Research

Correlation of Brixia Score Changes with Length of Stay in Patient with COVID-19

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ABSTRACT

Background: The increase in Covid-19 cases in Indonesia as well as the hospital length of stay is unpredictable. The degree of lung damage in Covid-19 largely determines the severity of the disease, a serial chest X-ray using Brixia score can be used to assess changes in pulmonary parenchymal damage and could predict the length of hospitalization. This study aims to analyze the correlation of Brixia score with the length of hospitalization in Covid-19 patients.

Subjects and Method: This cross-sectional study was conducted at Sumber Waras Hospital from November 2021 until January 2022. The samples are Covid-19 confirmed patients who were treated at Sumber Waras hospital. Independent variable is Brixia score and dependent variable is length of hospitalization. Brixia's score assessment from two serial chest X-rays was divided into 4 categories: low to low, low to high, high to low, and high to high. All the categories were analyzed using Kruskall-Wallis method then continued with Mann-Whitney U test. The multivariate variable was analyzed using linear regression.

Results: There are 190 samples, the median score of Brixia at the beginning of treatment is 4 (range 0 - 18), and the median score of Brixia on serial examination is 6 (range 0 - 18). Patients in low to low category had median 10 days length of hospitalization, low to high category and high to low category had median 11 days, and high to high category had median 8 days. There was no statistically significant correlation between Brixia score and length of hospitalization (p= 0.377).

Conclusion: There is no significant relationship between the median Brixia score changes with the length of hospitalization of covid-19 patients.

Keywords: Covid-19, hospitalized, Brixia score changes, length of stay

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BACKGROUND

Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) is a new virus transmitted from human to human, first discovered in Wuhan, Hubei province in December 2019 (Chams et al., 2020). World Health Organization announced a pandemic period in March 2020 (Worldometer, 2021).

The SARS-COV2 virus is transmitted mainly through droplets and in some conditions it can be transmitted through aerosols or indirect contact with the surface of contaminated objects (Liu, 2020). Lung is the primary target of Covid-19 infection, there are 4 phases of pathology disturbances consist of initial phase (day 0 to day 1), exudative

phase (day 1 to day 7), organization phase (week 1 to several weeks), and fibrosis phase (weeks to months). Initial phase is characterized by epithelial, capillaries, and endothelial injury. Exudative phase is characterized by extensive disruption of alveoli accompanied by fluid accumulation, increased number of macrophages, intraallveolar bleeding, thrombosis, and secondary infection. The organization phase showed myofibroblastic proliferation in interstitium, accumulation of collagen, and fibrosis (Bösmüller, 2021). Although lung computed tomography had high sensitivity and specificity value, chest X-rays remain a first-line option to detect lung lesions. Chest X-rays are widely available in health care facilities and had a mobile machine that can be used to examine unstable patients who cannot be transported to the radiology room.

Covid-19 patients with symptoms of moderate, severe, or critical require hospitalization. One of the parameters of assessing the quality and efficiency of treatment of Covid-19 patients is the length of treatment. It is suspected that the assessment of Brixia scores through thoracic X-ray can predict the length of treatment of COVID-19 patients (Au-Yong, 2022; The Radiology Assistant, 2021). The Brixia score is one of the most popular and widely used scores in a number of hospitals in the world because it is considered easy and systematic (Zimatore et al., 2019). Brixia score assessment is carried out by dividing the pulmonary field from the top to the base of the lung into three parts, namely the right A-B- C and the left D-E-F. The abnormality findings in the pulmonary parenchyma are divided into 4 categories, normal pulmonary parenchyma has a score of 0, changes in interstitium tissue have a score of 1, changes in dominant interstitium tissue and changes in pulmonary alveoli have a score of 2, and the changes in alveoli are more dominant than

changes in interstitium tissue have a score of 3. Brixia's total score is 18, a high score if a score greater is equal to 9 and a low score with a score value of less than 9 (Bösmüller, 2021). This study aims to analyze the correlation of Brixia score with the length of hospitalization in Covid-19 patients.

SUBJECTS AND METHOD

1. Study Design
This cross-sectional study was conducted at Sumber Waras Hospital from November 2021 until January 2022. The samples are patients who were confirmed with Covid-19 and treated at Sumber Waras hospital.

2. Population and Sample
The samples were collected by consecutive sampling. The inclusion criteria are patients $\geq$ 18 years old, confirmed with Covid-19 and treated at Sumber Waras hospital between November 2021 until January 2022. The exclusion criteria are patients who refused medical treatment, discharged against medical advice, had different imaging modalities in serial imaging, and death in hospitalization.

3. Study Variables
The independent variable is the changes of Brixia score and the dependent variable: the length of hospitalization of covid-19 patients.

4. Operational definition of variables
The independent variable in this study is Brixia score, it defined as the changes in the progression of serial chest X-rays based on score (<9 low; $\geq$ 9 high). This data was collected from serial chest X-rays in PACS (Picture Achieving and Communication System). The dependent variable is the length of hospitalization of covid-19 patients, it is defined as the mean length of stay in days. This data was collected from electronic medical record.

5. Study Instruments
This study use electronic medical record to

documented the patient's diagnosis, characteristics, and length of hospitalization. Serial chest X-rays were documented using PACS (Picture Achieving and Communication System).

6. Data Analysis

The analysis of changes in Brixia scores on the serial chest X-rays were read by two radiologists with more than 10 years of experience. Brixia's score assessment from two serial chest X-ray then divided into 4 categories: low to low, low to high, high to low, and high to high. The data obtained were processed and analyzed using the IBM SPSS 20. All the categories was analysed using Kruskall- Wallis method then continued with Mann- Whitney U test. After that, the multivariate variable was analysed using linear regression.

7. Research Ethics

This proposal has been submitted and approved by the Research Ethics Committee of Sumber Waras Hospital with ethical clearance number 035/RSSW/KoM.EP/-EC/XII/2021.

RESULTS

There were 190 patients complete the inclusion criteria in this study. The median age was 55 years, the youngest in this population is 18 years-old and the oldest is 89 years-old. Male patients outnumbered the female, they being 52% of the study samples. There are 30.5% patients had no comorbidities, and most of the patients (69.5%) had comorbidities. The median length of hospitalization is 10 days, the minimum length of stay was 3 days, and the maximum length of stay was 38 days.

Table 1. Characteristic of subjects

Characteristics	Value N (min-max) or (%)
Age (year) – median (min-max)	55 (18-89)
Gender – n (%)	
Male	98 (52)
Female	92 (48)
Initial Brixia score – median (min-max)	4 (0 - 18)
Serial Brixia score – median (min-max)	6 (0 - 18)
Brixia score categories – n (%)	
Low to low	109 (57.4)
Low to high	23 (12.1)
High to low	49 (25.8)
High to high	9 (4.7)
Others finding in chest X-ray – n (%)	
Cardiomegaly	40 (20)
Pleura Effusion	16 (8)
Emphysema	5 (3)
Mass	0 (0)
Comorbid – n (%)	
With comorbid	132 (69.5)
Without comorbid	58 (30.5)
Length of star (days) – median(min-max)	10 (3-38)

Tabel 2. Analysis of the differences between the length of hospitalization in 4 different categories of Brixia score

Category of Brixia score	Length of treatment (days)			Overall p value	p value
	Median	Min	Max		
Low to low	10	3	24	0.377	referensi
Low to high	11	3	22		0.238
High to low	11	4	38		0.175
High to high	8	5	21		0.590

Median Brixia score at the time of admission was 4, the minimum value was zero and the maximum value is 18. The median Brixia score at serial chest x-ray examination is 6, the minimum value was zero and the maximum value is 18. Based on changes in Brixia score from serial chest X-rays examination, there are 109 patients (57.4%) in low to low category, 23 patients (12.1%) in low to high category, 49 patients (25.8%) in high to low category, and 9 patients (4.7%) in high to high category.

The median length of stay of patients in low to low category was 10 days (minimum 3 days, maximum 24 days), low to high and high to low category was 11 days (minimum 3 days and 4 days, maximum 22 days and 38 days, respectively), high to high was 8 days (minimum 5 days, maximum 21 days). Statistical analysis showed no significant correlation (p= 0.377).

Table 3. Analysis of the correlation between confounding variables with the length of hospitalization

Variables	Length of treatment (days)			p
	Median	Min	Max	
Emphysema				
Yes	11.7	6	20	0.857
No	10	3	38	
Cardiomegaly				
Yes	10	5	23	0.391
No	10	3	38	
Pleural Effusion				
Yes	10	4	26	0.561
No	10	3	38	
Mass				
Yes	-			0.842
No	10	3	38	

The median length of hospitalization in confounding variables showed emphysema had 11.7 days (minimum 6 days, maximum 38 days), cardiomegaly and pleural effusion were 10 days (minimum 5 days and 3 days, maximum 23 days and 38 days, respectively). There is no lung mass lesion found in patients sample, the median length of stay of patients without lung mass lesion was 10 days (minimum 3 days, maximum 38 days). The stastistical analysis showed no significant correlation (p = > 0.05).
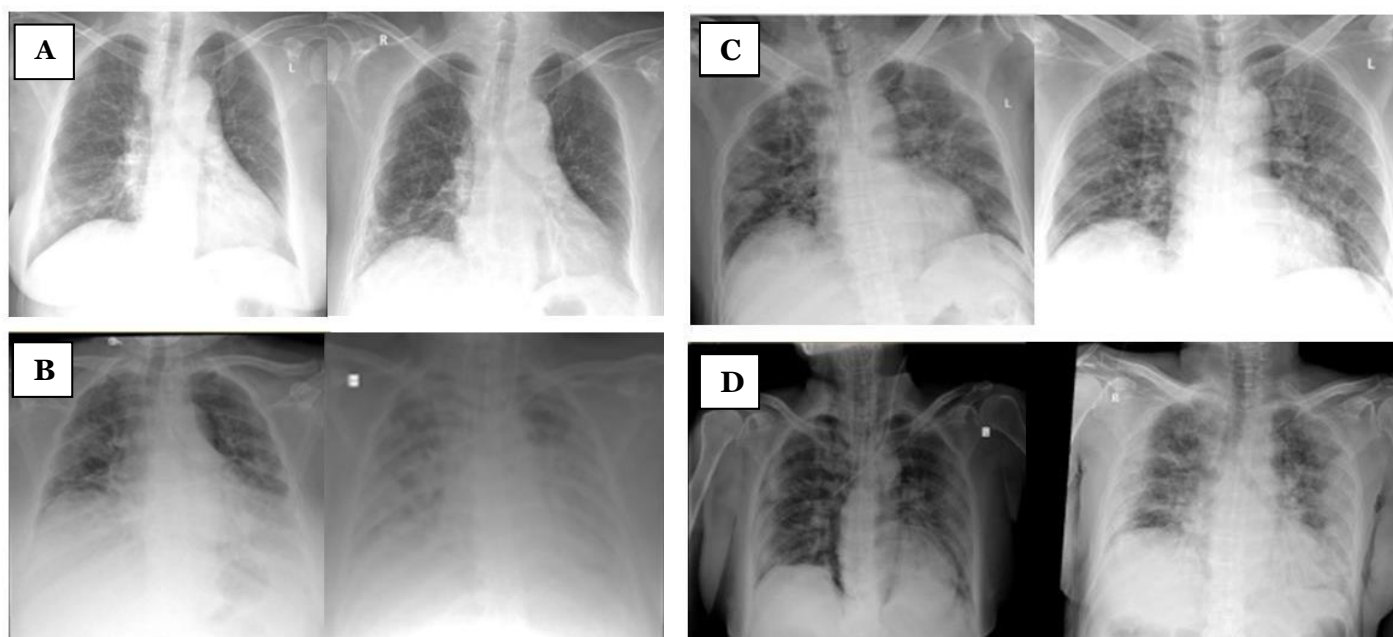
Picture 1. Cases based on Brixia score changes. A. Low to low; B. Low to high; C. High to low; D. High to high

DISCUSSION

COVID-19 has the main target in the respiratory tract which can be assessed through radiological examination, chest X-ray and lung CT-scans performed when the patient is confirmed and or suspected of COVID-19 as evidenced through rt- PCR swabs (Zimatore et al, 2019).

The study was conducted by assessing Brixia scores on the initial chest X-ray of the treatment and follow-up photos performed during the treatment between the third and seventh days. The majority of the study samples came with a mild abnormality in chest X-ray. This is similar to the study by Sathi S, et al which reported that most (45%) hospitalized patients had a mild chest X-ray abmormality (Liu, 2022).

The score changes judged from the two serial chest X-rays were categorized into four groups. Of the patients with mild abnormality of initial chest X-ray, only 17% (23 out of 132) experienced aggravation on serial examination. Of the patients with severe abnormality in initial chest X-ray, 84% (49 out of 58) experienced

significant improvements in serial examination. This reflects a fairly good prognosis in Covid-19 patients who were hospitalized at Sumber Waras Hospital. Based on a multicenter study conducted in 15 hospitals in Jakarta, the recovery rate of COVID-19 patients treated was 85% (Huang et al, 2020).

Brixia score evaluation of the length of treatment of COVID-19 patients has two conflicting opinions. In several studies that support the evaluation of Brixia scores in predicting the length of treatment (Guan et al, 2020; Celverly, 2020). Several other studies found no correlation between changes in Brixia scores against length of treatment (Santhi et al, 2021; Wasilewski, 2020). Based on statistical analysis, median differences in the length treatment of that are not correlated to changes in Brixia scores can occur due to the duration from the beginning of illness or the onset of symptoms to patients entering hospitalization which may vary (Borghesi, 2020), additional disease like TB and HIV [Borghesi, 2020; Maroldi, 2021], the absence of

standard criteria for discharge of patients from the Hospital. Patient repatriation is the full authority of the doctor in charge by considering clinical and supporting data, patients who do not have a place to self-isolate based on the Phc certificate are allowed to continue treatment at the hospital even though clinically/ radiologically there are no indications of hospitalization, in the early period of the pandemic the SARS-COV2 RT- PCR examination takes a long time, so there is a possibility that stable patients have not been discharged because waiting for the result.

This study has several disadvantages, focus of the treatment length is influenced by many things, one of which is social indications where patients with mild symptoms have a long treatment duration due to the unavailability of infrastructure to self-isolate, the interval of serial chest X-ray has not been uniform because there are no operational standards and applicable procedures, the selection of times for monitoring chest X-ray is determined by the doctor the person in charge of the patient and the patient's clinical condition, there are differences in modalities in monitoring the progression of the disease, not all chest X-ray are taken, whether they are AP projections and some are PA projections with the image quality on the AP projections are not good compared to pa positions, and the presence of pre-existing comorbidity differences can obscure the findings of signs of pneumonia in COVID-19 (Djaharuddin, 2021).

Most of COVID-19 patients have mild symptoms and also their x-ray findings is included into low to low category. The median length of treatment in all Brixia score categories was 10 to 11 days and there was no significant difference in statistical tests conducted between changes in brixia scores between each category and length of

treatment. The assessment of Brixia scores on chest X-ray has not been able to predict exactly the duration of treatment, the presence of severe clinical with comorbidities of the disease previously greatly affected the patient's condition in the treatment mass.

AUTHOR CONTRIBUTION
All the authors contributes to select the topics, searched, and collected data of the study.

CONFLICT OF INTEREST
There is no conflict of interest in this study.

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