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Cardiopulmonary responses to neurophysiological facilitation of respiration in mechanically ventilated ICU patients

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Abstract. Mechanical ventilation is essential in acute illness but may lead to complications such as atelectasis and monotonous breathing, which physiotherapists help counter by using neurophysiological facilitation techniques to enhance the respiratory function of unconscious and sedated patients. By exploring neurophysiological facilitation techniques, the study aimed to evaluate the immediate effects of perioral pressure and intercostal stretch on cardiopulmonary parameters in mechanically ventilated patients at the University of Benin Teaching Hospital. A randomised crossover experimental design was used, involving ten patients (5 males, 5 females; mean age 66.2 ± 8.5 years) who were haemodynamically stable but unconscious and ventilated. Cardiopulmonary variables including systolic blood pressure, diastolic blood pressure, heart rate, respiratory rate, oxygen saturation, and mean arterial pressure were measured before and after each neurophysiological facilitation techniques intervention using a standardised protocol. The results showed that perioral pressure significantly improved diastolic blood pressure (77.10 ± 9.01 to 79.30 ± 10.34 mmHg, $p = 0.005$), respiratory rate (26.40 ± 6.08 to 28.30 ± 6.60 breaths/min, $p = 0.014$), and mean arterial pressure (92.70 ± 10.70 to 94.00 ± 10.06 mmHg, $p = 0.022$). Intercostal stretch significantly increased respiratory rate (26.8 ± 6.07 to 28.2 ± 6.07 breaths/min, $p < 0.001$), while changes in systolic pressure, heart rate, and oxygen saturation were not statistically significant ($p > 0.05$). Gender did not influence the magnitude of changes in any cardiopulmonary parameter. The study established that neurophysiological facilitation techniques elicited beneficial acute effects on respiratory rate and haemodynamic parameters in mechanically

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ventilated patients and highlighted neurophysiological facilitation techniques as a practical adjunct to respiratory physiotherapy for improved cardiopulmonary stability in critically ill patients

Keywords: haemodynamic parameters; perioral pressure; intercostal stretch; respiratory therapy intervention; intensive care physiotherapy

Introduction

The respiratory care of unconscious patients in the intensive care unit (ICU) is particularly complex due to their inability to perform optimal voluntary respiratory activities, which leads to shallow breathing, atelectasis, reduced chest expansion, and monotonous breathing. This predisposes them to complications such as atelectasis, inefficient gas exchange, and secretion retention. Mechanical ventilation remains a vital supportive treatment for patients with acute respiratory failure, sedation, or compromised consciousness; however, prolonged use of a mechanical ventilator can result in respiratory muscle atrophy, reduced lung compliance, ventilation-induced lung injury, and altered haemodynamics. These challenges underscore the need for adjunct physiotherapeutic techniques to preserve respiratory function, maintain ventilation efficiency, and minimise complications in ventilated patients.

Researchers are working to improve respiratory mechanics, gas exchange, and treatment outcomes for patients on mechanical ventilation. The study by S. Das *et al.* [1] investigated the effect of intercostal stretch in combination with standard chest physical therapy in mechanically ventilated patients. They found significant improvements in arterial oxygen partial pressure (PaO_2) and significant reductions in arterial carbon dioxide partial pressure ($PaCO_2$), with the intervention group showing greater effect than control. In the scoping review by J.A. Carabalí-Rivera *et al.* [2], respiratory muscle training protocols (threshold load training at 40-50% maximal inspiratory pressure, twice daily, 30 repetitions) were reported to improve inspiratory muscle strength and enhance weaning success. In a systematic review by D. Mankad *et al.* [3], combining intercostal stretch and anterior basal lift techniques in neurophysiological facilitation of respiration, vertebral pressure, and perioral pressure techniques were collectively found to effectively improve haemodynamic (heart rate (HR), blood pressure) and pulmonary parameters (tidal volume, lung compliance, respiratory rate (RR), and peripheral oxygen saturation (SpO_2)) in mechanically ventilated patients.

In the research by K.N. Chowdhury [4], narrative review highlighted that intercostal stretch technique produced consistent improvements in chest expansion, diaphragm excursion, and intra-thoracic lung volume across various pulmonary conditions, including among patients with chronic respiratory disease and in ICU settings. S. Tong *et al.* [5] found that diaphragmatic stimulation significantly reduced the duration of patients on mechanical ventilation, improved maximal inspiratory pressure, and increased the proportion of patients who were successfully weaned. Furthermore, the study by T. Bassi *et al.* [6] on restoring Brain Connectivity by Phrenic Nerve Stimulation, the addition of phrenic nerve stimulation in deeply sedated ventilated patients with acute respiratory distress syndrome increased cortical connectivity in frontal-temporal-parietal cortices, suggesting neural benefits that may extend beyond gas exchange alone. F. Azimi *et al.* [7] compared two physiotherapy techniques (lung squeezing versus chest vibration/percussion) in mechanically ventilated patients and found that lung squeezing significantly improved weaning indices such as the rapid shallow breathing index. Similarly, J. Bickenbach *et al.* [8] demonstrated that structured, protocolised physiotherapy delivered during prolonged weaning improved clinical outcomes, further supporting the integration of physiotherapy into routine ICU management. Ultimately, X. Xingyu *et al.* [9] provided evidence that pulmonary rehabilitation, including inspiratory muscle training, significantly enhanced respiratory pressures and tidal volume among ventilator-dependent patients, underscoring its role in attenuating ventilator-associated decline in respiratory function.

These studies collectively showed progress, but differences in techniques, durations, outcome measures, and patient populations leave gaps in practice knowledge regarding the immediate cardiopulmonary effects of perioral pressure and intercostal stretch in unconscious or deeply sedated mechanically ventilated patients. The purpose of this pilot study was to investigate the immediate cardiopulmonary effects of neurophysiological facilitation of respiration techniques in mechanically ventilated ICU patients by assessing haemodynamic variables after eliciting neurophysiological facilitation of respiration in the form of perioral pressure protocol and intercostal stretch protocol.

Materials and Methods

This experimental study was carried out in the ICU of the University of Benin Teaching Hospital, Benin City, Nigeria. The research focused on assessing the immediate effects of neurophysiological facilitation (NPF) techniques on key cardiopulmonary parameters in mechanically ventilated patients. Participants included 5 male and 5 female adults aged 18 years and above who were unconscious and receiving mechanical ventilation in the ICU. Only patients who demonstrated some level of spontaneous respiratory effort and who were haemodynamically stable were considered eligible for inclusion. To ensure safety and consistency, patients were excluded if they had suffered fractures to the ribs, sternum, or thoracic vertebrae, had a recent history of cardiac arrest while in the ICU, or had sustained facial or chest burns. A simple random sampling method, which is a type of probability sampling technique, was adopted to recruit a total of ten eligible participants who met the predefined criteria. Each participant underwent a comprehensive clinical evaluation to confirm eligibility before inclusion in the study.

Socio-demographic data, including age and sex, were collected and recorded. The mechanical ventilator used for patient support during the interventions was the Shangri-La 590 (China) by AEOMED Surgi Care. Cardiopulmonary variables such as systolic blood pressure (SBP) and diastolic blood pressure (DBP), HR, SpO_2, RR, and mean arterial pressure (MAP) were measured using a calibrated EDAN patient monitor (model iM60). A stopwatch timer was employed to standardise the timing and duration of each intervention. A crossover research design was utilised to enhance the internal validity of the study and control for individual variability in physiological response. A randomised crossover design was employed, allowing each participant to serve as their own control, which helped reduce confounding factors and improves the reliability of the outcomes. In this design, each patient received both NPF techniques, which consisted of perioral pressure stimulation and intercostal stretch, sequentially.

A washout period of 30 minutes was maintained between the two interventions to minimise any carryover effects. The order of intervention administration was randomised for each patient to reduce the potential for bias associated with treatment sequence. Each technique was carefully applied while observing chest wall and diaphragmatic movements as clinical indicators of respiratory engagement. Before the application of each NPF technique, which were also selected randomly for each patient, baseline readings of all cardiopulmonary parameters were taken and recorded. Following each intervention, the same parameters were re-measured immediately to assess acute physiological responses. The neurophysiological facilitation techniques were applied using standardised manual methods designed to elicit reflexive activation of respiratory muscles through proprioceptive and tactile stimulation. Perioral pressure was administered by applying consistent digital pressure at specific perioral points, while intercostal stretch involved gentle but firm stretching of the intercostal spaces in sync with the ventilator's inspiratory phase.

Each application was performed by trained physiotherapists experienced in neurophysiological techniques in critical care settings. Data obtained from the assessments were compiled and subjected to statistical analysis using the IBM Statistical Package for the Social Sciences (SPSS), version 27. Descriptive statistics, including means and standard deviations, were calculated for each variable. To determine whether there were statistically significant differences between baseline and post-intervention measurements, paired t-tests were conducted for each parameter. Additionally, independent t-tests were used to explore possible gender-based differences in response to the interventions. The level of statistical significance was set at $p < 0.05$ for all analyses. Table 1 shows the sociodemographic characteristics of the patients. The mean age among the participants in this study was 66.2 (± 8.46) years. There were equal proportions of male and female participants. Ischaemic stroke was the most common diagnosis, present in 5 (50%) of the participants. The Glasgow Coma Scale (GCS) scores for the patients ranged from 7-14.

Table 1. Sociodemographic characteristics of the patients

	Frequency	Percentage
Gender		
Male	5	50.0
Female	5	50.0
Diagnosis		
Haemorrhagic stroke	3	30.0
Ischaemic stroke	5	50.0
Septic shock	2	20.0
Marital status		
Married	8	80.0
Widowed	2	20.0
Occupation		
Business	2	20.0
Civil servant	1	10.0
Farmer	4	40.0
Retired farmer	1	10.0
Trader	2	20.0
	Range	Mean ± SD
Age	54-80	66.2 ± 8.46
GCS	7-14	9.60 ± 2.32

Source: compiled by authors

The study protocol was reviewed and approved by the University of Benin Teaching Hospital Research Ethics Committee (Protocol No. ADM/E/22/A/VOL. VII/148381521853). Ethical approval confirmed that the research complied with institutional requirements, and written informed consent was obtained from patients' relatives or legal guardians, as the participants were unconscious and unable to provide consent. The study was conducted in accordance with the ethical principles outlined in the World Medical Association [10] Declaration of Helsinki on medical research involving human subjects and followed the European Commission [11] guidelines on ethics and data protection to ensure confidentiality and responsible handling of patient information. Non-invasiveness, and low cost of these techniques make them particularly valuable in resource-limited ICU environments, where advanced interventions may not always be feasible. Nevertheless, this study was limited by its small sample size (n = 10), single-centre setting, and focus on immediate effects.

This rigorous methodological approach allowed the researchers to evaluate the immediate physiological effects of the neurophysiological facilitation techniques on mechanically ventilated patients. By carefully selecting participants and monitoring key cardiopulmonary parameters, the study was able to capture real-time responses to the intervention. Additionally, the design permitted an examination of potential differences in response between male and female participants, providing a more nuanced understanding of treatment effects. Overall, this approach offered valuable insights into the potential role of neurophysiological facilitation in optimising acute care for ICU patients.

Results and Discussion

The study evaluated the immediate effects of perioral pressure and intercostal stretch techniques on cardiopulmonary parameters in mechanically ventilated patients. Results were presented in four tables: descriptive statistics, effects of each intervention, and gender-related responses. Key findings highlighted significant improvements in RR, DBP, and MAP with perioral pressure and RR with intercostal stretch. Table 2 shows changes in cardiopulmonary parameters before and after applying perioral pressure and intercostal stretch. Statistical analysis demonstrated that perioral pressure led to significant improvements in DBP: 77.1 ± 9.0 to 79.3 ± 10.3 mmHg, p = 0.005, RR: 26.4 ± 6.1 to 28.3 ± 6.6 breaths/min, p = 0.014, and MAP: 92.7 ± 10.7 to 94.0 ± 10.1 mmHg, p = 0.022. Intercostal stretch produced a significant increase in RR (26.8 ± 6.1 to 28.2 ± 6.1 breaths/min, p = 0.001). Conversely, SBP, HR, and SpO_2 showed no significant differences (all p > 0.05).

Table 2. Descriptive statistics of the SD of cardiopulmonary parameters among the patients

	Range	Mean ± SD
Pre- and post-application of perioral pressure		
Pre-SBP	105-146	125.00 ± 15.42
Post-SBP	110-140	124.30 ± 12.83
Pre-DBP	68-91	77.10 ± 9.01
Post-DBP	70-96	79.30 ± 10.34
Pre-HR	88-108	98.60 ± 7.69
Post-HR	84-111	97.40 ± 11.15
Pre- SpO_2	91-99	97.70 ± 2.50
Post- SpO_2	92-100	98.00 ± 2.21
Pre-RR	20-40	26.40 ± 6.08
Post-RR	20-41	28.30 ± 6.60
Pre-MAP	83-108	92.70 ± 10.70
Post-MAP	83-108	94.00 ± 10.06
Pre- and post-application of intercostal stretch		
Pre-SBP	104-176	124.70 ± 21.14
Post-SBP	105-181	127.60 ± 21.78
Pre-DBP	62-114	77.30 ± 14.69
Post-DBP	67-99	78.80 ± 10.59
Pre-HR	86-103	94.80 ± 7.38
Post-HR	86-106	94.90 ± 7.71
Pre- SpO_2	92-100	97.8 ± 2.3
Post- SpO_2	92-99	96.8 ± 2.201
Pre-RR	20-38	26.8 ± 6.07
Post-RR	22-40	28.2 ± 6.07
Pre-MAP	78-134	92.7 ± 16.337
Post-MAP	84-126	94.8 ± 13.579

Source: compiled by the authors

Table 3 showed the effect of perioral pressure protocol on cardiopulmonary parameters in mechanically ventilated patients. There were statistically significant acute effects for DBP (t = -3.713, p = 0.005), RR (t = -3.051, p = 0.014), and MAP (t = -2.751, p = 0.022). The magnitude of the mean difference in DBP, 2.20 mmHg

(±1.874), did not reveal any meaningful clinical increase. The magnitude of the mean difference in RR, 1.90 (± 1.97) bpm, did not reveal any meaningful clinical increase, and lastly, the magnitude of the mean difference in MAP, 1.30 mmHg (± 1.494), did not reveal any meaningful clinical increase.

Table 3. Effect of perioral pressure protocol on cardiopulmonary parameters in mechanically ventilated patients

	Paired differences				
	Mean	SD	t-value	Degrees of freedom	p-value
SBP	-0.700	6.430	0.344	9	0.739
DB	2.200	1.874	-3.713	9	0.005
HR	-1.200	7.452	0.509	9	0.623
SpO2	0.300	0.949	-1.000	9	0.343
RR	1.900	1.969	-3.051	9	0.014
MAP	1.300	1.494	-2.751	9	0.022

Source: compiled by the authors

Table 4 showed the effect of the intercostal stretch protocol on cardiopulmonary parameters in mechanically ventilated patients. There were statistically significant acute effects for RR ($t = -3.713$, $p = 0.005$), but the magnitude of the mean difference in RR, 1.30 (± 0.516) bpm, did not reveal any meaningful clinical increase.

Table 4. Effect of intercostal stretch protocol on cardiopulmonary parameters in mechanically ventilated patients

	Paired differences				
	Mean	SD	t-value	Degrees of freedom	p-value
SBP	2.900	5.587	-1.642	9	0.135
DBP	1.500	6.819	-0.696	9	0.504
HR	0.100	1.912	-0.165	9	0.872
SpO_2	-1.000	2.211	1.430	9	0.186
RR	1.400	0.516	-8.573	9	<0.001
MAP	2.100	5.666	-1.172	9	0.271

Source: compiled by authors

Table 5 showed the influence of gender on the change in cardiopulmonary parameters following neurophysiological facilitation intervention. Gender did not influence responses, as independent t-tests revealed no significant differences between male and female participants across all parameters (all $p > 0.05$).

Table 5. Influence of gender on change in cardiopulmonary parameters following neurophysiological facilitation interventions

Perioral pressure		Mean ± SD	t-value	Degrees of freedom	p-value
SBP	Male	0.20 ± 5.89	0.422	8	0.684
	Female	-1.60 ± 7.50			
DBP	Male	1.4 ± 0.89	-1.425	8	0.192
	Female	3 ± 2.35			
HR	Male	-1.8 ± 7.66	-0.241	8	0.816
	Female	-0.6 ± 8.08			
SpO_2	Male	0.4 ± 0.89	0.316	8	0.760
	Female	0.2 ± 1.10			
RR	Male	0.8 ± 1.30	-2.060	8	0.073
	Female	3 ± 2			
MAP	Male	1.2 ± 1.64	-0.20	8	0.846
	Female	1.4 ± 1.52			
Intercostal stretch					
SBP	Male	3.6 ± 5.13	0.377	8	0.716
	Female	2.2 ± 6.53			
DBP	Male	-0.4 ± 8.53	-0.869	8	0.410
	Female	3.4 ± 4.77			
HR	Male	-0.4 ± 1.52	-0.811	8	0.441
	Female	0.6 ± 2.30			
SpO_2	Male	-2.2 ± 2.59	-1.973	8	0.084
	Female	0.2 ± 0.84			

Continued Table 5

Perioral pressure		Mean ± SD	t-value	Degrees of freedom	p-value
Intercostal stretch					
RR	Male	1.6 ± 0.54	1.265	8	0.242
	Female	1.2 ± 0.45			
MAP	Male	1 ± 6	-0.591	8	0.571
	Female	3.2 ± 5.76			

Source: compiled by the authors

Hypothesis testing showed that perioral pressure had a statistically significant effect on DBP ($p = 0.005$), RR ($p = 0.014$) and MAP ($p = 0.022$), and therefore, the null hypotheses were rejected. However, no significant effect was found on SBP, HR and SpO_2, which gave grounds for accepting the null hypotheses. The effect of intercostal stretch was observed only for RR, where a statistically significant change was recorded ($p = 0.001$), leading to the rejection of the null hypothesis. However, no significant effects were identified for systolic and DBP, HR, SpO_2, and MAP; therefore, the null hypotheses for these parameters were accepted. The findings of statistical analysis demonstrated that perioral pressure led to significant improvements, suggesting that NPF techniques (perioral pressure protocol) can elicit positive changes in selected cardiopulmonary parameters, though not uniformly across all variables. The observed improvements were attributed to the physiological mechanisms underlying NPF techniques. Perioral pressure protocol most likely activated trigeminal afferents, hence projecting to medullary respiratory centres, thereby enhancing respiratory drive and autonomic responses. This reflex pathway may explain the rise in DBP and MAP, thereby reflecting modest increases in vascular tone and peripheral resistance.

The reliability of these observed responses may also be influenced by the randomised crossover design employed in this study. As B. Jones & M.G. Kenward [12] explained, crossover designs are highly effective in biomedical and clinical research because they allow each participant to serve as their own control, thereby reducing confounding factors and improving the reliability of outcomes. This principle aligned with the present study, in which each participant experienced both intervention protocols, allowing within-subject comparisons that strengthened the validity of the observed changes in DBP, MAP, and RR.

Intercostal stretch protocol (produced a significant increase in RR; 26.8 ± 6.1 to 28.2 ± 6.1 breaths/min, $p = 0.001$ still SBP, HR, and SpO_2 showed no significant differences; all $p > 0.05$) on the other hand, may stimulate intercostal muscle spindles and rib mechanoreceptors, thereby augmenting afferent input to the brainstem and improving ventilatory rhythm, as reflected in the consistent increases in RR. These findings were supported by previous studies that explored the physiological effects of respiratory facilitation techniques. K.D. Thorat *et al.* [13] demonstrated that respiratory PNF enhances chest wall mobility and stimulates neural pathways, which aligns with the observed increase in RR in the present study. While K.D. Thorat *et al.* investigated spinal cord injury patients, the underlying mechanism of neural activation may similarly explain the enhanced ventilatory rhythm in the participants of this study. A. Salve *et al.* [14] reported significant improvements in RR, tidal volume, and oxygen saturation following vertebral pressure and intercostal stretch in patients with impaired consciousness. These results reinforced author's findings of increased RR, suggesting that intercostal stimulation contributes to improved afferent signalling to the respiratory centres. Although SpO_2 did not change significantly in author's cohort, the alignment with A. Salve's *et al.* findings supported the notion that short-term interventions may initially affect ventilatory patterns before impacting oxygen saturation. Furthermore, T.O. Jenkins *et al.* [15] demonstrated that inspiratory muscle training in ventilated patients enhanced oxygen consumption proportional to inspiratory load, highlighting the capacity of respiratory muscles to adapt to stimulation. In a recent randomised clinical trial involving COVID-19 patients, S. Kumar *et al.* [16] demonstrated that NPF techniques significantly improved SpO_2 and reduced dyspnea, supporting the idea that NPF stimulation can enhance respiratory effectiveness even in acute illness. Similarly, S. Patel & H. Prajapati [17] reported that NPF applied in children with spastic cerebral palsy significantly increased respiratory rate and chest expansion, aligning with author's findings on enhanced ventilatory drive and thoracic mobility following perioral pressure and intercostal stretch. Taken together, these studies provided mechanistic support for author's observations and indicate that NPF techniques can acutely enhance respiratory dynamics, even in critically ill participants. The present findings also align with those of Q. Zhou *et al.* [18], who demonstrated that proprioceptive neuromuscular facilitation combined with inspiratory muscle training significantly improved respiratory function and extubation outcomes in neurocritical patients. The increase in respiratory rate observed in the intercostal stretch protocol is consistent with their report of enhanced respiratory dynamics following neuromuscular facilitation. Although inspiratory muscle training was not included in the present study, the physiological enhancements described by Q. Zhou *et al.* support the interpretation that NPF techniques can modulate respiratory centres and improve respiratory effectiveness even in short-term application.

The improvements in RR, DBP, and MAP observed in this study suggested that NPF techniques of respiration may enhance alveolar ventilation, gas exchange efficiency, and circulatory stability. Enhanced upper chest wall expansion and diaphragmatic excursion, as reported by A. Nair *et al.* [19], likely contributed to the observed improvements in RR, DBP, and MAP in the current study by facilitating greater lung volumes and more efficient alveolar ventilation. While A. Nair's study primarily evaluated structural changes in chest wall mechanics, the findings of the current study suggest that these mechanical improvements translate into functional benefits in ventilation and circulatory stability. These effects were further supported by K.D. Thorat *et al.* [13], whose research on respiratory PNF highlighted how stimulation of neural pathways can augment chest wall mobility. Comparing these studies with the current results, it appears that NPF techniques produce both mechanical and neurophysiological enhancements, which together may explain the modest but consistent increases in respiratory and haemodynamic parameters observed in the study participants. Although SpO_2 did not significantly change in this study, the observed increases in RR and MAP may still provide clinically relevant benefits, such as reducing the risk of hypoventilation, atelectasis, and inadequate organ perfusion in critically ill patients. Similarly, T. Réginault *et al.* [20] demonstrated that structured inspiratory muscle training improved maximal inspiratory pressure and endurance in ventilated patients. This aligns with current findings of increased RR and MAP, suggesting that even short-term NPF interventions may enhance respiratory muscle performance and autonomic regulation. A.I.C. de Medeiros *et al.* [21] further confirmed that inspiratory muscle training strengthens respiratory muscles and improves functional outcomes in patients with ICU-acquired weakness, supporting the idea that targeted stimulation can produce measurable physiological adaptations. Notably, the present study observed no significant gender differences, consistent with the systematic review by D. Mankad *et al.* [3], indicating that chest NPF techniques benefit both male and female patients. Together, these studies contextualise author's findings within a broader evidence base, highlighting that NPF interventions can acutely improve respiratory dynamics, enhance circulatory stability, and support clinical practice in intensive care settings. Additionally, the study by I. Etikan *et al.* [22] corroborated these findings, emphasising the positive impact of respiratory PNF techniques on improving respiratory function in critical care patients.

In summary, neurophysiological facilitation techniques, including perioral pressure and intercostal stretch, can improve key cardiopulmonary parameters in critically ill participants. The interventions increased respiratory rate, diastolic blood pressure, and mean arterial pressure, reflecting enhanced respiratory and circulatory function. These benefits were consistent across genders and align with previous evidence on respiratory facilitation techniques. Overall, the findings support the use of NPF interventions to optimise respiratory and haemodynamic outcomes in intensive care settings.

Conclusions

This pilot study investigated the acute cardiopulmonary responses to NPF techniques, specifically perioral pressure and intercostal stretch, in mechanically ventilated intensive care patients. The findings provided preliminary evidence that such physiotherapeutic interventions may offer measurable benefits in optimising respiratory and haemodynamic function in critically ill, unconscious patients. Perioral pressure improved diastolic blood pressure, mean arterial pressure, and respiratory rate, while intercostal stretch primarily enhanced respiratory rate, indicating that both techniques can positively influence cardiopulmonary performance without adverse effects. Other parameters, including systolic blood pressure, HR, and oxygen saturation, did not demonstrate statistically significant changes. Importantly, no adverse effects were observed, and gender did not influence the magnitude of responses.

These results suggest that NPF techniques used on mechanically ventilated unconscious ICU patients to stimulate intermittent deep breaths in monotonous breathing and encourage chest expansion and diaphragmatic excursion, may serve as safe and practical adjuncts in intensive care physiotherapy. As the impact of these manifestations does not adversely affect the cardiopulmonary variables, even modest increases in RR may reduce the risk of atelectasis and secretion retention, while small increases in MAP could enhance perfusion in patients with haemodynamic compromise. The modest magnitude of change in haemodynamic parameters also raises questions about long-term clinical relevance. Future research should involve larger, multicentre trials with repeated NPF interventions to assess long-term outcomes and clarify underlying physiological mechanisms, providing stronger evidence to guide clinical practice in mechanically ventilated patients.

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Conflict of Interest

None.

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Серцево-легеневі реакції на нейрофізіологічне полегшення дихання у пацієнтів відділення інтенсивної терапії, які перебувають на ШВЛ

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Анотація. Штучна вентиляція легень є необхідною при гострих захворюваннях, але може призвести до таких ускладнень, як ателектаз і монотонне дихання, яким фізіотерапевти допомагають протидіяти, використовуючи нейрофізіологічні методи стимуляції для поліпшення дихальної функції пацієнтів, які перебувають у непритомному стані та під дією седативних препаратів. Дослідження було спрямоване на вивчення нейрофізіологічних методів стимуляції з метою оцінки безпосереднього впливу натискання на верхню губу та розтягування міжреберних м'язів на серцево-легеневі параметри у пацієнтів, які перебували на штучній вентиляції легень в Університетській клінічній лікарні Беніну. Було використано рандомізований перехресний експериментальний дизайн, в якому взяли участь десять пацієнтів (5 чоловіків, 5 жінок; середній вік 66,2 ± 8,5 років), які були гемодинамічно стабільними, але перебували у непритомному стані та на штучній вентиляції легень. Кардіопульмональні показники, включаючи систолічний артеріальний тиск, діастолічний артеріальний тиск, частоту серцевих скорочень, частоту дихання, насичення киснем та середній артеріальний тиск, вимірювали до та після кожного втручання за допомогою нейрофізіологічних методів фасилітації, використовуючи стандартизований протокол. Результати показали, що пероральне притискання значно поліпшило діастолічний артеріальний тиск (77,10 ± 9,01 до 79,30 ± 10,34 mmHg, p = 0,005), частоту дихання (з 26,40 ± 6,08 до 28,30 ± 6,60 вдихів/хв, p = 0,014) та середній артеріальний тиск (з 92,70 ± 10,70 до 94,00 ± 10,06 mmHg, p = 0,022). Міжреберне розтягнення значно збільшило частоту дихання (з 26,8 ± 6,07 до 28,2 ± 6,07 вдихів/хв, p < 0,001), тоді як зміни систолічного тиску, частоти серцевих скорочень та насичення киснем не були статистично значущими (p > 0,05). Стать не впливала на величину змін будь-яких серцево-легеневих параметрів. Дослідження встановило, що нейрофізіологічні методи стимуляції мали позитивний гострий ефект на частоту дихання та гемодинамічні параметри у пацієнтів, які перебували на штучній вентиляції легень. Виділено нейрофізіологічні методи стимуляції як практичний допоміжний засіб респіраторної фізіотерапії для поліпшення серцево-легеневої стабільності у пацієнтів у критичному стані

Ключові слова: гемодинамічні параметри; періоральний тиск; міжреберне розтягнення; респіраторна терапія; інтенсивна терапія; фізіотерапія