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Nursing Care for Patients with Respiratory Failure to Meet Oxygenation Needs and Monitor Blood Sugar Levels

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ABSTRACT

Respiratory failure poses a critical medical challenge, often leading to emergency room visits and mortality. This study delves into of respiratory failure, focusing on the nursing management in meeting the oxygenation needs and blood sugar monitoring in patients with the condition of respiratory failure. Utilizing a descriptive approach with a case study methodology, the research was conducted in the ICU at Hospital in special region of Yogyakarta over a period of six days. Through observation, physical examination, and documentation analysis, the study aimed to understand the nursing intervention of meeting oxygenation requirements in respiratory failure patients, particularly through ventilator intervention and blood sugar monitoring. The study underscores the importance of individualized nursing care in addressing respiratory failure and optimizing patient care outcomes in the ICU setting.

Keywords: respiratory failure, oxygenation, ventilation

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INTRODUCTION

Respiratory failure is a clinical condition that requires immediate medical attention and is often the leading cause of death in the emergency room (Kacmarek et al., 2020) This condition is characterized by the failure of the respiratory system to maintain the body's demand for oxygen and/or the elimination of carbon dioxide (Urner et al., 2020). Patient with Respiratory failure often shows severe symptoms, including difficulty breathing, hypoxia, and significant reduction in lung function (Agus Dwi Susanto et al., 2021) Appropriate and fast treatment is needed to improve the prognosis of these patients. The causes of respiratory failure also vary, ranging from pneumonia, acute lung injury, chronic obstructive pulmonary disease (COPD), to asthma (Madania & Sawitri, 2022). Acute respiratory distress syndrome (ARDS) is a rare but life-threatening complication of diabetic ketoacidosis (DKA) (Darrat et al., 2021).

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The mortality rate of patients with DKA in developed countries is less than 5% in many areas, while in clinics with modest means and elderly patients the mortality rate can reach 25–50%. Mortality rates are higher in some of the conditions that accompany DKA, such as sepsis, severe shock, extensive acute myocardial infarction, elderly patients, high baseline blood glucose levels, uremia and low blood acidity levels. Death in young DKA patients can generally be avoided with rapid diagnosis, appropriate and rational treatment according to the pathophysiology. In patients of the elderly age group, the cause of death is more often triggered by the underlying disease factor (Paramitha & Suparmanto, 2020)

The incidence of Acute Respiratory Distress Syndrome (ARDS) varies globally. In 2010, it ranged from 12.6 to 28.0 cases per 100,000 people annually in Europe. In Germany and Sweden, acute respiratory failure rates were notably high, ranging from 77.6 to 88.6 cases per 100,000 annually. In Indonesia, respiratory failure accounted for 20.98% of inpatient deaths in 2010, ranking second among non-communicable diseases. Effective management, including prevention and early diagnosis, is crucial for reducing mortality (Paramitha & Suparmanto, 2020).

The foundation of treating and caring for Acute Respiratory Distress Syndrome (ARDS) lies in adopting an individualized approach tailored to each patient's unique needs. Central to this approach is the development of comprehensive plans aimed at reducing existing lung damage and preventing further decline. This encompasses a multifaceted strategy comprising Mechanical Ventilation (MV), supportive interventions, and pharmacological treatments. By delineating these components, healthcare professionals can chart a course toward effective ARDS management, optimizing patient outcomes and fostering a framework for improved care delivery (BÖLÜKTAŞ et al., 2022). Subsequently, this paper delves into the nursing care of the patient with respiratory failure.

The most widely used method for in critically ill patient is tracheal intubation it involves using an endotracheal tube (Jaber et al., 2021). Endotracheal intubation is the placement of a tube into the trachea, either orally or nasally for airway management. Endotracheal tube forms an open passage in the upper airways. To be able to ventilate the lungs, the air must be free to enter and exit the lungs. The patient is connected to the mechanical ventilator to provide continuous respiration with an endotracheal tube.

Ventilator-associated pneumonia (VAP) is a common infection among mechanically ventilated patients. Nurses can significantly impact patient outcomes by enhancing their knowledge and decision-making abilities. Awareness of VAP's causative agents is crucial, as is understanding that suctioning is a sterile procedure requiring single-use catheters. Positioning the patient with the head elevated and maintaining appropriate cuff pressure are key preventive measures. Hand hygiene practices, including standard washing and alcohol rub use, are essential. During suctioning, nurses should employ aseptic technique and limit attempts to 10-15 seconds. Nasogastric feeding requires hand hygiene and tube placement assessment. Elevating the head to ≥30° and maintaining cuff pressure are vital practices for preventing aspiration (Kalyan et al., 2020).

Pharmacological treatment options for acute respiratory distress syndrome (ARDS) remain limited and elusive in significantly reducing mortality rates. Current investigations have explored various agents, including inhaled nitric oxide (NO) and glucocorticoids, yet their efficacy in improving survival outcomes remains uncertain. Additionally, several potential treatments, such as surfactant replacement therapy and anti-inflammatory drugs, have shown little to no benefit or even harmful effects in clinical trials. Experimental agents like aspirin, granulocyte–monocyte colony stimulating factor (GM-CSF), and bosentan, an endothelin-1 (ET-1)

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receptor antagonist, hold promise in preclinical studies, but their clinical utility awaits further validation. (Araz, 2020)

METHOD

The type of this research is descriptive using the method case study approach. The subject of this study used one patient to explore the problem of holistic nursing care for patients with respiratory failure. The focus of the study in this case is to fulfill oxygenation and blood sugar monitor in patients with nursing diagnose of Impaired spontaneous ventilation, Gas Exchange Disorders and Instability of blood glucose levels. The research located in the ICU at Hospital in special region of Yogyakarta. The patient observation lasted 6 days days from March 29 2024 to May 4 2024. Data collection using, observations and technique physical examination, documentation study before the data was collected patient family were informed about the study and provided their consent before any data collection procedures were initiated.

RESULT AND DISCUSSIONS

Result

The case study explored the nursing care for a 62-year-old female patient admitted to the ICU with respiratory failure necessitating ventilator support. The patient presented with impending respiratory failure, reduced consciousness (GCS ≤ 8), and multiple organ dysfunction syndrome (MODS) with a high risk of severe complications such as sepsis. Upon assessment, the patient exhibited compromised airway, breathing, and circulation, necessitating various interventions including endotracheal tube (ET) insertion, nasogastric tube (NGT), mechanical ventilation, and intravenous medication administration.

Primary assessments revealed a compromised airway with ET and NGT in place, along with productive coughing and audible rhonchi. Breathing assessment indicated mechanical ventilation with a SIMV mode and PEEP settings, alongside low oxygen saturation levels (SpO2 89%). Circulatory parameters showed stable blood pressure and sinus rhythm on EKG. Neurological assessment indicated reduced consciousness and sedation with a Glasgow Coma Scale (GCS) of E:X V:X M:X. Secondary assessments highlighted a history of diabetes mellitus (DM), hypertension (HT), and previous stroke. Diagnostic tests, including chest X-ray and blood gas analysis, confirmed cardiomegaly with pulmonary edema and metabolic acidosis. Laboratory findings showed fluctuating blood glucose levels and worsening blood gas parameters over subsequent days.

The nursing diagnoses formulated included gas exchange impairment due to respiratory failure, spontaneous ventilation impairment secondary to metabolic disturbances, Instability of blood glucose levels and risk of infection following invasive procedures. Nursing interventions were tailored to address each diagnosis, focusing on airway clearance, ventilation monitoring, gas exchange optimization, monitoring glucose level, and infection prevention. These interventions involved continuous respiratory and glucose monitoring, sputum assessment, positioning to facilitate breathing, and maintaining infection control measures.

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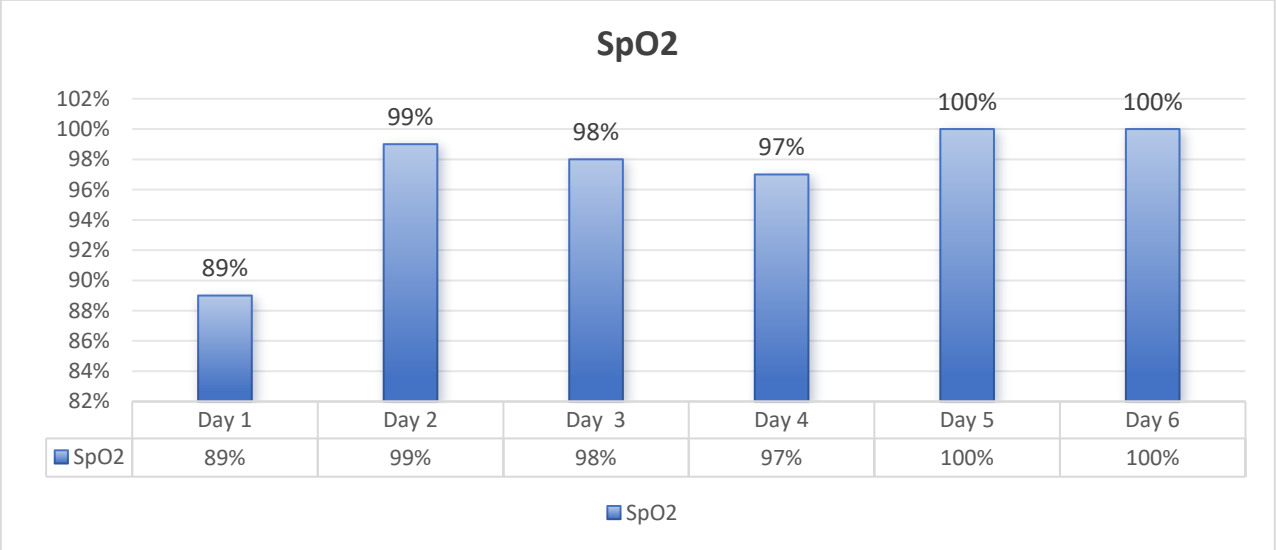

Figure 1. Shows the changes of SpO2 in 6 days of observation.

Throughout the care plan implementation, there were gradual improvements in respiratory parameters, including reduced sputum production, improved oxygen saturation (Figure 1), and stabilization of blood gas values. However, challenges persisted, particularly in addressing spontaneous ventilation and gas exchange impairments, as evidenced by persistent acidosis and fluctuating blood gas levels (Table 1).

The nursing care plan emphasized the importance of ongoing monitoring and intervention adjustment to optimize respiratory function and mitigate complications. Despite the challenges encountered, the interdisciplinary approach and tailored nursing interventions contributed to managing the patient's respiratory failure and promoting stabilization over the course of ICU admission.

Table 1 shows the patient still experienced gas exchange impaired on the sixth day with the conclusion of partially compensated metabolic acidosis.

Table 2 shows that the highest blood sugar level recorded during the intervention was 413 mg/dl on the morning of Day 3 (01-05-2024), indicating the absence of sustained instability across the six days. The results of sputum examination in patients showed that there was a lot of sputum, there was a sound of rhonchi breathing so it was necessary to do suctioning and gave a 45% semi fowler position to facilitate breathing and control the infection to prevent respiratory tract infections, in the results of laboratory examination on patients, leukocyte values were obtained 26.47 rb /ul.

Tabel 1. Arterial Blood Gas (ABG) throughout 6 days of intervention

ABG/DAY	*Day 1*	*Day 2*	*Day 3*	*Day 4*	*Day 5*	*Day 6*
pH	7.21	7.35	7.39	7.18	7.22	7.16
pCO2	49	35	34	57	49	46
pO2	89	175	140	62	157	203
CO2 Total	20.9	19.7	20.9	21.4	20.4	16.9
HCO3	19.4	18.7	19.9	19.9	19.1	15.7
Interpretation	A combination of Metabolic Acidosis and repiratory acidosis.	fully Compensated Metabolic Acidosis	fully Compensated Metabolic Acidosis	A combination of Metabolic Acidosis and repiratory acidosis.	A combination of Metabolic Acidosis and repiratory acidosis.	A combination of Metabolic Acidosis and repiratory acidosis.

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Tabel 2. Blood sugar levels throughout 6 days of intervention

Assessment 0f blood glucose/DAY and time	*Day 1 29-04-2024 (mg/dl)*	*Day 2 30-04-2024 (mg/dl)*	*Day 3 01-05-2024 (mg/dl)*	*Day 4 02-05-2024 (mg/dl)*	*Day 5 03-05-2024 (mg/dl)*	*Day 6 04-05-2024 (mg/dl)*
Morning	-	281	413	-	305	217
Afternoon	54	-	398	310	134	-
Evening	200	227	-	113	51	-

Discussion

Respiratory failure complicates DKA is a cconditions that causes respiratory failure due to KAD are caused by decreased potassium, magnesium, phosphate, hydrostatic and non-hydrostatic pulmonary edema. In DM there are changes in the structure, function of the lungs, and other organs. Involves changes in the walls of the alveoli, pulmonary capillaries, and functional changes including decreased lung volume, decreased pulmonary elasticity, and a decrease in the volume of pulmonary capillaries leading to diffusion disorders. Lung dysfunction occurs which causes overload. Decreased serum colloidal osmotic pressure can increase fluid transfer from intravascular to interstitial causing shortness of breath. Respiratory infections are a major trigger for DKA. Metabolic acidosis will induce hyperventilation through stimulation of peripheral chemoreceptors and respiratory centers in the brainstem, which will then lower the partial pressure of carbon (Konstantinov, 2015).

Diabetic ketoacidosis is an emergency that is a complication of diabetes mellitus characterized by hyperglycemia, acidosis and ketosis. Infection remains the most frequent precipitating factor for KAD, but some recent research suggests discontinuation or lack of insulin doses may be an important precipitating factor. The most commonly found infections are pneumonia, respiratory failure and urinary tract infections which account for between 30-50% of cases (Gotera & Budiyasa, 2011)

To overcome the problem of respiratory failure on the patients are providing corrections to gas exchange interference problems including remove accumulated pulmonary secretions, and hence ensure airway patency for adequate ventilation and oxygenation with a SIMV mode and PEEP settings. his action is in line with some research that stating the nursing care plan to patient with respiratory failure is supporting spontaneous ventilation mechanical ventilation is a mainstay in the management of patients with severe acute hypoxaemic respiratory failure (AHRF)(Aslam et al., 2023), monitor gas exchange in Critical illness often threatens the adequacy of O_2 delivery or CO_2 excretion. Gas-exchange failure can threaten survival in mere minutes. Monitoring seeks to identify the adequacy of oxygenation and ventilation and to detect deterioration early (Schmidt, 2020), and minimizing infection risks. Strategies such as suctioning ETT suctioning is used to remove secretions, reduce bacterial colonization, and reduce the rate of biofilm formation.(Dsouza et al., 2021a), administering medications, and positioning the patient appropriately therapeutic body positioning is different from routine body positioning which is prescribed to optimize cardiopulmonary function and oxygen transport(Patel & Shah, 2021).

The nursing care plan prioritized interventions aimed at optimizing airway clearance the aim is to reduce airway obstruction caused by secretions occupying the airway lumen and so prevent respiratory tract infections(Belli et al., 2021), supporting spontaneous ventilation mechanical ventilation is a mainstay in the management of patients with severe acute hypoxaemic respiratory failure (AHRF)(Aslam et al., 2023), monitor gas exchange in Critical illness often threatens the adequacy of O_2 delivery or CO_2 excretion. Gas-exchange failure can threaten survival in mere minutes. Monitoring seeks to identify the adequacy of oxygenation and ventilation and to detect deterioration early

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(Schmidt, 2020), and minimizing infection risks. Strategies such as suctioning ETT suctioning is used to remove secretions, reduce bacterial colonization, and reduce the rate of biofilm formation.(Dsouza et al., 2021a), administering medications, and positioning the patient appropriately therapeutic body positioning is different from routine body positioning which is prescribed to optimize cardiopulmonary function and oxygen transport (Patel & Shah, 2021). These interventions were implemented to address these issues.

Acute hypoxemia can cause a variety of problems including cardiac arrhythmias and coma. Chronically low PaO2 can be tolerated by patients who have adequate heart reserves. Alveolar hypoxia (PAO2<60 mgHg) can cause pulmonary alveolar vasoconstriction and increased pulmonary vascular resistance within weeks to months leading to pulmonary hypertension. Hypercapnia can cause acidemia. An acute decrease in brain pH increases ventilation drive. Over time, the buffer capacity in the brain increases and eventually there is a buildup to the brain. Stimulation of pH drops in the brain with the result decreased drive. Hyperpnea also causes dilation of brain blood vessels and increased cranial pressure. Acidemia that occurs when intense (pH<7.3) causes pulmonary alveolar vasoconstriction, systemic vascular dilation, decreased myocardial contractility, hyperkalemia, hypotension and increased cardiac sensitivity lead to life-threatening arrhythmias (Hariadi 2010). In this problem, what is done is to check blood sugar regularly, give drugs in accordance with doctor's instructions as an effort to control blood sugar levels in patients.

Special care is needed to keep endotracheal tubes (ETTs) clean and free from secretions to ensure the airway stays open. Regular maintenance is essential to prevent blockages caused by secretions buildup and to preserve airway patency. Endotracheal suctioning (ETS) is one of the most common invasive procedures performed by critical care nurses (CCNs) to remove accumulated pulmonary secretions, and hence ensure airway patency for adequate ventilation and oxygenation as well as prevent atelectasis. ETS is a procedure that involves catheter insertion through the ETT to remove the airway secretions by applying a negative pressure. (Alkubati et al., 2022) The formation of bacterial biofilms within these ETTs provides a vessel for infectious bacteria to colonize and become resistant to antibiotics. Current standard-of-care suctioning of the ETT is used as a management strategy to reduce airway colonization by pathogenic bacteria, reduce resistance to airflow, and decrease biofilm formation. (Dsouza et al., 2021b)

In the state of sepsis caused due to infection causes inflammation and an increase in temperature. Every 1ºC increase in temperature there is a 15% increase in the body's metabolism, which causes the volume of oxygenation to increase. Oxygen delivery is obtained from the multiplication of cardiac output and oxygen content in the arteries. Cardiac output increases in can be from increased stroke volume and increased heart rate. The use of Inotrope such as dobutamine, digoxin, epinephrine and aminophylline can help lower the decrease cardiac output. Decreased cardiac output in cardiogenic or septic shock is a cause of respiratory fatigue leading to severe alveolar hypoventilation and bradypnea (Roussos, 2003)

On this case, patients also experience infections due to invasive procedures, to overcome this what can be done is to keep the sterile procedure and optimizing airway clearance to prevent respiratory tract infections. This action is in line with research This action is in line with research conducted by Belli et al., (2021) which states the nursing care plan prioritized interventions aimed at optimizing airway clearance the aim is to reduce airway obstruction caused by secretions occupying the airway lumen and so prevent respiratory tract infections.

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CONCLUSION

Effective nursing care plays a crucial role in managing respiratory failure and ensuring optimal patient outcomes. This case study underscores the importance of comprehensive assessment, evidence-based interventions, and continuous monitoring in addressing the complex needs of patients with respiratory failure. During 6 days intervention it is showed that for airway problem and instability of blood glucose level was resolved, gas exchange disorder and spontaneous ventilation disorder not resolved until the sixth day because the patient on the sixth day experiences metabolic and respiratory acidosis conditions caused by multiple organ failure so that the correction given to the patient is not only related to oxygenation but also very important to make electrolyte corrections in patients and overcome problems in other body functions.

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