

The Relation Between Chest X-Ray (CXR) and RT-PCR in COVID-19 Patients Hospitalized at Dustira Hospital

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Abstract—Corona virus disease 2019 (COVID-19)-caused by infection of RNA virus from Coronaviridae family- can be manifest as mild to severe disease. Nowadays, CXR and rRT-PCR are mostly used additional examination to establish the diagnosis of COVID-19. The objective of this study is to determine relation between CXR and rRT-PCR on COVID-19 patients. This is an analytic observational study with cross sectional approach using secondary data from medical record of COVID-19 patients hospitalized at Dustira Hospital during March – December 2020. There are 47 patients whose match inclusion and exclusion criteria from 51 sample that successfully gathered. Statistical analysis is performed using chi-square test. Basic characterized of this population study showed male predomination (76,60%) with more than half patient aged between 20 – 39 years old (51,10%). CXR result of forty-one patients (87.33%) reflect COVID-19 specific feature. Most patients have rRT-PCR with positive result (89,36%). Chi-square test showed no significant relation between CXR and rRT-PCR result. This condition can be happened because the patient truly does not get infected with SARS-Cov-2 or may be their test giving false negative result.

Keywords—COVID-19, CXR, rRT-PCR

I. INTRODUCTION

Coronavirus disease 2019 (COVID-19) is a disease which caused by *Betacoronavirus*, afterwards named as *Severe Acute Respiratory Syndrome Coronavirus-2* (SARS-CoV-2). This virus was in the first instance discovered in Wuhan, Hubei Province, People's Republic of China. SARS-CoV-2 was identified to have similarity with a corona virus sample which was collected from Huanan seafood market. COVID-19 could be easily transmitted through droplets from the infected patients, exposed through the mucosa (mouth, nose, and

conjunctiva), orofecal transmission, physical contact with certain objects which were previously contacted by infected patients, and the airborne transmission. Its easily transmitted feature led to the rising of the COVID-19 cases over time.

According to the latest data obtained through the World Health Organization (WHO)'s website, 223 countries have confirmed the existence of COVID-19 cases with 88.383.771 confirmed cases and 1.919.126 deaths reported on January 10th, 2021. Indonesia is ranked 21st among these 223 countries. To date, the confirmed cases keep increasing over time. In Indonesia, the COVID-19 cases data which obtained by Badan Nasional Penanggulangan Bencana (Indonesian National Board for Disaster Management) shows that on January 10th, 2021, 34 provinces have been infected with 836.718 confirmed cases with 688.739 recovered patients, 24.343 deaths, and 123.626 active cases [1]. West Java becomes the second-highest number of COVID-19 cases after DKI Jakarta. West Java has confirmed to have 97.570 COVID-19 cases on January 10th, 2021.

The primary clinical symptoms which can be found from COVID-19 infected patients are fever with temperature with 38°C or greater, cough, and breathing difficulty. The symptoms can be accompanied by the shortness of breath, myalgia, fatigue, gastrointestinal symptoms such as diarrhea, and other respiratory disease symptoms. In certain severe cases, other symptoms such as acute respiratory distress syndrome (ARDS), septic shock, metabolic acidosis which difficult to correct, and haemorrhagic or coagulation disorder. In most cases, patients came with mild COVID-19 symptoms, even sometimes with no fever indication.

A person who is classified as a high-risk contact case is a person who has a history of contact with a probable or a confirmed COVID-19 case or a front-line health-care workers to the probable cases. A person who is classified to be involved in a suspect case is the one who experiences symptoms and/or Upper Respiratory Infection (URTI) and heavy pneumonia which requires hospital care, the one who has a travel history, or lives in the area which have been reported to have a local-transmitted case and confirmed/probable COVID-19 cases. A person who is classified to be involved in a probable case is a person who develops heavy URTI/ARDS or is dead along with the COVID-19 symptoms without no rRT-PCR lab result. A person who is classified as a confirmed case is a person who is stated positive for COVID-19 proven by an rRT-PCR test result, whether it is a confirmed symptomatic case or a confirmed asymptomatic case. The specimens of high-risk contact cases, suspect cases, confirmed cases, and the probable cases should be collected to be tested with the rRT-PCR.

Due to the increasing cases of the COVID-19, early detections have been conducted in various regions using the Antibody Rapid Test and Antigen Rapid Test. Rapid Test often have caused false positive or negative result. The Antigen Rapid Test will only detect the antigen of SARS-CoV-2 and the Antibody Rapid Test will detect the antibody which carries the SARS-CoV-2 antigen, in which it can only be detected on 5-14 days after the clinical symptoms occur. The antibody cannot be detected in the early phase of infection. Thus, it can cause the false negative test result. The Rapid Test also enables to detect antibody in the recovered patients, which then can result in a false positive test result.

Real-time reverse-transcriptase-polymerase chain reaction (rRT-PCR) is one of the methods which able to detect SARS-CoV-2 infection more accurately. The reverse transcriptase enzyme is operated to alter RNA, the genetic material of SARS-CoV-2, into DNA. DNA from the virus will be detected by using the (rRT-PCR) method. The specimen collecting can be implemented on two locations, which are from the upper respiratory tract (nasopharyngeal swab and oropharyngeal swab) or and from the lower respiratory tract (sputum, bronchoalveolar lavage/BAL, endotracheal aspirate, and biopsy). The blood sample, urine, or feces have not yet been routinely recommended. The samples which contained RNA SARS-CoV-2 will depict the positive result.

The primary image which become the option to support the diagnosis is the Chest X-Ray and Computed Tomography Scan (CT-Scan) of thorax. The ground glass opacification, infiltration, peribronchial cuffing, focal consolidation, pleura effusion, and atelectasis will be depicted on the thorax's photos of COVID-19's infected patient is deemed to be less sensitive compared to CT-Scan. However, Chest X-Ray is the most efficient way which could applied to all healthcare services. Chest X-Ray observation is also one of the sequences of COVID-19 diagnosis process and a way to observe the disease's progressivity.

Based on the descriptions above, the researchers are keen to do the observation regarding "The Relation Between Chest X-Ray (CXR) and RT-PCR in COVID-19 Patients Hospitalized at Dustira Hospital". The research is conducted in Dustira Hospital, as Dustira Hospital is the referred hospital of COVID-19 cases in West Java. Cimahi city is also opted by the researchers due to the high COVID-19 epidemiology data cases. Cimahi was highlighted as the red zone in June 2020 and Cimahi was highlighted as the orange zone (medium risk) on January 10th 2021. Red zone is a country or a geographic region which has the high increasing number of COVID-19 cases, while the orange zone is a country or a geographic region that closely located with the red zone with the smaller cluster.

II. METHODS

This research is an analytical research using the cross-sectional method which aim to discover the relation between the photo of the thorax with the rRT-PCR test result which serve for the COVID-19 diagnostic process. The data that have been obtained in this research is secondary data, which is the medical record of COVID-19's infected patients in Dustira Hospital within the period of March – December 2020. The amount of the used samples in this research, which are 47 samples, is determined through the formula to examine two different proportions. Based on the data collected, 51 samples were obtained with only 47 samples fulfilled the inclusion and exclusion criteria. The steps taken on this research are including the research preparation process, the medical record collecting process using the simple random sampling technique which have been observed by the Chest X-Ray and rRT-PCR. The obtained photos of thorax will be re-examined by Ilma Fiddiyanti, dr., Sp.Rad (K), M.Kes. Furthermore, the data will be presented in percentage on table using Microsoft Excel, statistically examined using Statistical Product and Service Solution (SPSS) software using chi square examination and will finally be processed in the research disposition.

III. RESULTS AND DISCUSSIONS

The data collected, the research conducted and the analysis regarding "The Relation Between Chest X-Ray (CXR) and rRT-PCR in COVID-19 Patients Hospitalized at Dustira Hospital" were conducted from October 2020 – January 2021. This research was conducted based on 47 COVID-19's infected patients' medical records in Dustira Hospital within the period of March – December 2020 which fulfilled the inclusion criteria. The analysis begins from the descriptive analysis to overview the respondents' characteristics based on age and sex of the COVID-19 infected patients in Dustira Hospital, hypothesis testing with *chi-square* method to analyse the relation of the photos of thorax on COVID-19 patients with the rRT-PCR test results in Dustira Hospital.

TABLE I. FREQUENCY DISTRIBUTION OF PATIENTS' CHARACTERISTICS BASED ON AGE

Age	Frequency	Percentage (%)
Age 20 – 39	24	51,10
Age 40 – 59	21	44,70
Age ≥ 60	2	4,20
Total	47	100

Based on the Table 1 observation result from the age characteristic, the majority of patients are including 24 people (51,10%) in the age of 20 – 39, 21 people (44,70%) in the age of 40-59, and 2 people in the age of ≥ 60. As per December 5th, 2020, the Minister of Health reported that the highest number of COVID-19 cases are occurred on the people within the age range of 25-29, followed by the range of age of 25 – 29, and the age of above 90 on the least number. The result of this research is aligned with the prior research which conducted by Al-Mahruqi *et al* on 2020 in Kuwait, where the research shows that the highest number of COVID-19 infected patients based on the positive rRT-PCR result is occur on the people within the age range of 20-40 [2]. However, this research is not in accordance with Tao Ai *et al* research in 2020 in China, where the research shows that the highest number of COVID-19's infected patients is occurred in the age of 40 – 59 [3]. According to *Badan Pusat Statistik* (Central Bureau of Statistic Indonesia), the residents who are classified as the labour force are residents within the age range of 15 and above. Based on this research, it has shown that there is a corelation between labour force and this research, since the labour force itself is the range of age which characterizes the highest percentage of COVID-19 cases based on age, which is the age range of 20-39. Another factor of risk that affected one to be infected by COVID-19 is the sex of male, actively smoking, the consumption of alcohol, the infrequent physical exercises, and air pollution.

TABLE II. FREQUENCY DISTRIBUTION OF PATIENTS' CHARACTERISTICS BASED ON SEX

Sex/Gender	Frequency	Percentage (%)	Sex/Gender
Men	36	76,60	Men
Women	11	23,40	Women

Based on the Table 2 observation result based on sex, the majority of research's object is men with the number of 36 (76.60%) and 11 women (23.40%). The result of this research is aligned with earlier research conducted by Ping Wu *et al* in 2020 in China, where the study shows that men is more likely to be infected by COVID-19 compared to female [4]. This research's finding is also aligned with Dawei Wang *et al* in Wuhan, China, where the result shows that the majority of the COVID-19 infected patients strikes men compared to women [5].

The issue of how men is more likely to be infected than women has been mentioned in the 2017 *BMJ's* article. Dr. Kle Sue demonstrated the effect of sex hormones, estrogen and testosterone on the immune system. The study resulted that the immunology respond in men is weaker along with the increase

of mortality and morbidity of respiratory disease caused by the virus infection. Moreover, the custom and cultural factors are also deemed as risks. It is suspected that there is in relevance with the prevalence of active smokers, in which an ACE2 expression increase occurs on smokers.

TABLE III. FREQUENCY DISTRIBUTION OF CHEST X-RAY ON COVID-19 INFECTED PATIENTS IN DUSTIRA HOSPITAL WITHIN PERIOD OF MARCH – DECEMBER 2020

Chest X-Ray's Test Result	Frequency	Percentage (%)
Specific Image of COVID-19	41	87,23
Specific image of COVID-19 dan non specific (pleura effusion dan cardiomegaly)	6	12,77
Total	47	100

The difference between two groups of Chest X-Ray's criteria based on the specific images which commonly found on COVID-19 patients is the finding of opacification ground glass images, consolidation, and fibrosis. Nonspecific images on COVID -19 patients were found through the pleura effusion and cardiomegaly. Based on table 4 observation Chest X-Ray result, the majority of cases were found along with the specific image of Covid-19, which are opacification ground glass, consolidation, and fibrosis that depicted on 41 patients (87.23%), with the 6 patients (12.77%) with nonspecific image of Chest X-Ray's remainder.

This research finds a depiction of mild cardiomegaly on the Chest X-Ray which can be seen on the patients in the age of 55, and a pleura effusion on the Chest X-Ray on the 34 years old patients. This research is aligned with the prior research examined by Soon Ho Yoen *et al* in 2020 in Korea, where the research concluded that the typical images on the COVID-19 can be seen through an opacification ground glass, consolidation on the periphery posterior of both lungs [6]. Another finding is the nonspecific image of COVID-19 pneumonia such as vascular congestion, cardiomegaly, pleura effusion, and pneumothorax.

On minority of patients, some nonspecific COVID-19 pneumonia images appeared caused by several factors. The primary factor is the comorbidity, or the prior disease occurred on patients before infected by COVID-19. Another influential factor is age, sex, confirmed cases' exposures, and the severity of disease that could lead into complications like cardiomegaly and pleura effusion.

The receptor of SARS-CoV-2 is the ACE enzyme receptor. ACE2 enzyme receptor can be found in the upper of lungs and the blood vessels. The expression of ACE enzyme receptor is very often found in the pneumocyte cell type II. ACE2 enzyme can also be found in the oral mucosa, gastric, small intestine, colon, spleen, liver, heart, and kidney. Since ACE2 is also located in the heart's myocyte, thus there is a possibility that SARS-CoV-2 could cause myocarditis or cardiomyopathy. There are 4 mechanisms which could cause cardiac injury, which are myocarditis, cytokine storm, coronary artery ischemia on patients with cardiovascular medical record, and the increase of vascular thrombosis in the coronary artery. High

virus' concentration could also affect the myocarditis risk to occur.

PERKI stated that the autopsy of COVID-19 infected patients shows that there is an infiltration of mononuclear interstitial's inflammation cells on myocardium. The COVID-19 infection is also correlated with the increase of heart biomarker. Myocardial injury and the increase of biomarker are suspected to be related with the myocarditis and infection-induced ischemia. Other than acute complication, COVID-19 infection is also related with the increasing of long-term cardiovascular risks. Patients with pneumonia, hypercoagulability, and systemic inflammation could survive longer in terms of the time.

Based on the pathogenesis and pathophysiology that occurs, SARS-CoV-2 is firmly related with the ACE2 enzyme receptor in the type II pneumocyte cells which replicated. Later, a disturbance in balance of ACE2/SRA along with the SARS-CoV-2 infection, which highly suspected to have role in the pathogenesis process on heavy lung disease and difficulty of breath on COVID-19 patients. COVID-19 patients primarily are a respiratory disease, however in a lot of patients it can also manifested as cardiovascular, including hypertension, acute cardiac injury, and myocarditis. These manifestations are the secondary of lung disease, since the acute lung disease could increase the workload of the heart and cause a condition, specifically on the patients who previously had a history of heart disease.

According to the study conducted by Chong et al in 2020 in United States, the occurrence of pleura effusion on COVID-19 patients are caused by the increase of a significant inflammation mediator which later could cause a dysfunction on capillary and endotel [7]. Inflammatory mediator that caused a fluid drainage on pleural space are the increase of d-dimer, fibrinogen, lactate dehydrogenase (LDH), c-reactive protein (CRP), and fibrinogen. This issue can lead to the fluid exudation process into the pleural space. Based on this study, the pleura effusion that related and caused by SARS-CoV-2 is commonly unilateral and occurred in a week after clinic manifestation. Another secondary infection on patients also needs to be considered.

TABLE IV. FREQUENCY DISTRIBUTION OF RRT-PCR TEST RESULT IMAGE ON COVID-19 PATIENTS

rRT-PCR Test Result	Frequency	Percentage (%)
Positive	42	89,36
Negative	5	10,64
Total	47	100

According to Table 4 regarding the rRT-PCR test result on COVID-19 patients, the majority of patients, which are 42 people (89,36%) were tested positive while the 5 remained (10,64%) are tested negative. The result of this research is aligned with prior study conducted by Tao Ai et al [3] in China where the characteristic of pneumonia viral COVID-19 Chest X-Ray on the majority of rRT-PCR test result signed as positive.

The rRT-PCR test with negative results can caused by the fact that the patients are not infected by SARS-CoV-2 or false results. The negative rRT-PCR test result on a suspect of COVID-19 infected individual can be caused by:

- Low quality of the collected specimen or the lack amount of virus sample/numbers.
- The virus does not exist in the collected sample.
- The incorrect technique of the sample collecting, such as too slow or too fast.
- Lacking quality of collecting or managing the specimen.

Furthermore, the rRT-PCR technique provides high accuracy within the period of 2 until 5 days after the symptoms appeared. Based on the outlined points, those points are the key account which underlying the routine rRT-PCR examinations to decrease the undetected infected patients.

The Table 5 below illustrates the statistic result using the SPSS program with *chi-square* (χ^2) to determine the relation between the Chest X-Ray examination with the rRT-PCR test result, where a meaningless result is obtained with the *p-value* of 0,366. Based on the data provided, it is concluded that there is no relation between the Chest X-Ray result of COVID-19 patients with the rRT-PCR test result in Dustira Hospital within the period of March – December 2020.

TABLE V. THE RELATION BETWEEN CHEST X-RAY OF COVID-19 PATIENTS WITH THE RRT-PCR TEST RESULT IN DUSTIRA HOSPITAL WITHIN THE PERIOD OF MARCH – DECEMBER 2020

		rRT-PCR Test Result				Total		P-Value
		Positive		Negative		F	%	
		F	%	F	%			
Chest X-Ray	Specific Image of COVID-19	36	87,8	5	12,2	41	100,0	0,366
	Specific Image of COVID-19 and Non Spesific Image of COVID-19	6	100,0	0	0	6	100,0	
	Total	42	89,4	5	10,6	47	100,0	

This research shows that there is no significant relation between the photo thorax test result on COVID-19 patients with the rRT-PCR test result in Dustira Hospital within the period of March – December 2020. Puspariani stated that this issue can be caused by incorrect method in the collecting

process, transfer, and the sample processing of the COVID-19 infected patients suspect when they got their rRT-PCR test result negative. According to the Diletta Cozi *et al's* research in 2020 in University Hospital, photo thorax has the 67,1% sensitivity. Chun Qin Long's 2020 research in Yichang Tiling

Hospital illustrates that rRT-PCR has 83,3% percentage of sensitivity [8].

In the theory, it is also stated that the photo thorax observation is deemed as less sensitive, and the rRT-PCR test has been declared as the golden standard due to the existence of *reverse transcriptase* enzyme used to alter RNA, which is the genetic material of SARS-CoV-2. The sample obtained through the lower respiratory tract is highly recommended to the patients who suffer severe or progressive clinical symptoms. In this research, 5 people (10,6%) who were tested with COVID-19's suspected photo thorax obtained the negative rRT-PCR result. This issue is likely to be caused by the error process of rRT-PCR test, which lead to the false negative result and require to be re-examined to eliminate the false negative result.

IV. CONCLUSION

This research concludes that the highest age criteria of the COVID-19 patients is on the age range of 20-39 with the number of 24 people (51,10%) and male as the majority based on sex/gender with the number of 36 (76,60%). The major criteria of photo thorax observation are on the specific image of COVID-19 with 41 people (87,23%). The criteria of the positive rRT-PCR test result are on the number of 42 people (89,36%). It is concluded that there is no significant relation between the photo thorax test result on COVID-19 patients with the rRT-PCR test results.

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