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Research

Correlation between Mortality of COVID-19 Patients with Hypertension and Thorax Radiography Treated in the Intensive Care Unit of Dr. Moewardi Hospital

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ABSTRACT

Background: Coronavirus 2019 or COVID-19, caused by the new SARS-CoV2 virus, has become a pandemic and attacked more than 200 countries, including Indonesia. The most comorbid disease in COVID-19 patients was hypertension. Chest radiography can predict prognosis and mortality in COVID-19 cases and one of the methods that can be used for chest radiographic assessment is the Brixia Score, specifically designed for COVID-19 patients to measure and analyze the severity of lung abnormalities in patients with COVID-19. This study aimed to find the correlation between the mortality of COVID-19 patients with hypertension and chest radiography using the Brixia Score treated in the intensive care unit (ICU) of Dr. Moewardi Hospital.
Subjects and Method: This study used an analytic observational study with a cross-sectional approach. The subjects were 84 COVID-19 patients with hypertension who met the exclusion and inclusion criteria. The independent variable is chest radiography and dependent variable is mortality. Sampling was collected by purposive sampling and the data obtained were analyzed using the contingency coefficient test.
Results: There was a significant correlation between the mortality of COVID-19 patients with hypertension and chest radiography as assessed using the Brixia Score ($p < 0.001$). The youngest patient was 20 years old and the oldest was 87 years old.
Conclusion: There was a correlation between the mortality of COVID-19 patients with hypertension and chest radiography treated in the ICU RSUD Dr. Moewardi, Surakarta.

Keywords: COVID-19, mortality, hypertension, chest radiography, Brixia Score, intensive care unit

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BACKGROUND

Coronavirus 2019, commonly called COVID-19, caused by the new virus SARS-CoV2, has become a pandemic. Nowadays, more than 200 countries are attacked by the disease. As of January 30, 2022, more than 370 million cases of COVID-19 have been confirmed and more than 5.6 million deaths have been reported globally (WHO, 2021). Given the current high mortality rate of COVID-19 (Baud et al., 2020), health workers must be aware of risk factors that worsen the

patient's condition. They can lead to death, such as old age, and comorbid diseases, such as hypertension, cardiovascular disease, lung disorder, and diabetes, which are significantly correlated with the increased risk of mortality in COVID-19 patients (Borghesi, Zigliani, Golemi, et al., 2020).

Several reports of severe cases of COVID-19 pastients with a relatively high mortality rate are associated with hypertension (Du et al., 2021). In March 2020, the Italian Institute of Health reported that there had been 3,200 deaths from COVID-19 in Italy. Of these deaths, 98.7% of patients had at least one comorbidity and hypertension was the most frequently in COVID-19 cases in Italy, affecting 73.8% of patients (Kario et al., 2020). In Indonesia, as many as 52.4% of COVID-19 patients have a comorbid disease, namely hypertension and previous studies have also concluded that the most comorbid disease in COVID-19 patients is hypertension (Hikmawati & Setiyabudi, 2021).

From the high number of COVID-19 patients with hypertension with varying severity, a study is needed to evaluate the severity of COVID-19 patients with this hypertension comorbid disease. One of the methods that can be used in this clinical practice is a chest radiography scoring system to measure and analyze the severity of lung abnormalities in COVID-19 patients. This chest radiography evaluating system uses the Brixia score, a semiquantitative assessment method designed specifically for COVID-19 patients (Hedibah et al., 2021) to assess lung abnormalities through radiological imaging with a severity scale of 0-18 points and assess the severity of lesions in the lungs (Maroldi et al., 2020). This study aims to determine the correlation between mortality of COVID-19 patients with hypertension and chest radiography using the Brixia Score to predict the risk of hospital mortality in patients with COVID-19 infection with the hypothesis that there is a correlation between mortality of COVID-19 patients with hypertension and chest radiography treated in ICU RSUD DR. Moewardi, Surakarta.

SUBJECT AND METHOD

1. Study Design

The study used an analytic observational study with a cross-sectional approach at the RSUD Dr. Moewardi, Surakarta on April-June 2022, using medical records and chest X-rays.

2. Population and Sample

The subjects were COVID-19 patients with comorbid hypertension treated in the ICU RSUD Dr. Moewardi, Surakarta. The inclusion criteria of the subjects included patients diagnosed with COVID-19, those aged over 18 years, and those with comorbid hypertension. The exclusion criteria were patients with a history of previous chronic lung disease and patients with incomplete medical record data. The research sample amounted to 84 samples with the purposive sampling technique.

3. Study Variable

The independent variable is chest radiography and dependent variable is mortality.

4. Operational Definition of Variable

Chest radiography is an examination technique using electromagnetic wave radiation to provide an overview of the inside of the thorax. This study uses chest radiography of COVID-19 patients with hypertension in the ICU. Mortality is the number of deaths that occur in a population and used in this study is the mortality of COVID-19 patients with hypertension treated in the ICU.

5. Study Instruments

Chest radiography was measured using Brixia Score with an ordinal measurement scale. Patient medical record data from March to December 2021 measured patient

mortality with a nominal measurement scale.

6. Data Analysis

Data analysis technique in this study used contingency coefficient test, the correlation test used for ordinal and nominal data. If the result is $p < 0.05$, there is a significant correlation between the research variables. Data analysis will be performed using SPSS software.

7. Research Ethics

Research ethical issues including informed consent, anonymity, and confidentiality, were addressed carefully during the study process. This research ethical clearance approval letter was obtained from the Research Ethics Committee at Dr. Moewardi Hospital, Surakarta, Indonesia, No. 363/ III / HREC / 2022 on March 24, 2022.

RESULTS

1. Sample Characteristics

This study involved 84 COVID-19 patients with hypertension treated in the ICU of RSUD Dr.Moewardi, Surakarta, by taking secondary patients data. The characteristics description of the subjects by gender, the most patients were male, namely 53 patients (63.1%), and the rest were females, 31 patients (36.9%). Based on age, most patients were aged 61-70 years (34.5%) and the age group with the least number of patients was 20-30 years old (3.6%). The youngest was 20 years old and the oldest was 87. Based on Brixia Score, most patients had a severe Brixia Score, namely 46 patients (54.8%), and the most slightly in the mild category, namely 17 patients (20.2%). Based on mortality, most patients had a dead outcome, namely 60 patients (71.4%) and the rest had an alive outcome, 24 patients (28.6%). Based on antihypertensive drug which taken from 37 sample patients, the category of antihypertensive drugs used the most consumed was ARB (36.6%) and the least was ACE-I (3.7%).

Table 1. Sample characteristics

Characteristic	Category	Frequency	Percentage
Gender	Male	53	63.10%
	Female	31	36.90%
Age	20-30 years	3	3.60%
	31-40 years	5	5.90%
	41-50 years	8	9.50%
	51-60 years	25	29.80%
	61-70 years	29	34.50%
	>70 years	14	16.70%
Brixia Score	Mild	17	20.20%
	Moderate	21	25.00%
	Severe	46	54.80%
Mortality	Dead	60	71.40%
	Alive	24	28.60%
Antihypertensive Drug*	ACE-i	3	3.70%
	ARB	30	36.60%
	Beta-blockers	10	12.20%
	CCB	22	26.80%
	Diuretics	17	20.70%

2. Bivariate Analysis

Data analysis of this study used the contingency coefficient correlation test. The results of the contingency coefficient test (r_k) show that the correlation between sex and mortality is very weak with a value of r = 0.008 and statistically does not show a significant correlation with p = 0.943 (p> 0.050). Based on age, the results of the contingency coefficient test (r_k) get a value of r = 0.159 which means that the level of the relationship between age and mortality is very weak and statistically does not show a significant correlation with p = 0.825 (p> 0.050). Based on Brixia Score, patients with mild category mostly had alive outcomes, namely 88.20%, patients with moderate category mostly had a dead outcomes, 76.20%, and patients with severe category mostly had a dead outcomes 91.30%. Thus, the heavier the Brixia Score, the greater the risk of the patient having a dead outcome. The results of the contingency coefficient test (r_k) get a value of r = 0.562 which means the level of the correlation between Brixia *Score* and mortality is in the medium category and statistically shows a significant correlation with p = <0.001 (p < 0.05).

Table 2. Data analysis (an analysis by contingency coefficient correlation test)

Variable	Died	Alive	r_k (Contingency Coefficient)	p
Gender			0.008	0.943
Male	38 (71.70%)	15 (28.30%)		
Female	22 (71.00%)	9 (29.00%)		
Age			0.159	0.825
20-30 years	2 (66.70%)	1 (33.30%)		
31-40 years	4 (80.00%)	1 (20.00%)		
41-50 years	6 (75.00%)	2 (25.00%)		
51-60 years	16 (64.00%)	9 (36.00%)		
61-70 years	23 (79.30%)	6 (20.70%)		
>70 years	9 (71.40%)	5 (35.70%)		
Brixia Score			0.562	<0.001
Mild	2 (11.80%)	15 (88.20%)		
Moderate	16 (76.20%)	5 (23.80%)		
Severe	42 (91.3%)	4 (8.7%0)		

Based on table 3, it is known that the proportion of severe category Brixia Score in the 20-30 year age group is two patients (66.7%), 31-40 year age group are two patients (40.0%), 41-50 year age group are three patients (37.5%), 51-60 year age group are 14 patients (56.0%), 61-70 year age group are 17 patients (58.6%), and the age group above 70 years are eight patients (57.1%). From these data, the age group with the highest number of patients with Brixia Score in the severe category is 61-70. The results of the Spearman correlation test found that the value of r = 0.023, which means that the level of the correlation between age and Brixia Score is very weak and statistically does not show a significant correlation with the value of p = 0.835 (p> 0.050).

Table 3. Age analysis of Brixia Score (an analysis by spearman correlation test)

Variable	Brixia Score			r	p
	Mild	Moderate	Severe		
Age				0.023	0.835
20-30 years	1 (33.30%)	0 (0.00%)	2 (66.70%)		
31-40 years	0 (0.00%)	3 (60.00%)	2 (40.00%)		
41-50 years	1 (12.50%)	4 (50.00%)	3 (37.50%)		
51-60 years	5 (20.00%)	6 (24.00%)	14 (56.00%)		
61-70 years	6 (20.70%)	6 (20.70%)	17 (58.60%)		
>70 years	4 (28.60%)	2 (14.30%)	8 (57.10%)		

3. Result of Scoring Brixia

The number of patients in the mild category and alive outcome was 15 patients from 17 patients in the mild category. The number of patients in the severe category with a dead outcome was 42 patients from 46 patients in the severe category.

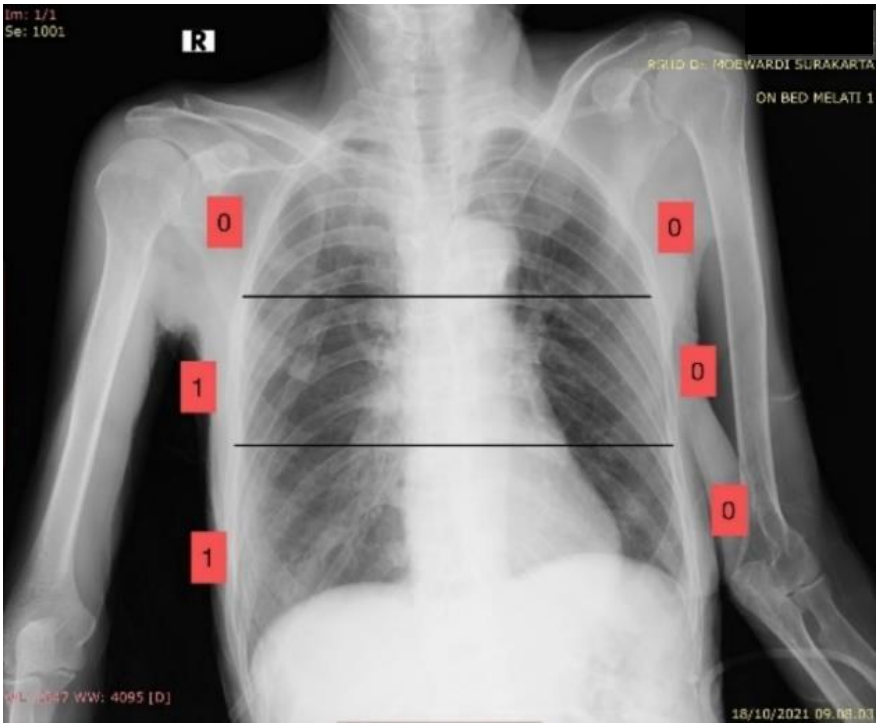

Figure 1. Chest x-ray of patient live with mild category of Brixia Score

Table 4. Score result of figure 1

Right lung	Left lung
0	0
1	0
1	0
Total: 2	

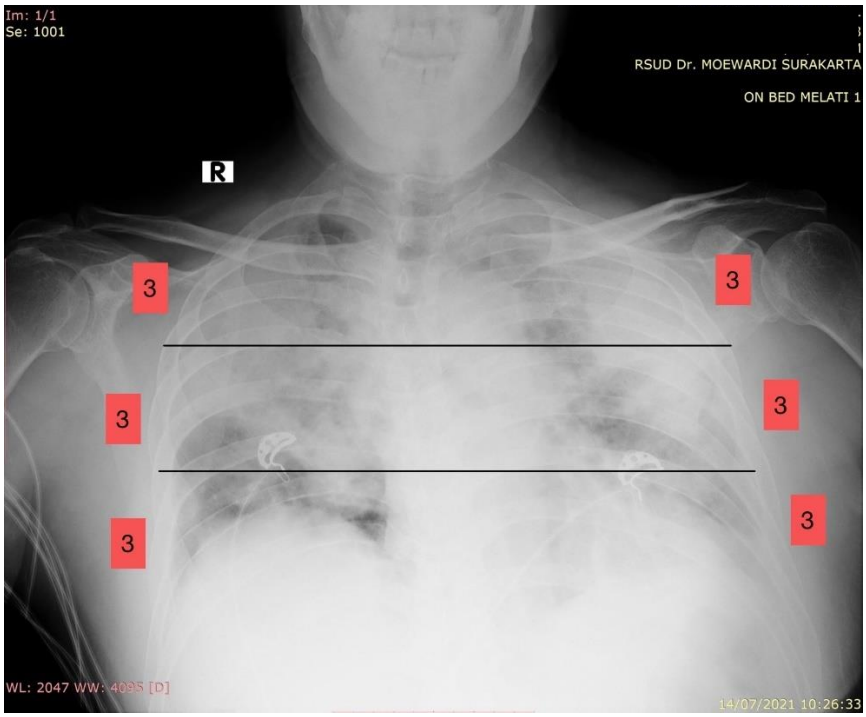

Figure 2. Chest x-ray of patient died with severe category of Brixia Score

Table 5. Score result of figure 2

Right lung	Left lung
3	3
3	3
3	3
Total: 18	

DISCUSSION

This study was conducted to find the correlation between mortality of COVID-19 patients with hypertension and chest radiography treated in the ICU RSUD DR. Moewardi, Surakarta. The total number of samples studead was 84 COVID-19 patients with hypertension in March-December 2021 and adjusted for the inclusion and exclusion categories.

Patients also took antihypertensive drugs in combination with several categories of antihypertensive medications. Studies show that concurrent use of antihypertensive drugs of two different classes can lower blood pressure five times greater than an increased dose of one class of antihypertensive medications (Oster et al., 2022). The type of antihypertensive drug consumed by the patient, the most widely used from ACE-I is Ramipril, the more commonly used from ARB are Candesartan and Telmisartan, the most widely used from beta-blocker are Bisoprolol and Carvedilol, the most commonly used from CCB are Amplodipine, Nicardipine, and Nimodipine, and the most frequently used from diuretic is Furosemide from loop diuretic class, Spironolactone from the aldosterone antagonist diuretic class, and Acetazolamide from the carbonic anhydrase enzyme inhibitor class. Of the five categories, the most widely used are Candesartan (ARB), Amlodipine (CCB), and Furosemide (Diuretic). This is by a study

that explained that the most recommended first line of antihypertensive treatment, namely from the ARB, CCB, and Diuretic classes (Oster et al., 2022). Thus, this study represents the use of five categories of antihypertensive drugs. Of the five categories, there is no significant difference in the number of each class. This means that each class has the same risk of mortality in COVID-19 cases because there is no evidence that antihypertensive therapy is correlated with an increased risk of death from COVID-19, both patients taking ACE-I or ARB with patients taking antihypertensive drugs from a different category (Rezel-Potts et al., 2021).

This studies results prove that there is no significant correlation between gender and mortality of COVID-19 patients with hypertension. Male and females have the same risk of being infected with COVID-19 (Peckham et al., 2020). In addition, gender in COVID-19 patients is not a risk factor that can increase patient mortality (Borghesi, Zigliani, Golemi, et al., 2020).

In another result of this study show no significant correlation between age and mortality because there is no big difference in the mean number of COVID-19 patients with a dead outcome in all age groups. This is because the level of susceptibility to COVID-19 infection is the same among different age groups (Ji Kang & In Jung, 2020).

Correlation between Mortality of COVID-19 Patients with Hypertension and Thorax Radiography (Brixia Score)

Radiological profiles involved in predicting the outcome of COVID-19 patients, especially chest X-rays (Hoang et al., 2022). Chest X-rays can be assessed using the Brixia Score, designed specially for semi-quantitative assessment of the progression and severity of lung abnormalities in COVID-19 patients (Hedibah et al., 2021). Brixia Score is a helpful method for predicting the risk of patients with COVID-19 by identifying the severity index of lung abnormalities easily and quickly (Borghesi, Zigliani, Masciullo, et al., 2020). Brixia Score divides the lungs into six zones on the anterior chest projection, and each zone will be assigned a score on a scale of 0-3 based on the lung abnormalities found, as follows: (i) score 0: no lung abnormalities, (ii) score 1: interstitial infiltrates, (iii) score 2: interstitial and alveolar infiltrates (interstitial predominance), and (iv) score 3: interstitial and alveolar infiltrates (alveolar predominance). The total score will be interpreted into three categories, as follows : (i) total score 0 : normal, (ii) total score 1-6 : mild category, (iii) total score 7-12: moderate category, and (iv) total score 13-18 : severe category (Hedibah et al., 2021).

The results show that the number of patients included in the mild category was 17 patients with an average score was 3, the number of patients included in the moderate category was 21 patients with an average score was 10, and the number of patients included in the severe category was 46 patients with an average score was 16. The more severe lung abnormalities were associated with a worse prognosis (Borghesi, Zigliani, Golemi, et al., 2020).

In this study, the correlation between the Brixia Score and mortality have a significant correlation with $p < 0.001$. This is consistent with a study in 278 patients that the Brixia Score was a significant predictor of mortality with $p<0.0001$ (Hoang et al., 2022). In addition, this study showed that 91.3% of patients in the severe category had a dead outcome. This is consistent with a study in 953 patients that showed high results of Brixia Score or in the severe category significantly in the patients who mostly had a dead outcome than those

who returned alive (Maroldi et al., 2020). Multivariable analysis of a study in 302 patients showed that the Brixia Score was one of the risk factors closely associated with mortality. The study find that the severity of lung disease was correlated with a poor prognosis in pastients with COVID-19. In addition, the results obtained that the optimal limit score for the Brixia Score is 8 points (Borghesi, et al., 2020). This is related to the results of this study, where 8 points or more will be included in the moderate-severe category and the average in this study for the moderate category was ten and the average for the severe category was 16. From these results, COVID-19 patients who dead in the moderate category were 76.2% and 91.3% in the severe category. That means that most patients in the moderate-severe category had a dead outcome. This is also in line with a study in 340 COVID-19 patients that a high Brixia Score could predict hospital mortality (Balbi et al., 2021).

The study concluded that there was a correlation between the mortality of COVID-19 patients with hypertension and chest radiography treated in the ICU of RSUD DR. Moewardi, Surakarta. The limitation of the study is that this study was only conducted in one hospital and the geographic area was small. Therefore, further research is needed with a broader coverage area.

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AUTHORS CONTRIBUTION

All authors had equal contribution in collecting the data of this research, radiological finding, and wrote the manuscript.

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CONFLICT OF INTEREST

There are no conflict of interest.

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