ASEAN Movement in Radiology

Post-COVID-19 lung diseases: A short note from AOCR 2023, Bangkok, Thailand

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Abstract

The Asian Symposia II: Post-COVID Lung Diseases at the Asian Oceanian Congress of Radiology (AOCR) 2023, Bangkok, Thailand, discussed the current understanding regarding post-COVID-19 lung diseases, one of the topical health concerns. At the AOCR2023 Asian Symposia, representatives from South Korea, India, Malaysia, and Thailand presented different views, initiatives, and experiences in post-COVID-19 lung diseases.

Keywords: Post-COVID-19 lung disease, Asia, AOCR2023

Main messages:

- The definitions, terms, timelines, imaging findings, management, and outcomes of post-COVID-19 lung diseases remain inconclusive.
- It is essential for radiologists to be familiar with and able to identify imaging features of acute and post-COVID-19 pneumonia and consider the time frame and other related factors when interpreting chest imaging.
- Since residual lung abnormalities after COVID-19 pneumonia usually exist in the short follow-up period but gradually resolve over time, radiologists should avoid describing residual lung abnormalities as fibrosis at short-term follow-up CT.
- Radiologists should also be aware of rebound phenomena and other complications associated with COVID-19 pneumonia.

Introduction

The Asian Symposia was established by the Asian Oceanian Congress of Radiology (AOCR) Scientific Committee to discuss current topical health concerns in Asian countries. The symposia were held on 10th February, the second day of AOCR2023, in Bangkok, Thailand, and participation was by invitation only. The proposed topics discussed in the AOCR2023 Asian Symposia was *I: Situation and Imaging Innovation in Tuberculosis* and *II: Post-COVID-19 Lung Diseases.*

In the session of Post-COVID-19 Lung Diseases, the chairpersons were Noriyuki Tomiyama and Yutthaphan Wannasopha. The following societies provided representatives who presented and subsequently submitted a written report summarizing the perspectives of their countries: the Korean Society of Radiology (KSR), the Indian Radiological & Imaging Association (IRIA), the College of Radiology, Academy of Medicine of Malaysia (COR/AMM), and the Royal College of Radiologists of Thailand (RCRT).

The situation of post-COVID-19 lung diseases in Korea

Yeon Joo Jeong, presented on behalf of the KSR, elucidated that post-COVID-19 condition (PCC) is a condition that can occur following COVID-19 and is more common in females, hospitalized patients, and patients with underlying diseases [1, 2]. There are no specific tests to diagnose PCC, but it can be identified through symptoms, signs, and blood tests. Clinical work-up for PCC includes pulmonary function tests, chest radiography or CT, echocardiography, and non-invasive tests for severe COVID-19. These tests are recommended for patients with persistent respiratory distress or chest discomfort for three months after a COVID-19 diagnosis to differentiate from other diseases and detect early pulmonary fibrosis, pericarditis/myocarditis, and heart failure.

The imaging features of PCC are characterized by a typical evolution of COVID-19 pneumonia, with post-acute lung abnormalities showing gradual improvement over time. The incidence and morphology of chronic lung abnormalities in PCC are related to the severity of the initial COVID-19 pneumonia. Fibrotic-like lesions may be present, with bronchial dilatation, reticulation, parenchymal bands, architectural distortion, and ground-glass opacities. However, most residual lung abnormalities are mild, and fibrosis is uncommon except in severe pneumonia. Also, a progressive course is not typical [3-5]. Longitudinal CT imaging helps distinguish fibrosis from resolving or improving lesions, evaluating uncommon cases of persistent pulmonary fibrosis or interstitial lung disease (ILD) associated with COVID-19, and assessing the worsening of pre-existing ILD by COVID-19.

The Korean preliminary guidelines recommend evaluating patients with persistent symptoms beyond 12 weeks after COVID-19 diagnosis for the possibility of long COVID, excluding other underlying diseases or complications of COVID-19, and performing relevant tests as needed. Still, there is no specific test to diagnose long COVID and insufficient evidence to recommend specific medical treatments or steroid administration. Thromboprophylaxis should not be routinely administered, and respiratory rehabilitation can be considered in consultation with a specialist. COVID-19 vaccination does not increase the incidence of long COVID [6].

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In conclusion, PCC is a complex syndrome with a wide range of physical and mental health consequences that can last for several weeks. Lung abnormalities in PCC represent a mixture of sequelae of direct viral damage, acute lung injury, and immune-mediated processes, with increased risk associated with the severity of infection, adult respiratory distress syndrome, duration of hospitalization and mechanical ventilation, older age, and the presence of inflammatory markers. While most residual CT findings improve or resolve over time, some patients may develop persistent fibrosis.

The situation of post-COVID-19 lung diseases in India

Hemant Patel, presented on behalf of the IRIA, discussed the importance of radiologically identifying post-COVID complications for better management of patients. Post-acute sequelae of COVID-19 (PASC) is defined as the persistence of symptoms for more than a month after the onset of COVID-19. Radiologists should identify the prevalence and significance of pulmonary CT abnormalities in PASC and apply appropriate descriptive terminology to CT findings. Risk factors for pulmonary abnormality at CT in PASC include the severity of illness, such as the need for admission, oxygen, and mechanical ventilation. Ventilator-induced lung injury can lead to pulmonary fibrosis, including hyaline membrane formation and alveolar collapse.

The typical CT findings of acute COVID-19 pneumonia include ground-glass opacities, the halo sign, and the reversed halo sign. Post-acute sequelae of COVID-19 can lead to air trapping, atoll sign, lung fibrosis, and pulmonary vascular disease. Fibrosis should be reserved only when CT features indicating fibrosis, such as traction bronchiectasis or bronchiolectasis, honeycombing, or architectural distortion, are present. Some uncommon complications associated with PACS, such as secondary infection, hydro-pneumothorax, pneumomediastinum, and cystic bronchiectatic changes with cavity formation, can be visualized. Radiologists should be able to identify the prevalence and significance of pulmonary CT abnormalities in PACS and apply appropriate descriptive terminology to CT

findings in PACS. It remains essential to identify the risk factors for pulmonary abnormality at CT in PACS, such as the severity of illness and ventilator-induced lung injury.

To summarize, post-COVID lung diseases can cause dyspnea in patients who have recovered from acute COVID-19 pneumonia. The prevalence of these abnormalities varies depending on the severity of initial lung involvement and the time since infection. High-resolution CT (HRCT) can help diagnose the CT abnormalities associated with post-COVID lung diseases, such as ground-glass opacities, parenchymal bands, reticular abnormalities, traction bronchiectasis, mosaic attenuation, and fibrotic changes. Future research is required to investigate the long-term outcomes of COVID-19 and the clinical significance of CT findings.

The situation of post-COVID-19 lung diseases in Malaysia

Bushra Johari, presented on behalf of the COR/AMM, discussed the high-risk factors for post-acute COVID-19, including the severity of the primary infection and the need for ICU admission and mechanical ventilation. The CT protocol should include HRCT with a slice thickness of ≤ 1.5 mm, a high-spatial-frequency reconstruction algorithm for the lung parenchyma, and computed tomographic pulmonary angiography if pulmonary embolism is suspected [7]. Some also advocate for expiratory scans to detect air trapping.

In post-acute COVID-19, residual abnormalities on chest X-rays can be present for up to six months, with ground-glass opacities being the most common finding. Many patients also show residual ground glass and fibrotic-like changes on CT obtained three months after COVID-19. CT features at three months include low-attenuation ground-glass opacities, linear consolidation, perilobular opacities, reticulation, interstitial thickening, and mosaic attenuation pattern, while honeycombing is uncommon [8]. There is a debate about whether post-

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acute COVID imaging findings should be classified into "inflammatory" and "fibrotic" categories based on radiological patterns. However, the ambiguity of some features, the absence of histological correlates, uncertain trajectories, and the likelihood of reversibility make it difficult to classify these findings. Persistent ground-glass abnormalities may indicate immature fibrosis instead of inflammation, and fibrotic-like changes may be capable of regression and remodeling, albeit at a slower rate [9]. Further research is needed to determine the best approach to classify these findings.

The take-home messages from the discussed content are that Malaysia has established a comprehensive follow-up protocol for post-acute COVID-19 patients, and the role of radiologists in imaging these patients is crucial. There are many areas of uncertainty regarding the long-term effects of COVID-19 on lung health, such as the division of imaging findings into inflammatory and fibrotic categories, the interpretation of certain radiological features, and the likelihood of reversibility of imaging findings. Further research is required to address these uncertainties and improve patient care.

The situation of post-COVID-19 lung diseases inThailand

Thitiporn Suwatanapongched, on behalf of the RCRT, stated that as of January 2023, after facing multiple waves of COVID-19 during the pandemic, there were nearly 5 million confirmed COVID-19 cases with a mortality rate of less than 0.1% [10]. The two most problematic waves were the third and fourth waves when the Alpha and Delta variants hit Thailand, especially Bangkok, between April 2021 and October 2021 [11, 12]. A rapid rise in confirmed cases during these two waves overwhelmed the existing country's healthcare facilities. In response to this COVID-19 crisis, multiple case-management strategies and guidelines were developed. One of them was setting up alternative healthcare facilities such as field hospitals and "hospitels" (the latter involving turning vacant hotels into temporary

healthcare facilities) for accommodation, surveillance, and management of confirmed COVID-19 cases. For triaging and managing confirmed COVID-19 cases in these alternative healthcare facilities, chest X-rays obtained by a portable X-ray machine were used for an initial evaluation. Challenges faced at that time were issues regarding communication among staff of uneven experiences.

A cutting-edge and practical tool called Rama Co-RADs was developed to facilitate the timely communication, triage, diagnosis, management, and treatment of these patients [11, 12]. Rama Co-RADs is a categorical assessment regarding chest X-ray findings of pulmonary involvement in confirmed COVID-19 cases. It is designed based on the existing knowledge of the typical chest X-ray and CT features of COVID-19 pneumonia published in the literature and our experience during the first wave [11-13]. After using Rama Co-RADS, the healthcare team noticed improved communication, triage, management, and treatment of confirmed COVID-19 cases in the hospitels. This, in turn, led to a favorable clinical outcome for patients with relatively non-severe cases [14]. The modified version of Rama Co-RADS has been subsequently developed by providing additional categorical schemes to signify radiographic changes on follow-up chest X-rays in COVID-19 patients during admission and after discharge [15].

In addition, the RCRT initiated the RadioVolunteer project during the crisis. This innovative project combined social, technological, and management strategies, bringing together volunteers from government, private, and non-profit sectors to work on a digital platform. The project allowed radiologist volunteers from any part of Thailand to promptly read and report chest radiographs based on Rama Co-RADS for triage and managing COVID-19 cases in prisons and field hospitals across Thailand. Between June 2021 and December 2021, over 280,000 chest X-rays were served by 328 dedicated radiologist volunteers involved in this impressive and vital project [16].

Furthermore, the Department of Diagnostic and Therapeutic Radiology of the Faculty of Medicine, Ramathibodi Hospital at Mahidol University has launched an in-house AI system called RAMAAI (pronounced as "RA-MAI" or ระไม in Thai).

It assists with interpreting chest X-ray findings in COVID-19 cases and is available as a free service. RAMAAI can be integrated into portable chest X-ray machines or radiographic interpretation systems and is accessible through a web service or LineBot [17].

Due to various definitions and heterogeneous clinical courses of post-COVID-19 conditions, the exact number of COVID-19 survivors with post-COVID-19 lung disease is difficult to be estimated [18, 19]. There is no official consensus on management guidelines regarding the technique and duration of imaging follow-up in post-COVID-19 lung disease in Thailand. To wrap up the discussion, Thitiporn Suwatanapongched highlighted the existence, sequential pulmonary alterations, and an unusual phenomenon of post-COVID-19 lung diseases through a sample of cases.

Figure 1. *Authors in Asian Symposia I: The Situation of Post-COVID-19 Lung Diseases in Thailand on 10th April 2023 at the AOCR2023, Bangkok, Thailand.*

Conclusion

The Asian Symposia II in AOCR 2023, Bangkok, Thailand, was held to discuss topical health concerns in Asian countries and invited representatives from the KSR, IRIA, COR/AMM, and the RCRT to present their perspectives on post-COVID-19 lung diseases.

The KSR representative elucidated the PCC and shared the Korean preliminary guidelines for evaluating patients with persistent symptoms after COVID-19. The IRIA representative emphasized the importance of radiologically identifying post-COVID complications for better patient management. The COP/AMM representative provided high-risk factors for post-acute COVID-19 and shared Malaysia's established comprehensive follow-up protocol. The RCRT representative shared the Thailand COVID-19 situation, the national collaborative actions during the COVID-19 crisis, and interesting cases regarding various post-COVID-19 lung diseases. Nevertheless, the definitions, terms, timelines, imaging findings, management, and outcomes of post-COVID-19 lung diseases still need to be more conclusive; therefore, further research in these areas is mandatory.

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Author Contributions

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