outcomes of COVID-19 patients. This patient-centered approach has the potential to increase patients' self-efficacy and satisfaction levels, emphasizing the importance of incorporating patient-centered care in healthcare practices.

Keywords: Self-efficacy; COVID-19; Awake prone positioning; Clinical study

1. INTRODUCTION

The outbreak of novel coronavirus pneumonia (coronavirus disease 2019, COVID-19) caused by a novel coronavirus SARS-CoV-2 has become a major public health concern since its emergence. This disease is primarily characterized by fever, dry cough, and malaise, with severely ill patients developing respiratory distress and/or hypoxemia approximately one week after symptom onset. In severe cases, patients may rapidly progress to acute respiratory distress syndrome (ARDS), septic shock, metabolic acidosis, bleeding and coagulation dysfunction, and multi-organ failure [1]. On December 7, 2022, the Joint Prevention and Control Mechanism of the State Council (JPCMSC) released a notice on optimizing prevention and control measures for the COVID-19 epidemic. Since this notice was issued, severe pneumonia caused by COVID-19 and subsequent ARDS has become a major focus of attention. As such, effective management strategies for COVID-19 patients, particularly those with severe diseases, are urgently needed.

One such strategy is the awake prone position, which has been shown to improve oxygenation and reduce the need for invasive mechanical ventilation in patients with ARDS [2]. Awake prone positioning involves positioning the patient on their stomach to improve oxygenation and clear the airway. Previous studies have demonstrated that awake prone positioning can enhance diaphragmatic movement and position, which in turn leads to the reopening of collapsed alveoli, facilitating secretion drainage, and reducing secondary multi-organ dysfunction. In COVID-19 patients with hypoxemia requiring noninvasive respiratory support, such as a high-flow nasal cannula or noninvasive positive pressure ventilation, the addition of awake-prone position therapy has been shown to improve oxygenation and reduce intubation rates, thereby improving patient outcomes [3]. Moreover, awake-prone position therapy is a low-cost and easy-to-implement intervention that can be performed independently by patients without additional resources. In the context of the ongoing COVID-19 epidemic, this therapy is gradually gaining attention as a potentially effective intervention to improve patient outcomes.

Self-efficacy theory, proposed by Bandura, emphasizes the role of an individual's beliefs in shaping their behavior. It refers to an individual's confidence in their ability to successfully perform a specific behavior, rather than their actual skill levels. Self-efficacy influences cognitive, motivational, and emotional processes, which in turn affect the levels of proficiency in completing tasks [4]. In this study, we aimed to investigate the effect of additional self-efficacy theory on awake prone positioning in COVID-19 patients with severe respiratory distress, in order to improve their treatment outcomes and overall satisfaction.

2. METHODS

2.1 Research participants

A total of 80 patients diagnosed with COVID-19 and admitted to the respiratory department of our hospital between December 2022 and February 2023 were included in this study. The patients were numbered according to the order of admission, and then they were divided into two groups (intervention group versus control group, with 40 patients in each group) using the random number table method. To prevent contamination, patients in different groups were assigned to different medical wards. The intervention group consisted of 23 males and 17 females, with a mean age of 72.20±15.30 years, mean arterial pressure of 98.18±9.39 mmHg, mean heart rate of 85.45±12.42 beats/min, mean respiratory rate of 25.35±4.98 breaths/min, mean height of 163.43±7.73 cm, and mean weight of 59.02±9.51 kg. The control group consisted of 25 males and 15 females, with a mean age of 70.95±13.50 years, mean arterial pressure of 98.39±7.84 mmHg, mean heart rate of 84.75±13.58 beats/min, mean respiratory rate of 24.95±5.04 breaths/min, mean height of 163.14±6.16 cm, and mean weight of 60.05±8.18 kg. The demographic characteristics, vital signs, and oxygen therapy modalities were similar between the two groups (summarized in Table 1), and the differences were not significant ($P > 0.05$).

Table 1. Comparison of general information between the two groups of patients.

Parameters	Intervention (n=40)	Control (n=40)	χ^2/t	P
Age (years)			0.456	0.796
<60	9	8		
60 to 80	17	20		
>80	14	12		
Gender			0.208	0.648
Male	23	25		
Female	17	15		
Oxygen therapy modality			0.295	0.990
N/A	9	11		
Nasal catheter	22	20		
Mask	4	4		
Transnasal high-flow oxygen therapy	4	4		
Noninvasive positive pressure ventilation	1	1		
Mean arterial pressure (mmHg)	98.18±9.39	98.39±7.84	-0.108	0.914
Mean heart rate (beats/min)	85.45±12.42	84.75±13.58	0.241	0.811
Average respiratory rate (times/min)	25.35±4.98	24.95±5.04	0.357	0.722
SpO_2 (%)	93.50±3.32	93.80±4.83	-0.324	0.747
Height (cm)	163.43±7.73	163.14±6.16	0.184	0.855
Body weight (kg)	59.02±9.51	60.05±8.18	-0.522	0.603

Note: N/A, not available.

2.2 The inclusion and exclusion criteria

The inclusion criteria for this study were: (1) patients diagnosed with COVID-19 [5]; (2) patients with a pulse oxygen saturation (SpO_2) level of < 94% and/or respiratory rate > 22 breaths/min without oxygen therapy; (3) patients who required oxygen therapy via nasal cannula, oxygen mask, high-flow nasal cannula (HFNC), or non-invasive positive pressure ventilation (NIPPV); (4) conscious patients who were able to communicate verbally to a certain extent, and able to voluntarily or cooperatively perform awake prone positioning; and (5) patients who provided informed consent and signed an informed consent form.

The exclusion criteria for this study were: (1) patients with severe damage to other organs who were unable to adjust their position independently for comfort or tolerate the prone position; (2) patients at risk of airway obstruction or even asphyxia, or those with respiratory failure due to cardiogenic pulmonary edema [2]; (3) patients with abdominal injuries or wounds that affect the implementation of the awake prone position, or those with intra-abdominal hypertension [2]; (4) patients with unstable cervical spine or spinal fractures that require fixation; (5) patients with increased intracranial pressure caused by traumatic brain injury or other factors; and (6) patients with a high risk of pulmonary embolism or acute hemorrhagic diseases.

2.3 Implementation of awake prone positioning

Based on the treatment plan for COVID-19 patients, both groups received routine respiratory care and treatment, including oxygen therapy, airway clearance, and anti-infection measures, as well as awake prone positioning ventilation therapy. The specific steps for awake prone positioning ventilation therapy are as follows. First, an awake prone positioning ventilation therapy team was established, consisting of one respiratory physician, one respiratory therapist, two respiratory nursing supervisors, one nurse, and one nursing graduate student. Before the study, the team underwent concentrated training on relevant knowledge, operational procedures, and precautions of awake prone positioning ventilation therapy. Theoretical and practical assessments were conducted before the study, and only those who passed the assessments were allowed to join the treatment team and carry out the therapy.

Standard operating procedures for awake prone positioning ventilation therapy are listed below.

1) Pre-operative preparation: patient preparation – for eligible patients, patient education and informed consent should be obtained from the patient's family, explaining the purpose and significance of the therapy, as well as precautions. Hemodynamic evaluation should be performed to ensure the patient's vital signs are stable. Gastrointestinal examination should be performed, and for patients with nasogastric tubes, gastric fluid should be drawn before ventilation therapy to evaluate gastric retention. Airway evaluation should be performed to remove nasal and oral secretions before awake prone positioning ventilation therapy. The tube should be securely fixed, and the need for clamping should be evaluated. Ward preparation – the bed should be maintained at a distance of approximately 1 meter, and an adjustable bed should be used. Item preparation – soft pads (folded blankets), several towels and pillows, a chair, an emergency call bell, an oxygen saturation monitor, an oxygen therapy device, a suction device, and a rescue cart should be prepared.

2) Positioning: Step 1 – prone position, with the patient facing down towards the bed surface, and a soft pillow placed under the patient's chest or abdomen, another soft pillow placed under the forehead to make room for the oxygen mask, and a third soft pillow placed under the lower leg. The head should be turned to the comfortable side, and the position

should be maintained for 30 minutes to 2 hours. Step 2 – right lateral position, with an incline angle of greater than 130 degrees, maintained for 30 minutes to 2 hours. Step 3 – left lateral position, with an incline angle of greater than 130 degrees, maintained for 30 minutes to 2 hours. Step 4 – the patient sits on the edge of the bed, with a soft pillow placed on the thighs, leaning forward, and the head placed on the overlapped forearms in a comfortable position.

3) Optimization of position: By placing pillows and adjusting the bed angle, the pressure on the stressed areas is reduced, and the patient's comfort is improved (e.g., knee bending, comfortable angle of the arms and shoulders).

4) Observation and monitoring: Immediately after turning to the prone position, the patient's blood pressure, pulse rate, respiratory rate, and SpO_2 should be checked. If the patient experiences a significant decrease in blood oxygen saturation or obvious dyspnea, the oxygen supply device and other pipes should be checked immediately for looseness or twisting. The patient's gastrointestinal function should be monitored, including oral secretion, gastric distension, and reflux, to avoid aspiration. The drainage of phlegm should be monitored, and airway secretions should be promptly cleared.

5) Recommended ventilation time: More than 12 hours per day.

2.4 Self-efficacy intervention

According to the theory of self-efficacy, interventions targeting four key factors of patients, including direct experience, vicarious experience, verbal persuasion, and emotional and physiological states, can be effective. The following is a detailed explanation of these four factors.

Direct experience refers to an individual's firsthand experience of successfully completing a particular behavior or activity and is the most influential source of efficacy information. To assist patients in correctly positioning themselves for the first awake prone ventilation, materials and images related to awake prone ventilation are provided to the patient, and the patient is encouraged to demonstrate the proper position until they fully understand it. Specific goals are set for each ventilation therapy session, and once those goals are achieved, patients are encouraged to reflect on and accumulate successful experiences, thereby enhancing their confidence and promoting the implementation of the next ventilation therapy session.

Vicarious experience refers to the indirect experience gained by observing the successful experiences of others. When observing other similar patients achieving success with prone positioning ventilation treatment, patients' self-confidence and beliefs are strengthened. Nurses introduce successful cases of other patients undergoing prone ventilation treatment at the same time, organize patients in the same ward to watch and learn from each other, summarize experiences, and serve as role models, thereby instilling the belief that they too can independently complete awake prone positioning ventilation and achieve success, thus enhancing their self-efficacy.

Verbal persuasion refers to changing an individual's self-efficacy through others' suggestions, guidance, explanations, and encouragement [6]. During the first prone ventilation treatment session, the ventilation treatment team introduces themselves and educates the patient, including explaining the purpose and significance of the treatment and its effects, gaining the patient's consent and cooperation, and providing targeted advice if necessary. Through persuasion and encouragement from medical staff, family members, and other patients, patient self-efficacy can be strengthened.

Emotional and physiological states involve monitoring the patient's physiological condition and listening to their psychological feelings, providing personalized psychological guidance, and techniques to alleviate physical and mental discomfort [7]. During the intervention, attention should be paid to cultivating and regulating the patient's emotional and physiological state, timely detecting any physical and mental discomfort, and making adjustments. Patients who perform well are praised, while those who perform poorly are asked about their difficulties in adhering to the plan and provided with suggestions. Patients are encouraged to express their feelings and provided with psychological support.

2.5 Observation indicators

The following indicators were used to evaluate the effects of prone position ventilation on patient outcomes. SpO_2 and RR were monitored and recorded in patients before and after prone position ventilation for half an hour, 1 hour, and 1 hour after the end of ventilation. The modified UK mMRC dyspnea scale [8] was used to quantify the degree of dyspnea based on the patient's activity level when experiencing shortness of breath, graded on a scale of 0 to 4, with assessment criteria ranging from "only feeling short of breath during strenuous exercise" (Grade 0) to "being too breathless to leave home or experience breathlessness when dressing or undressing" (Grade 4). The general self-efficacy scale was used to evaluate self-efficacy, with a total score of 40, and this evaluation was conducted before and after prone position ventilation on the first, second, and third days. Finally, patient and family satisfaction and the cumulative ventilation time were surveyed and recorded after three days of prone position ventilation, with each questionnaire item rated as "satisfied", "overall satisfied", "average", or "unsatisfied". The total satisfaction rate (%) was calculated as (number of satisfied cases + number of basically satisfied cases + number of average cases) divided by the total number of cases, multiplied by 100%.

2.6 Statistical analysis

Statistical analysis was performed using SPSS 23.0 software. Continuous data were presented as mean ± standard deviation (mean ± SD), and independent sample t-tests were used for normally distributed continuous data. For non-normally distributed continuous data, the Mann-Whitney U test was used. Categorical data were presented as counts and percentages, and the chi-square test was used to compare between groups. The Wilcoxon rank-sum test was used for ordinal data. A P-value less than 0.05 was considered statistically significant.

3. RESULTS

The findings presented in Table 2 indicate that there was no significant difference in the levels of peripheral arterial oxygen saturation (SpO_2) and respiratory rate (RR) between the two groups of patients before the intervention and 30 minutes after ventilation ($P>0.05$ in both cases). However, the results showed a significant difference in SpO_2 and RR between the two groups of patients 1 hour after ventilation and 1 hour after the end of ventilation ($P<0.05$). These findings suggest that combining the self-efficacy intervention may have a positive impact on the SpO_2 and RR of patients, especially in the longer term.

Table 2. Comparison of SpO_2 and RR at different times between two groups of patients.

Timing	Group	SpO_2 (%)	t	P	RR (times/min)	t	P
Baseline	Intervention	93.50±3.32	0.324	0.747	25.35±4.98	0.357	0.722
	Control	93.80±4.83			24.95±5.04		
30min after ventilation	Intervention	95.17±2.66	0.498	0.62	23.35±4.92	-0.497	0.62
	Control	94.80±3.95			23.90±4.97		
1hr after ventilation	Intervention	97.03±1.76	2.531	0.013	20.15±3.02	-3.544	0.001
	Control	95.68±2.88			22.68±3.35		
1hr after completing the ventilation	Intervention	96.68±2.15	2.786	0.007	19.88±2.45	2.699	0.009
	Control	95.05±2.99			21.63±3.29		

The difference in mMRC scores between the two groups of patients before intervention and on the first day of ventilation therapy did not have statistical significance ($P>0.05$). However, there was a statistically significant difference in mMRC scores between the two groups on the second and third days of ventilation therapy ($P<0.05$), as shown in Table 3, indicating that the self-efficacy intervention-assisted awake prone positioning may have had a more pronounced effect on reducing dyspnea.

Table 3. Comparison of mMRC at different times between two groups of patients, n (%).

Timing	Grade 0	Grade 1	Grade 2	Grade 3	Grade 4	Z	P
Baseline							
Intervention	0 (0.00)	2 (5.00)	15 (37.50)	20 (50.00)	3 (7.50)	-0.158	0.874
Control	0 (0.00)	1 (2.50)	18 (45.00)	17 (42.50)	4 (10.00)		
Day 1							
Intervention	0 (0.00)	2 (5.00)	23 (57.50)	12 (30.00)	3 (7.50)	-1.58	0.114
Control	0 (0.00)	0 (0.00)	18 (45.00)	19 (47.50)	3 (7.50)		
Day 2							
Intervention	0 (0.00)	6 (15.00)	26 (65.00)	8 (20.00)	0 (0.00)	-2.89	0.004
Control	0 (0.00)	1 (2.50)	21 (52.50)	17 (42.50)	1 (2.50)		
Day 3							
Intervention	3 (7.50)	18 (45.00)	16 (40.00)	3 (7.50)	0 (0.00)	-4.087	0.001
Control	0 (0.00)	4 (10.00)	26 (65.00)	10 (25.00)	0 (0.00)		

The two groups of patients did not show statistically significant differences in their self-efficacy scores before intervention (P>0.05). However, there were statistically significant differences in the self-efficacy scores on the first, second, and third day after intervention (P<0.05), as presented in Table 4. These results suggest that the intervention had a positive effect on the self-efficacy of the patients.

Table 4. Comparison of self-efficacy scores at different times between two groups of patients.

Timing	Intervention	Control	t	P
Baseline	18.85±1.72	19.15±1.61	-0.806	0.423
Day 1	22.48±2.34	21.13±2.20	2.658	0.01
Day 2	28.05±2.99	25.47±2.77	4.021	0
Day 3	31.85±2.94	28.75±2.83	4.808	0

The cumulative duration of ventilation between two groups of patients exhibited a statistically significant difference (P<0.05), as depicted in Table 5. The intervention group had a significantly higher cumulative duration of ventilation compared to the control group.

Table 5. Comparison of cumulative duration of ventilation at different times between two groups of patients.

Group	Cumulative duration of ventilation (hr)	t	P
Intervention	22.78±5.89	3.28	0.002
Control	18.85±4.75		

The satisfaction levels between two groups of patients exhibited a statistically significant difference (P<0.05), as indicated in Table 6. The intervention group had a significantly higher level of satisfaction compared to the control group. These data suggests that the intervention had a positive impact on patient experience and their perception of care quality.

Table 6. Comparison of cumulative duration of ventilation at different times between two groups of patients.

Group	Intervention	Control	Z	P
Satisfied	12 (30)	8 (20.00)		
Overall satisfied	21 (52.50)	15 (37.50)		
Average	5 (12.50)	11 (27.50)	-2.304	0.021
Unsatisfied	2 (5.00)	6 (15.00)		
Total satisfaction rate (%)	95	85.5		

4. DISCUSSION

During the peak of the COVID-19 pandemic, an increasing number of patients, especially the elderly, progressed from mild or moderate to severe or even critical illness. These patients presented with pulmonary inflammation and abnormalities in lung function, such as dyspnea, respiratory distress, and decreased oxygen saturation, and could develop complications such as ARDS and hypoxemia [9]. Beitler et al. suggested that awake prone positioning could reduce the mortality rate of moderate to severe ARDS [10]. Similarly, another study including 15 COVID-19 patients with mild to moderate ARDS showed that awake prone positioning combined with non-invasive mechanical ventilation significantly improved respiratory rate, SpO_2, and P/F ratio in all patients within 1 hour of starting treatment, with sustained improvement in oxygenation in 12 patients even after the end of treatment[10]. It has been demonstrated that awake prone positioning technique could improve the uneven distribution of gas in the lungs, enhance the ventilation/perfusion ratio, promote the re-expansion of collapsed alveoli in the dorsal region, and effectively limit excessive inflation of normal alveoli, thus improving patient oxygenation and reducing mortality [11].

This study applied the self-efficacy theory to nursing interventions for awake prone positioning, which effectively increased blood oxygen saturation and improved dyspnea symptoms in patients with COVID-19. Statistical analysis revealed significant differences in SpO_2 and RR between the two groups of patients during the one-hour intervention and one hour after intervention, with the intervention group showing higher SpO_2 and lower RR than the control group. This can be attributed to the self-efficacy intervention received by patients in the intervention group during the awake prone positioning ventilation. Most patients in this study were elderly with low physical tolerance and low education levels, and had limited skills in performing the awake prone positioning ventilation technique [12]. In the control group, most patients were unable to persist with the therapy for more than half an hour due to changes in body position, resulting in large fluctuations in SpO_2 and increased RR. However, the healthcare professionals in the intervention group provided self-efficacy intervention from four different aspects, which improved patients' confidence and belief in adhering to the prone positioning ventilation therapy, thereby promoting their engagement in the treatment. The respiratory distress index of both groups of patients decreased with the ventilation therapy, but the improvement was more significant in the intervention group, whose respiratory distress index was lower than that of the control group on the second and third day after intervention, with a statistically significant difference. The self-efficacy theory as the guiding framework for the intervention motivated the potential of patients in the intervention group [13], allowing them to accumulate successful experiences, continuously enhance their confidence, and promote their adherence to the prone positioning ventilation therapy. On the first, second, and third day of intervention, the self-efficacy of patients in the intervention group was higher than that of the control group, and their cumulative ventilation time and satisfaction were also higher than those of the control group.

The awake prone positioning is a patient-centered treatment. Therefore, in the process of ventilation treatment, healthcare providers in this study continuously provided positive feedback to help patients summarize their experiences and solve difficulties, encouraging them to actively engage in prone ventilation. In this study, the self-efficacy theory was used as a theoretical basis and applied in the awake prone positioning in COVID-19 patients. Through direct experience, indirect experience, verbal persuasion, and regulation of emotions and physiological states, the self-efficacy of patients was improved from multiple dimensions, promoting the efficacy of prone ventilation and achieving a positive effect on improving the prognosis and quality of life of COVID-19 patients. This approach is worthy of clinical promotion and application.

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