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Radiological Features in Deceased COVID-19 Patients at a Hospital in Bandung

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Abstract.
COVID-19 attacks the respiratory system, especially the lung. Therefore, it is necessary to examine the lung radiology of COVID-19 patients to plan the best treatment. This study aimed to describe radiological features in deceased patients at a hospital in Bandung, Indonesia. This study uses secondary data from the medical records of deceased COVID-19 patients from December 2020 to February 2021. Amongst the 129 patients who died whilst hospitalized, their chest X-ray showed pneumonia consisting of ground glass opacities (GGO) and consolidated lesions. The mean distribution of lesions was unilateral in 3 (2.33%) and bilateral in 126 (97.67%). In comparison, peripheral lesions were found in 80 (62.02%), and peripheral-medial lesions were found in 49 (37.98%). The mean of the lesions affecting the upper lung fields were 2.63 (DS 1.19), the middle lung fields were 4.39 (DS 1.82), and the lower lung fields were 4.88 (DS 1.53). When admitted to the isolation ward, the average Brixia score on a chest X-ray was 11.9 (95% CI 12.74; 11.16). In conclusion, the radiological features of COVID-19 patients who died under treatment showed ground glass opacities and consolidated lesions. The predominant distribution was on bilateral, peripheral, and lower lesions with a high Brixia score.

Keywords: COVID-19, mortality, the brixia score.

1. INTRODUCTION

The coronavirus disease 2019 was declared a pandemic emergency by the World Health Organization (WHO) on 11 March 2020. On 13 April 2020, the Indonesian government declared COVID-19 a national disaster [1]. On 31 January 2021, the number of cases of COVID-19 in Indonesia reached 175,095 active cases with 29,998 death [2]. This infectious disease attacks various organs, especially the respiratory tract [3]. The symptoms

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it causes vary from mild to moderate symptoms, severe pneumonia, and even death [4]. The three main symptoms of COVID-19 are fever, cough, and shortness of breath [5]. From all recorded deaths, 53.8% of patients died from pneumonia [6].

Considering the main clinical symptoms of COVID-19 patients in the form of symptoms of respiratory tract disorders and many deaths caused by pneumonia, chest imaging of COVID-19 patients is essential to support diagnosis and evaluation [3]. Chest imaging is an evaluation element in managing COVID-19 patients [7,8]. Sensitive imaging to assess lung abnormalities is a chest CT-scan. Still, chest X-rays are preferred during this pandemic because serial examinations with chest X-ray have a much lower risk of cross-infection than CT-scan. In addition, they can be performed in isolation rooms (bedside), and the equipment can be relatively easier to disinfect. Also the risk of chest X-ray radiation is lower [4,8,9]. Technically, examination with CT-scan is more difficult for patients treated in isolation rooms. Patients have to leave the isolation room to go to the CT-scan section. In addition, the cost of an examination with a CT-scan is more expensive [4], and in Indonesia, not all health facilities have access to it.

The purpose of this study was to determine the severity of pneumonia based on chest X-rays in COVID-19 patients who died during hospitalized.

2. METHODS

This study is a cross-sectional, taking data from hospital digital medical records with subject of 129 confirmed COVID-19 patients who were hospitalized and died while in treatment from December 2020–February 2021. The inclusion criteria were all hospitalized confirmed COVID-19 patients over 17 years old and performed a chest X-ray when admission to the hospital. Exclusion criteria were poor chest X-ray and patients with chronic lung diseases comorbid such as pulmonary tuberculosis.

Following currently developing studies, in patients with COVID-19 pneumonia occurs. The direct cause of death was respiratory failure due to diffuse alveolar damage. All chest X-ray from digital archives were reexamined to assess the presence of opacities, both ground glass opacities and consolidated lesions, and their distribution pattern. First is the distribution in the peripheral or a mixture in the peripheral and medial. The second is whether unilateral or bilateral. Next the severity of the lesion was assessed using the Brixia score by an experienced radiologist.

The Brixia score of the chest X-ray of COVID-19 patients used in this study is the score developed by Borghesi and Maroldi [10]. This score has a strong correlation with clinical symptoms [11]. This severity rating is semi- quantitative by assessing lung opacity

lesions in COVID-19 patients. There are two steps to make this score, namely: the first step, a posteroanterior or anteroposterior chest X-ray was divided into six zones (A, B, C, D, E, F). Zones A, B, C were in the right lobes and zone D, E, F were in the lobes. Zones A and D are the upper zones positioned above the inferior wall of the aortic arch. Zones B and E are the middle zones below the upper zone and above the right inferior pulmonary vein (hilar structure). Zones C and F are the lower zone, positioned below the right inferior pulmonary vein (lung base). In the second step, each zone is given a score based on the lung opacity found. Score 0 for no lung abnormalities, score 1 there is an interstitial infiltrate, score 2 there are interstitial and alveolar infiltrates (interstitial dominant), score 3 there are interstitial and alveolar enters (alveolar dominant). Brixia score is the result of accumulated scores from six lung zones, then classified into severe if Brixia score >8, mild if Brixia score <8 [4].

3. RESULTS

Of the 129 COVID-19 patients who died during treatment, 80 were male (62.01%) and 49 were female (37.98%). All had pneumonia with ground glass opacities mixed with consolidated lesions. The distribution of pneumonia lesions was mainly in the pheriperal, in 80 people (62.01%) with a confidence interval (CI) of 53.2870.04 and bilateral in 126 people (97.67%) with CI of 92.9799.26. The most severe degrees of severity based on the Brixia score was in a severe category, namely in 108 people (83.72%) with CI of 76.2489.18. Lower lobe lesions dominated this category with mean Brixia score of 4.88 (DS 1.53). The distribution of lesions and severity based on the Brixia score can be seen in Table 1, while Brixia score based on lung zioning is in Table 2.

Table 1: Chest X-ray of confirmed COVID-19 patients.

Frequency			Percentage	95% CI	
Gender	Female	49	37.98	29.96	46.72
	Male	80	62.01	53.28	70.04
Lession 1 distribution	Perifer	80	62.01	53.28	70.04
	Perifer-medial	49	37.98	29.96	46.72
Lession 2 distribution	Unilateral	3	2.32	0.74	7.03
	Bilateral	126	97.67	92.97	99.26
Severity	Mild (<8)	21	16.28	10.82	23.76
	Severe (>8)	108	83.72	76.24	89.18

CI: Confidence Interval

Table 2: Severity of confirmed COVID-19 based on chest X-ray.

		Mean Score Brixia	DS
Lung Zone	Upper Midlle Lower	2.63 4.39 4.88	1.91 1.82 1.53

DS: Deviation Standard

4. DISCUSSION

4.1. Radiological Picture

In this study, all chest X-rays in COVID-19 patients who died under treatment gave a picture of pneumonia. Ground glass opacities mixed with consolidated lesions were the most common finding. The same is shown in David L et al. and Diletta C et al. In both studies, most chest X-rays were GGO without consolidation lesions [12,13].

Ground glass opacities are blurry with a slight increase in lung tissue opacity, with pulmonary vascular maskings still visible [3,14]. Consolidation was any pathological process that fills the alveoli with fluid, pus, blood, cells, or the other substances resulting in lobar, diffuse or multifocal ill-defined opacities [15].

Radiopathological picture of GGO lesions occurs due to viral invading bronchioles and alveolar epithelium. The virus replicates in the alveolar epithelial cells, causing inflammation of the alveolar walls, thickening of the alveolar walls, thus giving a picture of increased lung opacity [14].

In several scientific papers, it is stated that the coronavirus has four structural proteins, namely spike (S), membrane (M), envelope (E), and nucleocapsid (N). Spike is a glycoprotein that protrudes on the virus's surface, so it looks like a crown (corona). Spike consists of two functional subunits: the S1 subunit, which binds to host cell receptors, and the S2 subunit for fusing viral and cell membranes [16]. This virus most often attacks the lungs because the lung is one of the organs that expresses the most angiotensin-converting enzyme 2 (ACE 2), specifically type II alveolar cells. Angiotensin-converting enzyme 2 is a receptor that can bind to the S1 spike subunit [16,17]. After binding to alveolar cells, the virus fuses into cells, then causes an inflammatory reaction, increasing vascular permeability and exudation of inflammatory fluid in lung tissue [14,18,19].

4.2. Peripheral, Bilateral and Lower Lobe Distribution

This study showed that the distribution of pneumonia lesions was mainly in the peripheral lung, involving both lung lobes (bilateral) and lower lobes. This finding follows many

studies in various countries, including the studies by David LS, et al, Ho YF, et al, Diletta C, et al and Sara H, et al. [12,13,20,21]. It is related to the invasion of the COVID-19 virus in the alveolar epithelium subpleural [14]. The distribution of pneumonia in this study mainly involves both lungs (bilateral) and affects the lower lobes of the lungs. Therefore, it may have something to do with gravity. However, it is unclear why many lesions occur in the lung area, so further research is needed.

4.3. Severity

The chest X-ray severity in the COVID-19 patients who died in this study was assessed by the Brixia score. Borghesi and Maroldi introduced this scoring system [10]. Of all subjects, 108 people (83.72%) had severe Brixia score (score >8) and 21 (16.28%) had mild Brixia score (score<8). The severity of chest X-ray based on lung zone in this study showed the most significant average (mean) of Brixia score was in the lower lung zone (4.88) and then following by the mid-lung site (4.39).

5. CONCLUSION

We conclude that radiological features of COVID-19 patients who died under treatment show ground glass opacities and consolidated lesions. In addition, it was found severe Brixia score correlates with the predominant distribution of bilateral, peripheral, and lower lesions. Therefor, we believe this study is helpful for clinicians to plan

treatment and various actions needed the risk of death if the Brixia score in the severe category at the initial examination.

6. STUDY LIMITATION

The drawback in this study is that only one radiologist assessed severity based on Brixia score.

References

[1] Kementerian KR. Pedoman Pencegahan Dan Pengendalian Corona Virus Disease (Covid-19). 2020.

[2] Keputusan Presiden Republik Indonesia No 12 Tahun 2020 Tentang Penetapan Bencana Nonalam Penyebaran Corona Virus Disease 2019. Indonesia: Sebagai

Bencana Nasional; 2020.

[3] Sánchez-Oro R, Torres Nuez J, Martínez-Sanz G. Radiological findings for diagnosis of SARS-CoV-2 pneumonia (COVID-19). Med Clín (Engl Ed). 2020 Jul;155(1):36–40.

[4] Balbi M, Caroli A, Corsi A, Milanese G, Surace A, Di Marco F, et al. Chest X-ray for predicting mortality and the need for ventilatory support in COVID-19 patients presenting to the emergency department. Eur Radiol. 2021 Apr;31(4):1999–2012.

[5] da Rosa Mesquita R, Francelino Silva Junior LC, Santos Santana FM, Farias de Oliveira T, Campos Alcântara R, Monteiro Arnozo G, et al. Clinical manifestations of COVID-19 in the general population: systematic review. Wien Klin Wochenschr. 2021 Apr;133(7-8):377–82.

[6] Elezkurtaj S, Greuel S, Ihlow J, Michaelis EG, Bischoff P, Kunze CA, et al. Causes of death and comorbidities in hospitalized patients with COVID-19. Sci Rep. 2021;11(1):1–9.

[7] Rubin GD, Ryerson CJ, Haramati LB, Sverzellati N, Kanne JP, Raoof S, et al. The Role of Chest Imaging in Patient Management during the COVID-19 Pandemic: A Multinational Consensus Statement from the Fleischner Society. Radiology. 2020 Jul;296(1):172–80.

[8] World Health Organization Guidance Note. Use of chest imaging in COVID-19: a rapid advice guide. 2020. 56.

[9] Sarkodie BD, Osei-Poku K, Brakohiapa E. Med Case Rep (Wilmington). 2020;6(2):10–2.

[10] Borghesi A, Maroldi R. COVID-19 outbreak in Italy: experimental chest X-ray scoring system for quantifying and monitoring disease progression. Radiol Med (Torino). 2020 May;125(5):509–513.

[11] Setiawati R, Widyoningroem A, Handarini T, Hayati F, Basja AT, Putri AR, et al. Modified Chest X-Ray Scoring System in Evaluating Severity of COVID-19 Patient in Dr. Soetomo General Hospital Surabaya, Indonesia. Int J Gen Med. 2021 Jun;14:2407–2412.

[12] Smith DL, Grenier JP, Batte C, Spieler B. A Characteristic Chest Radiographic Pattern in the Setting of the COVID-19 Pandemic. Radiol Cardiothorac Imaging. 2020 Sep;2(5):e200280.

[13] Cozzi D, Albanesi M, Cavigli E, Moroni C, Bindi A, Luvarà S, et al. Chest X-ray in new Coronavirus Disease 2019 (COVID-19) infection: findings and correlation with clinical outcome. Radiol Med (Torino). 2020 Aug;125(8):730–7.

[14] Chen H, Ai L, Lu H, Li H. Clinical and imaging features of COVID-19. Radiol Infect Dis. 2020 Jun;7(2):43–50.

[15] Smithuis R, Delden OV.Chest X-Ray: Basic Interpretation. From https://radiologyassistant.nl. 2013.

[16] Attaway AH, Scheraga RG, Bhimraj A, Biehl M, Hatipoğlu U. BMJ. 2021;372.

[17] Shang J, Ye G, Shi K, Wan Y, Luo C, Aihara H, et al. Structural basis of receptor recognition by SARS-CoV-2. Nature. 2020 May;581(7807):221–4.

[18] Wu YC, Chen CS, Chan YJ. The outbreak of COVID-19: an overview. J Chin Med Assoc. 2020 Mar;83(3):217–20.

[19] Yuki K, Fujiogi M, Koutsogiannaki S. COVID-19 pathophysiology: A review. Clin Immunol. 2020 Jun;215.

[20] Haseli S, Khalili N, Bakhshayeshkaram M, Taheri MS, Moharramzad Y. Arch Acad Emerg Med. 2020;8.

[21] Wong HY, Lam HY, Fong AH, Leung ST, Chin TW, Lo CS, et al. Frequency and Distribution of Chest Radiographic Findings in Patients Positive for COVID-19. Radiology. 2020 Aug;296(2):72–78.