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Effects of Progressive Mobilization on Hemodynamic Status of Bedridden Patients in the Intensive Care Unit (ICU)

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Abstract

Patients treated in ICU generally last for an extended period due to the severity of the patient's suffering. One of the efforts made by nurses to improve the functional and hemodynamic status of patients is to mobilize. Progressive mobilization given to the patient is expected to cause an excellent hemodynamic response. In the upright sitting position, the performance of the lungs, both in the distribution of ventilation and perfusion, will improve during mobilization. This study contributed to knowing the effectiveness of progressive mobilization on hemodynamic status in bedridden patients in the ICU. ***The design used Pre-Experiment research with one group pre-test and post-test design. Thirty samples were selected in the ICU for 21 days. Data analysis used Paired T-Test analysis. There is an effect of progressive mobilization on the hemodynamic status of patients in ICU (pulse: p-value 0.000, respiratory rate p-value 0.000, systolic blood pressure p-value 0.000, diastolic blood pressure p-value 0.004, MAP p-value 0.000, and SaO2 p-value 0.000). There is an effect of progressive mobilization on the hemodynamic status of patients in the ICU. It is expected that nurses and physiotherapists in hospitals would continue to apply progressive march in an effort to overcome the problem of hemodynamic disorders in the ICU.*

Keywords: *Progressive Mobilization; Hemodynamic; Intensive Care Unit*

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1. Introduction

The Intensive Care Unit is a unit that treats critically ill patients who experience acute failure or more vital organs that can threaten the patient's life, so close monitoring, exceptional staff, and special equipment are needed. Patients treated in the ICU generally last for an extended period of time due to the severity of the disease suffered by the patient (Rebel et al., 2019). During the treatment period in the ICU, patients experience risks and side effects from intensive care, both from the patient's illness, the therapy given, and the condition of prolonged bed rest. Bed rest is one of the risk factors for infection, contractures, pressure ulcers, and blood clots. In addition to decreased respiratory muscle function, other impacts resulting from the decreased function of the musculoskeletal system are hemodynamic imbalances, including blood pressure, pulse, respiration, temperature, and pain, and decreased functional status (Martínez-Ballesté, P. et al. (2019). Hemodynamic imbalance requires good and critical monitoring by the nurse. Hemodynamic monitoring is carried out to assess the patient's developmental condition and anticipate the patient's deteriorating condition (Aseni, P., Orsenigo, S., Storti, E., Pulici, M., & Arlati, S. (2019). Research conducted by Needham et al. showed that patients treated in the ICU experience hemodynamic imbalances, one of which is caused by bed rest for a long time. One of the efforts made by nurses to improve the functional and hemodynamic status of patients is to mobilize (Mokorimban, (2021).

Bed rest is one of the interventions to rest the patient in bed for therapeutic purposes. Bedridden patients in the ICU have limited physical activity that could reduce pain and oxygen demand in patients. The reality of post-intensive care creates challenges for patients and families, including social recovery, financial burden, and adjustments to physical and psychological impairments (Xiaolong Yang et al., 2022). The time required to perform bed rest interventions can vary according to the patient's condition. Total bed rest for a long time can make the patient experience a decrease in medical condition. Bed rest is a risk factor for infection, contractures, pressure ulcers, and blood clots. One study conducted by Johnson and Bruch states that after 2 weeks of bed rest, there can be a loss of muscle mass of 5%-9% and a decrease in muscle strength of up to 20%-27%. In addition to a decrease in respiratory muscle function, other impacts resulting from a decrease in the function of the musculoskeletal system are hemodynamic imbalances, including blood pressure, pulse, respiration, temperature, and pain, as well as a decrease in functional status, and standard implementation of high fall-risk patients so that the incidence of falls can be prevented or reduced (Haryanto, R., & Haryanto, M. 2022).

Hemodynamic imbalance requires good and critical monitoring by the nurse. Hemodynamic monitoring is carried out to assess the patient's developmental condition and anticipate the patient's deteriorating condition. The basis for conducting hemodynamic monitoring is adequate tissue perfusion, such as a balance between oxygen intake and what is needed by the body, maintaining body temperature, and electrochemical imbalances in the body. Patients treated in the ICU experience hemodynamic imbalances, one of which is caused by bed rest for a long time. One of the efforts made by nurses to improve the functional and hemodynamic status of patients is to mobilize.

Mobilization interventions performed on patients in the ICU have a good effect, including increasing muscle strength, reducing the patient's length of stay, reducing the patient's dependence on delirium, and accelerating the weaning process in patients who are on a ventilator (Mokorimban, 2021). Research conducted by Rebbel et al. showed the results that mobilization had an effect on the hemodynamic status of patients, including breathing, blood pressure, pulse, and temperature. Mobilization is one of the nursing interventions that nurses can carry out. But in fact, nurses rarely carry out mobilization because there is still uncertainty in the implementation of mobilization. One of the mobilization interventions recommended is progressive mobilization (Noraini Hashim & Melati Wahab, 2022).

Progressive mobilization takes the form of a procedure containing a series of plans or steps to prepare the patient to move or move in a gradual and continuous manner (Burchell & Power, 2021). Progressive mobilization was introduced by Rick Basset and the team in 2010. Progressive mobilization begins by assessing patient safety based on the patient's general condition. Progressive mobilization consists of five levels starting from patients with total dependence, namely level 1, until patients independently mobilized, namely level 5. The mobilization that can be done includes Head of Bed (HBO), passive and active Range of Motion (ROM) exercises, advanced therapy lateral rotation, prone position, a movement against gravity, sitting position, hanging leg position, standing, and walking (Anna, S, Olsén, 2021). Progressive mobilization explains the procedures, frequency, and criteria for mobilizing so that nurses can perform appropriate mobilization interventions.

2. Method

This research is Pre-Experiment research with one group pre-test and post-test design. Samples were selected from as many as 30 patients for 21 days in the Intensive Care Unit (ICU). Data analysis used Paired T-Test analysis. This research was conducted in the Intensive Care Unit (ICU) of the Sanjiwani Hospital. The population in this study were all patients in the Intensive Care Unit (ICU) of Sanjiwani Hospital using sampling Non-Probability Sampling with a Purposive Sampling technique that used the minimum number of samples for experimental research of 30 people. The treatment was given by the researcher and 3 nurses in ICU as enumerators. The researcher had given treatment to patients in the morning and continued by nurses as enumerators in the afternoon. The treatment was given amounted 2 times a day for 3 days in each patient. The factor that can't be controlled is medicines treatment in hospitals.

3. Results and Discussion

Based on Table 1, the results show that most respondents have an age range of 36-45 years 40% This age includes middle age with high productivity expectations, most of them are female 70%, and most are in the field of 4-14 days of treatment, which is 70%, treatment of one to 2 weeks is sufficient treatment for treatment in the ICU room, and more patients are found than treatments that are more than two weeks, only a few patients are found,

Table 1. Frequency Distribution of Patient Characteristics in ICU

Characteristic	Frequency	Percentage (%_
Ages (years)		
26 – 35	6	20%
36 – 45	12	40%
46 – 55	6	20%
56 – 65	6	20%
Total	30	100%
Gender		
Male	9	30%
Female	21	70%
Total	30	100%
Care Day		
1-3 days	6	20%
4-14 days	21	70%
>14 days	3	10%
Total	30	100%

Based on Table 2, the results show that the average pulse frequency before being given progressive mobilization is 65.90 times/minute, and after being given progressive mobilization, the average frequency is 84.10 times/minute. The average respiratory rate was 19.8 times/minute before being given progressive mobilization measures, and after being given progressive mobilization measures obtained an average of 23.2 times/minute. Systolic blood pressure obtained an average of 108 mmHg before being given progressive mobilization measures, and after being given progressive mobilization measures obtained an average of 126 mmHg. Diastolic blood pressure obtained an average of 68.90 mmHg before being given progressive mobilization measures and, after being given progressive mobilization measures, obtained an average of 73.60 mmHg. MAP obtained an average of 71.90 mmHg before being given progressive mobilization measures and, after being given progressive mobilization measures, obtained an average of 85.90 mmHg. SaO2 obtained an average of 90.30 mmHg before being given progressive mobilization measures, and after being given progressive mobilization measures obtained an average of 96.10 mmHg.

Table 2. Patient Hemodynamic Results Before and After Given Progressive Mobilization

Characteristics	n	Mean	SD	P-value
Pulse				
- Before progressive mobilization intervention	30	65.9	78.3	0.000
- After progressive mobilization intervention	30	84.1	4.99	
RR				
- Before progressive mobilization intervention	30	19.8	3.34	0.000
- After progressive mobilization intervention	30	23.2	1.26	
Systolic				
- Before progressive mobilization intervention	30	108	10.24	0.000
- After progressive mobilization intervention	30	126	4.64	
Diastolic				
- Before progressive mobilization intervention	30	68.9	1.85	0.004
- After progressive mobilization intervention	30	73.6	3.86	
MAP				
- Before progressive mobilization intervention	30	71.9	2.84	0.000
- After progressive mobilization intervention	30	85.9	3.38	
SaO2				
- Before progressive mobilization intervention	30	90.3	1.25	0.000
- After progressive mobilization intervention	30	96.1	0.99	

Heart Rate (HR) with a p-value of 0.000 (p <0.05). Heart rate is a pulse (pulse rate) that is changed through the arteries in response to the ejection of blood from the heart into the aorta. The pulse is formed as blood is pushed through the arteries. The arteries contract and relax periodically to support circulation, contracting and relaxing the heart as blood is pumped into the arteries and veins. Thus, the pulse (pulse rate) can also represent the heartbeats per minute or what is known as the heart rate (heart rate). The pulse is counted every minute with a count of repetitions (times/minute). Respiratory Rate (RR) with p-value = 0.000 (p <0.05). Respiratory Rate (RR) is the number of breaths taken per minute. In a resting state, the respiratory rate is about 15 breaths per minute Pulmonary respiration is the exchange of oxygen and carbon dioxide that occurs in the lungs. The function of the lungs is the exchange of oxygen and carbon dioxide gases in breathing through the lungs/external respiration. Oxygen is collected through the nose and mouth. When breathing, oxygen enters through the trachea and bronchial tubes to the alveoli and can be closely associated with the blood in the pulmonary capillaries. The negative effects of immobility are rarely limited to a single system. Numerous other comorbidities may result from hospitalization in an Intensive Care Unit: Cardiovascular (hypotension, corporal fluid redistribution, cardiac function changes, and thrombotic events) (Keibun Liu, *et al (2022*). Systolic blood pressure with p-value = 0.000 (p <0.05). Systolic blood pressure is the force or push of blood against the artery walls when blood is pumped out of the heart throughout the body, while blood pressure is the force exerted on the artery walls when blood is flowing. This energy is risking the flow of blood in the arteries to keep it smooth. Average normal blood pressure is 120/80 mmHg and measured. MAP (Mean Arterial Pressure) with p-value = 0.037 (p <0.05). The mean arterial pressure is the main driving force that moves blood to the tissues. This pressure is monitored and regulated in the body, not arterial systolic or diastolic pressure or pulse pressure and not pressure in other parts of the vascular tree. The mean arterial pressure is slightly less than the median values between the systolic and diastolic pressures. The value in adults is about 90 mmHg which is slightly less than the average systolic and diastolic pressure.

Oxygen saturation (SaO2) with p-value = 0.000 (p <0.05). Oxygen saturation is the percentage of hemoglobin bound to oxygen in the arteries. Normal oxygen saturation is between 95-100%. In medicine, oxygen saturation (SaO2), often referred to as "SATS," measures the percentage of oxygen bound by hemoglobin in the bloodstream. At low oxygen partial pressures, most of the hemoglobin is deoxygenated, meaning the process of distributing oxygenated blood from the arteries to the body's tissues. Measurement of oxygen saturation can be done by several techniques. The use of pulse oximetry is an effective technique to monitor patients for small or sudden changes in oxygen saturation (Shah S., et al. 2020). The result of this research showed before treatment, the saturation was 90.1 % and had increased to 96.3% after treatment. This is because passive ROM can increase blood circulation so that oxygen saturation increases. Progressive mobilization can affect oxygen saturation, this is because after being given level 1 progressive mobilization in the Head of Bed position, gravity will pull the diaphragm down, resulting in better lung expansion (distributing oxygen in the lungs). So that the oxygen bound by hemoglobin increases, the oxygen saturation value increases (Shinichi Watanabe et al. 2021). When passive ROM is given to the upper and lower extremities, the oxygen demand in the cells increases. haemoglobin that binds oxygen also increases to meet oxygen needs. The previous study also proved that Level I progressive mobilization significantly proved in preventing decubitus and increased oxygen saturation significantly therefore, level I progressive mobilization could prevent decubitus and maintain values on the oxygen saturation of critical patients using a ventilator (Martínez-Ballesté, P. et al. 2019).

Changes in blood pressure, both in a state of decreased consciousness and a conscious state, are strongly influenced by the presence of a stimulus. The stimulus can come from within as a manifestation of changes in the body's physiology as a result of the disease it suffers. In addition, the stimulus can come from outside the individual, both physical and social (Shinichi Watanabe et al., 2022). Patients who are admitted to the ICU with decreased consciousness caused by a disease such as a stroke or cerebral injury are unable to feel and communicate the pain they feel, or patients feel pressure, but they cannot tell others to help change positions. Impacts that may occur in patients with decreased consciousness include impaired mobility, an ineffective airway, impaired circulation due to immobilization, and communication barriers (Noraini Hashim&Melati Wahab. 2022). This is in line with the research conducted by Aries that giving a lateral position can increase blood pressure by 4-5 mm Hg. Also supported by the results of Almeida's study that lateral position can increase systolic and diastolic blood pressure by 15 mmHg in the first 60 minutes of positioning in pregnant women in the last trimester. Critical patients spend a long time in the hospital. Major changes occur in the cardiovascular system during bed rest. The supine position makes 11% of the blood volume disappear from the legs, which should be mostly towards the chest. In the first 3 days of bed rest, plasma volume will decrease by 8% to 10%. Losses are 15% to 20% in the fourth week. These changes result in an increase in the workload of the heart, an increase in the resting period of the heart rate, and changes in stroke volume, causing a decrease in cardiac output (Bruss, Z. S., & Raja, A. 2022). The dose of mobilization may affect the outcomes of critical patients; therefore, the description and integral control of the mobilization dose in clinical trials is essential (Dina Aryanti, Dudut Tanjung, 2022).

Blood pressure can be influenced by several factors, namely cardiac output (COP), preload, and peripheral resistance. Cardiac output is the amount of blood ejected from the left ventricle in one minute. Preload is the pressure when filling the right atrium during diastole, which describes the volume of cardiac return. The position has an effect on changes in blood pressure and central venous pressure. In the head of bed position, it shows that the backflow of blood from the inferior part to the right atrium is quite good because the vascular resistance and right atrial pressure are not too high so that the volume of blood entering (venous return) to the right atrium is quite good and the right ventricular filling pressure (preload) increases, which can lead to increased stroke volume and cardiac output. Changes in lateral or oblique position affect the backflow of blood to the heart and have an impact on hemodynamics. Morris et al. were the first to describe a protocol in which the main foundation was the progression of mobilization according to neurological function (conscious and unconscious), cardio-respiratory stability, and muscle strength in the arms and legs (Shinichi Watanabe et al. 2022).

In this study, from the results of the statistical recap, it was known that before progressive mobilization, the systolic value was 108 mmHg with diastolic 68.9 mmHg, whereas, after progressive mobilization, the value of systole was 126 mmHg and 73.6mmHg for diastolic. The systolic pressure value that allows progressive mobilization is in the range of values > 90 to <180. Intolerant response to mobilization at blood pressure is when there is an increase in blood pressure >20mmHg and decreased blood pressure <20mHg (Mayara Gabrielle et al. 2022).

Progressive mobilization given to the patient is expected to cause a good hemodynamic response. In the upright sitting position, the performance of the lungs, both in the process of distribution of ventilation and perfusion, will improve during mobilization. The process of blood circulation is also influenced by body position and changes in body gravity. So that perfusion, diffusion, distribution of blood flow, and oxygen can flow throughout the body (Nelson, J. 2020). The rate and depth of breathing increase alveolar ventilation, decrease the work of breathing and increase the expansion of the diaphragm (Castagna O., et al. 2023). Progressive mobilization level 1 in the Head of Bed position, gravity will pull the diaphragm down so that there is better lung expansion (distributing oxygen in the lungs) so that the oxygen bound by hemoglobin increases, then there is an increase in oxygen saturation values. In addition, changes in body position and increased exercise improve blood circulation, relieve respiratory muscle atrophy, and reduce the risk of ventilator-associated pneumonia, deep vein thrombosis, and pressure sores (Shang, P., Zhu, M., Baker, M., Feng, J., Zhou, C., & Zhang, H. L. (2020).

Mobilization is expected to increase oxygen transport throughout the body. In critical patients, it is better to be given mobilization than the patient being left in a supine position continuously. The only way to decrease the mortality rate and improve post-hospital quality of life is the mobilize and stabilize the critical patients as soon as possible (Clarissa, C, Salisbury, L, Rodgers, S & Kean, S. 2019). because leaving the patient immobilized will have a negative impact on the organs of the body. Nurses need to plan mobilization activities for patients. Mobilization is a fundamental nursing activity that requires knowledge and skills to apply effectively to critically ill patients. A previous study reported an increased rate of out-of-bed mobilization is significantly associated with a dedicated physical therapist with Mechanical Ventilators in Intensive Care (Shinichi Watanabe et al., 2021). Mobilization can produce good outcomes for patients, such as increasing gas exchange, reducing VAP rates, reducing the duration of ventilator use, and increasing long-term functional abilities (Mayara Gabrielle et al. (2022). Achieving mobilization within the first 3 days of ICU stay was significantly associated with better outcomes. Patients might benefit most from achieving mobilization within 2–4 days (Rodrigo Santos de Queiroz et al. (2020). Hemodynamic instability is one of the challenges for nurses in mobilizing critical patients. To balance the risks and benefits of mobilization in critical patients, nurses must determine the right type of mobilization, pay attention to certain diseases, assess risk factors, determine the time of mobilization sessions, and reduce the speed when mobilizing, which can affect the response of the cardiovascular system (Bruss, Z. S., & Raja, A. 2022). For instance, providing EM improves independent physical function at the time of discharge, shortens delirium duration, and increases ventilator-free days (Shinichi Watanabe et al., 2022).

4. Conclusions and Suggestions

There is an effective progressive mobilization on the hemodynamic status of patients in the ICU (pulse frequency: p-value 0.000, respiratory rate p-value 0.000, systolic blood pressure p-value 0.000, diastolic blood pressure p-value 0.004, MAP p-value 0.000, and SaO2 p-value 0.000)

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