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Trendelenburg Modification as an Effort to Improve Hemodynamic Status in Grade III Hemorrhagic Shock Patients: Case Study

Trendelenburg Modifikasi Sebagai Upaya untuk Memperbaiki Status Hemodinamik pada Pasien Syok HemoragikGrade III : Studi Kasus

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Abstract

Objective: The purpose of conducting this case study was to identify the application of Trendelenburg modification to improve hemodynamic status in patients with grade III hemorrhagic shock.

Methods: The method used in this study was descriptive analytic with a case study approach in grade III hemorrhagic shock patients with ineffective tissue perfusion nursing problems in the GICU B room of Dr. Hasan Sadikin Bandung. Data collection techniques include interviews, observations, physical examinations, observation flowcharts and medical records.

Results: The results of this case study showed that after 2 days of modified Trendelenburg intervention, there was a significant increase in hemodynamic status.

Conclusion: In conclusion, independent intervention by giving a modified Trendelenburg position can be an early intervention as an autotransfusion and improve hemodynamic status in patients with grade III hemorrhagic shock.

Keywords: Hemodynamic status, hemorrhagic shock, modified trendelenburg.

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Introduction

A hemorrhagic shock is a form of hypovolemic shock that is defined as a significant loss of intravascular blood volume.[1] Advanced Trauma Life Support (ATLS) has classified hemorrhagic shock into 4 classes based on blood volume loss. Class, I hemorrhagic shock is a loss of blood volume of less than 15%, slightly anxious consciousness, pulse rate less than 100x/minute, and normal systolic blood pressure. Class II is a blood volume loss of 15% to less than 30%, anxiety awareness, pulse rate of more than 100x/minute to 120x/minute, and normal systolic blood pressure. Class III is blood loss of 30% to less than 40%, very anxious or confused consciousness, heart rate of more than 120x/minute, and decreased systolic blood pressure. And class IV is blood loss of more than 40%, latergi consciousness, heart rate of more than 140x/minute, and decreased systolic blood pressure[2].

Excessive blood loss will cause inadequate oxygen supply to cells, tissues, and organs and activate homeostatic mechanisms to maintain perfusion to vital organs. At the cellular level, inadequate oxygen supply will result in an increase in lactic acid because metabolism will change from aerobic to anaerobic resulting in reduced ATP production so that cells cannot maximally carry out homeostasis and become apoptosis or necroptosis and, in turn, hypoperfusion will occur. At the tissue and organ level, the brain and myocardium will experience hypoperfusion; if not treated immediately, it will result in multiple organ failure (MOF) and multiple organ dysfunction syndrome (MODS)[3].

When persistent hypoperfusion occurs, there will be disturbances in vessel filling, which can occur in veins (preload), arteries (afterload), venules, and capillaries and will reduce venous return to the heart and then the ventricles will not stretch too much due to lack of blood to filling and will reduce stroke volume so that according to Starling's law that cardiac output will also decrease so that patients will experience persistent hypotension[4]. When this happens, the body will compensate by increasing systemic pressure and resistance so that it can reperfuse the heart compared to other tissues and also stimulates the sympathetic nerves to increase heart rate (HR) so that heart contractility will continue to increase[5].

Changes in hemodynamic status such as blood pressure, heart rate (HR), especially the mean arterial pressure (MAP) in patients with hemorrhagic shock can be used as an indicator of how well perfusion of vital organs is and can also categorize hemorrhagic shock appropriate management can be given according to the class of hemorrhagic shock[4].

Changes in hemodynamic status (persistent hypotension and decompensation phase) in patients with hemorrhagic shock have a risk of predictive death of 54%[6]. Therefore, as a professional nurse, a critical response that occurs in patients must be immediately resuscitated and given adequate early intervention to restore tissue perfusion and Redistributes blood volume and oxygen. In addition to collaborative interventions, independent interventions for the management of reperfusion in the heart is to position the patient in a modified Trendelenburg position[7].

Modified Trendelenburg position is a position with the head down and the feet elevated 45 degrees. This aims to increase venous return to the heart, cardiac output, and vital organ perfusion[8]. However, the technique of positioning the head below more than the feet will increase the potential risk of increased intracranial pressure and cerebral compromise[9], so the authors apply for a modified Trendelenburg position with the head flat and feet elevated 45 degrees in grade III hemorrhagic shock patients and analyze the changes in hemodynamic status that occur.

Methods

The methodology used is descriptive analytic with a case study approach in grade III hemorrhagic shock patients with ineffective tissue perfusion nursing problems in the GICU B room of RSUP Dr. Hasan Sadikin Bandung. Data collection techniques include interviews, observations, physical examinations, observation flowcharts, and medical records. Data were analyzed to formulate nursing problems ineffective tissue perfusion and perform nursing interventions.

The process of applying the modified Trendelenburg position nursing intervention was carried out for 2 days. Within a day the modified Trendelenburg position is carried out 3 times every 2 hours at 08.00, 10.00 and 12.00 for 15 minutes and the patient's hemodynamic status is evaluated including blood pressure (BP), mean arterial pressure (MAP) and heart rate HR) every 1 hour which is documented on the observation flowchart sheet.

The time interval and duration of the modified Trendelenburg intervention followed the bed transfer protocol in GICU B Dr. Hasan Sadikin Bandung, that is, every

2 hours the patient is shifted to a 30 degrees head-up position for 15 minutes but due to the lack of rationality and effectiveness in providing this intervention to changes in the patient's hemodynamic status so that the 30 degree head-up position is replaced with a modified Trendelenburg position.

Results

Case Report

Patient Mr. I, male 18 years old, Sundanese and Muslim. The patient was a victim of the Cianjur earthquake on November 20, 2022. According to the family, during the incident, the patient did not have time to run because he was immediately hit by a wall. The patient was immediately evacuated after approximately 18 hours of being hit by a wall. During the hit by the wall, the patient was still conscious until he was taken to the hospital. Dr. Hasan Sadikin, on November 21, 2022, a new patient experienced a decreased consciousness. When examined, the patient needed emergency surgery because of an injury to the left abdominal region.

On November 22, 2022, at 07.00 the patient underwent an exploratory laparotomy and splenectomy because he experienced a splenl rupture. While in the resuscitation room of the operating room, the patient experienced hemorrhagic shock with the production of an abdominal drain of 3000 ccs so that he was moved to the GICU B room of the General Hospital. Dr. Hassan Sadikin.

The initial postoperative awareness of the patient was still under the influence of the drugs midazolam 4mg/hour and rocuronurium 30mg/hour. The patient was mechanically ventilated with P-CMV mode, P control 16x/minute, RR setting 14x/minute, tidal volume in the range of 279-335 milliliters, and PEEP 5 cmH.

The patient's hemodynamic status on the first day of study, namely November 22, 2022, was still in the low range, including blood pressure in the range of 88-99/55-59 mmHg, MAP in the range of 66-71 mmHg and HR in the range of 60-102x/minute.

The patient's hemodynamic status on the second day of assessment, namely November 23, 2022, included blood pressure in the range of 88-106/58-61 mmHg, MAP in the range of 68-76 mmHg, and HR in the range of 98-110x/minute and abdominal drain production of 1600 cc.

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The patient's hemodynamic status on the third day of assessment, namely November 24, 2022, included blood pressure in the range of 99-110/55-80 mmHg, MAP in the range of 69-90 mmHg, and HR in the range of 89-110x/minute and abdominal drain production of 500 ccs.

Postoperative laboratory examination results included hemoglobin 8.8 g/dL, Hematocrit 27.6%, Platelets 29,000/µL, PT 44.5 seconds, APTT 88.0 seconds, Fibrinogen 59.0 md/dL. EKG results showed sinus rhythm with occasional premature complexes and long QTc intervals.

Nursing Process

Patient Mr. I, male 18 years old, Sundanese and Muslim. The patient was a victim of the Cianjur earthquake on November 20, 2022. According to the family, during the incident, the patient did not have time to run because he was immediately hit by a wall. The patient was immediately evacuated after approximately 18 hours of being hit by a wall. During the hit by the wall, the patient was still conscious until he was taken to the hospital. Dr. Hasan Sadikin, on November 21, 2022, a new patient experienced a decreased consciousness. When examined, the patient needed emergency surgery because there was an injury to the left abdominal region.

The nursing process is a series of systematics in the activities of providing nursing care including the stages of assessment, data analysis, planning, implementation and evaluation.

The study found that there was edema in both lower extremities, pale skin color, cold acral, and CRT for more than 3 seconds and collected additional data to support the study, namely the results of laboratory tests.Nursing problems that arise in patients based on assessment include ineffective tissue perfusion, impaired spontaneous ventilation, ineffective airway clearance, and risk of infection.

On the first day of implementation, the modified Trendelenburg position has not been applied. The interventions carried out were independent interventions and collaborative interventions. Independent interventions carried out were monitoring hemodynamic status, namely blood pressure (BP), mean arterial pressure (MAP), and heart rate HR), monitoring laboratory results, monitoring peripheral circulation, namely edema, CRT, color, and acral temperature, and monitoring abdominal drain production. And providing collaborative interventions, namely giving vitamin K, PRC 2 pumpkins, FFP 1 pumpkin, and maintenance Ringer lactate 1500/hour.

Table 1. First Day Hemodynamic Status

	13	**14**	**15**	**16**	**17**	**18**
TD	88/58	99/58	97/5	97/59	90/55	88/55
MAP	68	71	69	71	67	66
HR	84	68	60	88	92	102

Table 1 shows the hemodynamic status with indicators of blood pressure (BP), mean arterial pressure (MAP), and heart rate (HR), which are monitored every hour from 13.00 to 18.00. Collaborative intervention giving vitamin K 10 mg/8 hours was shown at 13.00, PRC 2 pumpkins, and FFP 1 pumpkin delivered at 15.00. After the collaborative intervention, there was a change in hemodynamic status, although not significant, and the hemoglobin value was still low at 8.8 g/dL. The modified Trendelenburg position intervention has not been applied because researchers want to know the differences in changes in hemodynamic status before and after the intervention.

Table 2. Second Day Hemodynamic Status

	07	**08**	**09**	**10**	**11**	**12**
TD	88/60	90/58	95/60	97/60	103/61	106/61
MAP	69	68	71	72	75	76
HR	98	103	102	110	106	106

Table 2 shows the hemodynamic status with indicators of blood pressure (BP), mean arterial pressure (MAP), and heart rate (HR) which are monitored every hour from 07.00 to 12.00. The collaborative intervention provided was giving vitamin K 10 mg/8 hours at 13.00 and maintenance RL 1500/hour. The modified Trendelenburg position intervention has begun to be applied every 2 hours with a duration of 15 minutes every 08.00, 10.00, and 12.00. After the application of the modified Trendelenburg position, there was a constant increase in hemodynamic status and an increase in the hemoglobin value of 11.2 g/dL even though it was not supported by PRC and FFP administration.

Table 3. Third Day Hemodynamic Status

	07	**08**	**09**	**10**	**11**	**12**
TD	99/58	99/60	97/55	99/60	104/65	110/80
MAP	71	73	69	73	78	90
HR	89	93	110	98	105	102

Table 3 shows the hemodynamic status with indicators of blood pressure (BP), mean arterial pressure (MAP), and heart rate (HR), which are monitored every hour from 07.00 to 12.00. The collaborative intervention given on the third day was the same as the intervention given on the second day, namely giving vitamin K 10 mg/8 hours at 13.00 and maintenance RL 1500/hour. Modified Trendelenburg position intervention was also applied every 2 hours with a duration of 15 minutes every 08.00, 10.00, and 12.00. After applying for the modified Trendelenburg position, there was a change in hemodynamic status and a decrease in hemoglobin of 9 g/dL. However, what must be considered is that with an increase in blood pressure, the heart rate (HR) will also increase. This is evidenced after being given a modified Trendelenburg position at 08.00 the patient's heart rate (HR) was 93x/minute after being evaluated for an hour at 09.00. increase in heart rate (HR) to

110x/minute as well as at 10.00 before applying the Trendelenburg position modification of the patient's heart rate (HR), which was 98x/minute but increased at 11.00 to 105x/minute.

Discussion

Trendelenburg position is a position with the head down and the feet elevated 45 degrees. This maneuver is useful as an autotransfusion because blood flow from the lower extremities to the central part increases thereby increasing venous return to the heart, increasing cardiac output, and increasing vital organ perfusion[8]. However, the technique of positioning the head below more than the feet will increase the potential risk of increased intracranial pressure, interference with mechanical ventilation, and aspiration[9].

When the head is lower than the feet, there will be an increase in the work of breathing and cause hypercabia and hypoxaemia because the shift of the stomach contents towards the cephalad increases abdominal pressure, disrupts the function of the diaphragm and inhibits lung expansion. The impedance mechanism of the lungs and chest wall increases and is associated with decreased tidal volume[10]. A 20-degree drop in the head creates a gravitational movement of mucus and gastric secretions into the oropharynx which can increase the potential for aspiration[11]. The risk of increased intracranial pressure can also occur due to increased venous pressure. central, according to Makic et al. increased internal jugular distension on the head-down tilt maneuver[12].

There are many complications with the Trendelenburg position in which the head is lower than the feet, so the authors apply for a modified Trendelenburg position with the head flat and feet elevated 45 degrees. In a similar study[13], showed that when the rats were placed in the Trendelenburg position, there was an increase in mean arterial pressure (MAP) and systolic blood pressure. After that, they were placed in special cages with head-down, head-up, and horizontal positions, in the head-down position 9 out of 12 rats survived, in the head-up position 7 out of 12 rats survived, and in the horizontal head position, all the rats survived.

The physiological mechanism of the Trendelenburg position is to elevate the feet from the horizontal plane, so the law of gravity will mobilize blood from the lower limbs to the central part of the circulation, especially to the heart cavity. In Komariah's research using radiolabeled erythrocytes, the results showed that during the modified Trendelenburg position, blood volume decreased by about 150 ml in calves. This intervention directs some of the blood located in the venous reservoir and converts unpressurized volume to pressurized volume so that there will be an increase in right heart preload through an increase in the average circulating pressure which pushes pressure for venous return.

In patients with grade III hemorrhagic shock, decreased heart rate (HR) indicates inadequate compensatory mechanisms to increase cardiac output. When the modified Trendelenburg position is applied, the heart rate (HR) increases indicating adequate cardiac compensation due to increased cardiac output and the volume of blood returning to the heart increases so that cardiac contractility also increases and heart rate (HR) will also increase. In line with research Rahmawati showed that there was an increase in cardiac output and stroke volume of more than 12% which in turn would increase heart rate (HR)[14].

The effect of applying for the modified Trendelenburg position on cardiac output and stroke volume will vary depending on the degree of leg elevation and the timing of the intervention. According to Boulain et al. induced significant changes in stroke volume occur at an angle of 45 degrees within 4 minutes[15]. Reuter agrees that elevation of the feet 45 degrees within 4 minutes will increase the preload of the right and left ventricles. The increase in preload during the modified Trendelenburg position will disappear when the legs are returned to a horizontal position. Other studies also state that increased blood flow in the descending aorta occurs a few seconds and a maximum of almost 1 minute after a moment of modified Trendelenburg position maneuver is given. Thus the hemodynamic effects should be evaluated over a period of 30 to 90 seconds after the modified Trendelenburg position is established. When the modified Trendelenburg position is started in a semi-recumbent position, additional blood mobilization from the splanchnic compartment is obtained and the cardiac index is found to be higher.

The limitation of this case study is that the modified Trendelenburg position is given too long, namely 15 minutes with maintenance RL 1500/hour. It is feared that an increase in right cardiac output will result in the moderate left ventricular filling (pre-load) which can result in significant changes in cardiac output. The provision of a modified Trendelenburg position is also reversible, that is, it is not sustainable when the leg is elevated for a long time and the hemodynamic effects must be evaluated for a period of 30 to 90 seconds after being given the modified Trendelenburg position.

Conclusion

Modified Trendelenburg position can be used as an early intervention as autotransfusion and improve hemodynamic status in patients with hemorrhagic shock. The application of a modified Trendelenburg position with the head remaining horizontal will increase cardiac output because blood flow from the lower extremities to the central part increases thereby increasing venous return to the heart, increasing vital organ perfusion, and maintaining a horizontal head position in order to reduce the potential risk of increased intracranial pressure and cerebral compromise.

The effectiveness of this intervention is influenced by the degree of elevation of the feet with an angle of 45 degrees and 4 minutes. The increase in preload during the modified Trendelenburg position will disappear when the foot is returned to a horizontal position so that hemodynamic status evaluation is needed within 30 to 90 seconds after being given the modified Trendelenburg position. Changes in the patient's hemodynamic status which continues to increase after administration of the modified Trendelenburg position can be used as an indicator of the effectiveness of the modified Trendelenburg position in patients with hemorrhagic shock. taking into account the angle of elevation of the feet and time.

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