Clinical Profile Of Diabetes Mellitus Patients With COVID-19 In Dr. Soetomo General Hospital Surabaya

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Abstract

Background: The COVID-19 pandemic were designated as world's major health problem. Its impact has cause significant morbidity and mortality, especially for diabetes mellitus patients which more likely to acquire poorer prognosis because of the inflammatory conditions and COVID-19's effect on glycemic control. A better depiction is needed to understand these disease and how they corelate. **Purpose:** This study aims to give a better depiction of COVID-19 patients with diabetes mellitus. **Methods:** A retrospective descriptive study was conducted in special isolation room of Dr. Soetomo General Hospital Surabaya on diabetes mellitus patients with COVID-19 that is ≥ 18 years old. Patients data including demographic characteristic, COVID-19 characteristic, and diabetes mellitus characteristic were collected and analyzed. **Results:** Male patients dominated the study's population (50,3%). Most patients were in the age of 56 – 65 years old (34.1%). Patient's mean oxygen saturation were 92 ± 0.08 and most were categorized as severe (35.4%). Patients mean random blood glucose were 263.1 ± 142.1 and some patients acquire chronic microvascular and macrovascular complications such as diabetic foot (11.4%) and diabetic retinopathy (0.3%). Most patients survived the disease (56.4%). **Conclusion:** COVID-19 infection in diabetes mellitus patients caused a tendency of oxygen saturation decline and poorer glycemic control which resulted in severe condition that needed an intensive care.

Keywords: COVID-19; diabetes mellitus; random blood glucose; oxygen saturation

1. Introduction

The world is currently in the midst of a COVID-19 pandemic. Acute respiratory syndrome coronavirus is the cause of COVID-19. The virus was first detected in December 2019 in China with reports of pneumonia-like symptoms accompanied by an unknown cause. On 11 March 2020, WHO declared a 'pandemic' status for COVID-19[1]. Up until this day, COVID-19 has infected 636 million people and has caused about 6,61 million deaths worldwide. COVID-19 can attack anyone and does not have criteria for certain criteria, but patients who have comorbidities tend to have worse prognosis and severity of the disease[2]. For people with diabetes mellitus, COVID-19 tends to affect glycemic control and induce hyperglycemia, which is generally associated with poor outcomes. Specifically on the values of random blood glucose and HbA1c patients[3].

It is a well-known fact that COVID-19 can affect glycemic control. Based on a study, COVID-19 patients tend to have a significant increase in blood glucose levels. However, it was found that the increase wasn't so significant in HbA1c. This may be caused by HbA1c which represent blood glucose levels in the last 2-3 months so that the effect of viral infection that occurs in the near term is not very visible. These increases may be caused by an infection which does have a considerable impact on the body's metabolism. Inflammation that occurs continuously can affect systemic glucose homeostasis and trigger hyperglycemia. According to a study report, an activated immune system can lead to insulin resistance. In addition, other studies have also stated that the

activation of the innate immune system for a long time can interfere with insulin secretion and action. This can lead to hyperglycemia and hyperglycemia itself is associated with a poor prognosis. Therefore, it is speculated that there is a link between COVID-19 and glycemic control[3].

This study aims to evaluate the clinical profile of diabetes mellitus patients with COVID-19 in Dr. Soetomo General Hospital Surabaya in hopes to increase the understanding of COVID-19 and diabetes mellitus and improve the patients management.

2. Methods

This study was a retrospective descriptive study using a secondary data obtained from medical records of diabetes mellitus with COVID-19 patients. This study was carried out in the special isolation room of Dr. Soetomo General Hospital Surabaya and was approved by the ethical committee of Dr. Soetomo General Hospital with ethical signed number 1009/101/4/X/2021.

The patients included in this study have to meet the inclusion criteria which were adult patients aged ≥ 18 years old who suffered from diabetes mellitus and COVID-19. The exclusion criteria of this study was records who doesn't contain HbA1c and random blood glucose data. The variables of this study were age, sex, BMI, oxygen saturation, severity degree of COVID-19, chronic complications of diabetes mellitus, random blood glucose, HbA1c, and outcome of the patients. In this study the data were analyzed using Microsoft Excel. The data will be presented in the form frequency, distribution, and mean ± SD.

3. Result

This study that was conducted in July 2020 – June 2021 have a total sample of 308 patients, but only 296 patients met the inclusion and exclusion criteria. The sample in this study were dominated by male (50.3% or 149 patients) population, in the range of 56 – 65 years old (34.1% or 101 patients). The frequency distribution of variables in this study will be presented in Table 1 and the mean ± SD will be presented in Table 2.

Patient's vital sign was observed based on oxygen saturation. The oxygen saturation distribution in this study was dominated by ≥ 95% group (39.5% or 117 patients) which was considered as normal based on Indonesia's COVID-19 2020 guideline.

The characteristic of COVID-19 in populations was observed based on the severity degree. The severity degree was divided into 4 category which was mild, moderate, severe, and critical based on Indonesia's COVID-19 2020 guideline. Most patients in this study was categorized in the severe category (35.4% or 105 patients).

The characteristic of diabetes mellitus in this study was observed based on the random blood glucose, chronic diabetes mellitus complications, and outcome. The random blood glucose in this study's population was dominated by ≥ 200 mg/dL group (58.7% or 174 patients) which was considered as hyperglycemic. Most observed chronic diabetes mellitus complications in this study was diabetic foot (11.4% or 34 patients). Despite the all, most of the patients in this study survived the disease (56.4% or 167 patients).

Table 1. Frequency Distributions of Variables

Variables	Frequency (n)	Percentage (%)
Age (years)		
18 – 25	1	0.3
26 – 35	9	3
36 – 45	38	12.8
46 – 55	94	31.7
56 – 65	101	34.1
> 65	53	17.9
Sex		
Male	149	50.3
Female	147	49.6
Oxygen Saturation (%)		
< 95	117	39.5
≥ 95	97	32.8
Severity Degree		
Mild	9	3
Moderate	102	34.4
Severe	105	35.4
Critical	78	26.2
Random Blood Glucose (mg/dL)		
< 140	54	18.2
140 – 199	58	19.5
≥ 200	175	58
Chronic Diabetes Complication		
Macrovascular		
Coronary Heart Disease	3	1
Stroke	6	2
Peripheral Arterial Occlusive Disease	2	0.6
Diabetic Foot	34	11.4
Microvascular		
Diabetic Retinopathy	1	0.3
Diabetic Nephropathy	0	0
Diabetic Neuropathy	0	0
Outcome		
Survived	167	56.4
Deceased	129	43.5

Table 2. Mean ± SD Distribution of Variables

Variables	Mean ± SD
Age	55.8 ± 10.7
Oxygen Saturation (%)	92 ± 0.08
Random Blood Glucose (mg/dL)	263.1 ± 142.1

4. Discussion

Most prevalent age distribution of this study was the 56 – 65 years old group (34,1% or 101 patients). this phenomena synchronize with the data from Indonesia's basic health research (RISKESDAS) in 2020 which also shows that the most prevalent age for diabetes mellitus in Indonesia is 55 – 64 years old[4]. A study by Daud et al. (2022) also shows that most prevalent age for COVID-19 is > 60 years old[5]. One of the best indicators to predict whether a patients would experience a mild or severe symptoms is their ability to manage the viral load. The immune system needs to do four key points in order to successfully supress and subsequently get rid of SARS-CoV2 which are recognize, alert, destroy, and clear. Older patients are known to exhibit heterogeneity and malfunction of each of these processes[6]. The alteration of those chains of events will cause older people to be more vulnerable when exposed to the virus and acquire poorer prognosis of the disease[7].

Male was most observed in the sample population of this study. The same result is also seen in a study by Daud et al. (2020) in Bitung city[5]. This phenomena might be due to the fact that men are more likely to exhibit behavioural traits that enhance the risk of contracting COVID-19, such as smoking and drinking . For instance, the findings of studies taken together revealed that te likelihood of sever COVID-19 for smoker was 1.4 times higher. Smoking is associated to greater levels of ACE2 which is the receptor of SARS-CoV2, this explain why male are more susceptible to COVID-19[8]. It is also said that in general, males have stronger cell type-specific expression of the ACE2 receptor than females do in type II alveolar epithelial cells[9].

Most observed oxygen saturation in this study were the < 95% group. This result is aslo suppported by the result of a study conducted in France[10]. A possible explanation that could be associated with this phenomenon was obtained from early modeling studies related to COVID-19 which showed that there was suffering in the S1 protein that interacts with Hb so that it has an impact in the form of reducing Hb affinity and total Hb content[11]. It was also said that patients with diabetes mellitus tend to have poorer oxygen saturation because of the enhanced of oxygen consumption of the tissues and deterioration of blood's ability to circulate and release oxygen to the tissues. For COVID-19 patients who also suffers from diabetes mellitus, low oxygen saturation values have theoretical compatibility, where COVID-19 attacks the respiratory organs and high sugar levels interfere with the affinity of Hb. The combination of the two events certainly has a bad impact such as a significant decrease in oxygen saturation[12].

Most patients in this study was considered as severe. Similar result was also found in a study conducted in Bathseda Hospital Yogyakarta and Mitra Medika General Hospital Amplas during 2021[13,14]. The domination of severe patients observed in this study could be caused by the diabetes mellitus that the sample population suffers from. It is said that diabetes mellitus is one of the three most common comorbidities in COVID-19 which increase the severity degree[15]. In a joint mission report by WHO-China, the case fatality rate of COVID-19 patients with diabetes mellitus was 9.2% which is number two after cardiovascular[16]. Patients with diabetes mellitus exhibit higher

ACE-2 receptor expression. Diabetes mellitus patients are more likely to contract SARS-CoV-2 due to increased expression of ACE-2, which also impacts viral load, worsens symptoms, and can even be fatal. More ACE2 protein is also seen in the pulmonary alveoli of diabetes mellitus patients, which can result in more severe clinical symptoms[15].

The most prevalent random blood glucose group in this study was the ≥ 200 mg/dL which is categorized as hyperglycemic. This result is in line with a study conducted in Surakarta and Romania[17,18]. COVID-19 patients with diabetes mellitus have higher levels of furin and higher levels of ACE-2 receptors in response to hyperglycemia, which promote viral replication and increase viral load in the body and can worsen symptoms and cause death. These factors increase a person's susceptibility to SARS-CoV-2 infection. It should also be noted that individuals with poor glucose control or diabetes mellitus frequently experience glycaemic worsening as a side effect of COVID-19. For instance, SARS-CoV infection was linked to a rapidly rising requirement for high doses of insulin in individuals who needed it. It appears that changes in inflammatory cytokine levels are related to changes in insulin requirements[19]. By any means, hyperglycemic conditions have an important role in the susceptiveness and disease progress of COVID-19 patients[20].

Chronic diabetic complication which ofetn occurs is divided into two category, macrovascular and microvascular. Most observed macrovascular complication observed in this study was diabetic foot which align with a study by Ong (2018). However, most observed microvascular complication in this study was diabetic retinopathy while most observed microvascular complication in a study by Ong (2018) was diabetic neuropathy[21]. Diabetes mellitus and COVID-19 have a reciprocal relationship that creates a cycle, in which an increase in inflammatory markers such as D-dimer, ferritin, and IL-6 is found in COVID-19 patients. The rise in these inflammatory markers contributes to an increased risk of microvascular and macrovascular complications originating from low-grade vascular inflammation in patients with diabetes mellitus[19]. Pathomechanism from COVID-19 triggers stress reaction in patients with diabetes mellitus which cause an increase in the production of hyperglycemic hormones such glucocorticoids and catecholamines and resulting a high blood sugar levels and diabetes complications. In this study there's only a low number of recorded chronic diabetic complications which could be caused by undetected complications in patients who didn't do routine control to the doctors[15].

Most patients observed in this study survived the disease, despite most studies said that diabetes mellitus increase mortality in COVID-19[19]. Baesd on a study, deaths of COVID-19 patients with diabetes mellitus was 21,28% higher than deaths of COVID-19 patients without diabetes mellitus[22]. However a study in Moewardi General Hospital shows a result that is align with the result in this study[23]. The result in this study might be casued by the vaccination that begins in early 2021. Based on a study, it is proven that vaccination could reduce the deaths caused by COVID-19 up to 7,6% for every 10% increase in vaccination coverage[24].

5. Conclusion

Most patients that suffers from COVID-19 and diabetes mellitus in the isolation room of Dr. Soetomo General Hospital Surabaya was male and in the age range of 56 – 65 years old. Oxygen saturation of most patients was < 95% and fell into the severe category. Most patients were in a hyperglycemic state on admission as the random blood glucose of study population were dominated by the ≥ 200 mg/dL. Diabetic foot was the most common marcovascular complication while diabetic retinopathy was the most common microvascular complication. Despite all, most patients observed survived.

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