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Characteristics of COVID-19 patients with pressure injuries in a COVID-19 referral hospital in Surabaya, Indonesia

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Abstract

Introduction: For more than two years, Corona Virus Disease 2019 (COVID-19) has been a global pandemic. As the number of patients admitted to hospitals grows, particularly in the intensive care unit (ICU), more of these individuals are vulnerable to pressure injury (PI) as a result of disease complications.

Methods: This retrospective study describes the data of COVID-19 patients treated at Airlangga University Hospital, a COVID-19 referral hospital in Surabaya, Indonesia, who experienced pressure injuries either before or after admission. The age, gender, BMI, symptoms, comorbidities, location and severity of pressure injury, complete blood count, serum creatinine, albumin, d-dimer, oxygen therapy, length of stay (LOS), and usage of vasopressors of the patients were all presented.

Results: In this study, 1070 patients were confirmed for COVID-19, although only twelve (1.1 percent) had PI. Eight (66.7 percent) patients were male. The median age was 60 (51 - 71), and half of the patients were obese. Eleven (91,4%) patients had at least one concurrent condition. The sacrum and gluteus were the two most commonly affected sites. Those with stage 3 PI had a substantially greater median d-dimer (7,900 ng/mL) than patients with stage 2 PI (1,100 ng/mL). The average length of stay (LOS) was 22 days (9.8 – 40.3).

Conclusion: As a possible risk for severity, health professional should put attention to the increase in d-dimer in COVID-19 patients who develop pressure injury. While pressure injuries in these patients may not result in immediate mortality, an increase in morbidity may be prevented with proper treatment.

Keywords: COVID-19, d-dimer, Pressure injury

INTRODUCTION

For more than two years, Corona Virus Disease 2019 (COVID-19) has been a global pandemic. It was caused by the severe acute respiratory syndrome coronavirus 2 (SARS-Cov-2) and began in Wuhan, China[1], before spreading worldwide. In Indonesia, the first case was discovered in March 2020; since then, over 2 million people have contracted COVID-19, with over 21,000 testing positive as of the end of June 2021[2]. As the number of patients admitted to hospitals grows, particularly in the intensive care unit (ICU), more of these individuals are vulnerable to pressure injury (PI) as a result of disease consequences such as inactivity, immobility, and the use of artificial airways[3].

Pressure injury is a type of local trauma caused by unceasing pressure on the skin, most commonly over bony prominences. This pressure is high enough to interfere with blood flow to the capillaries, reducing oxygen supply to the tissues. This results in ischemia and necrosis of the afflicted tissue[4]. The sacrum, heel, sciatic tuberosity, greater trochanter, and lateral malleolus are frequently impacted[5]. Advanced age, immobility, poor nutrition, excessive wetness and incontinence, altered state of consciousness, poor perfusion, specific skin diseases, and concomitant disorders such as respiratory failure, anemia, diabetes, and septicemia are all risk factors[6]. Patients who acquire PIs are older, have less mobility, and stay in the hospital for a longer period of time than patients who do not[7]. In one study, patients who were hospitalized for 7-20 days had a higher rate of PI than those who were hospitalized for fewer than seven days[8].

A "cytokine storm" may arise as the COVID-19 proceeds. Systemic inflammation, hyperferitinemia, and hemodynamic dysfunction characterize a cytokine storm[9]. This unregulated immune response will cause immune cells, lymphocytes, and macrophages to infiltrate. A substantial amount of proinflammatory cytokines will be produced by these immune cells[10]. The cytokines interleukin-6 (IL-6) and tumor necrosis factor-alpha (TNF-a) [11] are both involved in the production of PI[12,13] and are essential components of the cytokine storm. The rise in d-dimers in COVID-19 indicates that these two cytokines are related with a mix of systemic inflammatory processes and hypercoagulability situations[14].

Nearly half of COVID-19 pneumonia patients developed acute respiratory distress syndrome (ARDS), and more than two - thirds required intensive care and mechanical ventilation[15,16]. Patients who are ventilated are at risk of developing PI because they become immobilized and sedated[17].

According to the researchers, this is the first study in Indonesia to characterize the clinical characteristics of COVID-19 patients with PI. Because of the urgency of the issue and the increased risk of PI in COVID-19 patients, this study was conducted at an infectious disease hospital in Surabaya, Indonesia, to describe the clinical characteristics of COVID-19 patients with PI.

METHODS

Ethical considerations and consent

On June 22, 2021, the Clinical Research Ethics Committee at Airlangga University Hospital in Surabaya, Indonesia, accepted this study with ethical approval number 157/KEP/2021. Because this was a retrospective research study based on anonymous and de-identified data, no consent was sought.

Study design and setting

This was a descriptive and retrospective study. Between March 2020 and June 2021, samples were collected consecutively from all patients diagnosed with pressure injury and COVID-19 at Airlangga University Hospital.

Participant

The polymerase chain reaction confirmed that the patients were positive for COVID-19. Patients on both invasive and noninvasive mechanical ventilation were included in the study. The study included only patients who were at least 18 years old. Twelve patients with COVID-19 who were admitted at Airlangga University Hospital and experienced pressure injuries were included in the study. Two of the twelve patients had already suffered a pressure injury before being admitted to the hospital. Only PIs induced by supine position were considered, such as those on the sacrum, occipital, temporal, heels (calcaneus), gluteus, scapula, and trochanter, according to the National Pressure Ulcer Advisory Panel[18]. PIs to the bridge of the nose caused by noninvasive ventilation face masks was ruled out.

Variables and data sources

Secondary data from medical records were used in this study, including: the patients' gender and age; BMI, defined as body weight in kilograms divided by height in meters squared and categorized by definitions as follows: 1) underweight (BMI < 18.5kg/m^2); 2) normal weight (BMI 18.5 – 22.9 kg/m^2); 3) overweight (BMI 23 – 24.9 kg/m^2); 4) obese I (BMI 25 – 29.9 kg/m^2); 5) obese II (BMI< 30 kg/m^2) according to the WHO recommendations for Asian populations[19]; symptoms related to COVID-19 on admission; coexisting disorder (hypertension, diabetes mellitus, cerebrovascular disease, coronary artery disease); type of oxygen therapy used during the time the patient was consulted for pressure injury (room air, nasal cannula, simple oxygen mask, mechanical ventilation); laboratory results of complete blood count, creatinine, glucose, albumin, and d-dimer less than or equal to 3 days prior to the pressure injury consultation; location of pressure injury; classification of pressure injury in accordance with the National Pressure Ulcer Advisory Panel[18] and length of stay in the hospital. The data collecting period was determined by the date of hospital admission.

Data analysis

The data was presented in a descriptive analysis. The data collection findings are presented in tabular style, with the median, percentages, and interquartile range displayed.

RESULTS

The authors collected data from confirmed COVID-19 patients treated at Airlangga University Hospital in Surabaya during the start of the pandemic in Indonesia in March 2020 and June 2021. Out of 1070 patients hospitalised for COVID-19, 12 (1.1 percent) established PI. All data will be presented in **Table 1**. Eight (66.7 percent) patients were male. 5 (41.7 percent) of the 12 participants had stage 2 PI, 7 (58.3 percent) had stage 3 PI, and none of the patients in this study had stage 1, stage 4, unstageable, or suspected deep tissue injury (sDTI) PI. These patients had a median age of 60 years. The median age of patients with stage 2 PI was 65 years, which was only slightly older than the median age of patients with stage 3 PI, which was 63.5 years. There was no difference in the number of male patients with stage 2 or stage 3 PI in this study. In female patients, three (75%) had stage 3 PI and one (25%) had stage 2 PI. Two-thirds of the patients were obese. The majority of PI patients in stages 2 and 3 were also obese.

Symptoms

Cough (58.3%), fever (50%), shortness of breath (50%), fatigue (41.7%), and nausea or vomiting were the most prevalent symptoms we saw in these patients (33.3%).

Location

The sacrum (66.7%) was the most frequent site of pressure ulcers in these patients, followed by the gluteus (25%), calcaneus, scapula, temporal, and hip. Sacral ulcers are more prevalent in patients with stage 3 PI.

Coexisting disorder

On admission to the hospital, 11 (91.7 percent) of the 12 patients who suffered from pressure injuries during treatment had at least one comorbidity, including hypertension (50 percent), diabetes (41.7 percent), stroke (41.7 percent), and coronary artery disease (25 percent). More patients in stage 2 PI had hypertension (80%), while most patients in stage 3 PI also had diabetes and cerebrovascular disease.

Median laboratory values

During treatment, the patients were found to be anemic with a median hemoglobin of 10.7 g/dL, hypoalbuminemia (median 3.1 g/dL), and had an elevated leukocyte count. Patients with stage 3 PI had lower hemoglobin levels than those with stage 2 PI (10.2 versus 11.3). In these patients, the median d-dimer value was 3.700 (1,500-8,400) ng/mL. Those with stage 3 PI had a substantially greater median d-dimer (7,900 ng/mL) than patients with stage 2 PI (1,100 ng/mL).

Oxygen therapy

A ventilator was required in eight patients (66.7%), five of whom had stage 3 PI and three of whom had stage 2 PI. The patient who utilized nasal cannula oxygen therapy acquired a stage 2 PI, while one of the two patients (16.7%) who used a basic oxygen mask developed a stage 3 PI.

Vasopressor support

Because of low blood pressure, the use of vasopressors contributes to poor peripheral tissue perfusion. There were 5 patients (71.4%) with stage 3 PI who were on vasopressors, compared to only 2 patients (40%) with stage 2 PI.

Length of stay

The median length of stay for these patients was 22(9.8 – 40.3) days, with stage 2 PI patients treated for 29(26 - 41) days and stage 3 PI patients treated for 13(8 - 29) days.

DISCUSSION

While all of these individuals received proper care, pressure injuries developed throughout their hospitalization. In this study, the median age of COVID-19 patients with PI was 60 years old, which was close to a Chinese study[20]. The median age difference between individuals with stage 2 and 3 PI was unremarkable. However, a study on pressure injury in COVID-19 patients in Spain included more (37,3%) patients between the ages of 80 and 89[21]. As age is a determinant in the development of PIs[6], older patients made up the majority of the age group in COVID-19 hospitalized cases[22,23].

Two-thirds of the patients were obese. The majority of PI patients in stages 2 and 3 were also obese. Most studies suggest that patients with low weight or severely obese were more likely to develop PI[24,25]. One reason this study had more patients who were obese was almost all (87.5%) of the patients with a BMI > 25 kg/m^2 were using ventilators, whereas only one of the patients with a BMI < 25 kg/m^2 were on a ventilator, thus putting them at risk of developing PI[3].

Most common symptoms seen in this research were cough, fever, shortness of breath, followed by fatigue and nausea or vomiting. Several research also reported cough, shortness of breath, fever as a frequent complaint from COVID-19 patients[20,26]. While diarrhea, loss of sense of taste or smell, and sore throat was less common[26,27]

The majority (66.7%) of patients in this study had PI on their sacrum, while the gluteus came in second (25%). Other research also found the sacrum to be the most common site of PI on COVID-19 patients[20,28]. According to a study in Germany, the strongest predictors for sacral pressure ulcer development were mobility (completely dependent vs. completely independent OR 27.1, 95% CI)[29]. As most of these patients were eventually on mechanical ventilator, immobility would be a factor in their PI development[30,31].

In older persons, the atherosclerosis process reduces blood circulation to vital organs such as the heart, brain, legs, and skin, increasing the risk of PI development. Hypertension was the most

frequent coexisting disorder in this study. Cardiovascular disease is frequently associated with PI. Reduced left ventricle ejection fraction predicts PI in patients who have had a myocardial infarction[32]. These patients are more likely to have hypertension, while evidence of its consequences on PI development is conflicting[33]. The second most common coexisting disorders in this study were diabetes and cerebrovascular disease. Diabetes-related peripheral vascular disease and neuropathy appear to be the root causes of PI in diabetic patients[34]. In a Turkish study, diabetes was revealed to be a significant ($p<0.001$) risk factor for PI development in ICU patients[28]. Patients with cerebrovascular disease (CVD) are more likely to become immobile and acquire PI[33].

This study's patients were all anemic. Anemia lowers blood oxygen levels, resulting in a lack of oxygen flow to body tissues[33]. This may enhance the likelihood of tissue ischemia and the development of PI. Two other investigations discovered lower-than-normal hemoglobin levels in pressure injury ICU patients[20,28].

In this study, patients with stage 3 PI had a larger increase in mean d-dimer readings than patients with stage 2 PI. COVID-19 stimulates the immunological response, causing proinflammatory cytokines to be released, causing damage to the vascular endothelium. Following platelet aggregation activation in response to vascular damage, thrombosis and microemboli cause plasmin to promote fibrinolysis, resulting in an increase in d-dimer level[4,35]. Although the mechanism by which COVID-19 affects the development of pressure injury remains unknown, it has been proposed that the myalgia generated by COVID-19 may disguise the discomfort of a pressure injury. Simultaneously, a cytokine storm could exacerbate inflammatory and ischemic tissue damage, as well as create oxygen-induced metabolic acidosis and microemboli[35,36]. Research found that COVID-19 patients in the ICU who developed stage 2 and stage 3 PI had a higher d-dimer value than those with stage 1 PI[20].

The majority (66,7%) of these patients were in the ICU with ARDS and had to be on a ventilator, making them immobile, which contributed to the PI development[30,31,37]. This conclusion is consistent with studies of COVID-19 ICU patients who developed PI[20,28]. COVID-19 predominantly infects lung tissue, resulting in hypoxia due to decreased oxygen exchange. Low blood oxygen levels contribute to the development of PI[33]. As pressure builds up on the skin, the interruption of blood circulation combined with a lack of appropriate oxygen delivery worsens the severity of ischemia.

Characteristics of multi-organ dysfunction syndrome (MODS) might be detected in critically ill COVID-19 patients, such as dysregulation of the body's response to infection characterized by hyperinflammation, alterations in coagulation, and dysregulation of the immunological response[38]. A weakened immune response puts the body vulnerable to opportunistic bacterial infections, which can result in septic shock[39]. Vasopressors constrict blood arteries to assist keep blood pressure stable. The perfusion of smaller blood arteries may be reduced, putting the skin at risk of pressure injury[40].

The shorter hospital stays of patients with stage 3 PI in this study compared to patients with stage 2 PI could be attributed to the quick progression of COVID-19, which led the patient to die before further progression of their pressure injury.

This study recommends that additional attention should be paid to cases of pressure injury in COVID-19 patients. According to one study, having a wound and skin care skilled nurse assigned to these patients reduces the likelihood of PI development by 93%[41].

The study's limitations include the fact that it only reports on a single-center experience with a small group of patients. More analytical observational studies with a bigger sample size could help identify the risk variables for PI in COVID-19 patients.

CONCLUSION

According to the findings of this study, healthcare professionals should pay close attention to cases of pressure injury in COVID-19 patients, particularly those in the ICU. Patients would be immobile due to the constant requirement for ventilators. In these COVID-19 patients, a rise in d-dimer may impact the severity of pressure injury. While pressure injuries in these patients may not result in immediate mortality, an increase in morbidity may be prevented with careful treatment.

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