Radiology and COVID-19

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Within a few short months, the coronavirus disease 2019 (COVID-19) pandemic has rapidly spread across the globe, affecting at least 10.5 million people in more than 210 countries and territories, with over 500 000 deaths reported.[1] As a result of the collective effort of the medical community and the general public, the number of confirmed cases in Hong Kong and the local mortality rate were kept at a low level relative to many other parts of the world.

Owing to the rapid response from the research community during the pandemic, we have increasing evidence and our understanding of the disease is improving. Accurate diagnosis relies on epidemiology, real-time reverse transcription–polymerase chain reaction (RT-PCR) assays, and imaging findings. For confirming severe acute respiratory syndrome coronavirus 2 infection, which is the cause of COVID-19, RT-PCR is regarded as the gold standard. However, its limited availability, long turnaround time, and variable diagnostic performance have hindered the swift detection and containment of COVID-19 patients necessary to mitigate the exponential spread of the pandemic. Therefore, radiology has a crucial role in diagnosing patients suspected to have COVID-19.

Chest radiograph is inexpensive, highly accessible, easy to operate, and portable. An initial chest radiograph helps not only to detect features of pneumonia but also to provide an alternative diagnosis. Medical triage is recommended for patients who present with moderate to severe clinical features in places with a high prevalence of COVID-19.[2] Mobile radiography systems in isolation wards or intensive care unit facilitate monitoring of the disease severity and progression without the need for patient transportation, which increases the risk of virus transmission within the hospital.[3] Common chest radiograph findings of COVID-19 pneumonia include ground-glass opacities and consolidations, more often in bilateral, peripheral, and lower zone distributions.[4,5] Lymphadenopathy or pleural effusion is rare. Nevertheless, a plain chest radiograph cannot exclude the diagnosis of COVID-19 because its sensitivity depends on the time of imaging and severity of pulmonary involvement.

Chest computed tomography (CT) provides superior delineation of disease involvement with high sensitivity of up to 98%.[6] During the early outbreak of COVID-19 in Hubei Province, China, when RT-PCR assays and isolation beds were scarce, CT was used together with epidemiological criteria to provide screening for or diagnosis of COVID-19. The early experience in Hong Kong also indicated that CT was useful in achieving early diagnosis, especially in patients with initial negative RT-PCR results.[7,8] However, the imaging features of COVID-19 overlap with other viral pneumonia such as influenza and even those of non-infectious states such as drug reactions. The framing of such a pivotal role of imaging in disease diagnosis is likely due to the high pre-test probability.[9] Support for CT as a screening or diagnostic test for COVID-19 has now been challenged, as CT provides no additional clinical benefit but might lead to a false sense of security, because up to 20% of symptomatic patients have negative CT scan results.[10] Patients with a high index of suspicion should be isolated pending confirmation with RT-PCR tests, or until quarantine has lapsed. The result of a chest CT does not alter patient management. Safe usage of CT scanners to image COVID-19 patients is also logistically challenging and can overwhelm the available resources. Even with proper cleaning protocols, CT scanners are still at risk of becoming vectors of infection to vulnerable patients and staff. Therefore, multiple societies recommend against the use of chest CT for screening and diagnosis of the disease.[11]

The pulmonary abnormalities of COVID-19 pneumonia in chest CT scans echo but predate those in chest radiographs. Typical findings include bilateral distribution of ground-glass opacities in the peripheral and posterior lungs.[12] As the disease progresses, the ground-glass opacities can increase in size as well as extent of involvement, with additional crazy-paving patterns or consolidations observed. It is atypical to see pleural effusion, multiple tiny pulmonary nodules, or mediastinal lymphadenopathy.[9] However, the presence of consolidations with air bronchogram, central lung involvement, and pleural effusion on initial chest CT are more commonly seen in severe patients who need intensive care.[13] The abnormalities generally peak around 14 days after the disease onset, with some patients developing bilateral and diffuse infiltration of all segments of the lungs and thus manifesting as "white lung".[14] After that, healing of pulmonary inflammation is observed, with gradual replacement of cellular components by scar tissues shown as fibrous stripes.[15] Currently, the long-term pulmonary sequalae of the disease remain unclear and further research is needed to explore the relationship between fibrosis and patients' prognosis.

Artificial intelligence algorithms have been employed to aid radiologists to interpret images more rapidly and accurately in this pandemic. An early study showed that artificial intelligence could augment radiologists' performance in distinguishing COVID-19 from pneumonia of other aetiologies on chest CT, yielding higher accuracy (90%), sensitivity (88%), and specificity (96%).[16] By analysing CT radiomics and clinical and demographic factors, researchers have developed machine learning models which can predict the likelihood of COVID-19 patients requiring mechanical ventilation with a promising accuracy up to 75%.[17] However, the only way to combat and contain this disease is to establish a fast, sensitive, and cost-effective triaging tool. A recently developed nowcast deep learning model might provide a solution that can identify COVID-19 on chest radiographs more accurately than radiologists, with an area under the receiver operating characteristic curve of 0.81, sensitivity of 84.7%, and specificity of 71.6%.[18]

The COVID-19 pandemic has had a profound impact on radiology practices across the world. Many radiology units have reported a decline in patient numbers of 50% to 70%[19] due to governmental limits on patient movement and curtailment of non-urgent imaging, as well as patient cancellations and no-shows due to fear of viral exposure. In the aftermath of the outbreak, radiology departments must take steps to restore public confidence in their ability to conduct radiological investigations safely. Logistic arrangements should be made to decrease the waiting room exposure and maximise social distancing in waiting areas. Each department also needs to create strategic plans to redistribute deferred cases by increasing the capacity of imaging services and re-evaluating all cases to allow efficient prioritisation across all specialties and referrers. This system should be based on assessing urgent and emergent imaging, time-critical imaging, imaging of known versus potential disease, and screening programmes.[20] As the crisis recedes, proactive and careful management should allow radiology departments to actively manage the recovery process that will ultimately ensure the safety of patients and staff and enable radiologists to respond accordingly as the uncertainty of the coming months unfolds.

Author contributions

All authors contributed to the editorial, approved the final version for publication, and take responsibility for its accuracy and integrity.

Conflicts of interest

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