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HEAD UP POSITION 30° - 45° FOR SUCCESSFUL VENTILATOR WEANING PROCESS IN INTENSIVE CARE UNIT

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Original Research

A B S T R A C T

***Introduction**: Ventilator weaning is the process of transitioning a patient from ventilator support to independent breathing for more than 48 hours. A 30°-45°head-up position, where the patient's head is raised above the bed, with the body parallel to the bed and the legs straight or unflexed, is believed to influence the success of the weaning process. This study aims to analyze the relationship between a 30°-45°head-up position and the success of ventilator weaning. **Methods**: A retrospective design was used, with 40 patients meeting the inclusion and exclusion criteria. Total sampling was applied, taking the entire population as the sample. Data were collected from patient medical records in the ICU from May to July 2023 to evaluate the head-up position and the success of ventilator weaning. Data analysis was performed using the chi-square test to determine the significance of the relationship between the variables. **Results**: The study results showed a significant association between a 30°-45° head-up position and successful weaning in ventilator patients, with a p-value of 0.000 (<0.05). The majority of patients positioned with their heads up were successfully extubated and did not require further ventilator support for the next 48 hours. This head-up position is believed to help increase lung capacity and respiratory efficiency during the weaning process. Conclusions: maintaining a 30°-45° head-up position playe a crucial role in successful ventilator weaning. Therefore, careful monitoring and thorough assessment during the weaning process could be essential to ensure rapid and accurate extubation in ventilator patients.*

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INTRODUCTION

The Intensive Care Unit (ICU) is a specialized medical environment equipped with advanced facilities and staffed by highly skilled healthcare professionals, including experienced medical and nursing personnel, who provide intensive care for critically ill patients (Sole et al., 2020). The ICU infrastructure supports complex respiratory interventions and continuous monitoring to ensure patient safety and effective treatment. Weaning from mechanical ventilation is a staged clinical process aimed at gradually discontinuing ventilator support, culminating in the removal of the artificial airway (extubation) (Bahonar et al., 2024). Success in weaning is typically defined as the patient's ability to sustain spontaneous breathing without ventilatory assistance for at least 48 hours (Eweas et al., 2020; Thomas et al., 2022). This process requires careful assessment of the patient's respiratory function and readiness to breathe independently (Jhou et al., 2021).

In the United States in 2020, approximately 100,000 patients underwent mechanical ventilation in ICUs, with about 40% requiring it during their stay. Among these patients, nearly 20% experienced prolonged ICU admissions due to difficulties with weaning (Burns et al., 2021). Reported success rates for weaning vary between 30% and 53%, and the average duration from initiation to liberation ranges from 16 to 37 days. Failure to successfully wean within 60 days often results in persistent dependence on ventilation. In Indonesia, a study involving 139 ICU patients from 2019 to 2020 found a 93.5% prevalence of patients undergoing weaning attempts. Among them, 33.8% experienced weaning failure, often necessitating ongoing non-invasive ventilation or permanent tracheostomy (Dolinay et al., 2024). A preliminary study from 2022 observed that among 106 ventilated patients, 46 successfully weaned, while 60 patients succumbed, reflecting a mortality rate of 64%. The prevalence of ventilator use in intensive care units is recorded at 64% from April to August 2022, with a slight decline to 62.5% in September. These data underscore the complexity and challenges of weaning from mechanical ventilation, highlighting the need for specialized ICU care, multidisciplinary approaches, and ongoing research to optimize protocols and improve patient outcomes (Deppe, 2023; Güner & Kutlutürkan, 2022). The high mortality associated with prolonged mechanical ventilation and weaning failure further

stresses the importance of effective care strategies in the ICU setting (Inoue et al., 2023).

Based on the preliminary study, ventilator use is frequent and associated with significant risks, including mortality. This underscores the necessity of thorough patient assessment during ventilator management and evaluation of the success of the weaning process (Mihandoust et al., 2024; Zhou et al., 2023). The primary criterion for successful weaning is the patient's ability to sustain spontaneous breathing over a specific duration (Binda et al., 2024; Mikkonen et al., 2024). Failure occurs when the patient requires ventilator support again after a brief period of spontaneous breathing. Due to the considerable risks linked to ventilator use, prompt initiation of weaning is critical (Jiandani et al., 2020; Zhao et al., 2024). The most severe consequence of failed weaning is mortality, with evidence indicating that unsuccessful weaning significantly contributes to high ICU death rates. Weaning represents the final phase of mechanical ventilation, typically involving ventilator disconnection and removal of the artificial airway (Javeri et al., 2020). While mechanical ventilation has saved many lives by addressing oxygenation deficits, prolonged use beyond three days is linked to increased complications, higher healthcare costs, and elevated mortality risk (Inoue et al., 2023). Strategies to accelerate weaning include immediate extubation after a successful spontaneous breathing trial, the use of a T-tube, pressure-support ventilation at 7 cm H_2O for 30–120 minutes, or synchronized intermittent mandatory ventilation (SIMV) (Dimitriou et al., 2021). However, the ventilator weaning process often encounters several challenges, including patient positioning to maximize lung function. Adjusting the patient's position to optimize lung expansion is essential for successful weaning. Therefore, based on the aforementioned phenomenon, the researchers aimed to examine the head-up position to support successful ventilator weaning. This study aimed to investigate the relationship between the weaning process and maintaining a 30°–45° head-up position in ICU patients on ventilators.

MATERIALS AND METHODS

Study Design

This study used an observational analytical method with a retrospective approach (Gardner & Charlesworth, 2023; Zaorsky et al., 2022) to examine the relationship between patient head position at a 30°-45° angle and successful ventilator weaning in the ICU. The study was conducted in the ICU of Haji Hospital, Surabaya, with data collected from May to July 2023 using e-medical records.

Population, Samples, and Sampling

The population in this study consisted of all patients who were placed on a ventilator and underwent the weaning process at RSUD Haji Surabaya within a three-month period (May–July 2023), totaling 40 patients. The inclusion criteria were: respiratory rate (RR) < 35 breaths/minute, oxygen saturation (SpO_2) > 95% at oxygen fraction (FiO_2) ≤ 40%, Glasgow Coma Scale (GCS) ≥ 14, Positive End-Expiratory Pressure (PEEP) = 5 cmH_2O, and normal body temperature measured using an axillary thermometer. The exclusion criteria were patients in emergency conditions or those who had died. The sampling technique in this study was total sampling, resulting in a final sample of 40 patients.

Instruments

The independent variable in this study was the 30°–45° head-up position, and the dependent variable was the success of the ventilator weaning process. The head-up position instrument used a nationally standardized medical record observation sheet, while the ventilator weaning instrument followed standard operational procedures based on clinical indicators of successful ventilator weaning.Success indicators are seen based on: 1) Stable cardiovascular status; 2) No cardiac arrhythmia, heart rate < 140 beats/minute; 3) Systolic blood pressure 90-180 mmHg; 4) Compos metis level of consciousness; 5) Use of vasopressors and inotropics at low doses; 6) Respiratory rate <35x / minute; 7) Tidal volume 4-5 cc/kgBW; 8) SpO_2 > 90%, $PaCO_2$ 35–45 mmHg, PaO_2 > 60 mmHg, and PEEP 5 cmH_2O; 9) No respiratory acidosis. The final interpretation of the ventilator weaning process was successful if the patient met seven or more of the clinical criteria above; if fewer than seven, the patient was considered to have failed to wean from the ventilator (Burns et al., 2021; Jaber & De Jong, 2023; Pham et al., 2023).

Procedure

The data collection procedure for this study employed a retrospective study, utilizing medical records stored in e-medical records. Data collection began with a preparatory phase, which included developing a comprehensive research design, obtaining research ethics approval, and obtaining research permits from the Haji Hospital in Surabaya, specifically for the e-medical records database. After obtaining permits, the researchers collected data on all patients admitted to the ICU from May to July 2023 and selected the them using predetermined inclusion and exclusion criteria. The selected samples were documented to assess patient positioning and weaning outcomes, including the success of ventilator weaning. All collected patient data were tabulated and analyzed to determine the relationship between the variables.

Data Analysis

The research data were analyzed using descriptive and inferential analysis. Descriptive analysis was used to analyze the frequency distribution of respondents, patient head-up position, and the success of patient weaning on a ventilator. Inferential analysis was conducted using a bivariate chi-square test to examine the relationship between head-up position and weaning success, with a significance level of $p < 0.05$.

Ethical Clearance

This research received a certificate of research ethics from the Hospital Health Research Ethics Commission with the ethics certificate number 445/10/KOM.ETIK/2024. The researchers focused on the ethical principles of protecting the confidentiality of patient medical records and not disclosing them to third parties, as this study used retrospective data.

RESULTS

Table 1. Frequency Distribution of Research Respondent Characteristics (n=40)

Demographic Characteristics	Frequency (f)	Percentage (%)
Gender		
Male	28	65
Female	12	35
Age		
Children (5 -11 years)	2	5
Teenagers (12 -25 years)	16	40
Adults (26 -45 years)	14	35
Elderly (56 -65 years)	8	20
Marital Status		
Married	29	72.5
Unmarried	11	27.5
Education		
Elementary School	2	5
Junior high school	6	15
Senior high school	18	45
University	14	35
Religion		
Moeslem	33	82.5
Christianity	6	15
Hinduism	1	2.5
Buddhism	0	0
Head Up Position 30º - 45º		
Yes	40	100
No	0	0.0
Weaning Process		
Success	30	75
Failure	10	25
Total	**40**	**100.0**

The respondents of the study showed that 40% of teenagers were aged 12–25 years, 29 people (72.5%) were married, 18 people (45%) had a high school education, and 14 people (35%) had higher levels of education. The most dominant religion among the respondents was Islam, accounting for 82.5%. All respondents were positioned in a head-up position of 30º–45º, and 30 people (75%) succeeded in weaning, while 10 people (25%) did not succeed in weaning (Table 1).

Table 2. Analysis of the Relationship between Head Up Position 30º - 45º and Weaning Success

Head up position	Weaning Process	
	Success	Failure
Yes	30 (75.0)	10 (25.0)
No	0 (0.0)	0 (0.0)

P-Value = 0,000 < 0,05

Table 2 shows that 75% of patients who were given the head-up position had successful weaning. The Pearson chi-square test value showed that the p-value was 0.000 (<0.05), so it can be concluded that H_0 was rejected and H_1 was accepted, indicating that there was a relationship between the head-up position and the success of weaning in the ICU.

DISCUSSION

The 30°-45° head-up position was shown to be successful in terms of ventilator weaning, with success reaching 75% of all patients. The 30º-45º head-up position is an essential non-pharmacological intervention for patients with head injuries aimed at reducing intracranial pressure (ICP) while simultaneously improving oxygen perfusion to brain tissue (Dolinay et al., 2024). Recent studies have demonstrated that maintaining the head elevation within this range significantly lowers ICP and increases mean arterial pressure (MAP) and patient consciousness levels (Tume et al., 2017). The primary mechanism involves facilitating venous drainage from the intracranial compartment, thereby decreasing pressure and reducing the risk of cerebral ischemia. This also helps maintain or enhance cerebral perfusion pressure (CPP), which is critical for optimal brain oxygenation. However, it is important to note that elevating the head beyond 40º may excessively decrease cerebral perfusion, thus such angles are not recommended (Martí-Hereu & Marañón, 2017; Perkins et al., 2018).

Demographic factors also play a role in the success of ventilator weaning. Factors such as gender, age, marital status, education level, and religion can significantly influence the weaning process, especially in patients requiring intensive care (Huang et al., 2025). Gender influences a patient's physiological and psychological responses during ventilator weaning. In general, research shows that men and women differ in their recovery process and tolerance to respiratory distress, which can affect the duration and success of ventilator weaning (Elsehrawy & Saleh, 2024). Furthermore, hormonal differences and varying lung capacities between the sexes can impact adaptation during weaning (Abd Eltawab Attia et al., 2022).

Age is an important factor influencing ventilator weaning. Older patients typically have lower organ reserves, decreased lung function, and a higher likelihood of comorbidities. This can make the process longer and more complex. Meanwhile, younger patients tend to recover more quickly and adapt to reduced ventilator support. Studies show that age has a significant impact but can vary depending on clinical conditions; therefore, weaning protocols need adjustment based on patient age (Aldabayan et al., 2023).

Marital status plays a crucial role in providing social support during intensive care, including ventilator weaning. Patients who are married or have family support often demonstrate better compliance and motivation during treatment (Pham et al., 2023). The patient's or family's education level also influences the process. Individuals with higher education tend to have a better understanding of healthcare processes and the importance of collaboration with the medical team. They are also better able to follow care instructions, such as breathing exercises or the use of assistive devices (Huang et al., 2025; Jaber & De Jong, 2023). Religion and beliefs can significantly influence a patient's psychological readiness for ventilator weaning. Religious beliefs often provide mental strength and calm that help patients navigate difficult processes, including weaning. However, religious or cultural practices can sometimes influence a patient's attitude toward medical procedures, such as final decision-making (Abd Eltawab Attia et al., 2022; Elsehrawy & Saleh, 2024).

Regarding ventilator weaning, this process is complex and requires gradual, comprehensive assessment, especially in patients who have been on mechanical ventilation for prolonged periods (Zhao et al., 2024). Weaning success depends on factors such as respiratory function, hemodynamic stability, and psychological status (Aldabayan et al., 2023; Yayan & Schiffner, 2024). Throughout the process, careful monitoring of symptoms, diagnoses, blood pressure, breathing patterns, and arterial blood gas (ABG) analyses is crucial to evaluate the patient's response. Key parameters include respiratory rate, spontaneous tidal volume, negative inspiratory pressure (NIP), and the Rapid Shallow Breathing Index (RSBI), which serve as primary indicators of readiness (Javeri et al., 2020; Yayan & Schiffner, 2024).

Studies indicate that the success rate of weaning can reach up to 75%, while about 25% of patients fail. Failure usually results from unmet criteria or factors such as respiratory muscle fatigue, increased airway resistance, or unresolved comorbidities. Weaning failure is associated with higher mortality, longer hospital stays, and increased risk of ventilator-associated pneumonia (VAP) (Mihandoust et al., 2024; Mikkonen et al., 2024).

In addition to the causes mentioned above, weaning failure is caused by the patient's psychological unpreparedness for prolonged spontaneous breathing, untreated underlying conditions that trigger ventilator use, and incomplete recovery or the emergence of new problems. This research was conducted by researchers to successfully wean patients from spontaneous breathing without any assistance for 24 hours or more (Lee et al., 2024; Purnawan et al., 2025). Not all patients are successfully weaned from the ventilation machine on the first attempt. In one study, the first weaning attempt was successful in only 52% of 110 patients requiring ventilators. The length of time required to wean patients from the ventilation machine can also be quite long (Al-Husinat et al., 2024).

Several previous studies have shown a significant relationship between the head-up position and successful weaning in patients on ventilators. Similarly, studies in various countries such as Malaysia (Dolinay et al., 2024), the United States (Rose & Messer, 2024), the United Kingdom (Mohamad et al., 2024), and China (Xu et al., 2024) have shown that the head-up position has a positive impact on lung expansion and improves the patient's respiratory status. By increasing chest wall stretch, patients can maximize the recovery of respiratory function after ventilator weaning.

The first criterion that needs to be considered before conducting a weaning trial is assessing the patient’s overall clinical condition, such as vital signs and spontaneous breathing ability (Mezidi & Guérin,

2018). The weaning program must be implemented immediately and planned from the start of ventilator use, as early weaning reduces complications. Moreover, successful weaning shortens ventilation time, reduces hospital stay, lowers care costs, and improves quality of life. In this study, the majority of patients (30 respondents) successfully weaned after being placed in the 30°–45° head-up position (Nuh, 2016). This is also inseparable from the role of nurses in determining patient readiness, ensuring high success rates.

From the results of this study, the sampling technique was in accordance with the number of samples that match all criteria. Severe complications and gradually improved so that weaning was carried out until it was successful and extubation was carried out (Martí-Hereu & Marañón, 2017; Zeng et al., 2015). Severe cases gradually improved until weaning and extubation were successfully performed (Martí-Hereu & Marañón, 2017; Zeng et al., 2015). Thus, regardless of how severe a patient's condition is in the ICU, with maximum care there remains hope for improvement and eventual transfer to a regular ward. This also helps reduce costs compared to extended ICU stays, especially when using ventilators, which significantly increase care expenses.

CONCLUSIONS

The 30°–45° head-up position was shown to be associated with successful ventilator weaning, as demonstrated by 75% of patients who were successfully weaned from the ventilator after being placed in the 30°–45° head-up position. The implications of this study are expected to provide valuable contributions to the successful process of ventilator weaning by offering evidence that can serve as a reference in clinical decision-making. Furthermore, the findings of this study may form the basis for the development of more effective weaning protocols and personalized interventions tailored to patient characteristics. Consequently, it is anticipated that these findings will improve patient clinical outcomes, reduce the duration of ventilator use, and minimize the risks of ventilator-associated complications in the ICU. The implementation of these findings also has the potential to enhance healthcare service quality and resource efficiency in intensive care units.

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AUTHORS' CONTRIBUTIONS

All authors in this study contributed to the writing of the scientific article. NAW contributed to developing the research concept, designing the study, and preparing the instruments used. The second author contributed to compiling the research results, analyzing the data, and drafting the manuscript. The third author contributed to reviewing and analyzing the study results. The fourth and fifth authors contributed to conducting the research and collecting and tabulating data.

CONFLICT OF INTEREST

The researchers declare that there were no conflicts of interest in this research, either among the researchers or with any external parties.

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