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Case Report

Standardized Nutrition Care Process for Critically Ill Patients with Traumatic Brain Injury, Pulmonary Contusion, and Alcohol Intoxication

Proses Asuhan Gizi Terstandar Pada Pasien Penyakit Kritis dengan Cedera Otak Traumatik, Contusio Pulmonum, dan Intoksikasi Alkohol

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Abstract: *Disturbed intake factors, hypermetabolism and hypercatabolism in critical patients cause increased energy needs. Critical patients are very susceptible to nutritional deficiencies resulting in decreased immune systems, poor wound healing, and organ failure that prolongs hospitalization and increases mortality. In these circumstances, nutrition becomes an important part of clinical medical therapy. This study was conducted to implement nutritional services and standardized nutritional care processes in patients with a medical diagnosis of Decreased Consciousness e.c. Severe Head Injury e.c. Traumatic Intracerebral Haemorrhage (TICH), Traumatic Subarachnoid Haemorrhage (TSAH), Intraventricular Haemorrhage (IVH), Pulmonary Contusion, Right Antebrachial Trauma, Close Fracture Ulna 1/3 Distal Right, Alcohol Intoxication, Brainstem Contusion in the Gatotkaca Ward 4 MICU Dr. Sardjito General Hospital. This study uses a descriptive qualitative research design with a case study design. This study used primary and secondary data with data presentation in narrative, tabular, and graphical form. Based on NRS 2002 screening, the patient was at risk of malnutrition. The food intake graph for six days with a high energy and protein diet in the form of enteral per NGT or parenteral diet showed fluctuations in intake from 8.30% on the first day to 33.78% on the sixth day. Acceptance of the NGT diet decreased since the third day as indicated by low absorption and gastric residue. The results of the blood gas analysis showed that the patient had respiratory acidosis. It can be concluded that the standardized nutritional care process and collaboration between health professionals that are carried out optimally and intensively cannot always provide a good prognosis in cases of severe head injury with various complications such as alcohol intoxication, pulmonary contusion, and brainstem contusion.*

Key word: nutritional care, critical illness, severe head injury, alcohol intoxication

1. INTRODUCTION

Intensive care unit (ICU) is a part of an independent hospital, with special staff and special equipment intended for observation, care, and therapy of patients suffering from acute illnesses, injuries, or complications that are life-threatening or potentially life-threatening with a dubia prognosis that is expected to be reversible (1). The ICU is prepared for critical patients with threats or who are experiencing organ failure or failure of vital functions, patients with potentially life-threatening diseases so that

adequate diagnostic examinations and medical or surgical therapy can be given to patients to improve patient outcomes. In the ICU, patients are closely monitored and given maximum supportive therapy (2). In limited circumstances, patients who require intensive therapy are prioritized compared to patients who only require intensive monitoring (1). One of the cases that is often encountered in ICU care is traumatic brain injury. Brain injury is a traumatic disorder that causes changes in the structure and function of brain tissue so that it can cause permanent or temporary disorders in psychosocial, physical, and cognitive functions. Head and brain injury is the highest mortality event, the severity of head injury can be related to the patient's mortality rate. Severe head injury has an incidence of around 10% of all head injury cases, severe head injury has a very high mortality. Knowing the outcome of head injury in the prehospital is very important for patient safety and outcome (3-6). In critical patients, especially those due to severe trauma, various metabolic changes occur, including changes in the use of energy sources from the body. In addition to disturbed intake, in this condition, hypermetabolism and hypercatabolism generally occur, which cause an increase in the body's energy needs. As a result, someone with a critical illness is very susceptible to nutritional deficiencies, resulting in a decreased immune system, poor wound healing, organ failure, prolonged hospitalization, and increased mortality. In this condition, nutrition becomes something important and becomes part of clinical medical therapy (7).

Enteral nutrition is needed to maintain optimal intestinal function, maintain the mucosal barrier and secretion of the gut associated immune system and immunoglobulin A (Ig-A). Total parenteral nutrition (TPN) is associated with immunosuppression (especially the content of lipid emulsions, which are generally omega PUFA). The results of the study showed that the incidence of infection was higher in patients receiving TPN compared to enteral nutrition in trauma, burns, post-operative, and chemotherapy patients. However, the provision of enteral diet therapy in patients with severe head injuries often faces challenges when adequate enteral diet is difficult to achieve. These challenges include various gastrointestinal disorders and complications that occur during enteral nutrition. Intolerance to enteral nutrition varies with the level of intolerance varying from mild to severe. Gastrointestinal complications can appear in the form of nausea, diarrhea, constipation, and bloating (8). This can be caused by gastrointestinal motility disorders and other complications that occur during enteral diet therapy. Improper installation of enteral feeding support equipment, changes in position or obstruction of the feeding tube, medical procedures, respiratory support and nursing management also have the potential to reduce the adequacy of enteral feeding (9). Therefore, it is important to understand the level of nutritional support and the challenges of interrupting enteral feeding in critically ill patients with mechanical ventilation in order to optimize the benefits of nutritional support including reducing length of stay, cost of care and mortality (10).

2. METHODS

Nutrition Assessment

Client History

A 21-year-old male patient was taken to dr Sardjito General Hospital in an unconscious condition and hematuria after a traffic accident. At the time of data assessment, the patient was intubated. The patient was diagnosed with decreased consciousness e.c. severe head injury e.c. traumatic intracerebral haemorrhage (TICH), traumatic

subarachnoid haemorrhage (TSAH), Intraventricular haemorrhage (IVH), pulmonary contusion, right antebrachial trauma, close fracture ulna 1/3 distal right, alcohol Intoxication, brainstem contusion. Confirmed by the family that the patient has no history of illness, surgery, and allergies related to food. Based on the results of the NRS 2002 screening, the patient is classified as having a risk of malnutrition. Patients receive various medical therapies such as *Ceftriaxon* 1 gram/ 12 hour per intravenous, *Paracetamol* 1 gram/ 8 hour per intravenous, *Omeprazol* 40 mg/ 24 hour per intravenous, *Mannitol* 125 mg/ 6 hour per intravenous, *Thiamin* 100 mg/ 24 hour per intravenous, and *Nicardipin*, titrasi per intravenous.

Food History

The patient's dietary history before admission could not be studied because the patient lived alone and far from family, but it was confirmed that the patient's eating pattern was irregular, often late for meals, and preferred food with fried side dishes. The patient had never been hospitalized and to the family's knowledge was not on a particular diet. The family did not know the patient's alcohol consumption pattern. High blood alcohol content is possible to be the cause of the patient's accident. At the time of 24-hour recall data collection, the patient received enteral food therapy support via NGT with *Pulmosol* 100 ml per serving during treatment in the ICU before being visited by a dietitian. The patient received intake at 7pm and 10pm. On the first day of hospitalization, there was no NGT residual or gastric residual. The patient has not received parenteral food support. From these data, it can be seen that energy and macronutrient intake are in the insufficient category.

Antropometric Data

The patient's weight data could not be measured directly because the patient was unconscious, had various fractures, and was lying on a bed that did not have an automatic weight measuring facility. The determination of the patient's weight was based on the family's statement that the patient did not appear to have lost weight since the last meeting. The patient's body dimensions were very similar to his parents who weighed around 70 kilograms.

Biochemical Data

SGOT (Serum glutamic oxaloacetic transaminase) and SGPT (Serum glutamate pyruvate transaminase) are two enzymes produced by the liver were high (529 U/l and 470 U/l, respectively). Leukocyte ($26.0x10^3$/uL), random blood glucose (187.0 mg/dL), ethanol alcohol/ EtOH (230.0 mg/dL), lactat serum (5.30 mmol/L), procalsitonin (1.60 ng/mL), pCO_2 (t) (52.3 mmHg) levels were high. Meanwhile, the albumin (3.78 gr/dL), potassium (4.4 mmol/L), calsium (2.03 mmol/L), pH (t) (7.180), $cHCO^{3-}$ (19.2 mmol/L) were low. Sodium (138 mmol/L), cloride (103 mmol/L), magnesium (1.9 mg/dL), and pO_2(t) (92.8 mmHg) were normal.

Nutrition-Focused Physical Examination

Overall, a sopor patient with GCS E1M2Vt was intubated, had 2 IV lines, endotracheal tube (ETT), nasogastric tube (NGT), active water sealed drainage (WSD), drain catheter installed. The patient's systolic, diastolic blood pressure, and mean arterial pressure (MAP) are 159 mmHg, 75 mmHg, 92 mmHg, respectively. Heart rate and respiration rate were normal (86 x per minutes and 26 x per minutes, respectively). Blood oxygen

saturation level were 91% without support. The body temperature of patient were normal 36.7C. Body fluid balance in the last 24 hours were (-)580 cc. The cough reflex were strong but the swallow reflex is weak. On the first day of observation, no gastric residual was found in the patient. The patient not experienced yet a decrease in muscle mass and fat mass in several sites of examination. In patients, no fluid accumulation was found in the upper and lower extremities.

Head and thorax multi-slice computed tomography (MSCT) test showed that patient had chepal hemmatoma regio temporoparietal dextra, oedema cerebrii difuse, intraventricular hemmorage (IVH) in ventrikel laterlis dextra, subarachnoid hemmorage (SAH) regio frontotemporoparietooccipotal bilateral and cerebellar bilateral, intracerebral hemmorage (ICH) in midbrain with counted volume 0.7mL, sinusitis maksilaris bilateral, frontalis sinistra, and ethmoidalis bilateral minimal, pneumothorax dextra, contusio pulmo dextra, no fractures are visible in the visualized bone system, no signs of hydropneumothorax are visible on the current chest X-ray. Endotracheal tube (ETT) is installed in the tracheal projection with the distal end facing caudally. Antebranchii Dextra examination showed that patient had soft tissue swelling of the right antebranch region and complete fracture of the distal part of the right ulna, poor apposition and alignment.

Estimated Requirement

The calculation of energy requirements that we use uses the Ireton-Jones equation for ventilated patients. We estimate protein requirements of 2.0-2.5 grams/kg body weight per day and fat up to a maximum of 2.5 grams/kg body weight per day.

Energy = 1784-(11*age)+(5*actual body weight)+(244*gender)+(239*trauma)= 2386 kcal
Protein = 1.7 gram/kg ideal body weight (or 20% energy) = 107.1 gram
Fat = 40%*energy = 106 gram
Carbohydrate by different 250.8 gram

Energy expenditure estimated by the Ireton-Jones formula does not show good agreement with that measured by indirect calorimetry, however, taking into account aspects related to equipment availability, this equation may be useful in nutritional planning for critically ill patients (11).

Nutrition Diagnosis

(NI-5.1) Increased protein requirements related to chronic illness and critical illness (*physiological-metabolic etiology category*) as evidenced by MSCT head and MSCT thorax showing hemorrhage in multiple locations, procalcitonin results 1.60 ng/mL and medical diagnoses of CKB ec ICH SAH, right anterior trauma, pulmonary contusion, CF ulna 1/3 distal right, brainstem contusion (*new nutritional diagnosis EV-2.1*). **(NC 1.1)** Difficulty swallowing related to mechanical and motor impairment (*physical function etiology category*) as evidenced by sopor consciousness, intubated, strong cough reflex, weak swallow reflex (*new nutritional diagnosis EV-2.1*). **(NC 1.4)** Impaired gastrointestinal function related to conditions that cause disturbances in gastrointestinal function (*physical function etiology category*) as evidenced by brainstem contusion diagnosis (*new nutritional diagnosis EV-2.1*). **(NC 2.2)** Nutrition-related laboratory changes (blood gases) related to pulmonary dysfunction (*etiology category of physical function*) as evidenced by blood gas analysis showing respiratory

acidosis (pH 7.180, PCO2 52.3 mmHg, cHCO3- 19.2 mmol/L), attached to SIMV 12 ventilator (*new nutritional diagnosis EV-2.1*).

Nutrition Intervention

The objective of a diet was to help meet 75% of basal needs in 3x24 hours. The nutritional requirements of this patient are 2386 kcal, 107.1 gram of protein, 106 gram of fat, 250.8 gram of carbohydrates. The Ireton Jones for ventilated patient formula was used to calculate the nutritional requirements. Energy administration can be adjusted to patient development, gastrointestinal tract (GIT) function, and patient acceptance. The target for energy fulfillment on the first day of hospitalization is 25%, then it will increase to 50% on the second day and 75% on the third day. Protein is given high at 20% of daily energy needs (1.7 grams/kg ideal body weight). Fat is given high at 40% of daily energy needs with priority given to unsaturated fats. Carbohydrates are given low at 40% of daily energy needs. These nutritional requirements were fulfilled from blenderized enteral diet and commercially prepared formulas that contain high in protein and fat but low in carbohydrate.

The nutritional interventions were given by dietitian with the administration of nutritional support during the patient care 6x/day at 150 ml, 1 cc/kcal, per bolus per NGT. This nutritional support can meet 41.3% energy needs (984.7 kcal), 46.3% protein needs (49.6 gram), 43.9% fat needs (46.6 gram), 38.2% carbohydrates (95.8 gram) of the total patient requirements during the first day of patient care on ICU. Enteral feeding is done gradually to meet basal needs. Diet provision is increased with increasing nutritional fulfillment targets if daily monitoring of the patient shows good acceptance. The dietitian provides explanation and education to the patient's family about the purpose of enteral diet via NGT and conveys restrictions on providing food and drink in any form from outside the hospital that may be brought by the family.

Joint patient monitoring activities and collaboration between professional care providers can be carried out well so that patients receive integrated and patient-centered services. Dietitian conducts information gathering with nurses regarding patient development on the patient flowchart sheet. Nurses and dietitian share information such as regarding the provision of liquid diet, modification of feeding (per NGT, continuous enteral feeding, and changes to parenteral nutrition), and daily gastric residue checks. Through nurses, dietitian receives information regarding the patient's hemodynamic condition and changes in medical equipment support such as WSD, changes in ventilator mode, installation of new IV lines. The patient's clinical development is obtained by collaborating with doctors. Collaboration with doctors is also carried out in changes in daily diet provision. Continuous enteral feeding or 10% *Dextrose* or *SmofKabiven* as parenteral nutrition therapy is obtained through collaboration with doctors. Parenteral diet provision by doctors is carried out after monitoring of enteral diet absorption shows suboptimal results.

Nutrition Monitoring and Evaluation

Nutrition monitoring and evaluation activities were carried out within 6 days of observation in the ICU. The biochemistry data, nutrition-focused physical examination data, and intake data were used to monitor the patient’s condition (Table I).

Based on monitoring data on patient food intake for six days, energy fulfillment through patient food intake with a high energy and protein diet in liquid form showed that there was a fluctuation in food intake. This happened because the patient's digestive tract was not always in good condition. The appearance of milky or brown gastric residue indicated that the absorption of enteral food in the patient's digestion was not completely good. Parenteral feeding was carried out on the sixth day. This was done because enteral feeding with various efforts such as modifying the bolus form (200 cc/hour in the third day) to titration in minimal amounts (50 cc/hour in the fourth day) still could not be absorbed properly. Gastric residual with a milky color and brown still appeared until the sixth day.

Table 1 Nutrition Monitoring and Evaluation and Follow Up

Indicator	Cut-off	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6
pH	7.350-7.450	7.18	7.33	7.326	7.293	7.332	7.416
pCO_2 (t)	35.0-45.0 mmHg	52.3	47.4	58	62.9	61.9	44.7
pO_2 (t)	83 - 108 mmHg	92.8	101	60.1	167.9	117.8	101.4
$cHCO^{3-}$ (t)	22 - 26 mmol/L	19.2	25.2	29.2	29.1	31.7	28.1
Lactate	<1.80 mmol/L	5.30	2.12	2.30	1.50	1.50	1.70
Random blood Glucose	74-106 mg/dL	187	N/A	N/A	111	N/A	N/A
Procalsitonin	<0.50 ng/mL	N/A	1.60	N/A	4.75	N/A	N/A
Blood pressure	120/80 mmHg	149/75	104/68	173/82	136/63	127/59	156/66
MAP	75-100 mmHg	104	79	105	81	74	89
Heart rate	60-100 x/minute	88	103	127	137	108	64
Respiration rate	12-20 x/minute	16	18	32	16	20	20
SpO_2	95-100 %	91	98	98	99	99	97
FiO_2	N/A	50	50	50	90	45	40
Gastric residual	negative	negative	negative	negative	milky	brown	brown
Enteral dietary	N/A	180 cc	650 cc	550 cc	80 cc	230 cc	50 cc
Parenteral support	N/A	N/A	N/A	N/A	N/A	N/A	1080 cc
Energy intake		198 kcal (8.30%)	704 kcal (29.51%)	601.4 kcal (25.21%)	80 kcal (3.35%)	230 kcal (9.64%)	806 kcal (33.78%)
protein intake		9.58%	34.08%	28.20%	2.24%	6.44%	33.67%
Fat intake		8.49%	30.19%	26.89%	7.74%	8.68%	30.42%
Carbohydrate intake		7.89%	28.07%	23.29%	4.15%	11.92%	33.17%

Normal blood lactate levels are below 1.8 mmol/L. Initial examination results when the patient was in the emergency room showed that blood lactate levels were up to 5.3 mmol/L. In the first three days of hospitalization, the patient's blood lactate levels were still high. This indicates that the body's tissues are not getting enough oxygen or cannot utilize the oxygen provided through the respiratory aid.

3. DISCUSSION

The most effective nutritional screening tools for critically ill patients are NRS-2002 and mNUTRIC (12). In this case, the nutritional screening used was NRS-2002. Nutritional screening was carried out using NRS 2002 because NRS has the best sensitivity (79.1%) and specificity (94.8%) to indicate severe malnutrition in ICU patients and is feasible (13). Although when admitted to the hospital the patient appeared to be in good nutritional status, intensive care due to the patient's current condition increased the risk of malnutrition in the patient.

Patients in intensive care units are more likely to become ill, die, and incur higher hospital costs due to malnutrition (14,15). The Academy of Nutrition and Dietetics (AND) and the American Society for Parenteral and Enteral Nutrition (ASPEN) reached a consensus on the definition of malnutrition, which is defined as the presence of two or more of the following symptoms: inadequate energy intake, weight loss, loss of muscle mass, loss of subcutaneous fat, local or general fluid accumulation, or decreased functional status (16). It is known that critically ill patients have a higher hypermetabolism, hypercatabolism, and inflammatory response. All of these explain why malnutrition is more common in the ICU (17,18). Malnutrition has serious implications for clinical outcomes, including the development of infectious complications such as nosocomial infections and non-infectious complications such as delayed wound healing, longer hospital stays, increased dependency on ventilators, loss of gut barrier function, higher Acute Physiolical Age and Chronic Health Evaluation II (APACHEII) scores, lower serum albumin levels, increased costs, and all-cause mortality (15,19,20). Critically ill patients, such as those suffering from trauma, sepsis, or major surgery, depend on adequate nutrition to keep their metabolism from becoming overstimulated. This critical state leads to a disproportionate release of cytokines and stress hormones, which disrupt energy and protein metabolism and ultimately lead to malnutrition (21).

It is recommended to start providing nutritional support in the first 24–48 hours after entering the ICU (22). Enteral nutrition is preferred because the enteral route will maintain the integrity of the intestinal mucosa so that the possibility of bacterial translocation from the intestine to the blood vessels is smaller. If enteral intake is disrupted, for example in critically ill patients who only receive parenteral nutrition, it will cause atrophy of the small intestinal villus, a decrease in the number of villus cells and a decrease in mucosal thickness.

Another reason to support early enteral nutrition is that fiber can prevent intestinal mucosal atrophy and weakening of gastrointestinal peristalsis because the energy substrate for the intestinal mucosa is partly supplied intraluminally. In addition, it is believed that early enteral nutrition can prevent bacterial translocation (23).

On the first day of critical patients being treated in the ICU ward, the target in the acute phase is set at 25% of energy and protein needs. In the next three days, the target for food fulfillment is increased to 50% on the second day and 75% on the third day (24). Enteral feeding via NGT begins with 100 mL every 4 hours with a calorie content of 1.0-1.5 kcal/mL. The administration can be increased to 150 mL every 4-8 hours until the target is met. Flush at least 30 mL every 4 hours using water or normal saline. Initiation

of feeding is stopped if there is gastric residual volume of more than 150 mL, there is intestinal distension, or complaints of nausea.

High blood alcohol levels in patients indicate that the patient consumed a large amount of alcohol before the blood test was performed. This conclusion is supported by liver enzyme examination. Increased liver enzymes can indicate inflammation or cell damage in the liver which can be caused by excessive alcohol consumption and over a long period of time.

Blood gas analysis will focus on lung function which is the place where oxygen and carbon dioxide are exchanged. Red blood cells that carry oxygen and carbon dioxide throughout the body are known as blood gases. When blood passes through the lungs, oxygen enters the blood, while carbon dioxide exits the lungs.

Respiratory failure is a clinical condition that occurs when the respiratory system fails to maintain its main function, namely gas exchange, which means PaO_2 levels <60 mmHg and/or $PaCO_2$> 50 mmHg (25). Respiratory failure is a condition with disorders caused by the lungs, chest wall, or brain that result in no oxygenation of arterial blood and incomplete removal of carbon dioxide.

The condition of patients with decreased consciousness due to critical illness produces blood gas analysis which shows signs of imbalance between oxygen, carbon dioxide, and blood pH levels. This examination, in addition to determining how well the lungs function, is also related to the function of the respiratory system, blood circulation, and the body's metabolic processes, especially patients treated for severe head injuries that have the potential to interfere with respiratory function. The use of a ventilator as a respiratory aid needs to be monitored with the results of a blood gas analysis.

The results of the examination showed that the patient was still experiencing respiratory acidosis. This is indicated by the blood pH value showing acid, high bicarbonate levels, high partial pressure of carbon dioxide. Respiratory acidosis is one manifestation of lung function failure. Impaired lung function in patients occurs due to pulmonary contusion.

Increased blood glucose levels as a component of the stress response in the acute phase are almost always present in severe brain injuries. In the acute phase, the body will adapt to stress and will stimulate increased hormone secretion (growth hormone, catecholamine) and stimulation of the corticotropin releasing hormone system. Stimulation of these hormones can result in increased blood glucose levels (26,27).

Catecholamine hormones will increase the glycogenolysis process in the liver, lipolysis in fat tissue and reduce insulin secretion by the pancreas. Cortisol and growth hormone hormones will increase the gluconeogenesis process, which of all these processes will increase the body's blood sugar levels (28). The gluconeogenesis process is actually the body's compensatory effort to provide an energy source for the continuation of cell metabolism, because glucose is needed as the main fuel for injured tissue (29). However, the mechanism of increased blood sugar levels in TBI patients will affect patient outcomes, and tend to increase morbidity and mortality (28).

Increased blood glucose levels can be used to predict the severity of patients with traumatic brain injury. Increased blood glucose levels will trigger secondary injuries

which then cause cell damage. This can worsen neurological damage which can ultimately result in a worse prognosis (27,30).

When blood oxygen levels are within normal limits, carbohydrates break down into water and carbon dioxide or the aerobic cycle because it involves oxygen. When blood oxygen levels decrease, carbohydrates will break down into energy and lactic acid or anaerobic metabolism where energy is formed without involving the use of oxygen. This indicates that body tissues are not getting enough oxygen or cannot utilize the oxygen provided through the respiratory aid. Abnormalities in blood lactate levels far above normal limits can be caused by high-dose ethanol poisoning. Failure of respiratory function causes the body to lack oxygen and causes the patient to experience decreased consciousness.

Procalcitonin (PCT) is a biomarker examination for bacterial infections with or without sepsis. The PCT test has a sensitivity and specificity of 76% and 69% for detecting bacteremia, with a cut-off value of 0.5 ng/mL or equivalent to 0.5 g/L. One of the uses of PCT examination is as a guide to provide antibiotic therapy for acute upper respiratory tract infections, both in stable and critical conditions. An increase in PCT as an infection is one sign of inflammation. The inflammation that occurs will increase blood vessel permeability and cause a decrease in serum albumin.

Based on the results of the physical examination, the patient was in good nutritional status, but the patient experienced decreased consciousness due to injuries to the head, thorax, and right arm. The Glasgow Coma Scale (GCS) <8 so that intubation was immediately performed to clear the airway, prevent pulmonary aspiration, hypoxia and hypercapnia. Intubation was performed by considering the risk of neck injury, maintaining stable hemodynamic status to avoid increased intracranial pressure due to excessive hypertension and hypotension which is dangerous due to the anesthetic drugs given. After intubation, the patient was given sedation, analgesia and relaxants to facilitate respiratory control.

At the time of data collection, the patient's hemodynamics were stable without support. The patient was intubated to provide respiratory assistance using a ventilator. Nutritional support was provided per NGT to the stomach. The presence of bleeding in the lung cavity was assisted by drainage with an active WSD. Hemodynamic monitoring is the observation of physiological parameters of the cardiovascular system, needed for patients treated in the intensive care unit due to hemodynamic instability which causes an imbalance between oxygen delivery and demand (31). Non-invasive parameters that are often used to assess patient hemodynamics are respiration, heart rate, mean arterial pressure (MAP), oxygen saturation and capillary refill time (CRT).

Disorders of the heart, lungs, and kidneys can disrupt patient hemodynamics because the circulatory center connects these organs, especially when the cardiovascular and respiratory organs are affected. This hemodynamic instability is based on 3 main hemodynamic abnormalities, namely changes in circulating volume (hypovolemia), cardiac dysfunction and changes in vascular tone (eg vasoplegic shock in sepsis) which will result in organ dysfunction, multi-organ failure, and ultimately death (31,32).

In this case, blood pressure tends to be high, hypertension can occur due to the release of catecholamines due to trauma and body compensation to maintain brain perfusion due to increased intracranial pressure, but does not require additional therapy to lower blood pressure aggressively (33,34). Intracranial pressure control efforts can be

carried out with the head in a neutral position and head up 15–30 degrees to ensure there is no disturbance of cerebral reflux, in addition the patient is given mannitol at 0.5 mg/kg body weight until hematoma evacuation is carried out.

To assist the breathing process, patients are given a mechanical ventilator. The use of mechanical ventilation in cases of severe head injury such as in patients is associated with a significant increase in morbidity and mortality such as ventilator-associated pneumonia (VAP), nosocomial infections, urinary tract infections, decubitus ulcers that prolong the length of stay, increase health care costs and affect the patient's neurological outcomes (35).

The use of mechanical ventilation with an endotracheal tube for more than 48 hours will increase the risk of VAP. Ventilator-associated pneumonia is pneumonia that occurs 48-72 hours after endotracheal intubation and mechanical ventilator installation, which is characterized by progressive infiltration, especially in plain chest X-ray images, clinical signs and symptoms of infection (fever, increased leukocytes), changes in sputum. Ventilator-associated pneumonia contributes to almost 50% of all causes of hospital acquired pneumonia or nosocomial pneumonia and is the most serious infectious complication in hospitals, and its occurrence is only below urinary tract infections, especially in the ICU in neurosurgical patients (36). Ventilator-associated pneumonia will make the situation of patients with severe TBI more difficult because there is an increase in temperature that increases brain metabolism which will cause increased blood flow to the brain and an increase in $PaCO_2$ and aggravate the edema that has occurred in the part of the brain that underwent surgery. This condition can affect brain homeostasis and make it increasingly difficult for patients to be weaned from the ventilator (36;37).

Patients with critical illness are very likely to experience impaired gastrointestinal function which causes enteral nutritional support to be suboptimal. The mechanism of changes in gastrointestinal function in critically ill patients can be classified as mucosal barrier failure, weakening of gastrointestinal peristalsis and intestinal mucosal atrophy, decreased lymphatic tissue related to the intestines and so on (23). Gastrointestinal dysfunction is impaired gastric emptying (NGT residual/ gastric residual volume) and intestinal dysmotility, which can cause regurgitation, increase the risk of aspiration and ventilator-associated pneumonia. Gastric residual volume monitoring is routine practice to assess enteral nutrition tolerance and gastric emptying in the ICU. Gastric residual volume is obtained by aspirating gastric contents through an enteral tube using a syringe and checked every 4 hours. Gastric residual volume between 200-500 ml should be a concern and lead to the implementation of measures to reduce the risk of aspiration. However, automatic cessation of feeding should be avoided if the gastric residual volume is <500 ml in the absence of other signs of impairment (22).

Increased enteral nutrition volume to an optimal or target volume is determined based on routine monitoring and interpretation of the remaining gastric residual volume and its color. Colors such as bile stains, especially dark green gastric residual, are often interpreted as enteral nutrition intolerance and are discarded. However, there is no evidence to support this practice. Removing dark green gastric residual containing bile acids is a potential barrier to optimizing enteral nutrition. Bile acids have physiological roles in regulating gut motility, liver lipids, glucose, and energy homeostasis. In addition, bile acids have anti-inflammatory agents and may play an important role in regulating gut and liver components of innate immunity (38).

Enteral nutrition is recommended to be given as soon as possible to critical patients with good gastrointestinal function before 24 hours of hospital admission if hemodynamics are stable to reduce infectious complications. Enteral nutrition is safer than parenteral nutrition and is correlated with better outcomes, preventing villous atrophy and maintaining normal intestinal mucosal barriers, thereby minimizing bacterial translocation, stimulating intestinal perfusion to prevent ischemia-reperfusion injury, and maintaining intestinal immunity (8).

The interval for administering enteral nutrition is 2-4 hours. Enteral nutrition is not given to patients between 24.00 and 06.00, considering the rest time for the digestive system. In practice, administering enteral nutrition in bolus form at irregular intervals often causes problems with the digestive system and intolerance to enteral nutrition (10).

Diet in patients with a medical diagnosis of brainstem contusion should be given directly to the jejunum (jejunostomy feeding) because disturbances in the brainstem will affect its function in the digestive tract. The nerves that regulate digestive function are located in the brain structure that is disturbed. The part of the digestive tract that is disturbed is the stomach, so feeding through a tube that ends in the stomach should be avoided. However, because the jejenostomy feeding process is related to costs and unfavorable prognosis projections, diet is given through a tube that ends in the stomach. Prokinetic agents can help increase motility and are expected to improve digestive tract function.

Semi-elemental diet is given to patients with limited digestive capacity such as intestinal absorption disorders. Semi-elemental formula does not contain fiber, lactose, and gluten, low residue, contains many nutrients in simple form so that it has a high osmotic value. Nutrients that have been hydrolyzed into smaller components in this food can be absorbed quickly. Semi-elemental formula contains peptides, simple carbohydrates, and fats in the form of medium-chain triglycerides (MCT).

Based on the patient's food intake graph for six days, the fulfillment of protein through the patient's food intake with a high energy and protein diet in liquid form shows that there is a fluctuation in intake. This happens because the patient's digestive tract is not always in good condition. High protein intake is given to help improve the condition of infection and catabolism that occurs in patients.

The condition of patients with decreased consciousness due to critical illness results in blood gas examinations that show signs of imbalance between oxygen, carbon dioxide, and blood pH levels. This examination, in addition to determining how well the lungs function, is also related to the function of the respiratory system, blood circulation, and the body's metabolic processes, especially patients treated for severe head injuries that have the potential to interfere with respiratory function. The use of a ventilator as a respiratory aid needs to be monitored with the results of a blood gas analysis examination.

The examination results showed that the patient was still experiencing respiratory acidosis. This is indicated by the blood pH value showing acid, high bicarbonate levels, and high partial pressure of carbon dioxide. Respiratory acidosis is one manifestation of lung failure. Impaired lung function in patients occurs due to pulmonary contusion. Pulmonary contusion is a condition in which damage occurs to lung tissue either

directly or indirectly due to chest trauma, which is characterized by swelling or bruising of the alveoli (air sacs in the lungs). The damage that occurs is in the form of torn alveoli and small blood vessels (capillaries) in the lung area, and results in the accumulation of blood and other fluids in the lung tissue. First, blood will appear in the affected lung area, then a few hours later followed by swelling in the affected area and around it. Lung tissue will also lose its elasticity, making it difficult for the lungs to expand and carry out their respiratory function.

The accumulation of blood, fluid, and swelling disrupts air exchange in the lungs, resulting in a lack of oxygen. This is evident in blood gas analysis monitoring that there is an imbalance between carbon dioxide production and release. As a result, the patient's blood becomes saturated with carbon dioxide and is acidic. To help remove fluid that accumulates in the lung cavity, drainage is performed using WSD from the beginning of the patient's treatment.

The next biomarkers studied are blood lactate content and procalcitonin. When blood oxygen levels are within normal limits, carbohydrates break down into water and carbon dioxide or the aerobic cycle because it involves oxygen. When blood oxygen levels decrease, carbohydrates will break down into energy and lactic acid or called anaerobic metabolism where energy is formed without involving the use of oxygen.

Abnormal blood lactate levels far above normal limits can be caused by high-dose ethanol poisoning. Respiratory failure causes the body to lack oxygen and results in the patient experiencing decreased consciousness. This is supported by blood gas examinations which show that the patient is experiencing respiratory acidosis. One of the medical treatments given to help reduce lactate in patients is the administration of thiamine 100 mg/24 hours intravenously.

The presence of high procalcitonin test results is one of the reasons for administering the antibiotic ceftriaxone 1.0 grams/12 hours from the first day the patient is admitted to the ICU ward. A Cochrane meta-analysis of 26 studies involving 6,708 patients found that PCT-guided antibiotic administration can significantly reduce mortality (as many as 1 in 71 people who underwent PCT-guided antibiotic therapy avoided death). This meta-analysis analyzed various types of acute respiratory infections, such as community-acquired pneumonia, bronchitis, and ventilator-associated pneumonia (39). Another meta-analysis of 11 studies with a total of 2,003 patients in the PCT group and 2,013 patients in the non-PCT group showed that a cut-off value of 0.25<PCT<0.5 ng/mL can reduce the duration of antibiotic therapy and the duration of hospitalization in the ICU. However, this reduction was not very significant. Further studies are still needed to confirm how beneficial PCT testing is (40).

4. CONCLUSION

Enteral feeding in critically ill patients needs to be done in a timely manner from the time the patient enters the hospital, starting with small portions and a regular feeding schedule. Based on the results of the implementation of nutritional care and monitoring for 6 days, it was concluded that the standardized nutritional care process starting from nutritional assessment, nutritional diagnosis, nutritional intervention, nutritional monitoring and evaluation as well as nutritional reassessment and collaboration between health workers that were carried out optimally and intensively could not always provide a good prognosis in cases of severe head injury with various

complications such as alcohol intoxication, pulmonary contusion, and brainstem contusion.

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