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EFFECTIVENESS OF PROGRESSIVE MOBILIZATION LEVEL I AND II ON HEMODYNAMIC STATUS AND DECUBITUS ULCER RISK IN CRITICALLY ILL PATIENTS

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Abstract

Background: Patient immobility remains to be one of the primary causes of pressure ulcers. Therefore, mobilization is necessity for patients being treated in the intensive care unit. However, the occurrence of pressure ulcers is dependent on not only the mobilization but also the bed itself and the type of mattress. This study used the same mattress and bed and compared the effectiveness of progressive mobilization with regular mobilization.

Objective: This study aims to examine the effectiveness of progressive mobilization level I and II on hemodynamic status and decubitus ulcer risk in critically ill patients.

Methods: This was a quasi-experimental study using repeated measure design. There were 40 respondents selected using purposive sampling, which 20 respondents assigned in each group. A Braden scale was used to measure the risk of decubitus ulcer. Paired t-test and repeated measures ANOVA were performed for data analysis.

Results: Paired t-test showed that there was a significant difference of systolic pressure, diastolic pressure, MAP, heart rate, and Braden score after given intervention with p-value <0.05. However, repeated ANOVA test showed that diastolic pressure had p-value >0.05, thus could not be continued to post-hoc test. The progressive mobilization of level I and II in critical patients can stabilize systolic pressure (52.46%), stabilize MAP (58.43%), stabilize heart rate (68.99%), and reduce the risk of decubitus (55.03%) for 7 days of recurrent intervention.

Conclusion: The progressive mobilization of level I and II can reduce the risk of decubitus and stabilize the patient's hemodynamic status in critical patients.

Keywords: progressive mobilization level I and II; hemodynamic status; decubitus risk

INTRODUCTION

Critical patients are those with dysfunction or failure in one or multiple body systems with a life-threatening condition that depends on monitoring equipment and therapies accompanied by hemodynamic disturbance where there is still a possibility to be recovered by intensive care, monitoring and treatment at Intensive Care Unit (ICU) (Morton & Fontaine, 2008). Short-term impacts for critically ill patients include Associated Pneumonia Ventilator (VAP), delayed weaning of mechanical ventilation due to muscle weakness, and development of compressive ulcers (Morton & Fontaine, 2008). Hemodynamic disorders in critical patients also almost always occur due to organ failure or dysfunction, requiring proper monitoring and handling as it greatly affects the oxygen delivery function in the body, which also involves heart function.

The development of a compressive or decubitus ulcer in a critical patient is the result of the use of a mechanical ventilator and the provision of sedation or sedation which results in a decrease in the patient's ability to change the position so that the pressure is prolonged. Normally, the skin cannot tolerate long pressure so that the patient with immobilization and prolonged bed rest has a great risk of skin damage or decubitus, which will interfere with the blood supply to the distressed area causing tissue death. Immobilization is one of the most significant factors in decubitus incidence (Setiyawan, 2008).

The presence of physical activity in critical patients in the early treatment at ICU is indispensable to the patient. The physical activity aims to improve hemodynamic status and post-treatment physical morbidity in ICU. One of the interventions that nurses can do is to mobilize progressively. Progressive mobilization is introduced and developed in 2010 by the American Association of Critical Care Nurses (AACN). Progressive mobilization is a series of plans designed to prepare patients to move gradually and sustainably, especially in critical patients with intensive care.

Research conducted by Kathy Stiller to 31 patients in the ICU who had received 69 total mobilization treatments found a significant increase in heart rate and blood pressure (Stiller, Phillips, & Lambert, 2004). According to research conducted by Zakiyyah, the number of respondents experiencing decubitus in the control group were significantly more than the numbers in the intervention group, there were 4 respondents (26.7%) identified in the control group who were not given progressive mobilization of level 1, with 3 respondents experiencing decubitus with Braden scores <9 in 1-3 days, and 1 respondent in 4-7 days (Zakiyyah, 2014). However, the occurrence of pressure ulcers is not only dependent on the mobilization, but also dependent on the bed itself and the type of mattress. This study used the same mattress and bed and compared the effectiveness of progressive mobilization with regular mobilization.

METHODS
Study Design
This research was a quasi-experimental study with repeated measures design. Repeated measures design is conducted by observing the same unit repeatedly to increase the validity of the experiment by performing more than once treatment (McBurney & White, 2009).

Settings
The study was conducted for 10 weeks (from December 19, 2016 to February 25, 2017) in the ICU of West Nusa Tenggara Regional General Hospital and Mataram District General Hospital.

Population and Sample
The number of samples in this study were 40 respondents selected using purposive sampling technique. The group was divided into two groups, namely 20 respondents in the intervention group carried out progressive mobilization of level I & II and 20 respondents in the control group who received routine mobilization intervention. The number of samples was obtained based on the Dahlan sample formula using the mean and SD of the previous study, as standard and calculated by the statistical formula obtained the results of 40 respondents (Dahlan Sopiyudin, 2009). Respondents were selected based on inclusion criteria: a) New patients were treated in ICU with mechanical ventilator, b) Patients with minimum adult age of 18 years, c) Patients with stupor awareness, d) Patients with GCS score> 8, e) Patients with systolic blood pressure (SBP) of 90 - 180 mmHg, f) Patients with mean artery pressure of 55-140, g) Patients with peripheral oxygen saturation (SpO2) of > 90% and the inspired oxygen fraction (FiO2) of <60%. The exclusion criteria included: a) Patients with fractures were not consolidated, b) Patients with independence changes or dependence of independent activity since before being treated, c) Patients with mechanical ventilators for more than 7 days or postoperative recurrence or cancer therapy within 6 months, d). Patients who died before the 7th day of intervention, starting from day one were designated as a sample.

Intervention

In this study respondents were given treatment for 7 days with 4 times measurement of pretest on the first day, posttest 1 after the intervention of the third day, posttest 2 after the intervention of the fifth day, and posttest 3 after the intervention of the seventh day. The intervention groups in this study used progressive mobilization interventions of level I & II that progressive mobilization was a series of plans designed to prepare patients to move gradually and sustainably. Progressive mobilization of level I consisted of: setting position of Head of Bed 30^0, performing passive ROM 2 times a day, performing continuous lateral rotation therapy (CLRT) every two hours by providing right sloping and left tilting positions according to the patient's ability. For the second-level mobilization, patients were given passive ROM measures three times per day, setting the Head of Bed position $450-65^0$ for fifteen minutes followed by training the patient for 20 minutes. This progressive mobilization intervention was carried out daily for 7 days. To find out the increase in patient's level II, the patient was assessed in terms of hemodynamic condition remained stable and the patient's level of awareness showed an improvement by seeing the patient able to open the eyes even though there was no good contact. The mobilization was done by the researcher and the research assistant who had been selected and qualified as research assistant. The control group received regular ICU mobilization of Head of Bed 30^0 and continuous lateral rotation therapy (CLRT) every 4 hours.

Instruments

Hemodynamic status was monitored using an observation sheet while the risk of decubitus using the Braden Scale (Bhoki, Mardiyono, & Sarkum, 2014). The Braden scale was one of the methods used to assess the risk of decubitus ulcer to patients with prolonged bed rest. In Braden scale there are six subscales to determine the level of risk of injury to the press. These subscales include: sensory perception, humidity, activity, mobilization, nutrition and friction & friction. The sum of all scores from each subscale on the Braden scale is 23 as the highest score, and the lowest score is 6. The lower the total score obtained by the patient indicated that the patient is increasingly at risk to suffer decubitus. The Braden scale has been validated with 10 patients with mechanical ventilator, with r-value count = 0.942 (r count > 0.878), indicated that the instrument was reliable. The result of validity test showed that 5 of 6 r-values of subscale item on Braden scale was > 0.878, so that item was valid. The six subscales included: sensory subscale (r= 0.958), humidity (r=0.502), activity (r=0.897), mobilization (r=0.958), nutrient (r=0.885) and frictional (r=0.911).

Ethical Consideration

This research has been through two times ethical test. First, the ethical test conducted in the Poltekkes Kemenkes Semarang with registered code number: 241/KEPK/ Poltekkes-SMG/EC/2016, and second was the ethical test by ethics commission of the General Hospital of NTB Province with code number of ethics: 070.1/08/KEP /2016. Prior to data collection, each respondent and family were given an informed consent to provide the basis of an explanation of the medical action as well as the risks associated with the patient.

Data Analysis

Paired t-test and repeated measures ANOVA were performed in this study.

RESULTS

Table 1 shows that there was a significant effect of progressive mobilization on systolic pressure in the experiment group in the posttest 2 (p=0.002) and posttest 3 (p=0.008). There was no significant effect in the control group.

While Table 2 shows that there was a significant effect of progressive mobilization on diastolic pressure in the experiment group in the posttest 2 (p=0.021) and posttest 3 (p=0.009). There was no significant effect in the control group.

Table 1 Effect of progressive mobilization level 1 and II on systolic pressure before and after intervention in the experiment and control group (n=40)

Variable	Experiment group		Control group	
	t	p	t	p
Posttest 1 (Day 3)	1.489	0.153	-0.241	0.812
Posttest 2 (Day 5)	3.653	0.002	0.346	0.733
Posttest 3 (Day 7)	2.981	0.008	1.066	0.300

Table 2 Effect of progressive mobilization level 1 and II on diastolic pressure before and after intervention in the experiment and control group (n=40)

Variable	Experiment group		Control group	
	t	p	t	p
Posttest 1 (Day 3)	0.901	0.379	-0.240	0.813
Posttest 2 (Day 5)	2.524	0.021	-0.080	0.937
Posttest 3 (Day 7)	2.911	0.009	0.737	0.470

Table 3 Effect of progressive mobilization level 1 and II on MAP before and after intervention in the experiment and control group (n=40)

Variable	Experiment group		Control group	
	t	p	t	P
Posttest 1 (Day 3)	1.237	0.231	-0.450	0.658
Posttest 2 (Day 5)	3.219	0.004	0.074	0.942
Posttest 3 (Day 7)	3.296	0.004	0.902	0.378

As shown in the Table 3, it is indicated that there was a significant effect of progressive mobilization on MAP in the experiment group in the posttest 2 (p=0.004) and posttest 3 (p=0.004). However, there was no significant effect of progressive mobilization on MAP in the control group.

Table 4 Effect of progressive mobilization level 1 and II on heart rate before and after intervention in the experiment and control group (n=40)

Variable	Experiment group		Control group	
	t	p	t	p
Posttest 1 (Day 3)	1.671	0.111	-0.072	0.944
Posttest 2 (Day 5)	3.127	0.006	0.328	0.746
Posttest 3 (Day 7)	4.831	0.000	0.246	0.808

Table 5 Effect of progressive mobilization level 1 and II on risk of decubitus ulcer before and after intervention in the experiment and control group (n=40)

Variable	Experiment group			Control group		
	Mean ± SD	t	P	Mean ± SD	t	P
Posttest 1 (Day 3)	-3.800 ± 1.673	-10.156	0.000	-2.350 ± 1.872	-5.615	0.000
Posttest 2 (Day 5)	-6.450 ± 2.139	-13.484	0.000	-3.850 ± 1.387	-12.414	0.000
Posttest 3 (Day 7)	-8.450 ± 1.669	-22.637	0.000	-4.450 ± 1.356	-14.673	0.000

Table 4 shows that there was a significant effect of progressive mobilization on heart rate in the experiment group in the posttest 2 (p=0.006) and posttest 3 (p=0.000). However, there was no significant effect of progressive mobilization on heart rate in the control group.

While Table 5 shows that there was a statistically significant effect of progressive mobilization level 1 and II on risk of decubitus ulcer in the experiment group as well as in the control group with p-value <0.05. However, there was a higher reduction of decubitus risk in the experiment group (t= -22.637) compared with the control group (t=-14.673).

Table 6 Comparison of the effect of progressive mobilization on systolic diastolic pressure, MAP, heart rate, and risk of decubitus in the experiment and control group using *Repeated ANOVA*

	Df	F	*p*
Systolic pressure between experiment and control group	2.79	4.534	0.013
Diastolic pressure between experiment and control group	2.505	2.738	0.057
MAP between experiment and control group	2.231	4.264	0.014
Heart rate between experiment and control group	1.831	6.345	0.004
Risk of decubitus ulcer between experiment and control group	2.059	307.225	0.000

Table 6 shows that there was a statistically significant difference of systolic pressure in the experiment and control group (F=4.534, p= 0.013). Similar with the other variables showed that there were statistically significant differences of diastolic pressure (F=2.738, p= 0.057), MAP (F=4.264, p= 0.014), heart rate (F=6.345, p= 0.004), and risk of decubitus (F=307.225, p= 0.000) in the experiment and control group.

Table 7 *Post hoc* in systolic pressure between experiment and control group (n=40)

Group	Experiment		Control	
	Mean	P	Mean	P
Pretest - Posttest (Day 3)	5.800	0.226	-1.300	0.784
Pretest - Posttest (Day 5)	13.250*	0.007	1.900	0.686
Pretest - Posttest (Day 7)	12.200*	0.029	6.850	0.211
Posttest (Day 3) – Posttest (Day 5)	7.450*	0.016	3.200	0.286
Posttest (Day 3) – Posttest (Day 7)	7.450	0.131	8.150	0.057
Posttest (Day 5) – Posttest (Day 7)	-1.050	0.677	4.950	0.055

Table 8 *Post hoc* in MAP between experiment and control group (n=40)

Group	Experiment		Control	
	Mean	p	Mean	P
Pretest - Posttest (Day 3)	3.367	0.294	-1.600	0.616
Pretest - Posttest (Day 5)	7.817*	0.008	0.233	0.934
Pretest - Posttest (Day 7)	8.100*	0.015	3.417	0.291
Posttest (Day 3) – Posttest (Day 5)	4.450*	0.042	1.833	0.391
Posttest (Day 3) – Posttest (Day 7)	4.733	0.051	5.017	0.039
Posttest (Day 5) – Posttest (Day 7)	0.283	0.864	3.183	0.061

Table 9 *Post hoc* in the heart rate variable between experiment and control group (n=40)

Group	Experiment		Control	
	Mean	p	Mean	P
Pretest - Posttest (Day 3)	7.100	0.101	-0.300	0.944
Pretest - Posttest (Day 5)	13.850*	0.008	1.800	0.720
Pretest - Posttest (Day 7)	22.900*	0.000	1.650	0.778
Posttest (Day 3) – Posttest (Day 5)	6.750*	0.038	2.100	0.507
Posttest (Day 3) – Posttest (Day 7)	15.800*	0.000	1.950	0.621
Posttest (Day 5) – Posttest (Day 7)	9.050*	0.001	-0.150	0.952

Table 7 revealed that there was a significant mean difference of systolic pressure in the experiment group in the *pre*test - *posttest* (day 5) (p= 0.007), in the *pre*test - *posttest* (day 7) (p=0.029), and between posttest (day 3) – posttest (day 5) (p=0.016).

While Table 8 revealed that there was a significant mean difference of MAP in the experiment group in the *pre*test - *posttest* (day 5) (p= 0.008), in the *pre*test - *posttest* (day 7) (p=0.015), and between posttest (day 3) – posttest (day 5) (p=0.042).

Table 9 revealed that there was a significant mean difference of heart rate in the experiment group in the *pre*test - *posttest* (day 5) (p= 0.008), in the *pre*test - *posttest* (day 7) (p=0.000), between posttest (day 3) – posttest (day 5) (p=0.038), between posttest (day 3) –

posttest (day 7) (p=0.000), and between posttest (day 5) – posttest (day 7) (p=0.001); and Table 10 shows that there was significant reduction of risk of decubitus ulcers between the experiment and control group. However, the experiment group showed the higher decrease of decubitus risk compared with the control group. It could be said that the progressive mobilization of level I & II is more effective in decreasing the risk of decubitus in critical patients.

Table 10 *Post hoc* in risk of decubitus ulcer between experiment and control group (n=40)

Group	Experiment		Control	
	Mean	**p**	**Mean**	**P**
Pretest - Posttest (Day 3)	-3.800*	0.000	-2.350*	0.000
Pretest - Posttest (Day 5)	-6.450*	0.000	-3.850*	0.000
Pretest - Posttest (Day 7)	-8.450*	0.000	-4.450*	0.000
Posttest (Day 3) – Posttest (Day 5)	-2.650*	0.000	-1.500*	0.000
Posttest (Day 3) – Posttest (Day 7)	-4.650*	0.000	-2.100*	0.000
Posttest (Day 5) – Posttest (Day 7)	-2.000*	0.000	-0.600*	0.003

DISCUSSION
Effect of progressive mobilization on hemodynamic status

Findings of this study revealed that there was a statistically significant effect of progressive mobilization on systolic pressure, and MAP with p-value (<0.05). The results of the study indicated that there was 52.46% increase of systolic pressure in the experiment group, considered effective to stabilize systolic pressure in critical patients.

This study result supports the previous research explained the significant effect of repeated (69 times) mobilization on systolic pressure with p = 0.001 (Stiller et al., 2004). Head of bed as one part of progressive mobilization causes the body perform various ways to adapt psychologically to maintain cardiovascular homeostasis. The cardiovascular system will regulate in 2 ways namely by plasma volume shift or by inner ear response as a vestibular response that affects the cardiovascular system during position changes. Critical patients usually have a weak heartbeat, a lack of respiratory or low cardiovascular acceptance so that it is better to be given intervention rather than

keeping a static position (Coyer, Lewis, & Tayyib, 2013; Vollman, 2010).

In this study most of the respondents were patients with neurological disorders that were almost entirely post-craniotomy. In addition, the other studies revealed that there is an effectiveness of head up 30^0 to increase cerebral perfusion in patient post op trepanation, statistically there were changes in blood pressure, pupil and MAP (Huda, 2017). The head up position of 30^0 also improves the cerebral perfusion pressure (CPP), in which CPP is the amount of blood flow from the systemic circulation required to provide adequate oxygen and glucose for brain metabolism. With stability of CPP, vital signs will remain constantly improving the flow blood and improve neurological status. The other studies suggested that for every 10^0 head elevation, ICP average decreased by 1 mm Hg, which was associated with a 2 to 3 mm Hg cerebral perfusion pressure (CPP) reduction, with blood pressure to be maintained was 10 - 20 mmHg (Rosner & Coley, 1986).

The most important arterial pressure reflex is the baroreceptor reflex. An increase in arterial pressure stretches the walls of the main arteries in the chest and neck, in turn stimulates baroreceptors. The signals are sent to the brainstem vasomotor center, and reflex signals are sent back to the heart and blood vessels to slow the heart and dilate the vessels, thereby lowering the normal arterial pressure. Thus, baroreceptor reflexes help stabilizing arterial pressure.

Findings of this study showed there was no significant effect of progressive mobilization on diastolic pressure. This result is in contrast with previous study which indicated that there was a significant influence between mobilization intervention and diastolic pressure of patients (p-value= 0.001) (Stiller et al., 2004). Similar with another study also showed a significant influence of mobilization with blood pressure (p=0.021). However, the magnitude of the change value in previous studies is relative small (≤10%), few research explain the effect of progressive mobilization on the diastolic pressure (Olviani, 2015).

On the other hand, finding of this study showed there was a significant effect of progressive mobilization on MAP, which increases 58.43%. It indicates that progressive mobilization level I and II is effective in stabilizing MAP value in the critical patients. According to Berney, there were no significant adverse cardiovascular effects of mobilization measures seen from MAP when applied to a stable patient population in hospitals with stable hemodynamics. MAP has no significant changes during the mobilization intervention, which indicated that the mobilization was safe to be performed in critical patients, in which the MAP measurements were conducted within 20 minutes before and after the mobilization. In contrast to this study, the effect of MAP improvement began to emerge on the fifth day of the intervention, the MAP was measured on day 1, day 3, day 5, and day 7, showing the improvement of the MAP measurement results (Berney & Denehy, 2003).

Similar with MAP result, the finding of this study also revealed that there was a significant effect of progressive mobilization on heart rate. There was a change of 68.99%, which indicated that the intervention was effective in stabilizing the heart rate level. In this study, the respondents were critical patients with ventilator, which the patient spend long time in bed that will cause changes in the cardiovascular system. In the first three days of bedrest, plasma volume was reduced by 8% -10%, and in the fourth week of bedrest the patient had a loss of 15% -20% plasma volume (Berney & Denehy, 2003). These changes resulted in increased heart workload, increased heart rate, decreased stroke volume and decreased cardiac output. Orthostatic hypotension will be worse in the third week if the patient is immobilized. Instability can also occur because the response of the autonomic nervous system diminishes, when the body's gravitational changes, the cardiovascular system adjusts to shift the volume of plasma transferred to the central nervous system to alter the pulse of the blood vessels. As the heart's workload increases, oxygen consumption also increases. The long bedrest position will be difficult to adapt in changing position, then continuous lateral rotation therapy (CLRT) can gradually train the patient to tolerate a change of position (Banasik & Emerson, 2001).

Effect of progressive mobilization on risk of decubitus ulcer
Findings of this study showed that there was a significant effect of the intervention on the risk of decubitus ulcer in the experiment and control group (p<0.05). However, the progressive mobilization level 1 & II showed a higher reduction of decubitus risk compared with the intervention in the control group. It could be said that the progressive mobilization of level I & II is more effective in decreasing the risk of decubitus in critical patients. The results of this study were in line with the previous studies that revealed that there was a significant effect of mobilization on the incidence of decubitus in stroke patients with p-value of 0.011 (Aini & Purwaningsih, 2013). It is also revealed that progressive mobilization achieved the best effect when performed at least 18 hours per day in every 2 hours (Vollman, 2010). Besides, the risk of decubitus is based on the level of dependence of patients, patients who need a minimum care have no risk for

occurrence of decubitus, while those who need partial care or total care have the high risk of decubitus (Okatiranti, Sitorus, & Tsuawabeh, 2013).

CONCLUSION

The progressive mobilization interventions of level I and II was effective for stabilizing systolic pressure, MAP, heart rate, and effectively decreasing the risk of decubitus in critical patients. Therefore, it is suggested that the implementation of progressive mobilization of level I and II for five days can be used as an alternative nurse intervention.

Declaration of Conflicting Interest
None declared.

Author Contribution
All authors contributed equally in this study.

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