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RESPIRATORY AND CIRCULATORY PROBLEMS OF COVID-19 IN THE CONTEXT OF ESTABLISHING INTENSIVE CARE UNIT NURSING DIAGNOSIS

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ABSTRACT

Introduction: The novel coronavirus disease 2019 (COVID-19) is a virus that attacks the respiratory tract with rapid spread and high mortality. Initial reports that COVID-19 associated with critical care due to the severity of the disease requiring mechanical assistive devices in its treatment. The purpose to identify the nursing diagnosis related to respiratory and circulatory problems of COVID-19 in the critical care unit.
Method: An integrative review highlights the issue that nursing problems related to respiratory and circulatory in COVID-19 patients admitted to the Intensive Care Unit (ICU). This study focuses on papers published from 2020 to 2021 using the keyword "clinical manifestation of COVID-19" which was accessed through the Pubmed database.
Result: The results showed that findings in articles that were reviewed and integrated with the SDKI. Nursing diagnosis related to respiratory problems such as 1) Ineffective airway clearance; 2) Dysfunctional ventilatory weaning response; 3) Impaired gas exchange; 4) Impaired spontaneous ventilation. Nursing diagnosis related to circulatory problems such as 1) Risk / decreased cardiac output; 2) Risk for bleeding; 3) Risk for effective renal perfusion; 4) Risk for ineffective cerebral perfusion.
Conclusion: Critical care nurses carry out a series of treatments based on the nursing process stages, one of which is the enforcement of a nursing diagnosis. The nursing diagnosis is needed to develop nursing plans and strategies for implementation so that the goals of nursing care are achieved.

Keywords
Covid-19, Nursing Diagnosis, Intensive Care Unit

INTRODUCTION

The novel coronavirus disease 2019 (COVID-19) is a virus that attacks the respiratory tract with a rapid spread and high mortality. The COVID-19 pandemic is having a major impact on the provision of health services. The spread of the virus is very fast, high cases, and the prognosis of acute critical illness. Initial reports that COVID-19 is linked to critical care because of the severity of the disease requiring mechanical aids in its treatment. The results of the study Al Aljuhani et al (2020) showed that the median length of stay in the ICU was 10.00 days with the fastest treatment duration of 6.00 days and the longest duration of 17.50 days. Patients with ICU readmissions within 3 months were 9.15 respondents.

In the condition of the severity of COVID-19, most of the patients experienced complications of Acute Respiratory Distress Syndrome (ARDS) of 78.36%, Acute Cardiac Injury of 55.97%, Acute Kidney Injury (AKI) of 47.01%. Besides, COVID-19 patients also need treatment management that involves mechanical aids and other forms of therapy. The results also showed that all COVID-19 patients treated in the ICU used mechanical ventilation (MV), the median of MV duration was 9.00 days with the fastest duration of 3.00 days and the longest duration of 17.00 days, patients with Extracorporeal Membrane Oxygenation (ECMO) of 15%, patients with Continuous Renal Replacement Therapy (CRRT) of 18.9%, and patients with Vasopressors/Inotropes of 54.6% respondents (Al et al., 2020; L. Zhang et al., 2020).

The achievement of treatment goals, especially the Intensive Care Unit (ICU), involves multidisciplinary disciplines, one of which is the nursing profession. Nurses provide nursing care to patients with 5 stages of the nursing process, such as assessment, nursing diagnosis, intervention, implementation, and evaluation. Nursing diagnosis is one of the most important in the nursing process because by establishing a proper nursing diagnosis and following the patient's condition, the goals of nursing care will be achieved during the treatment process. Therefore, this study aims to identify the nursing diagnosis related to respiratory and circulatory problems of COVID-19 in the Intensive Care Unit (ICU).

METHOD

This integrative review highlights the issue that nursing problems related to respiratory and circulatory in COVID-19 patients admitted to the Intensive Care Unit (ICU). This study focuses on papers published from 2020 to 2021 using the keyword "clinical manifestation of COVID-19" which was accessed through the Pubmed database. The criteria for selecting papers to be reviewed include clinical manifestations of COVID-19, problems related to respiratory and circulatory, and patients who were treated in the ICU. The first results obtained were 2725 articles then screened based on appropriate titles found that 166 articles and 15 articles were selected based on abstracts and 12 studies matched the criteria (exploring problems related to respiration and circulation in COVID-19 patients who were treated in the ICU).

RESULT

The study results obtained 12 appropriate articles arranged in a table that provided information about the author and year published, research methodology, samples used, and research results.

Table 1 Review of Article

Author & Research Method	Finding
Author: (Zeng et al., 2020) **Method:** A Single-Center Retrospective Study **Sample:** The total sample was 416 patients with COVID-19 (ICU and non-ICU) from January 11 to April 1, 2020, at Shenzhen- hen Third People's Hospital in China	**Laboratory finding:** The median of Fibrinogen was 4.55 g/L (min-max: 3.60-5.99); (NR: 2-4 g/L) The median of D-dimer was 1.25 μg/L (min-max: 0.62-3.02); (NR: 0-0.5 μg/L) The median of Troponin I was 0.029 ng/mL (min-max: 0.007-0.063); (NR: <0.026 ng/mL) The median of Myoglobin was 65.45 μg/L (min-max: 39.77-130.57); (NR: <100 μg/L) The median of C-reactive protein was 55.30 mg/L (min-max: 11.32-124.53); (NR: 0.8-8 mg/L) The median of Procalcitonin was 0.21 ng/mL (0.16-0.26); (NR: <0.05 ng/Ml) The median of Interleukin 6 was 46.18 pg/ml (min-max: 27.39-150.40); (NR: <7 pg/ml) The median of Ph was 7.45 (min-max: 7.43-7.47); (NR: 7.35-7.45) The median of PaO2 was 76.65 mmHg (min-max: 59.10-96.60); (NR: 83-100 mmHg) The median of PaO2/FIO2 was 267.38 (min-max: 145.50-355.17); (NR: 400-500) **The echocardiographic finding:** Left Ventricular Ejection Fraction (LVEF) <55% by 16% of respondents, There is a significant difference to LVEF <55% in ICU and non-ICU COVID-19 patients (p-value <0.05) Left-Ventricular Posterior Wall Depth (LVPWd) >11 mm by 39% of respondents **The complication:** Acute Cardiac Injury by 60% of respondents Atrial or Ventricular Tachyarrhythmia by 9% of respondents Acute Heart Failure (AHF) by 14% of respondents **Oxygen support:** Non-Invasive Ventilation (NIV) by 49% of respondents Invasive Mechanical Ventilation (IMV) by 51% of respondents ECMO by 15% of respondents
Author: (Amaratunga, Corwin, Moran, & Snyder, 2020) **Method:** Retrospective Case Series **Sample:** Four patients with COVID-19 in ICU St. Luke's University Health	The study results showed that 1 in 4 patients (25%) experienced a prolonged QTc of 539 ms that persisted. However, in patients experiencing episodes of bradycardia, the patient was experiencing a prolonged QTc of 491 ms occurred.
Author: (Sadeghi et al., 2020) **Method:** The observational, retrospective, single study **Sample:** The total sample was 214 patients with COVID-19 who were admitted to ICU and Non-ICU in Taleghani	**Clinical manifestation:** Cough by 45.45% of respondents Dyspnea by 50.90% of respondents The mean of admission O2 saturation was 86.08% with a standard deviation of 9.79%

Author: (McGovern, Conway, Pekrul, & Tujjar, 2020) **Method:** Retrospective Case Report **Sample:** Patient with COVID-19 was admitted to the ICU in Sligo University Hospital, Ireland	**Clinical manifestation:** Increased work of breathing and shortness of breath SpO2 of 68% on room air Pulmonary auscultation was fine crepitations and wheeze were heard throughout The peak value of D-dimers was 7655 ng/mL (during fourteen days in ICU) The peak value of Troponin T-hs was 115 ng/L (during fourteen days in ICU) The peak value of Fibrinogen was 680 mg/L (during the first week in ICU) **Diagnostic examination finding:** X-ray diagnostic showed elevated inflammatory markers **Treatment:** The patient was given mechanical ventilation within 24 hours of admission Enoxaparin (1 mg/kg SC BD) Dual Antiplatelet Therapy (ASA 300 mg and ticagrelor 180 mg STAT followed by ASA 75 mg OD and ticagrelor 90 mg BD)
Author: (Widysanto et al., 2020) **Method:** A Case Report **Sample:** The patient male, 48 years old with COVID-19 was admitted to ICU	**Clinical manifestation:** Couhg, dyspnea SpO2 of 77% on room air Pulmonary auscultation was rhonchi in bilateral lungs Disseminated Intravascular Coagulation (DIC) on day 18 hospitalization **Diagnostic examination finding:** Chest CT scan showed ground-glass opacity (GGO) and multifocal crazy paving pattern involving both lungs, predominantly in a peripheral distribution Chest X-ray showed bilateral lung opacities on perihilar and middle to inferior lung fields Blood Gas Analysis (BGA) showed pH 7.5, PaO2 57 mmHg, PaCO2 29 mmHg, HCO3 22.4 mmoL/L, SpO2 92.2% The median of D-dimer was 4.49 µg/L (min-max: 0.62-3.02); (NR: 0-0.5 µg/L) Bronchoscopy result (at fourteen hospitalizations) showed a very thick mucous plug on the right and left main bronchus and **Treatment:** The patient was given mechanical ventilation on day 4 of hospitalization The patient was given Water Seal Drainage (WSD) due to developed right lung hydropneumothorax and atelectasis as seen on serial thorax X-ray (removed on day 37 hospitalization) The patient was given tracheostomy on day 14 of hospitalization (removed on day 37 hospitalization)
Author: (J. Zhang et al., 2020) **Method:** A Retrospective Analysis **Sample:** The total sample was 19 patients with COVID-19 from the ICU Liyuan Hospital	**Clinical manifestation:** Cough by 42.10% of respondents **Diagnostic examination finding:** Chest CT scan showed ground-glass opacity (GGO) of 100% respondents
Author: (Díaz-Pérez et al., 2020) **Method:** Clinical presentation and diagnostic work-up of the patients	**Clinical manifestation:** Cough by 42.10% of respondents Disseminated Intravascular Coagulation (DIC) Neurological examination: inattention, disorientation, revealed drowsiness, and slow speech with no focal neurologic deficits

	Diagnostic examination and laboratory finding: Lymphopenia of 300 cells/μl (NR: 1000-4000) Fibrinogen of 631 mg/dl (NR: 150-400 mg/dl) D-dimer of 124.86 μg/ml (NR: 0.15-0.50) Ferritin of 538 ng/ml (NR: 30-400) Lactate Dehydrogenase (LDH) of 338 U/l (NR: 35-225) C-reactive protein (CRP) of 10.2 mg/dl (NR: <0.50) The EEG showed moderate diffuse encephalopathy A brain MRI showed multiple ischemic lesions CT pulmonary angiogram showed a bilateral pulmonary embolism **Treatment:** The patient was given mechanical ventilation Low-Molecular-Weight Heparin (LMWH) of 60-80 mg q.d
Author: (L. Zhang et al., 2020) **Method:** The study collected cases **Sample:** The total sample was 134 patient with COVID-19 in ICU at the Wuhan Jinyintan Hospital	**Clinical manifestation:** Dyspnea by 64.93% of respondents Productive cough by 35.07% of respondents **The complication:** ARDS by 78.36% of respondents Acute Cardiac Injury by 55.97% of respondents Acute Kidney Injury (AKI) by 47.01% of respondents **Treatment:** Invasive Mechanical Ventilation (IMV) by 58.96% of respondents ECMO by 5.22% of respondents CRRT by 5.97% of respondents
Author: (Gul et al., 2021) **Method:** A retrospective, cross-sectional, and descriptive study design **Sample:** The total sample was 20 patients with COVID-19 admitted to the ICU of DHQ Hospital, Faisalabad (Pakistan)	**Clinical manifestation:** Dyspnea by 80% of respondents Cough by 80% of respondents The mean respiratory rate (RR) was 29.30 bpm with a standard deviation of 7.21 bpm Respiratory rate >24 bpm by 70% of respondents **Diagnostic examination and laboratory finding:** D-dimer >1 mg/mL by 75% of respondents LDH >245 U/L by 85% of respondents
Author: (Chen et al., 2021) **Method:** A retrospective, single-center study **Sample:** The total sample was 92 patients with COVID-19 admitted to the ICU of the Sino-French New City Branch of Tongji Hospital	**Clinical manifestation:** Cough by 78.3% of respondents Productive cough by 44.6% of respondent Dyspnea by 60.9% of respondents **Laboratory finding:** The median LDH was 483 U/L (min-max: 37-1,867); (NR: 120.0-250.0) The median Hs Troponin I was 108.9 pg/ml (min-max: 2.4-19,731.4); (NR: 0-34.2) The median Hs CRP was 76.2 mg/L (min-max: 0.0-5.0); (NR: 1.3-300) The median IL-6 was 207.4 pg/ml (min-max: 2.37-5,000); (NR: 0.0-7.0) The median Serum Ferritin was 1,889.2 μg/L (min-max: 2.4-19,731.4); (NR: 0-34.2) The median D-dimer was 3.48 μg/mL (min-max: 0.25-21); (NR: 0.0-1.5) **Treatment:** IMV by 56.5% of respondents ECMO by 5.4% of respondents Antiviral by 68.5% of respondents

Author: (Al et al., 2020) **Method:** A multicenter, non-interventional cohort study **Sample:** The total sample was 560 patients with COVID-19	**Treatment:** The median of mechanical ventilation duration was 9.00 days (min-max: 3.00-17.00) The median of ICU length stay was 10.00 days (min-max: 6.00-17.50) ICU readmission within 3 months of 9.15% respondents Mechanical Ventilation by 71.4% of respondents ECMO by 1.8% of respondents CRRT by 18.9% of respondents Conventional dialysis by 15.7% of respondents Anticoagulation therapy by 30.2% of respondents Hydroxychloroquine therapy by 7.5% of respondents Vasopressors/Inotropes by 54.6% of respondents
Author: (Lipcsey et al., 2021) **Method:** A prospective single-center observational study **Sample:** The total sample was 66 patients with COVID-19 in the ICU of a mixed surgical and medical unit at Uppsala University Hospital	**Laboratory finding:** The median of D-dimer was 1.40 μg/ml (min-max: 0.88-2.65; (NR: 0.15-0.50) The median of Fibrinogen was 6.5 g/L (min-max: 5.1-7.6); (NR: 2.0-4.2) **Treatment:** Invasive Mechanical Ventilation by 63% of respondents CRRT by 11% of respondents

NR: normal range

DISCUSSION

Ineffective Airway Clearance

According to the Standard Diagnosis Keperawatan Indonesia (SDKI), ineffective airway clearance is an inability to clear secretions or airway obstruction to keep the airway patent (PPNI, 2016). The etiology of problems are airway hypersecretion and inflammatory processes (associated condition: respiratory tract infection). The nursing problem is integrated with the findings, such as 1) the majority of respondents with cough by 45.45-80.00%; 2) the majority of respondents with dyspnea by 50.90-80.00%; 3) increased work of breathing and shortness of breath; 4) productive cough by 35.07% of respondents; 5) the mean of respiratory rate (RR) was 29.30 bpm with standard deviation of 7.21 bpm; 6) respiratory rate >24 bpm by 70% of respondents; 7) pulmonary auscultation was rhonchi in bilateral lungs; 8) the median of C-reactive protein was 55.30 mg/L (min-max: 11.32-124.53); 9) the median of Procalcitonin was 0.21 ng/mL (0.16-0.26); 10) the median of Interleukin 6 was 46.18 pg/ml (min-max: 27.39-150.40); 11) chest CT scan showed ground-glass opacity (GGO) of 100% respondents Chest X-ray showed bilateral lung opacities on perihilar and middle to inferior lung fields; 12) bronchoscopy result (at fourteen hospitalizations) showed a very thick mucous plug on the right and left main bronchus (Gul et al., 2021; McGovern et al., 2020; Sadeghi et al., 2020; Widysanto et al., 2020; Zeng et al., 2020; J. Zhang et al., 2020; L. Zhang et al., 2020).

Mucous secretion is the physiology of the respiratory tract to protect the respiratory tract as a physical barrier against inhaled microbes and incoming particles. The increased secretion of excess from the respiratory mucosa is caused by the inflammatory response of SARS-CoV-2. The role of IL-4 and IL-5 is mediated by TH2 cells in mucus production and cell recruitment. IL-4 activates CD4 T cells resulting in differentiation of th0 cells into th2 cells (active IL-4 secretion) and maintains a positive feedback loop. IL-4 activates the JAK3 / STAT 6 pathway so that MUC54C transcription is induced. CLCA1 (calcium-activated chloride channel 1) is activated by STAT 6 to signal MAPK to produce mucin production and Th2 cells recruit lymphocytes and eosinophils into the lungs. This process can cause excess mucus secretion in the airway (Khan et al., 2021).

Dysfunctional Ventilatory Weaning Response

According to the SDKI, dysfunctional ventilatory weaning response is an inability to adapt to reduced mechanical ventilator assistance which can hinder and prolong the weaning process (PPNI, 2016). The etiology of the problem is a history of ventilator dependence >4 days (associated condition: respiratory failure). The nursing problems were integrated with the findings, such as 1) most of the respondents with MV by 71.4%; 2) the median of MV duration was 9.00 days (min-max: 3.00-17.00); 3) the patient was given tracheostomy on day 14 of hospitalization (removed on day 37 hospitalization). Most of the COVID-19 patients who undergo intensive care are reported with IMV assistance. The median of MV was 9 days with the shortest day being 3 days and the day being 17 days long. This is in line with a study conducted by Schenck et al (2020), where the median patient with MV was 18 days with the fastest duration of 14 days and the longest duration of 24 days. The results of this study indicate that most of the COVID-19 patients with MV cannot wean the ventilator so that the patient experiences a dysfunctional ventilatory weaning response (Ferri et al., 2020).

The European Archives of Otorhinolaryngology publish the timing of tracheostomy in COVID-19 patients to reduce ICU care for patients with prolonged IMV. Tracheostomy is recommended within 7 and 14 days of treatment with IMV to avoid potential damage to the trachea. In another study, it was stated that tracheostomy was performed on the 14th to 25th day of the intubated patient during the COVID-19 pandemic, but the condition of COVID-19 patients is generally unstable, so it is better if tracheostomy is done early within 10 days of intubation. Tracheostomy is the most common surgical procedure performed in the ICU to facilitate the MV weaning process, expedite the airway, reduce laryngeal injury due to endotracheal intubation (ETT), prevent long-term complications (eg tracheal stenosis), and increase patient comfort (Ferri et al., 2020; Mattioli et al., 2020).

Impaired Gas Exchange

According to the SDKI, impaired gas exchange is excess or lack of oxygen and/or elimination of carbon dioxide in the alveolar-capillary membrane (PPNI, 2016). The etiology of the problem is alveolar-capillary membrane changes (associated conditions: pneumonia, respiratory infection). The nursing problem is integrated with the findings, such as 1) the median of pH was 7.45 (min-max: 7.43-7.47); 2) the median of PaO2 was 76.65 mmHg (min-max: 59.10-96.60); 3) pulmonary auscultation was rhonchi in bilateral lungs, Chest CT scan showed ground-glass opacity (GGO) and multifocal crazy paving pattern involving both lungs, predominantly in a peripheral distribution; 4) Chest X-ray showed bilateral lung opacities on perihilar and middle to inferior lung fields; 5) Blood Gas Analysis (BGA) showed pH 7.5, PaO2 57 mmHg, PaCO2 29 mmHg; 6) The median of Interleukin 6 was 46.18 pg/ml (min-max: 27.39-150.40); 7) the mean of admission O2 saturation was 86.08% with a standard deviation of 9.79 (Widysanto et al., 2020; Zeng et al., 2020).

In the condition of the severity of COVID-19, the process of viral infection progresses from the upper respiratory tract to the bronchial epithelial cells. Coronavirus 2 (SARS-CoV-2) enters via ACE2 and many in alveolar type II (makes and releases pulmonary surfactant needed for gas exchange) then alveolar macrophages respond and infected phagocytosis and apoptotic epithelial cells, promote viral clearance, increase secretion pro-inflammatory, and chemotactic cytokines (IL-6 and IL-8). This process can increase surface tension and increase alveolar flooding, resulting in disruption of the diffusion process in the alveolar-capillary membrane (Mihaescu et al., 2020).

Impaired Spontaneous Ventilation

According to the SDKI, impaired spontaneous ventilation is decreased energy reserves resulting in the individual unable to breathe adequately (PPNI, 2016). The etiology of the problem is a metabolic disorder (related condition: ARDS). The nursing problem is integrated with the findings, such as 1) SpO2 of 68% on room air; 2) BGA showed pH 7.5, PaO2 57 mmHg, PaCO2 29 mmHg; 3) the median of PaO2/FIO2 was 267.38 (min-max: 145.50-355.17); 4) NIV by 49% of respondents; 5) IMV by 51-71,4% of respondents; 6) the patient was given mechanical ventilation within 24 hours of admission; 7) ECMO by1.8-15% of respondents; 8) Chest CT scan showed ground-glass opacity (GGO) of 100% respondents; 9) ARDS by 78.36% of respondents (Al et al., 2020; Chen et al., 2021; Lipcsey et al., 2021; McGovern et al., 2020; Widysanto et al., 2020; Zeng et al., 2020; L. Zhang et al., 2020).

ARDS is a serious respiratory disorder caused by fluid buildup in the alveoli (alveolar flooding) with protein-rich edema fluid. ARDS causes diffuse alveolar damage in the lungs by forming a hyaline membrane in the alveoli (acute stage) and fibroblast proliferation that can cause lung injury (epithelial cell prolonged inflammation) characterized by a PaO2 FiO2 ratio of less than 300. Respiratory failure (intrapulmonary ventilation-perfusion mismatch) resulting in impaired spontaneous ventilation. In COVID-19 patients, ARDS IS developed in 42% of patients with pneumonia. Oxygen-assisted strategies are important in the management of ARDS in COVID-19 patients. Mechanical aids such as IMV and ECMO are required under these conditions. ECMO is given to patients with mechanical ventilation and continued hypoxemia. Mechanical ventilation (MV) is the cornerstone of management in patients with severe respiratory failure. MV to ensure oxygenation and carbon dioxide clearance and significantly defines the principle and practice of invasive MV in ARDS patients in the last five decades (Gibson, Qin, & Puah, 2020; Lowe et al., 2021).

Risk/Decreased Cardiac Output

According to the SDKI, risk/decreased cardiac output is a risk or the inability of the heart to pump blood to meet the body's metabolic needs (PPNI, 2016). The etiology of the problem is changes in heart rhythm and changes in cardiac contractility.

The changes in heart rhythm. A study conducted by Zeng et al (2020), that COVID-19 patients admitted to ICU showed Atrial or Ventricular Tachyarrhythmia was 9% of respondents. The study results showed that 1 in 4 patients (25%) experienced a prolonged QTc of 539 ms that persisted. However, in patients experiencing episodes of bradycardia, the patient was experiencing a prolonged QTc of 491 ms occurred

(Amaratunga et al., 2020). Atrial tachyarrhythmia occurs in patients with severe pneumonia, which is an increase in atrial pressure as a result of increased lung resistance. Long-QT interval can also occur due to side effects of drugs given to COVID-19 patients, namely hydroxychloroquine. The results of the study also showed that most respondents received 68.5% antiviral therapy and some respondents received 7.5% Hydroxychloroquine therapy (Al et al., 2020; Chen et al., 2021). Hydroxychloroquine can significantly cause QT prolongation and Torsade de Pointes (TdP). TdP is a form of polymorphic ventricular tachycardia. This occurs in the setting of QT prolongation and changes in complex amplitude in the isoelectric line and can develop into lethal arrhythmias, namely ventricular fibrillation (Li et al., 2020; Saleh et al., 2020).

The changes in myocardial contractility. The change in cardiac output caused by changes in myocardial contractility is supported by the results of studies including an increase in Troponin I, an increase in Myoglobin, some respondents show LVEF <55%, some respondents show LVPWd, most respondents experience complications of acute cardiac injury, most respondents experience acute Heart Failure. The mechanisms for myocardial injury in COVID-19 patients include 1) respiratory failure and hypoxemia, which causes damage to myocytes of the heart; 2) cytokine storms mediated by pathological T-cells cause myocarditis; 3) hypercoagulability and progression of coronary microvascular thrombosis; 4) downregulation of ACE2 expression; 5) endothelium resulting from diffuse endothelial injury (one of which is to the heart); 6) rupture of coronary plaque due to stress or inflammation that causes ischemic or myocardial infarction. These conditions can cause a decrease in myocardial contractility function and cause a decrease (actual or risk) cardiac output (Bavishi et al., 2020).

Risk for Bleeding

According to the SDKI, the risk for bleeding is the risk of experiencing blood loss both internally (occurs in the body) and externally (occurs until it leaves the body) (PPNI, 2016). A risk factor for such problems is the effect of pharmacological agents (associated condition: Disseminated Intravascular Coagulation, DIC). The nursing problem is integrated with the findings, namely that the anticoagulant therapy obtained by the patient included 1) Enoxaparin (1 mg/kg SC BD); 2) Dual Antiplatelet Therapy; 3) Low-Molecular-Weight Heparin (LMWH) of 60-80 mg q.d, and Anticoagulation therapy of 30.2% respondents (Al et al., 2020; Díaz-Pérez et al., 2020; Zeng et al., 2020). The COVID-19 patients receive anticoagulant therapy because they experience coagulopathy abnormalities. This was in line with the findings that the majority of respondents experienced an increase D-dimer >1 mg/mL of 75%, D-dimer of 124.86 μg/ml (NR: 0.15-0.50), the peak value of D-dimers was 7655 ng/mL (during fourteen days in ICU), the median of Fibrinogen was 4.55 g/L (min-max: 3.60-5.99), and peak value of Fibrinogen was 680 mg/L (during the first week in ICU) (Díaz-Pérez et al., 2020; Gul et al., 2021; McGovern et al., 2020; Zeng et al., 2020).

The observed pattern of abnormal coagulation in COVID-19 patients is an increase in fibrinogen and D-dimers. D-dimers are the main breakdown fragments of fibrin. D-dimers are used as biomarkers of fibrin formation and degradation as well as markers of coagulation and fibrinolysis activation. The condition of the severity of COVID-19 is the occurrence of a cytokine storm. Cytokine storm is an excessive release of pro-inflammatory cytokines that affect the pathophysiology of coagulopathy associated with COVID-19. Pro-inflammation activates endothelial cells and leukocytes (particularly neutrophils in response) to produce neutrophil extracellular traps (NETs) and the process of formation is called NETosis. NET is tasked with strengthening cytokine production and promoting thrombus formation. Besides, innate immune systems such as plasma prekallikrein and factor XII (FXII) contribute to increased fibrin formation (micro thrombosis), thrombin formation, and increased D-dimer levels (Yao et al., 2020).

Risk for Ineffective Renal Perfusion

According to the SDKI, the risk for ineffective renal perfusion is a risk of having decreased blood circulation to the kidneys (PPNI, 2016). Risk factors for such problems are hypoxia, kidney dysfunction, and inflammatory processes. The nursing problem is integrated with the findings, such as 1) increased C-reactive protein; 2) the median IL-6 was 207.4 pg/ml (min-max: 2.37-5,000); 3) Acute Kidney Injury (AKI) by 47.01% of respondents; 4) most of the respondents were carried out by CRRT amounting to 5.97-18.9% of respondents; 5) conventional dialysis by 15.7% of respondents (Al et al., 2020; Chen et al., 2021; Díaz-Pérez et al., 2020; Lipcsey et al., 2021; Zeng et al., 2020; J. Zhang et al., 2020). AKI results from an increase in pro-inflammatory cytokines, direct viral injury to receptors (ACE2) that are highly expressed in the kidneys, unbalanced Renin-Angiotensin-Aldosterone System (RAAS), and microvascular thrombosis. Another mechanism can occur due to ARDS, such as decreased gas exchange and severe hypoxemia that occurs in COVID-19 patients (Gabarre et al., 2020). This was in line with the study results L. Zhang et al (2020) there were most of the respondents experienced ARDS of 78.36%.

Risk for Ineffective Cerebral Perfusion

According to the SDKI, the risk for ineffective cerebral perfusion is the risk of having decreased blood circulation to the brain (PPNI, 2016). The risk factor for this problem is Disseminated Intravascular Coagulation (DIC). The nursing problem is integrated with the findings, such as 1) Disseminated Intravascular Coagulation (DIC) on day 18 hospitalization; 2) the EEG showed moderate diffuse encephalopathy; 3) a brain MRI showed multiple ischemic lesions (Díaz-Pérez et al., 2020; Widysanto et al., 2020). According to the International Society on Thrombosis and Haemostasis (2001), DIC can be defined as "an acquired syndrome characterized by intravascular coagulation activation." In general, DIC occurs with low platelet counts, increased D-dimer, and (slightly) prolonged coagulation times.

Abnormalities of coagulopathy that occur in patients with severe forms of COVID-19, especially in patients who experience severe infections will cause systemic coagulopathy, namely Disseminated Intravascular Coagulation (DIC). Systemic levels of pro-inflammatory cytokines in severe COVID-19 patients such as interleukin (IL)-1 and IL-6 and tumor necrosis factor-α (TNF-α) are markedly increased. IL-6 induces tissue factor expression in macrophages and monocytes that can lead to thrombin formation. There is a cytokine storm characterized by high levels of pro-inflammatory chemokines and cytokines. Microvascular thrombosis can cause hemodynamic disturbances. DIC causes multi-organ dysfunction, one of which is impaired cerebral function (Levi & Iba, 2021; Papageorgiou et al., 2018).

CONCLUSION

Nursing diagnosis is one of the stages of the nursing process. It can be enforced in COVID-19 patients who are undergoing treatment in the ICU are based on the results of a review article which is integrated with the criteria in the SDKI. Nursing diagnosis related to respiratory problems such as 1) Ineffective airway clearance; 2) Dysfunctional ventilatory weaning response; 3) Impaired gas exchange; 4) Impaired spontaneous ventilation. Nursing diagnosis related to circulatory problems such as 1) Risk / decreased cardiac output; 2) Risk for bleeding; 3) Risk for effective renal perfusion; 4) Risk for ineffective cerebral perfusion.

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CONFLICT OF INTEREST

The authors have no conflicts of interest to declare.

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