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THORAX CT-SCAN EXAMINATION RESULT OF COVID-19 PATIENTS

(HASIL PEMERIKSAAN CT-SCAN THORAX PASIEN COVID-19)

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ABSTRACT

Coronavirus disease 2019 (COVID-19) is a pandemic disease caused by Severe Acute Respiratory Syndrome Coronavirus-2 (SARS-CoV-2 Anyone could have asymptomatic to severe symptoms. COVID-19 manifests in the lungs, so Radiological examinations, such as X-rays and CT-Scans are needed. The CT-Scan thorax is an examination to assess the progression, severity, and comorbidities based on the consensus of the Radiology Society of North America (RSNA). The purpose of this literature review is to discuss and provide information about the SARS-CoV-2 virus, pathogenesis and pathophysiology, clinical symptoms, and the results of the COVID-19 thorax CT scan. This research is a literature study, which is a type of research that collects, manages, uses, and reviews research data sourced from scientific research journals, previous research manuscripts, and textbooks. The results of the literature review

are discussions used to strengthen the management of COVID-19 based on symptoms with a CT-Scan of the thorax.

Keywords: clinical symptoms; CT-Scan; RSNA; SARS-CoV-2

ABSTRAK

Coronavirus disease 2019 (COVID-19) merupakan penyakit pandemi yang disebabkan oleh Severe Acute Respiratory Syndrome Coronavirus-2 (SARS-CoV-2). Infeksi SARS-CoV-2 akan menimbulkan gejala yang bervariasi dimulai dari tanpa gejala hingga gejala berat. COVID-19 bermanifestasi pada paru-paru sehingga diperlukan pemeriksaan radiologi, yaitu ronsen dan CT-Scan. CT-Scan thorax COVID-19 merupakan pemeriksaan untuk menilai progresivitas, tingkat keparahan, dan komorbiditas yang didasari oleh konsensus Radiology Society of North America (RSNA). Tujuan penulisan ini membahas dan memberikan informasi mengenai virus SARS-CoV-2, patogenesis dan patofisiologi, gejala klinis, dan hasil pemeriksaan CT-Scan thorax COVID-19. Penelitian ini merupakan penelitian studi kepustakaan atau literature review yaitu jenis penelitian yang mengumpulkan, mengelola, menggunakan dan mengkaji data penelitian bersumber dari jurnal penelitian ilmiah, naskah penelitian terdahulu dan textbook yang memiliki relevansi dengan tema. Hasil penelusuran literatur menunjukkan bahwa untuk memperkuat penatalaksanaan COVID-19 berdasarkan gejala dengan gambaran CT-Scan thorax.

Kata kunci: *CT-Scan; gejala klinis; RSNA; SARS-CoV-2*

INTRODUCTION

Coronavirus disease 2019 (COVID-19) is a respiratory disease caused by Severe Acute Respiratory Syndrome Coronavirus-2 (SARS-CoV-2).[1] The World Health Organization (WHO) declared COVID-19 to be a pandemic disease that attacked 223 countries in the world, and Indonesia was ranked 19th in June 2021, and the number of cases continued to increase.[2] As of June 2021, the number of cases in Indonesia had reached 2,072,867 confirmed cases and 56,371 deaths.[3] SARS-CoV-2 is a new variant virus of the Coronaviridae family in the Betacoronavirus genus. The SARS-CoV virus had an outbreak in China in 2002 and MERS-CoV in Central Asia.[1,4]

The component of SARS-CoV-2 consists of a spike protein (S protein) for attachment and entry of the virus into the host through the ACE-2 receptor. The receptor can be found in the oral, nasal, and conjunctival mucosa. A replication of the RNA component processes a new virus, then it will be spreading to the lower respiratory tract and cause clinical manifestations through an inflammatory reaction. The incubation period for COVID-19 is 5 days with symptoms from asymptomatic to severe.[1,4]

Real-Time Polymerase Chain Reaction (rRT-PCR) is a recommendation for diagnosing COVID-19 supported by case criteria, laboratory and radiological investigations.[1,4,5]

Radiological examination has a role in identifying lung damage, observing the effects of treatment, and evaluating disease.[6] According to the Radiology Society of North America (RSNA), the classification of COVID-19 is divided into negative, atypical, indeterminate, and typical. The density found is ground-glass opacity, consolidation, crazy paving pattern, bronchovascular thickening, reverse halo sign and/or halo sign, and others.[5,6]

METHOD

The design of this research is that of a literature review. Literature review research design is a research method used to collect data related to the formulation of problems in research papers obtained from various literature sources such as scientific research journals, previous research manuscripts, and related textbooks and can be used to answer the number of samples in scientific research journals. used in research.

A literature search was performed combining "covid-19" and "CT scan", having previously identified selected outcomes in articles published on the topic and in Medical Subject Headings (MeSH),

PubMed, NCBI, Science Direct, Radiological Society of North America (RSNA), and Google Scholar. The data used in this study are the national and international articles published from 2020 to 2021.

The inclusion and exclusion criteria included English and Indonesian publications with titles and abstracts related to the topic. Incomplete articles, duplicates, studies on animals, and which, when read, did not fit the theme were excluded from the study.

RESULT

After applying the inclusion and exclusion criteria, a literature search returned 57 published references, with 22 potentially eligible ones selected. There are 22 of literature left after reading this text in its entirety.

DISCUSSION

Etiology of COVID-19

SARS-CoV-2 is a positive single-stranded RNA virus, 50–200 nm in size, belonging to the Coronaviridae family with the betacoronavirus genus. The components of SARS-CoV-2 consist of spike protein (S protein), membrane protein (M), an envelope protein (E), nucleocapsid protein (N), and RNA.[1,2] In the oral and nasal mucosa, the lungs, and other organs, the protein S component will bind to angiotensin-converting enzyme 2 (ACE-2).[1,2] SARS-CoV-2 spreads through the air from an infected person, whether symptomatic or asymptomatic, or during the incubation period, through urine, orofecal, and can be found on objects.[7] Figure 1 shows images of SARS-CoV-2.

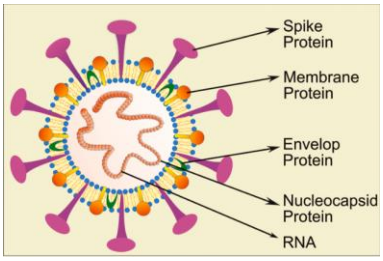

Figure 1.

Structure of SARS-CoV-2.

Pathogenesis and Pathophysiology of COVID-19

The SARS-CoV-2 infects the human body by attaching to the upper respiratory tract, nasal mucosa, mouth, and conjunctiva via the ACE-2 receptor. Viral binding to ACE-2 triggers down-regulation of ACE-2 receptors and disruption of the renin-angiotensin-aldosterone (SRAA) system, which can potentially increase vascular permeability and trigger the inflammatory response. It is through five stages of the life cycle: attachment, penetration, biosynthesis, maturation, and release. [4,8,9] Figure 2 shows the pathogenesis of SARS-CoV-2.[9]

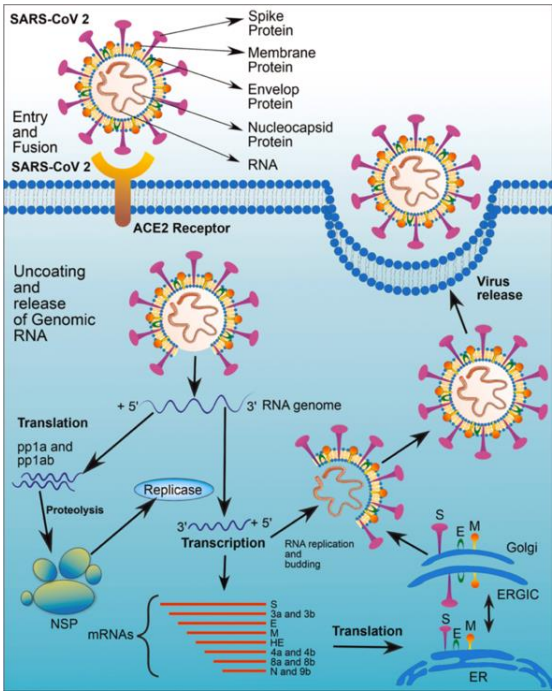

Figure 2. SARS-CoV-2 replication process in host cells.

When the body is responding to viral infections, the inflammatory response is related to the immune response process. Fever, cough, fatigue, increased phlegm production, and shortness of breath are all symptoms of this reaction. Other symptoms may appear depending on which organs are affected, including the central nervous system (CNS), kidneys, heart, liver, muscles, digestive system, and others. The immune system's response to the virus will produce immunity in the body, resulting in high levels of IgM and IgG antibodies. SARS-CoV-2 will influence the blood, producing thrombocytopenia, lymphocytopenia, leukopenia, and a rise in C-reactive protein, in addition to infecting organs. [4,8,9]

Figure 3 shows the pathophysiology and target organs of COVID-19.[9]

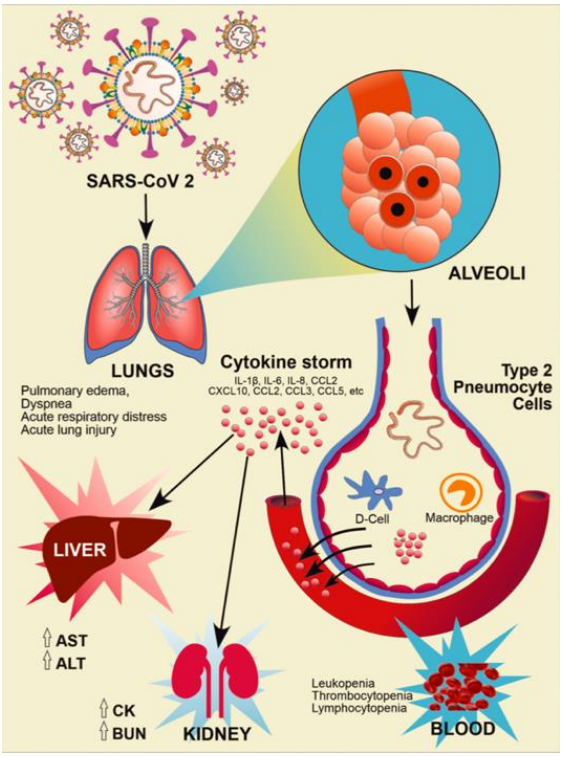

Figure 3. Pathophysiology and target organ.[9]

Clinical Symptoms of COVID-19

The clinical symptoms of COVID-19 range from asymptomatic to mild symptoms, moderate symptoms, severe symptoms, and critical symptoms. It is according to the third edition of the COVID-19 management guidelines.[1]

Table 1. Clinical Symptoms of COVID-19.[1]

Symptom	Description
Asymptomatic	No symptoms
Mild	fever, cough, fatigue, anorexia, shortness of breath, myalgia, sore throat, nasal congestion, headache, diarrhea, nausea and vomiting, loss of smell (anosmia), and loss of taste (ageusia)
Moderate	fever, cough, shortness of breath, rapid breathing, SpO2 > 93% in room air.
Severe	fever, cough, fatigue, anorexia, shortness of breath **Plus one of:** Respiratory rate > 30 x/min, severe respiratory distress, or spO2 < 93% on room air. **Critical:** Acute Respiratory Distress Syndrome (ARDS), sepsis and septic shock.

According to the results of the findings, severe symptoms (27.8%) and moderate symptoms (27.8%) were the most common causes of a CT scan of the thorax (25.3%). There are a variety of factors that influence the severity of COVID-19 symptoms, including comorbid factors or COVID-19 patient comorbidities. It is also additional risk factors such as age, active smokers, alcohol consumption, and failure to adhere to health protocols.[10-12]

CT-Scan Thorax of COVID-19

The SARS-CoV-2 rapid antigen, laboratory tests, and radiography can all be used to support the definite diagnosis of COVID-19.[1] The Association of Radiology Specialists (PDSRI) suggested that chest X-rays and CT-Scans of the thorax be performed.[13] The chest X-ray examination is the first line in supporting the diagnosis of COVID-19, which appears significant 12–17 days after onset.[14,15] A CT-Scan examination is provided for patients with a progressive illness course by determining the severity of COVID-19 and assessing comorbid disease (the American College of Radiologists).[14]

The difference between a CT-Scan of the thorax and a chest X-ray was confirmed by a sensitivity of 95.3%, specificity of 43.8%, and an accuracy of 63.3% for a CT-Scan of the thorax compared to a chest radiograph with a sensitivity of 67.1%.[16] There are currently two COVID-19 assessment guidelines, one based on the Radiology Society of North America (RSNA) and another based on the Dutch Association for Radiology, which released the COVID-19 Reporting and Data System (CO-RADS). According to the Radiology Society of North America (RSNA), COVID-19 will be classified into four categories: negative, atypical, indeterminate, and typical.[17,18] Table 2 shows the categorisation.[18]

Table 2. CT-Scan thorax COVID-19 according to RSNA.[18]

COVID-19 Pneumonia Imaging Classification	Rational	CT Findings
Typical appearance	Image features with greater specificity for frequently reported COVID-19 pneumonia.	Peripheral GGO, bilateral, with or without visible consolidation or intralobular streaks (crazy paving). Multifocal GGO with rounded morphology with or without consolidation or visible intralobular streaks (crazy paving). Reverse halo sign or other signs of organizing pneumonia (observed in later stages of disease).
Indeterminate appearance	COVID-19 pneumonia images with non-specific characteristics	There are no characteristic features, there is multifocal, diffuse, perihilar, or unilateral consolidation with or without consolidation that has no specific distribution, is non-rounded, and is non-peripheral. Small GGO with few distributions with non-rounded and non-peripheral distributions, in small numbers.
Atypical appearance	Uncommon or unreported features of COVID-19 pneumonia	Absence of typical or indeterminate features and presence of isolated lobar or segmental consolidation without GGO; discrete small nodules (centrilobular, tree-in-bud); lung cavities; smooth interlobular septal thickening with pleural effusion
Negative	There are no signs of pneumonia	No CT features suggestive of pneumonia

Typical

The typical appearance in Figure 4 shows a multifocal round ground glass appearance distributed peripherally (orange arrows) in interlobular scattered areas with or without consolidation (yellow arrows).[19,20]

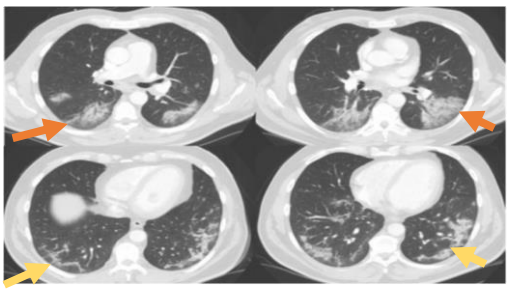

Figure 4. Description of a typical COVID-19 thorax CT-scan.

Indeterminate

The ground-glass opacity (orange arrows) is shown in both lung fields in the indeterminate appearance in Figure 5. Intermediate COVID-19 features include cases with minor ground-glass opacity that are not rounded or located on the periphery.[19,20]

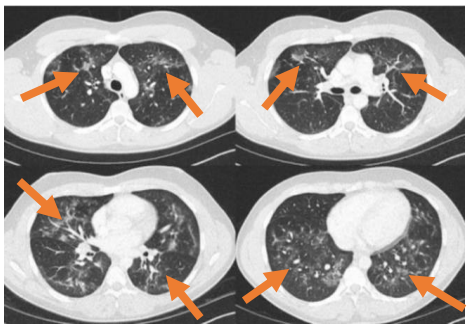

Figure 5. Description of indeterminate type of COVID-19 thorax CT-scan.

Atypical

Figure 6 shows the atypical appearance of multifocal trees in bud opacity (orange arrow). No typical COVID-19 features, lobe/segmental consolidation, lung cavities, interlobular septal thickening with pleural effusion.[19,20]

Figure 6. An atypical type of COVID-19 thorax CT scan.

Negative

On the negative, there was no CT-Scan of the thorax and the clinical picture of the patient indicated pneumonia.[36] In Figure 7, there is no typical picture of COVID-19.[19]

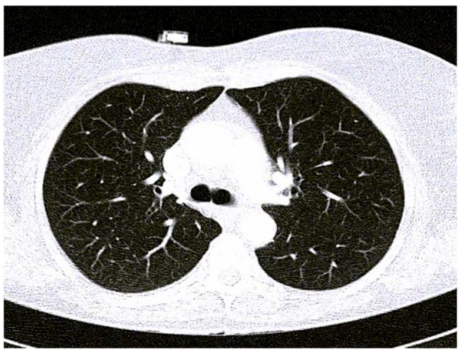

Figure 7. A negative type of COVID-19 thorax CT scan.

Based on the density of COVID-19, images such as ground-glass opacity, consolidation, crazy paving patterns, thickening of blood vessels, reverse halo sign, and/or halo sign will be found. [22]

Ground glass opacity

Due to inflammation, GGO is a blurry image with a higher density in the lungs, allowing the pulmonary vessels to be seen. Figure 8 shows GGO images.[22]

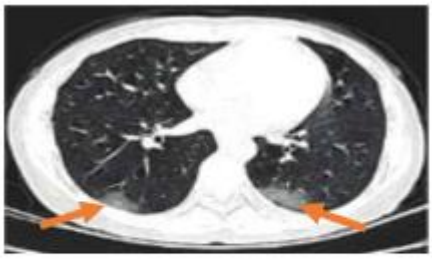

Figure 8. Bilateral peripheral ground glass opacity.

The Consolidation

The consolidation occurs when an inflammatory activity in the alveoli

continues over time, resulting in exudation of exudate in the alveoli in both lungs and the white appearance (white lung) in Figure 9.[22]

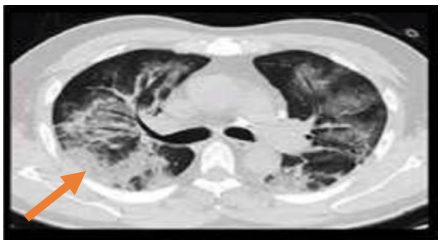

Figure 9. Overview of GGO and consolidation.

The Crazy paving pattern

On a high-resolution CT scan of the thorax in Figure 10, the crazy-paving pattern shows the existence of lobular thickening and interlobular line shadows that overlap with the GGO.[22]

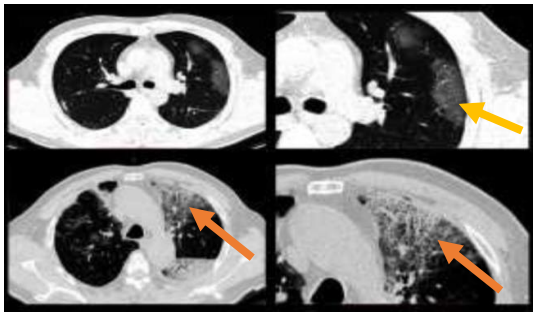

Figure 10. GGO with consolidation and crazy paving patterns.

The thickening of blood vessels

Vascular thickening occurs at any stage of the disease and occurs on the periphery or in the center of the lesion.[22]

Halo sign or reverse hello sign

Figure 11 shows a ground-glass opacity surrounded by a crescent/ring-shaped consolidation, and a halo sign (white arrow).[20]

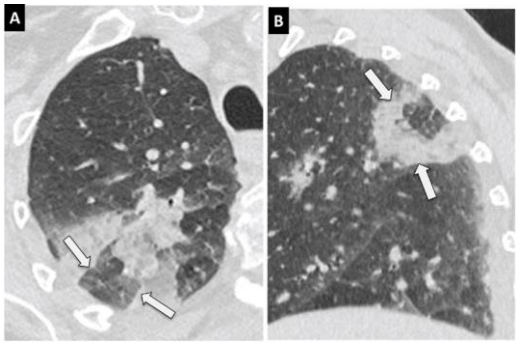

Figure 11. Overview of the halo sign on COVID-19.

CONCLUSION

COVID-19 (Coronavirus Disease 2019) is a respiratory disease that can affect other organs. RT-PCR is used to make a definitive diagnosis, which is confirmed by laboratory and radiographic examinations. The recommended radiological examinations, mainly X-rays and CT-Scans, can be used to assess COVID-19 progression and severity, and also comorbid diseases.

CONFLICT OF INTEREST

There is no conflict of interest in writing this article.

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