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The Effect of Hypertension Comorbidities on the Higher Income of Cardiovascular Disease Commorbides in Covid-19 Patients

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Abstract

Background: Covid-19 cases with cardiovascular comorbidities are associated with a high risk of morbidity and mortality in COVID-19 patients. Hypertension is one of the comorbidities found in people with COVID-19. In several studies, it was found that hypertension has the highest incidence rate in cases of COVID-19. Patients with cardiovascular comorbidities are more susceptible to SARS-CoV-2 infection and can experience more severe clinical manifestations presumably because it is associated with increased expression of ACE2, a functional coronavirus receptor that can bind to spike proteins on the viral surface directly. So that SARS-CoV-2 can enter host cells through the ACE2 receptor.

Objective: To determine the effect of comorbid hypertension on the incidence of comorbid cardiovascular disease in Covid-19 patients.

Methods: The data used in this study are secondary data by examining data from recaps of patients diagnosed with Covid-19 with heart disease in the isolation treatment room of the NTB Provine Hospital in the period March - December 2020. And analyzing research articles on the effect of hypertension on worsening and a high incidence of comorbid hypertension in Covid-19 patients.

Results: The use of anti-hypertensive drugs such as the ACE inhibitor and ARB class of drugs is often associated with the severity of the symptoms of COVID-19, but until now ACE inhibitors and ARBs are still recommended for hypertensive patients because there is no clear evidence that these drugs can aggravate the clinical manifestation of COVID-19 patients.

Conclusion: Hypertension is a comorbid that is often found in COVID-19 patients and can worsen the condition of COVID-19 patients. The use of ACE inhibitors (ACEi) and angiotensin receptor blockers (ARB) can reset ACE2 thereby increasing the susceptibility of cells to viruses.

INTRODUCTION

Background

Coronavirus disease 2019 (COVID-19) is an infectious disease caused by the Severe Acute Respiratory Syndrome Coronavirus-2 (SARS-CoV-2).[1] This disease was first reported in Wuhan, Hubei Province, China, in December 2019. The emergence of this novel virus caused widespread concern across various parts of the world.[2] Subsequently, on 30 January 2020, the World Health Organization (WHO) declared the COVID-19 outbreak a Public Health Emergency of International Concern (PHEIC), and on 11 March 2020, WHO officially designated COVID-19 as a pandemic due to its rapid global spread.[1]

COVID-19 cases with cardiovascular comorbidities are associated with a higher risk of morbidity and mortality compared with COVID-19 patients without comorbid conditions.[1] Patients with cardiovascular comorbidities are more susceptible to SARS-CoV-2 infection and may experience more severe clinical manifestations, which is thought to be related to increased expression of angiotensin-converting enzyme 2 (ACE2). ACE2 functions as a coronavirus functional receptor that can directly bind to the spike protein

on the viral surface, thereby allowing SARS-CoV-2 to enter host cells through ACE2 receptors. ACE2 receptors are widely expressed in the lungs (particularly in type II alveolar cells), heart, intestinal epithelium, vascular endothelium, and kidneys. This distribution underlies the mechanism of multiorgan dysfunction that may occur in SARS-CoV-2 infection.[1]

Hypertension is one of the most common comorbid conditions found in patients with COVID-19. Hypertension is closely associated with COVID-19, as it can exacerbate the severity of COVID-19 infection and may even contribute to the pathogenesis of SARS-CoV-2 infection.[2] Studies on SARS-CoV-2 have identified several factors related to the prognosis of infected individuals. Comorbidities, advanced age, higher Sequential Organ Failure Assessment (SOFA) scores, and elevated D-dimer levels are recognized risk factors for poorer COVID-19 outcomes. In a study involving 1,099 patients with COVID-19, hypertension was identified as the most common underlying disease among patients with severe COVID-19. Another study analyzing 140 confirmed cases reported that 30% of patients had comorbid hypertension and 12% had diabetes mellitus.[3]

In a study conducted in Wuhan, China, among 191 hospitalized patients, 30% had hypertension and 8% had heart disease.[4] Another cohort study reported that among 138 patients admitted to the intensive care unit, 72% had comorbid conditions, including hypertension in 31% and heart disease in 15% of patients.[5] Data from the National Health Commission of China indicated that 35% of patients had comorbid hypertension and 15% had comorbid coronary heart disease.[6]

A study conducted at the Regional General Hospital of West Nusa Tenggara Province reported a total of 826 patients diagnosed and hospitalized with COVID-19, of whom eighty-four patients had comorbid conditions. The most common comorbidity was hypertension, affecting fifty patients (6%).[7] The high incidence of COVID-19 cases with hypertensive comorbidity motivated the authors to conduct a study entitled **"The Effect of Hypertension as a Comorbidity on the High Incidence of Comorbid Heart Disease in Patients with COVID-19."**

Problem Statement

Why does hypertension represent the highest incidence among cardiovascular comorbidities in COVID-19 cases?

Research Objectives

To determine the effect of hypertension as a comorbidity on the incidence of cardiovascular disease comorbidities in patients with COVID-19.

Research Benefits

The benefits that may be obtained from this study include:

1. Providing an explanation of the incidence of cardiovascular disease comorbidities in patients with COVID-19.
2. Providing an explanation of the effect of hypertension as a comorbidity on the incidence of cardiovascular disease comorbidities in patients with COVID-19.
3. Serving as a source of information for researchers to conduct further studies.

RESEARCH METHODS

Study Design

This study is a descriptive study with a retrospective research design.

Study Location and Period

The study was conducted at the Regional General Hospital of West Nusa Tenggara Province. Data collection was carried out in March 2021 at the Regional General Hospital of West Nusa Tenggara Province.

Study Population

The study population consisted of patients with COVID-19 and cardiovascular disease who were treated in the isolation wards during the period March–December 2020 at the Regional General Hospital of West Nusa Tenggara Province.

Sample

The study sample included all patients diagnosed with COVID-19 who were treated in the isolation wards of the Regional General Hospital of West Nusa Tenggara Province. The sample comprised secondary data obtained from summarized records of COVID-19 patients undergoing isolation treatment.

Sample Criteria

The sample criteria for this study were patients diagnosed with COVID-19 with cardiovascular disease comorbidities, particularly hypertension, who were treated in isolation wards during the period March–December 2020 and registered in the summarized patient records.

Research Variables

The variable examined in this study was the diagnosis of heart disease based on the ICD-10 classification.

Operational Definitions

No.	Variable	Operational Definition
1.	ICD-10 Diagnosis	ICD-10 is a guideline and coding system developed by the World Health Organization (WHO) for signs, symptoms, abnormal findings, complaints, social conditions, and all causes of injury or disease.
2.	Diagnosis of Heart Disease	Diagnosis based on the ICD-10 classification, in which the codes for heart diseases range from I00 to I52.
3.	Diagnosis of Hypertension	Diagnosis based on the ICD-10 classification, in which the codes for hypertensive diseases range from I10 to I16.

Research Data Collection

The data used in this study were secondary data obtained by reviewing summarized records of patients diagnosed with COVID-19 and heart disease who were treated in the isolation wards of the Regional General Hospital of West Nusa Tenggara Province during the period March–December 2020. In addition, research articles examining the effect of hypertension on disease severity and the high incidence of hypertensive comorbidity in patients with COVID-19 were analyzed. A total of ten research articles were included in this analysis.

RESULTS AND DISCUSSION

Based on the results obtained from the medical records of patients treated in the COVID-19 isolation wards of the Regional General Hospital of West Nusa Tenggara Province during the period March 2020–December 2020, a total of 826 individuals were confirmed and diagnosed with COVID-19. Among these patients, eighty-four had comorbid conditions. The most prevalent comorbidity was hypertension, affecting fifty patients (6%), followed by coronary heart disease in ten patients (1.2%), congestive heart failure in ten patients (1.2%), hypertensive heart disease (HHD) with congestive heart failure (CHF) in four patients (0.5%), HHD without CHF in four patients (0.5%), secondary hypertension in one patient (0.1%), renal hypertension in one patient (0.1%), complete atrioventricular (AV) block in one patient (0.1%), ischemic cardiomyopathy in one patient (0.1%), left bundle branch block in one patient (0.1%), and sick sinus syndrome in one patient (0.1%).

Data regarding cardiovascular comorbidities among patients with COVID-19 treated at the Regional General Hospital of West Nusa Tenggara Province during the period March–December 2020 are presented in **Table 1**.

Table 1. Description of the Incidence of Cardiovascular Comorbidities in Patients with COVID-19

Heart Disease	Number	Percentage	ICD-10 Code
Hypertension	50	6%	I10
Coronary Heart Disease	10	1.2%	I25
Congestive Heart Failure	10	1.2%	I50
HHD with CHF	4	0.5%	I11
HHD without CHF	4	0.5%	I11.9
Secondary Hypertension	1	0.1%	I15
Renal Hypertension	1	0.1%	I12.9
Complete AV Block	1	0.1%	426.0
Ischemic Cardiomyopathy	1	0.1%	I25.5
Left Bundle Branch Block	1	0.1%	I44.7
Sick Sinus Syndrome	1	0.1%	I49.5
Total	**84**		

Table 2. Description of the Incidence of Hypertensive Comorbidities in Patients with COVID-19

Condition	Number	Percentage	ICD-10 Code
Hypertension	29	58%	I10
Hypertension with Pneumonia	3	6%	I10, J18.9
Hypertension with Type II Diabetes Mellitus without complications	3	6%	I10, E11.9
Hypertension with Hypokalemia	2	4%	I10, E87.6
Hypertension with Type II Diabetes Mellitus without complications and Functional Dyspepsia	1	2%	I10, E11.9, K30
Hypertension with HHD	1	2%	I10, I11
Hypertension with Chronic Lower Respiratory Disease	1	2%	I10, J46
Hypertension with Unspecified Respiratory Failure	1	2%	I10, J96.9
Hypertension with Unspecified Hyperlipidemia	1	2%	I10, E78.5
Hypertension with Unspecified Coccidioidomycosis	1	2%	I10, E14.9
Hypertension with Unspecified Thyrotoxicosis	1	2%	I10, E05.9
Hypertension with Type II Diabetes Mellitus and Native Coronary Artery CAD	1	2%	I10, E11.0, I25.1
Hypertension with Encephalitis, Myelitis, Unspecified Encephalomyelitis, Cerebral Edema, Acute Nephritic Syndrome with Unspecified Morphological Changes, and Bronchopneumonia	1	2%	I10, G04.9, G93.6, N00.9, J18.0
Hypertension with Type II Diabetes Mellitus and Glaucoma	1	2%	I10, E11, H40.9
Hypertension with Dyspepsia and Fatty Liver	1	2%	I10, K30, K76.0
Hypertension with Type II Diabetes Mellitus with Specific Complications	1	2%	I10, E11.6
Hypertension with ARDS, Sepsis, and Hyperglycemia	1	2%	I10, J80, A41.9, R73.9
Total	**50**	**100%**	

Among patients treated in the COVID-19 isolation wards of the Regional General Hospital of West Nusa Tenggara Province during the period March–December 2020, hypertension was the most prevalent comorbidity, affecting fifty patients (6%). Of these patients, twenty-nine (58%) had hypertension alone, while the remaining patients had hypertension accompanied by various additional conditions, as detailed in Table 2.

Cardiovascular disease is an indicator of accelerated immunological dysfunction associated with aging and is indirectly correlated with the prognosis of COVID-19.[8] A study from China analyzing 72,314 medical records reported 44,672 confirmed cases (61.8%), 16,186 suspected cases (22.4%), and 889 asymptomatic cases (1.2%). Among confirmed cases, approximately 12.8% had hypertension. Several studies have demonstrated that the severity and mortality of COVID-19 are influenced by comorbid diseases, including hypertension.[2]

Several studies have reported a high incidence of hypertension among COVID-19 cases. Guan et al. (2020) reported that approximately 23.7% of confirmed COVID-19 patients had at least one comorbid condition, such as hypertension or chronic obstructive pulmonary disease.[8] Lippi, Wong, and Henry (2020), through a pooled literature analysis, suggested that pre-existing hypertension may increase the severity of COVID-19 by up to 2.5-fold, particularly in older individuals. Wu et al. (2020) reported that among 66 COVID-19 patients (32.8%), 19.4% had hypertension as a comorbidity. Liu et al. (2020) found that 20 patients (25.6%) had comorbid diseases, with hypertension being the most frequently observed.[2]

Risk factors for worsening COVID-19 infection include hypertension, male sex, diabetes mellitus, and smoking, which are thought to contribute to increased ACE2 receptor expression.[2] The severity of COVID-19 has also been associated with the use of ACE inhibitors (ACEIs) and angiotensin receptor blockers (ARBs), as these medications may regulate ACE2 receptors.[9] The mechanisms by which comorbidities worsen patient outcomes remain unclear, but proposed hypotheses include advanced age, immune system dysfunction, increased ACE2 expression, and a possible association between COVID-19 and cardiovascular disease.[9]

Hypertension is a common condition among patients with COVID-19 and may exacerbate disease severity. The use of antihypertensive medications such as ACE inhibitors and ARBs has often been linked to COVID-19 severity; however, these medications continue to be recommended for hypertensive patients, as no clear evidence has demonstrated that ACE inhibitors or ARBs worsen outcomes in COVID-19 patients.[2]

One study demonstrated that SARS-CoV-2 recognizes ACE2 via its spike protein, enabling viral entry into host cells. This process leads to activation of $CD4^+$ T cells, which proliferate and differentiate into Th1 cells that secrete proinflammatory cytokines such as interleukin-6 (IL-6), interferon-gamma (γ-IFN), and granulocyte–macrophage colony-stimulating factor (GM-CSF). This cascade may culminate in a cytokine storm, potentially leading to acute respiratory distress syndrome (ARDS), multiorgan failure, and death. Therefore, IL-6 and GM-CSF released by T lymphocytes and monocytes may be key factors in triggering cytokine storms in patients with COVID-19. The cytokine storm mechanism may be closely related to an imbalance between specific and nonspecific immunity. Substantial evidence suggests that hypertension can skew T cells toward a Th1 phenotype, indicating that hypertension may contribute to cytokine storms in patients with COVID-19. In addition, depletion of $CD4^+$ and $CD8^+$ T cells has been observed in critically ill COVID-19 patients, which may be associated with poor prognosis.[3]

A study reported that patients with hypertension are more likely to experience immune dysfunction, as evidenced by higher levels of C-reactive protein (CRP), procalcitonin, IL-10, and IL-6, as well as lower $CD8^+$ T-cell counts. Moreover, hypertensive patients exhibit higher white blood cell and neutrophil counts and lower lymphocyte levels. These findings suggest that immune dysfunction may contribute to severe disease and poor outcomes in COVID-19 patients with hypertension.[3]

The administration of renin–angiotensin–aldosterone system (RAAS) inhibitors is an important strategy for protecting against heart failure, myocardial infarction, and hypertension. Other studies have demonstrated that RAAS inhibitors regulate ACE2 receptor expression, which may facilitate cellular invasion by SARS-CoV-2.[3]

Several studies have examined the association between RAAS inhibitor use and mortality among hospitalized COVID-19 patients with hypertension. Zhang et al. reported that inpatient use of RAAS inhibitors was associated with a reduced risk of all-cause mortality.[10] Mancia et al. also found that RAAS inhibitors were unlikely to affect the risk of SARS-CoV-2 infection and were not associated with severe or fatal infection. RAAS inhibitor use was not associated with increased in-hospital mortality. Yang et al. reported that patients receiving RAAS inhibitors had a lower proportion of critical illness and lower mortality rates than those receiving non-RAAS inhibitors, although these differences were not statistically significant. Pan et al. reported that patients who were regularly treated with RAAS inhibitors prior to hospital admission may have a better prognosis than those who were not previously treated with RAAS inhibitors.[3]

CONCLUSION

SARS-CoV-2 has major implications for the cardiovascular system. Patients with cardiovascular risk factors or established cardiovascular disease represent a high-risk population when infected with COVID-19. Risk factors for COVID-19 include impaired immunity, advanced age, smoking, and comorbid diseases such as hypertension. Patients with COVID-19 and hypertension experience more severe inflammation, greater depletion of $CD8^+$ T cells, and more extensive organ damage than non-hypertensive patients. Hypertension may serve as an independent risk factor for all-cause mortality in patients with COVID-19. The use of ACE inhibitors (ACEIs) and angiotensin receptor blockers (ARBs) may modulate ACE2 expression, thereby increasing cellular susceptibility to viral entry. However, several studies suggest that hypertensive patients with prior ACEI/ARB use may have a better prognosis than those treated with other antihypertensive medications. Currently, insufficient data exist to conclusively determine the relationship between ACEI/ARB use and worsening outcomes in COVID-19 patients.

Further research is recommended to evaluate and clarify the relationship between hypertension, various therapeutic backgrounds, and the progression of COVID-19. Additional high-quality studies are needed to strengthen the available evidence.

Abbreviations

ACE2: Angiotensin-converting enzyme 2

ACEI: Angiotensin-converting enzyme inhibitor

ARB: Angiotensin receptor blocker

ARDS: Acute respiratory distress syndrome

CAD: Coronary artery disease

CHF: Congestive heart failure

COVID-19: Coronavirus disease 2019

ICD-10: International Classification of Diseases, 10th Revision

RAAS: Renin–angiotensin–aldosterone system

SARS-CoV-2: Severe acute respiratory syndrome coronavirus 2

Declarations

Ethics approval and consent to participate

This study used **retrospective secondary data obtained from medical record recapitulations of patients with COVID-19** treated at the Regional General Hospital of West Nusa Tenggara Province between March and December 2020.

Ethical approval for this study was obtained from the **Health Research Ethics Committee of the Faculty of Medicine, University of Mataram**. The study was conducted in accordance with the principles of the **Declaration of Helsinki**.

Because this study used **anonymized retrospective medical record data**, the requirement for **informed consent to participate was waived by the Ethics Committee**.

Approval No: 00.9.1/31/KEP/2026

Consent for publication

Not applicable.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

YP conceived and designed the study.
YP, BZAL, and RE collected and analyzed the data.
YI, BR, and AASMMP contributed to data interpretation and manuscript preparation.
All authors read and approved the final manuscript.

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