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# The effect of acupressure on respiratory indices in patients undergoing mechanical ventilation



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## ABSTRACT

**Background and Purpose:** Acupressure as an uncomplicated and non-prescriptive approach may improve respiratory performance in patients undergoing mechanical ventilation. The present study aimed to determine the effect of acupressure on respiratory indices in patients undergoing mechanical ventilation.

**Materials and Method:** This randomized clinical trial study was conducted in three university hospitals in Tehran. 164 patients undergoing hemodynamic stability, GCS  $\geq 9$  and eligible for mechanical ventilation, were randomly assigned to one of the intervention and control groups. The intervention group received acupressure daily, twice a day for two consecutive days with routine care, but the control group received usual care. Acupressure intervention was performed in Zongfeng, Taiwan, Hugo, Niguang and Zooslanli locations for 20 minutes. In each session, the

respiratory indices of the patients were measured at four stages, before, immediately, 30 minutes and one hour after the intervention. Data were analyzed by SPSS software version 18 and inferential statistical tests.

**Finding:** Statistically significant difference was reported between groups regarding spontaneous respiratory rate ( $P = 0.025$ ) and spontaneous minute volume ( $P = 0.005$ ). In intra-group comparison, there was a significant improvement in expiratory tidal volume in the intervention group. The effect of acupressure on each intervention session was immediate and did not have a cumulative effect.

**Conclusion:** Acupressure could improve respiratory indices in patients with mechanical ventilation. Thus nurses of the intensive care unit can accelerate the improvement of patients undergoing mechanical ventilation using this non-pharmacological approach.

**Keywords:** Acupressure, Respiratory Indices, Mechanical Ventilation

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## INTRODUCTION

Patients with respiratory failure are under the supervision of a mechanical ventilation device, and with the help of which the alveolar ventilation and oxygenation of these patients are improved, the acid-base balance is restored and their respiratory function is determined. This supportive care of the mechanical ventilation device provides an opportunity for these patients to resolve respiratory failure and its causes.<sup>1</sup>

Mechanical ventilation is an aggressive and extremely costly measure.<sup>2</sup> The intensive care unit, although it includes less than 10% of hospital beds, accounts for more than 60% of the total cost of hospitalized patients and almost 40% of the total length of hospital stay.<sup>3</sup> According to estimates from the United States and Western countries, mechanical ventilation is the most cost-effective indicator ( $p < 0.0001$ ) and costs about \$ 16 billion to \$ 27 billion annually, which imposes significant economic burdens on the health care system.<sup>4</sup>

Among the indicators for assessing the respiratory state of patients under mechanical ventilation, respiratory volume, expiratory flow volume, minute ventilation, superficial and fast respiration index,

maximum damping pressure, airway resistance, and Raman static compilation were obtained. These indices show the rate of respiratory failure and respiratory muscle performance and have been used in various studies to assess the respiratory state of patients undergoing mechanical ventilation. Also, according to studies, these indices, especially the volume and the superficial and fast breathing index, have a high value in determining the readiness of patients to isolate mechanical ventilation.<sup>5,6</sup>

In this regard acupressure is a non-invasive and minimal cost treatment that plays an important role in multidisciplinary and multidisciplinary approaches to the treatment and management of symptoms, and the National Institutes of Health has used it as an effective tool. He advised managing various health problems.<sup>7</sup> Therefore, given the increasing trend in the number of patients admitted to the intensive care unit under mechanical ventilation, and despite the high costs of treatment and healthcare, interventions to reduce the length of hospital stay and the duration of mechanical ventilation are an opportunity to be able to reduced hospital costs<sup>3</sup> and due to the economic pressures

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associated with health care costs borne by developing countries,<sup>4</sup> complementary medicine and its subgroups Acupressure is a valuable tool that helps policymakers to prioritize potential interventions in the process. They will have the best use of resources and planning for future change.<sup>8</sup>

On the other hand, the combination of acupressure with therapeutic and pharmacological help to reduce the amount of drugs and their side effects, in other words, complement other therapies such as drugs and adjectives.<sup>7</sup> In addition, acupressure, as a nursing care intervention, can enhance the patient's progress in a comprehensive model and increase the quality of care for patients. Therefore, since acupressure as a valuable intervention has the ability to affect the psyche and human body<sup>9</sup> simultaneously. By using it, the patient's treatment process can be improved properly and comprehensively.

Acupressure applied by pressure using hand, fingers or thumb is a non-invasive and non-pharmacological intervention. It does not require any equipment. It can learn easily by nurses and apply in clinical practice.<sup>10</sup> This method promotes secretion of neurotransmitters and modulates adrenocorticotrophic hormones releasing.<sup>11,12</sup> Acupressure can produce deep relaxation and positive mental persuasion, improve tonicity of the muscles, Ease the flow of blood and lymph in the tissues and reinforce the nervous system in the body.<sup>10,7</sup> Acupressure technique improves oxygenation of lungs, reinforce the pulmonary function and palliates cough and pain and the signs of asthma in the lungs.<sup>5,13</sup>

Considering the pulmonary problems in patients undergoing mechanical ventilation, using this method can help to reduce the issues in these patients.

## MATERIAL AND METHODS

This study is a randomized clinical trial. The research participants consisted of all patients over 18 years of age admitted to the internal medicine intensive care unit, Surgical Care Department and Traumatic Care Unit. All patients who were exposed to these areas for the first time and had entry criteria and consent to participate in the study were included in this study during the 9 months of the sampling. The number of samples was 80 in both intervention and control groups, and a total of 160 people were examined.

Inclusion criteria were: Glasco comma scale 9 and above, with the ability to open the eyes in response to an acoustic or spontaneous stimulus; aged over 18; under mechanical ventilation over a minimum of 24 hours; under mechanical

ventilation with SIMV modes, PSV, CPAP, BIPAP during the study; stable in hemodynamic; hemoglobin higher than 8 mg/dL; absence of scars and scratches at compression points; lack of experience in the use of acupressure; auditory and verbal ability; lack of history of known psychiatric disorder; failure to receive psychiatric or psychosocial drugs; No use of sedation or sedation with high or high dose effect (deep seizure) within the past 6 hours; Failure to develop musculoskeletal disorders (such as myasthenia gravis and multiple sclerosis) Neurological damage to the respiratory tract (such as co-diplegia), the absence of acute and active heart disease, and the lack of use of muscle blocking agents.

Exclusion criteria include the patient's or patient's unwillingness to continue cooperation; the patient's emergency need for surgery during the study; an unpredictable incident during the treatment process; the patient's death during the study; the discharge of the patient with a personal consent or the transfer of the patient to the units Another treatment was completed before the course was completed.

For sampling, the researcher identified the informed consent in writing after describing the purpose of the study and providing complete information and vertigo with the patient or his guardian. Then, by examining the individual characteristics, the patients were matched, and the random blocks were used for random allocation in each of the intervention and control groups. The synchronization factors included age, sex, BMI, cigarette smoking, steroid use and bronchodilator. After matching, the patients were randomly assigned to one of the intervention and control groups. So, for both identical samples, the researcher selected a paper from the envelope containing the group design paper and assigned the group to the first patient, and the other group was appointed to the second patient. These opaque envelopes prepared by the head nurse of intensive care unit.

## Data Collection tools

The data gathering tool in this study was a form of recording of respiratory indices and acupressure form.

Respiratory Indicator form includes patient code, date of measurement, type of ventilator, ventilator mode in the day of measurement, hour of intervention (morning or evening), day of intervention (day 1 or 2) Endotracheal or tracheostomy tube and some respiratory indices that were recorded by the researcher in each session at 4 intervals (before intervention, immediately, 30 minutes and one hour after intervention) by the researcher.

Measurement of respiratory indices was carried out using mechanical ventilation devices. These devices were all made in Germany and were evaluated and calibrated by the company's service provider. Also, before the research was carried out, the calibration of the ventilators by the medical equipment engineer was verified, and their accuracy confirmed.

The acupressure questionnaire was used to record the various stages of intervention during the study for each patient. This form contains patient information, date, hour of intervention (morning or evening), day of intervention (day 1 or 2), 5 points of choice, zhongfu (lu1), taiyuan (lu9), hegu (li4), neiguan (pc6), and Zusanli (St36) was on the right and left side of the body.

In this study, acupressure technique was developed by a researcher who has undergone acupressure training with emphasis on learning the desired compressive points in this research and has been successful in obtaining a certificate in this course. The validity and reliability of the acupressure technique were evaluated in two parts, including the selection of correct points for pressure and pressure strength by two acupressure specialists. The method was used to select the points for the pressure and the stability of the compressive force (maintaining the force of 3 to 5 kg for 2 minutes) by the researcher for five patients. Then, two acupressure practitioners, in each patient, verified the choice of the actual compression points by the researcher and examined the pressure applied to each point. Also, measure the pressure applied to each point of 3 to 5 kilograms using a scale and validate it.<sup>13,14</sup>

### Data analysis

Data were analyzed using SPSS software version 18. Regarding the normal distribution of quantitative variables, independent t-test was used to determine the difference in the effect of intervention on the rate of respiratory indices in the two groups of intervention and control. ANOVA Repeated Measures were used to assess the impact of the intervention over time. Also, for comparing the rate of respiratory indices before and after intervention (at specific times) in each session and comparing the changes in the respiratory rate indices between different sessions for each group, follow-up ANOVA-R tests (Bonferroni's two-way comparison) used. The value of  $p < 0.05$  was considered statistically significant.

## RESULTS

The findings of this study showed that the mean baseline spontaneous respiratory rate in the intervention group was  $11.87 \pm 9.18$  in min and a control

group  $9.87 \pm 7.49$  in min. The mean of baseline spontaneous respiration in the intervention group was higher than the control group. Based on the independent t-test, there was no significant difference between the two groups regarding basal spontaneous respiratory rate ( $P = 0.143$ ) (Table 1).

The mean basal expiratory tidal volume in the intervention group was  $489.71 \pm 149.04$  and in the control group  $507.89 \pm 160.181$  ml. The mean basal expiratory tidal volume in the intervention group was lower than the control group. Based on the results of independent t-test, there was no significant difference between the two groups regarding expiratory tidal volume ( $P = 0.454$ ) (Table 1).

The mean basal spontaneous minute volume in the intervention group was  $5.125 \pm 3.76$  liters/min and a control group of  $4.63 \pm 3.49$  liters/min. Based on the independent t-test, there was no significant difference between the two groups regarding spontaneous minute volume and the two groups were homogeneous ( $P = 0.385$ ) (Table 1).

Based on the results of the R-ANOVA test, Table 2 shows there is a significant difference between intervention and control groups regarding the spontaneous respiratory rate ( $P = 0.025$ , Table 2). So, the rate of spontaneous in the intervention group was higher than control group. There is no difference between the two groups before intervention (Table 2).

The difference between the mean expiratory tidal volume at all times of the first session with other sessions, in the control group, did not show a significant difference. Therefore, in the control group, the volume of expiratory volume during the two days of intervention in the control group was constant (Table 4). Also, the data in Table 4 show that in the test group, the difference between the mean volume of expiratory flow of different sessions of the first session with other sessions did not have a significant statistical difference, so the effect of intervention at all times (immediately, 30 minutes and one hour later of intervention) at the first session was similar and homogeneous with the impact of intervention in other sessions. Regarding the homogeneity of the volumetric flow volume changes, the first session with other sessions suggests that the changes in the four sessions were similar. Therefore, the effect of acupressure on the improvement of exhaust volume did not have cumulative effect (Table 4).

Concerning the interaction between time and group, and time-dependent changes for expiratory tidal volume, it can be stated that in the intervention group, acupressure in each session was effective in comparison with the pre-interventional level, so four sessions, the effect of intervention was lasted up to 30 minutes. Considering that the expiratory

**Table 1 Comparison of basal respiratory indices between intervention and control Groups**

Respiratory indices	Control		Intervention		T test	
	Mean	Standard deviation	Mean	Standard deviation	P Value	T
Spontaneous respiratory rate	9.87	7.49	11.80	9.18	0.143	-1.46
Expiratory tidal volume	507.89	160.81	489.71	149.04	0.454	0.751
Spontaneous minute volume	4.63	3.49	5.125	3.76	0.385	-0.871

**Table 2 Comparison of the mean spontaneous respiratory rate before, immediately, 30 minutes, and 1 hour after intervention in both intervention and control groups for each session**

Number of breathing /min	Intervention		Control		T-test	
	Mean	SD	Mean	SD		
First Session					t	
Before	11.80	9.18	9.86	7.50	-1.47	0.143
Immediately	13.18	8.22	9.72	7.41	-2.83	0.005
30 minutes later	12.64	7.84	9.65	7.60	-2.83	0.014
1 hour later	14.80	7.26	9.68	7.60	-2.44	0.016
Second Session						
Before	12.05	8.53	13.32	11.40	-0.373	0.71
Immediately	13.11	7.27	10.16	7.89	-2.48	0.014
30 minutes later	12.90	8.08	10.11	7.72	-2.26	0.025
1 hour later	12.45	7.74	10.03	8.15	-1.95	0.052
Third Session						
Before	12.15	8.47	10.24	7.79	-1.50	0.136
Immediately	12.94	6.87	10.46	8.16	-2.10	0.037
30 minutes later	12.76	7.52	10.09	8.16	-2.22	0.028
1 hour later	12.30	7.65	10.23	7.77	-1.72	0.087
Fourth Session						
Before	11.92	8.61	10.54	8.23	01.05	0.296
Immediately	12.64	6.32	10.06	7.10	-2.29	0.023
30 minutes later	13.56	12.06	10.25	8.52	-2.04	0.043
1 hour later	12.27	6.95	9.99	8.12	-1.93	0.055
	Result R-ANOVA Inter-group effects				P=0.025	

tidal volume was homogeneous before intervention in each session with other sessions (table has not shown), it was possible to state that the effect of acupressure in each session was sectional, and not persistent until the beginning of the other session (Table 4). Although there was not a significant difference between 4 sessions for expiratory tidal volume totally (P=0.157), it can be showed in intra-session comparison (Table 4).

There was no significant difference in the spontaneous minute volume before the intervention in different sessions in the intervention group (P>0.05). Therefore, it can be concluded that the volume of spontaneous minute volume

was homogeneous before intervention, every four sessions, and patients had the same status at the beginning of each four sessions. Also, the impact of the intervention on each session until the start of the next session was not lasting. So the intervention in each session had a cross-sectional effect, and its impact did not persist until the beginning of the next sessions. Also, in the control group, the amount of spontaneous minute volume before intervention of different sessions did not have a significant difference (P>0.05) (Table 5).

The R-ANOVA test, the significance of the interaction between the group and the time and time-dependent changes for the spontaneous minute

**Table 4** Comparison the mean of expiratory tidal volume before and immediately after, before and 30 minutes, before and one hour after the intervention of the first session with the second, third and fourth sessions in both intervention and control group

Expiratory tidal volume (mL/min)	Intervention		Control		T-Test	
	Mean	SD	Mean	SD	T	P-value
First session						
Before	489.7	149.05	507.89	16.08	0.751	0.454
Immediately	589.95	171.5	511.78	153.69	-3.07	0.003
30 minutes later	537.40	171.57	509.98	141.02	-2.58	0.011
1 hour later	515.90	153.66	509.04	141.26	-0.294	0.769
Second Session						
Before	493.12	146.55	516.87	155.35	1.01	0.315
Immediately	607.47	184.95	511.70	158.96	-3.55	0.001
30 minutes later	567.96	156.53	521.57	151.28	-1.93	0.049
1 hour later	515.64	158.75	514.08	153.33	-0.064	0.949
Third Session						
Before	496.38	137.81	513.33	148.69	-0.757	0.450
Immediately	602.83	159.94	512.62	147.77	-3.79	0.001
30 minutes later	569.71	137.92	511.06	147.55	-2.63	0.009
1 hour later	521.87	122.69	512.49	142.29	-0.435	0.663
Fourth Session						
Before	494.74	131.76	511.14	151.85	0.74	0.461
Immediately	595.10	159.01	515.71	147.05	-3.22	0.001
30 minutes later	570.71	148.01	517.91	153.88	-2.24	0.026
1 hour later	515.94	129.81	514.69	152.16	0.077	0.929
R-ANOVA				P=0.157		

**Table 5** Comparison the mean of spontaneous minute volume before the intervention of the first, second, third, and fourth sessions in each intervention and control group

Spontaneous minute volume(L/min)	Intervention		Control		T-TEST	
	Mean	SD	Mean	SD	T	P-value
First session						
Before	5.13	3.76	4.63	3.49	-0.87	0.385
Immediately	7.19	4.19	4.64	3.54	-4.18	0.001
30 minutes later	6.68	2.83	4.67	3.63	-2.48	0.001
1 hour later	7.08	9.07	4.67	3.72	-2.20	0.029
Second Session						
Before	5.30	2.60	5.56	6.56	0.318	0.751
Immediately	7.26	2.70	4.87	3.88	-4.21	0.001
30 minutes later	6.73	2.81	5.01	3.85	-2.87	0.005
1 hour later	5.83	2.24	4.79	3.84	-1.85	0.067

Table 5 Continue

Spontaneous minute volume(L/min)	Intervention		Control		T-TEST	
	Mean	SD	Mean	SD	T	P-value
Third session						
Before	5.54	2.95	4.91	3.68	-1.05	0.294
Immediately	7.29	2.89	4.99	3.78	-4.01	0.001
30 minutes later	6.88	2.88	4.86	3.81	-2.26	0.001
1 hour later	6.10	2.79	4.92	3.68	-1.95	0.053
Fourth session						
Before	5.38	2.96	5.07	3.99	-0.49	0.626
Immediately	7.11	2.96	4.87	3.89	-2.87	0.001
30 minutes later	7.28	6.43	4.98	4.22	-2.68	0.008
1 hour later	5.86	2.38	4.75	3.74	-2.01	0.046
R-ANOVA				P=0.005		

volume in the intervention group ( $P = 0.005$ ), the results of the Bonferroni two-way comparison over the entire timeframe of the group is presented in Table 5 (Table 5).

According to the results of intra-group comparisons, it can be stated that in the intervention group, acupressure was effective on the amount of spontaneous minute volume in each session compared with the pre-interventional level, so that at the first, second and third session, the effective intervention was up to 30 minutes and at the fourth session, only in the immediate after of the intervention. Therefore, the effect of acupressure in each session was sectional. Also, the homogeneity of the spontaneous minute volume at the same intervals at different sessions with each other indicates a uniform and equal impact of intervention in each session. Therefore, the intervention in these four sessions did not have cumulative effect, while it was expected to increase significantly with increasing number of sessions, the improvement of spontaneous minute volume at different time points (Table 5).

It should be noted that according to the results of the R-ANOVA test, the lack of meaningful time-dependent changes for spontaneous minute volume (time effect) in the control group ( $P=309$ ) resulted from the comparison of Bonferroni's total results. The time intervals of this group were not expressed because all comparisons were not statistically significant. Accordingly, spontaneous minute volume in the control group during the two days of the study was similar.

## DISCUSSION

The purpose of this study was to compare the changes in respiratory indices before, immediately,

30 minutes and one hour after the intervention of different sessions in the intervention and control groups.

Many studies have been shown that acupressure has the effective and important roles in the improvement of respiratory function, arterial blood oxygen pressure, vital signs, bodily function and quality of life.<sup>15,16,17,12</sup> Also, it can be refined disorders in the respiratory system and improve the oxygenation into the lungs. Furthermore, this method can reduce the pain and cough in the lungs.<sup>5,13</sup> By acupressure, releasing of neurotransmitters specially endorphin increases.<sup>18</sup>

So far, only in two other studies, the effect of acupressure on respiratory parameters in patients undergoing mechanical ventilation has been investigated, as in Maa et al. (2013), the study showed that acupressure treatment with one or two sessions did not manage to reduce the respiratory rate of these patients.<sup>5</sup>

In a study by Tsay et al. (2005) that the effect of acupressure on 52 well-known and long-term mechanical ventilation patients was examined, the effect of acupressure was up to two days after the end of the intervention period, which could be attributed to a high number of acupressure sessions (9 sessions),<sup>14</sup> but in the present study, the implementation of four sessions of acupressure twice a day for two consecutive days could improve the respiratory rate during the study.

One of the most important points in this regard is how the effect of acupressure on the respiratory rate of patients under mechanical ventilation was different from the study by Tsay et al. (2005). In the study, patients at the basal level were tachypnea, and after acupressure, their respiratory rate significantly decreased. But in the present study, patients at the

basal level were bradypnea. Acupressure could significantly increase the spontaneous respiratory rate of patients to the normal range.

The findings of the present study were consistent with the results of Maa et al. (2013) regarding significant difference between the two groups of intervention and control at two-time points immediately and 30 minutes after the intervention. In the present study, in every 4 sessions, the expiratory tidal volume of the intervention group at two times immediate and 30 minutes after intervention had a significant statistical difference compared to the control group, respectively, improved from first to fourth sessions compared with the control group, respectively. However, there was no significant difference in the amount of expiratory tidal volume measured in the 16 time periods during the two days of the study in the control group with the control group.

In other words, the overall change in the intervention group was not at a level that was statistically significant in the overall comparison with the control group, although the comparison of the component in different time intervals between the two intervention and control groups was statistically significant.

In comparing the time scale, the effect of acupressure in the first and second sessions was up to one hour, and in the third and fourth session until 30 minutes, it was important. The results of Maa et al. (2013)<sup>5</sup> were consistent with the findings of the present study, but the survival time of acupressure was less in each session in the present study.

One of the essential points in the findings of the present study was the existence of time contiguity in the periods when acupressure was affected by the control group, i.e., in every 4 sessions, the volume of expiratory tidal volume was continuously up to 30 minutes after the intervention, a significant improvement compared with the control group, and this was of great benefit from the findings of the study, but in the study of Maa et al. 2013, there was no time correlation in effective time periods.<sup>5</sup> So far, except for our study, only in the study of Maa et al. (2013),<sup>5</sup> the effect of acupressure on the volume of patients under mechanical ventilation has been studied.

The findings of the study, Chu et al. (2007) and Suzuki et al. (2008) were consistent with the findings of the study.<sup>19,20</sup> But the results of Scheeve et al. (2011) and Deering et al. (2011) contradicted the findings of this study.<sup>21,22</sup>

The findings of the two studies, Suzuki et al. (2008 and 2012),<sup>20,23</sup> were consistent with the findings of the present study regarding the improvement of pulmonary volume. However, the results

of the Deering et al. (2011) study,<sup>22</sup> regarding the lack of increase in pulmonary volume, were inconsistent with the findings of the present study. This ineffectiveness in this study can be attributed to the destructive effects of high smoking in COPD patients and to reduce their responsiveness to stimulation of the medical site needles and a low dose of treatment. Based on numerous studies, stimulating acupuncture points affecting breathing, various neurotransmitters in the body, decreased sympathetic activity in the body and facilitated respiration, the conditions for obtaining higher pulmonary volumes in patients are provided.<sup>13</sup>

## LIMITATIONS

Due to the presence of a subclavian venous catheter in some patients, access to the Zhongfu point (Lu1) (because of its close proximity to the site of the catheter) was difficult, so in these patients, acupressure was applied to this point was impossible, and applied only on the opposite side.

## PROPOSAL FOR FUTURE STUDIES

Considering that the time of intervention used for acupressure in this study was performed twice a day for two consecutive days, and the results showed the effect of short-term and acute acupressure in this group of patients, it is suggested that the effect of acupressure in patients undergoing mechanical ventilation assess over a longer period (one week or more) to investigate the chronic impact.

## CONCLUSION

Based on the results obtained in this study and considering that the patients undergoing mechanical ventilation at the baseline level were bradypnea, acupressure could significantly increase the spontaneous respiratory rate of patients under mechanical ventilation compared to the control group. Therefore acupressure has an important effect on the spontaneous respiratory rate of patients under mechanical ventilation and its improvement.

According to the results obtained in this study, acupressure has not been able to change the amount of expiratory tidal volume of patients under mechanical ventilation compared to the control group, but in intragroup comparison, acupressure has been able to significantly increase the capacity of expiratory flow of patients under mechanical ventilation. In the intervention group, the effect of acupressure in each session was sectional and non-cumulative.

This study showed acupressure could significantly increase the volume of spontaneous respiration of patients under mechanical ventilation compared to the control group, but the effect of acupressure in each session, cross-sectional and non-effective Cumulative. Therefore, the findings of this study indicated that acupressure has an essential effect on the increasing the spontaneous minute volume of patients under mechanical ventilation.

Taken together, acupressure can improve the respiratory indices in patients under mechanical ventilation. So this procedure can use by nursing staff to increase the respiratory indices in patients.

## CONFLICT OF INTEREST

There is no conflict of interest.

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