Diagnostic role of chest computed tomography in coronavirus disease 2019

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KEY WORDS
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ABSTRACT
Coronavirus disease 2019 (COVID-19) is an infectious disease caused by a novel strain of coronavirus, severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), that appeared in China in December 2019 and spread globally, evolving into the currently observed pandemic. The laboratory diagnosis of SARS-CoV-2 infection is currently based on real-time reverse transcriptase–polymerase chain reaction (RT-PCR) testing, and imaging cannot replace genetic testing in patients with suspected COVID-19. However, with predominant respiratory manifestations of COVID-19, particularly in more severe cases, chest imaging using computed tomography (CT) plays a major role in detecting viral lung infection, evaluating the nature and extent of pulmonary lesions, and monitoring the disease activity. The role of chest CT as a diagnostic tool may be increased when the laboratory testing capacities using RT-PCR prove inaccurate or insufficient during a major outbreak of the disease. In these settings, a rapid presumptive diagnosis of COVID-19 potentially offered by CT might be an advantage, in addition to obvious benefits of delineating the nature and extent of pulmonary lesions. In the present paper, we reviewed the diagnostic role of chest CT in patients with COVID-19.

Introduction
Coronavirus disease 2019 (COVID-19) is an infectious disease caused by a novel strain of coronavirus, severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), that appeared in Wuhan, China in December 2019,¹,² with first cases tracked back to November 2019,³ and spread globally, evolving into the currently observed pandemic.

The etiology of COVID-19, its manifestations, clinical course, and radiologic findings are similar to 2 other recent coronavirus diseases, severe acute respiratory syndrome (SARS) and Middle East respiratory syndrome (MERS), but also show some important differences.

The laboratory diagnosis of SARS-CoV-2 infection is based on the nucleic acid amplification test using the real-time reverse transcriptase-polymerase chain reaction (RT-PCR). However, with predominant respiratory manifestations of COVID-19, particularly in more severe cases, chest imaging, mostly with computed tomography (CT), plays a major role in detecting viral lung infection, evaluating the nature and extent of pulmonary lesions, and monitoring the disease activity. However, the role of chest CT has not been clearly defined, particularly when the laboratory testing capacities using RT-PCR prove inaccurate or insufficient during a major outbreak of the disease, with a high number of new and suspected cases to be tested over a short period of time, as it was observed in Wuhan. Taking into account the major challenges of the current COVID-19 pandemic, with a rapidly growing number of affected people in many countries and regions, laboratory testing capacities may again prove to be insufficient, similarly as it was observed in China. Thus, attempts to curb the epidemic by detecting symptomatic cases...
TABLE 1 Clinical severity of confirmed coronavirus disease 2019 pneumonia

| Type     | Findings                                                                 |
|----------|--------------------------------------------------------------------------|
| Mild     | Mild clinical symptoms (fever <38 °C, with or without cough, no dyspnea) |
|          | No imaging findings of pneumonia                                          |
| Moderate | Fever ≥38 °C with respiratory symptoms                                   |
|          | Imaging findings of pneumonia                                             |
| Severe   | Any of the following:                                                   |
|          | - Respiratory distress, respiratory rate ≥30/min                          |
|          | - SaO₂ <93% at rest                                                      |
|          | - PaO₂/FiO₂ <300 mm Hg                                                   |
|          | - Rapid progression (>50%) on CT imaging within 24–46 hours              |
| Critical | Respiratory failure, need for ventilatory support                        |
|          | Shock                                                                    |
|          | Extrapulmonary organ failure                                              |

a Modified from Zu et al

b Added in the sixth version of the Chinese classification criteria (published on February 18, 2020).

Abbreviations: CT, computed tomography; FiO₂, fraction of inspired oxygen; PaO₂, partial pressure of oxygen; SaO₂, oxygen saturation

and known contacts may fail, especially without widespread lockdown and quarantine measures and with surveillance methods and diagnostic capacities varying between countries. In addition, this may lead to a large number of undiagnosed asymptomatic or presymptomatic carriers who have been proven to be the source of spread of this highly contagious virus.

As a result, it may be expected that some or many patients will present with respiratory symptoms or as severely or critically ill cases without a prior diagnosis or even suspicion of COVID-19. In an uncurbed, full-blown epidemic, the burden of such patients may become overwhelming, and waiting times for the results of RT-PCR testing may be excessively long. In such patients, a rapid presumptive diagnosis of COVID-19 potentially offered by CT might be an advantage, in addition to obvious benefits of delineating the nature and extent of pulmonary lesions. The purpose of the present study is to review the diagnostic role of chest CT in patients with COVID-19.

Clinical presentation, complications, and classification of the clinical severity of COVID-19 pneumonia

The typical clinical presentation of COVID-19 includes systemic and respiratory manifestations. Common symptoms and signs include fever, fatigue, cough, and dyspnea. Subjects infected with SARS-CoV-2 may also be asymptomatic carriers of the infection. Also gastrointestinal or cardiovascular symptoms may occur; however, less commonly. In a large study including 1099 patients from China, 6% of patients required invasive or noninvasive ventilation and 5% were admitted to the intensive care unit. More severely ill patients tend to be older and have more comorbidities. Common sequelae include acute respiratory distress syndrome (ARDS), acute cardiac injury (as manifested by elevated troponin levels), secondary infections, sepsis, acute kidney injury, multiorgan failure, and death.

Available data indicate that a high percentage of SARS-CoV-2 carriers may be asymptomatic. In a study that assessed the clinical characteristics of SARS-CoV-2-positive close contacts of patients with COVID-19, approximately 30% of these SARS-CoV-2–positive subjects never developed any clinical symptoms or lesions on chest CT. The remainder showed lesions on CT, and about 20% of them developed symptoms during their hospital stay but did not develop severe disease.

Patients with confirmed COVID-19 can be categorized into 4 groups depending on their clinical manifestations, that is, with mild, moderate, severe, or critical disease (TABLE 1). Patients with mild disease have no imaging findings of pneumonia, those with moderate disease show imaging findings of pneumonia, and those with severe or critical disease present with respiratory distress or failure. According to the Chinese classification system, patients showing rapid progression (>50%) on CT imaging within 24 to 48 hours should also be considered and managed as severe cases.

Laboratory diagnostic methods

The current definitive test for SARS-CoV-2 is the nucleic acid amplification test using RT-PCR. Its specificity is high but the reported sensitivity ranges from between 60% and 70% to between 95% and 97%. These differences may reflect sampling errors and different diagnostic yield of various sampling sites (eg, pharyngeal swab vs bronchoalveolar lavage) but also various timing of testing during the course of the infection, with low viral titers in the early phase leading to false-negative results. As a result, false-negative results may be a clinical challenge and several negative results during serial testing may be required to exclude the disease. The biological material for virological testing includes upper and lower respiratory tract samples and blood samples.

Other limitations of RT-PCR testing include time required for test performance, varying quality and reliability of available SARS-CoV-2 nucleic acid detection kits, limited number and throughput of laboratories performing these tests, and the fact that RT-PCR testing detects the presence of a virus but has a limited utility for monitoring the disease progression/regression.

Tests detecting anti-SARS-CoV-2 immunoglobulin (Ig) M and IgG antibodies and SARS-CoV-2 antigens, including rapid tests, are under development and some have already entered the clinical practice but their diagnostic precision has not been established yet. Based on the information available on the United States Food and Drug Administration (FDA) website, as of April 16, 2020, there are no FDA-approved diagnostic tests for COVID-19. The FDA has only issued an emergency use authorization for one serological test.
Other abnormalities seen in laboratory test results of patients with COVID-19 include leukopenia and lymphopenia, low procalcitonin level, increased prothrombin time, elevated levels of lactate dehydrogenase, creatine kinase, and D-dimer as well as elevated inflammatory markers (C-reactive protein [CRP] and erythrocyte sedimentation rate). Guan et al reported admission laboratory data of 1099 patients with COVID-19. Lymphocytopenia (<1500/µl) was present in 83.2% of these patients, thrombocytopenia (<150 000/µl) in 36.2%, and leukopenia (<4000/µl) in 33.7%. Most of the patients had an elevated CRP level (≥10 mg/l; 60.7%), and less common abnormalities included elevated levels of lactate dehydrogenase (41%), alanine aminotransferase (21%), aspartate aminotransferase (22%), creatine kinase (14%), and D-dimer (46%). Patients with severe disease (n = 173) had more prominent laboratory abnormalities than those with nonsevere disease (n = 926), namely, lymphocytopenia was present in 96% of patients with severe disease as compared with 80% in those with nonsevere disease, leukopenia in 61% as compared with 28%, elevated CRP level in 81% as compared with 56%, and elevated D-dimer level 60% as compared with 43%.

Shi et al in a study of 81 patients, compared those who had their first CT scan performed early after symptom onset (≤1 week) and those who had it performed later, at the time that corresponded to the usual peak disease severity on CT images (1–2 weeks). Laboratory findings, including the mean leukocyte, lymphocyte, and platelet counts, the proportion of patients with lymphocytopenia (<1000/µl), and increased levels of CRP, liver enzymes, and bilirubin did not vary significantly between the 2 groups.

**Imaging findings** Chest imaging plays a major role in detecting viral lung infection, evaluating the nature and extent of pulmonary lesions, and monitoring progression/regression of the disease. Plain chest radiograph and CT in patients with COVID-19 usually show atypical or organizing pneumonia, often with bilateral, peripheral, basal, and/or multilobar involvement. In mild and/or early cases, chest imaging has limited sensitivity for COVID-19, as normal chest X-ray or CT was noted in as many as 18% of patients with mild/early disease but this proportion is reduced to 3% in more severe cases.

Obviously, CT may also detect alternative lung pathologies and/or complications of COVID-19, such as pulmonary embolism and bacterial pneumonia, which is another role of CT in these patients. It seems, however, that the approach to diagnosing pulmonary embolism and bacterial pneumonia in this population is generally the same as in patients without COVID-19 and this issue is beyond the scope of the present review.

**Computed tomography findings** Typical findings reported in adults with COVID-19 include ground-glass opacities, crazy paving appearance, that is, appearance of ground-glass opacity with superimposed interlobular and intralobular septal thickening, consolidations, bronchovascular thickening in lesions, and traction bronchiectases. The ground-glass opacities and consolidations are usually located bilaterally, they are diffuse and they show peripheral and basal distribution.

In a large study that reported CT findings on hospital admission of 975 patients, positive findings were reported in 840 patients (86.2%), including ground-glass opacities in 505 (56.4%), local patchy shadowing in 409 (41.9%), bilateral patchy shadowing in 505 (51.8%), and interstitial lesions, mainly interlobular and intralobular septal thickening, in 143 (14.7%). All these types of abnormalities were more common in severe compared with nonsevere patients.

In a review of imaging findings that included 919 patients, ground-glass opacities were found in 88% of patients, bilateral involvement in 87.5% of patients, peripheral distribution in 76% of patients, and multilobar involvement in 78.8% of patients. The most common CT findings included isolated ground-glass opacities or a combination of ground-glass opacities and consolidative opacities.

With regard to the diagnostic value of chest CT findings, peripheral distribution of the lesions, ground-glass opacities, and bronchovascular thickening in the lesions were found to have the highest value for differentiating between COVID-19 and other viral pneumonias.

Other CT findings have been absent or seen in a small proportion of patients and thus could be considered as suggestive of other diagnoses including bacterial pneumonia. These findings include mediastinal lymphadenopathy, pleural

**Chest radiography and lung ultrasound** Plain chest radiograph in patients with COVID-19 may show a patchy or diffuse air space opacities, but it was shown to have much lower sensitivity compared with CT, reported as 69% and 91%, respectively, in one study.

As indicated by initial experience from China and later also from Italy, lung ultrasonography may also be of use when evaluating critically ill patients with COVID-19, especially when CT imaging is not feasible. Lesions seen on ultrasound tend to be predominantly bilateral and posterior. They include multiple B-lines ranging from focal to diffuse with spared areas, irregular thickened pleural line with scattered discontinuities (subpleural consolidations), and pneumatic consolidations typically associated with preservation of flow or hyperemia. Although lung ultrasound was found to be superior in the diagnostic workup of pneumonia and ARDS compared with chest X-ray and it may be performed repeatedly without exposure to radiation, its limitations include the need for an ultrasonographer with an adequate expertise in interpreting images in patients with COVID-19.
Effusion, multiple small discrete pulmonary nodules (in contrast to many other viral pneumonias), the tree-in-bud sign, pneumothorax, and cavitations.

The diagnosis of COVID-19 based on chest CT findings may be enhanced by artificial intelligence systems that facilitate differentiation from other etiologies of community-acquired pneumonia and other nonpneumonic lung diseases.

Chest CT imaging findings in COVID-19 pneumonia are summarized in Table 2, and typical CT images are shown in Figure 1A-1D. Typical CT findings were also recently reported in this journal by Sabri et al.

Evolution of computed tomography lesions. In general, 4 stages of the evolution of CT lesions have been described in patients with COVID-19. During the initial stage (0–4 days), CT scan is normal or only ground-glass opacities can be seen, which are usually focal or multifocal and are usually located peripherally (in about 50%–75% of patients). Normal CT scans have been reported in up to half of patients within 2 days of flu-like symptoms onset. During the progressive stage (5–8 days), increased ground-glass opacities and crazy-paving appearance are seen. At the peak stage (9–13 days), the predominant abnormalities are crazy paving pattern, but GGO may persist longer than other lesions (Wang et al).

Progression of pulmonary lesions has been associated with poor outcomes. It was also shown that serial chest CT imaging may provide precise data on the disease progression and may be used to monitor treatment effects. Some authors found that greater consolidations that generally develop later in the course of the disease indicated disease progression, while a smaller size, extent, and absorption of these lesions (developing organizing pneumonia pattern in what was pure consolidation) indicated improvement. This, however, is based on follow-up CT performed in only 13 patients, of whom 7 (54%) showed improvement and 4 (31%) showed...
a study by Chung et al. which included 8 patients, the mean time between the initial chest CT and follow-up scanning was 2.5 days (range, 1–4 days), and 7 of 8 patients showed progression. In some studies that provided the above data on the temporal evolution of CT lesions, CT has been repeated more systematically over the course of hospitalization, at the average interval of about 4 days (82 scans in 21 patients who all recovered and were discharged) or 6 days (366 scans in 90 patients, of which 70 survived and were discharged), with the average duration of hospitalization of 16 to 18 days. Of note, in a study by Wang et al., 66 of the 70 discharged patients (94%) had residual disease on final CT scans, with ground-glass opacities being the most common pattern. Thus, ground-glass opacities may be the most common initial finding, followed by other lesions (consolidations, crazy paving appearance) but ground-glass opacities may persist for a longer time (as noted by Wang et al., the percentage of pure ground-glass opacities showed a trend of “first falling then rising” in their study).

No data are yet available on the value of post-discharge CT in COVID-19 during long-term disease progression. Of note, lung CT findings showing improvement have been listed among the Chinese criteria for hospital discharge or discontinuation of quarantine. In one study, 42% of patients showed improvement on follow-up chest CT before the RT-PCR results turned negative.

Timing of repeated computed tomography scanning and postdischarge follow-up computed tomography

Regarding the timing of repeated CT scanning, it should generally depend on the clinical condition of the patient. A repeat CT scan may be performed even as early as after 24 hours if the patient’s condition worsens significantly. In the available literature, CT was usually repeated as deemed necessary on the clinical grounds. Thus, CT was usually repeated early in severe/clinically progressing patients and for this reason, progression was mostly seen with early repeated CT imaging (at the mean interval of 2.5–5 days) in some of the reported small series. For example, in a study by Li and Xia, the mean time between the initial and follow-up CT studies was 5 days (range, 2–15 days), and follow-up CT showed mild or marked disease progression in 18 of 24 patients (75%). In a study by Chung et al. which included 8 patients, the mean time between the initial chest CT and follow-up scanning was 2.5 days (range, 1–4 days), and 7 of 8 patients showed progression. In some studies that provided the above data on the temporal evolution of CT lesions, CT has been repeated more systematically over the course of hospitalization, at the average interval of about 4 days (82 scans in 21 patients who all recovered and were discharged) or 6 days (366 scans in 90 patients, of which 70 survived and were discharged), with the average duration of hospitalization of 16 to 18 days. Of note, in a study by Wang et al., 66 of the 70 discharged patients (94%) had residual disease on final CT scans, with ground-glass opacities being the most common pattern. Thus, ground-glass opacities may be the most common initial finding, followed by other lesions (consolidations, crazy paving appearance) but ground-glass opacities may persist for a longer time (as noted by Wang et al., the percentage of pure ground-glass opacities showed a trend of “first falling then rising” in their study).

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follow-up to evaluate for possible late fibrotic complications of ARDS and other long-term complications.

Case reports from China are also being published regarding postdischarge follow-up CT to evaluate patients who retested positive on RT-PCR after they had had negative test results and had been discharged from hospital.55,45

Computed tomography in asymptomatic patients including healthcare workers In a retrospective study of 112 cases from the Diamond Princess cruise ship, 54% of asymptomatic patients were found to have had pneumonic lesions on CT.46 Of these 112 cases, 82 (73%) were asymptomatic (44 [54%] of which had lung opacities on CT) and the other 30 (27%) cases were symptomatic (24 [80%] of which had abnormal CT findings). Asymptomatic patients presented with ground-glass opacities more frequently than with consolidations, while symptomatic patients presented with consolidations more frequently than with ground-glass opacities. The CT severity score was higher in symptomatic cases than asymptomatic cases, particularly in the lower lobes.

In another study, chest CT was performed in 15 healthcare workers exposed to SARS-CoV-2 before they developed clinical symptoms. Ground-glass opacities were found in 14 of them.19 Overall, these studies indicate that chest CT may identify asymptomatic and/or presymptomatic COVID-19 patients with pneumonic lesions.

Role of chest computed tomography in an epidemic COVID-19 outbreak An early diagnosis is of key importance in the management of patients with COVID-19 and to control the epidemic. It has been reported, mainly based on the Chinese experience with the COVID-19 epidemic outbreak in Wuhan, that in some healthcare settings, chest CT may be a more available, reliable, and rapid diagnostic tool compared with RT-PCR testing.

For example, one study reported that with limitations of sample collection, transportation and kit performance, the total positive rate of RT-PCR for throat swab samples in patients with COVID-19 was only about 30% to 60% at initial presentation.67 In addition, with a high number of new cases during the outbreak in Wuhan, the number of people awaiting RT-PCR for the detection of SARS-CoV-2 greatly exceeded the capacity of medical institutions. RT-PCR diagnostic kits could not be provided in sufficient amounts to keep up with the demand, and laboratories were not able to return the results within a reasonable time frame.

On the other hand, chest CT may detect COVID-19 more rapidly by showing lung lesions typical for SARS-CoV-2 infection, which are different from lesions observed in other viral and nonviral pneumonias. Indeed, abnormal CT findings with initial false-negative RT-PCR results were reported.48,49 For example, Fang et al49 compared the detection rate by initial chest CT and RT-PCR, both performed within 3 days from the disease onset, and reported a higher detection rate for the initial CT (50/51 patients [98%]) compared with the first RT-PCR (36/51 patients [71%]) (P <0.001). Ai et al21 reported the results of chest CT in comparison with the initial and serial RT-PCR results in a large series of 1014 patients with suspected COVID-19. Out of 308 patients with negative RT-PCR results but positive chest CT scans, 147 (48%) patients were reconsidered as highly likely cases, and 103 (33%) as probable cases by a comprehensive evaluation. In the analysis of serial RT-PCR assays and CT scans, 60% to 93% of patients had initial positive chest CT consistent with COVID-19 before the initial positive RT-PCR results.

Chest CT has been shown to be highly sensitive for the diagnosis of COVID-19 pneumonia, and it has been useful for the diagnostic purposes. In addition, the value of chest CT lies in the fact that it does not only detect the disease but also provides information on the location and extent of lung lesions, and when performed serially, may be used to monitor the progression and/or regression of the disease.44 The information provided by chest CT may again precede that provided by follow-up RT-PCR testing. In one study, 42% of patients showed improvement on follow-up chest CT scans before the RT-PCR results turned negative.21

As a result, a number of Chinese authors suggested that chest CT may be considered a primary tool for COVID-19 detection in epidemic areas.14,21,43,50 When reviewing triage strategies for COVID-19 in fever clinics established for triaging patients in Wuhan, Zhang et al51 recommended performing chest CT in all patients with dyspnea or hypoxia (oxygen saturation <93%), fever of 37.3 °C or higher, or absolute lymphocyte count less than 1100/µl.

In summary, it should be emphasized that CT cannot replace RT-PCR as a diagnostic method for COVID-19, but in some settings, RT-PCR, even if widely available, may return the diagnostic result with a delay, and/or may give a false-negative result for reasons discussed above, and thus repeat testing may be required, yielding a positive result with an even longer delay.

Expert position statements regarding the role of chest computed tomography as a primary diagnostic or screening tool for COVID-19 Some authors have suggested that the sensitivity of chest CT and rapid availability of its findings may justify its use as an early diagnostic tool in the acute setting in selected cases. Indeed, CT findings have been used as a surrogate diagnostic test by some authors.12,22

However, many radiological organizations including the American College of Radiology (ACR), the Royal College of Radiologists in the United Kingdom, and the Canadian Association of Radiologists have stated that chest CT should not be considered a primary diagnostic or screening tool when investigating for COVID-19.52-54 One

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argument that has been raised is that the above-
mentioned studies tended to suffer from a selec-
tion bias.\textsuperscript{29} For example, ACR stated that CT
should not be used to screen for COVID-19 or as
a first-line test to diagnose the disease. Accord-
ing to ACR, CT should be used sparingly and re-
served for hospitalized, symptomatic patients
with specific clinical indications for CT, with ap-
propriate infection control procedures followed
before scanning subsequent patients.\textsuperscript{52}

On the other hand, the Radiological Society
of North America stated that due to the current
shortage of nucleic acid testing kits used to con-
firm the presence of SARS-CoV-2, CT scans have
become the first line of defense in the diagnostic
workup of a suspected infection. The Radiological
Society of North America is currently in the pro-
cess of preparing a free diagnostic resource for
the global radiology community.\textsuperscript{55}

In February 2020, confirmed cases in the Hu-
bei province, China, could be defined based on
not only the laboratory criteria but also the clin-
cial criteria that included CT evidence of a viral
infection.\textsuperscript{54} The sixth edition of the Chinese cri-
teria published on February 18, 2020 no longer
included the CT findings without confirmation
by RT-PCR.\textsuperscript{57} CT findings also were not includ-
ed among the diagnostic criteria for COVID-19
which were published in March 2020 by a group
of American and Singaporean experts.\textsuperscript{19}

Finally, it should be noted that CT devices are
frequently located in multi-specialist hospitals
where patients with cancer and other immuno-
compromised patients are often examined, for
whom contact with those with COVID-19 poses
a very serious threat. A widespread use of chest
CT in patients suspected for COVID-19 requires
solving a number of biohazard and logistic issues
related, for example, to the need for facility and
equipment decontamination from SARS-CoV-2,
adequate protection of radiology unit personnel
from exposure to a highly contagious agent, pro-
viding/purchasing an adequate number of CT
imaging systems, and perhaps even allocating
dedicated diagnostic units only for the purpose
of imaging in patients suspected for COVID-19.

Summary and conclusions Chest CT without ad-
ministration of an intravenous contrast agent is a precise diagnostic tool for the detection
of COVID-19 pneumonia and the assessment of
the extent of pulmonary lesions, with a demonstrat-
ed advantage over plain chest radiography. Chest CT is a noninvasive and safe examination
modality, as the radiation dose used is not high. It
has been shown to be highly sensitive at detecting
inflammatory lesions. CT findings are not specific
for the SARS-CoV-2 pathogen but their typical
patterns have been well described and the rates of
false-positive results were low in the reported pa-
tient groups.\textsuperscript{43} Thus, imaging cannot replace ge-
etic testing in patients suspected for COVID-19.
However, chest CT is a very important tool for
assessing the extent of COVID-19, monitoring
the disease progression/regression, and planning
the therapeutic management and patient care. CT
findings of a viral lung infection may precede a pos-
tive RT-PCR test result, particularly in the settings
of an epidemic disease outbreak with a shortage
of RT-PCR tests and a limited capacity of diagnos-
tic laboratories. Thus, some authors suggested
that due to difficulties with providing a sufficient
number of nucleic acid detection test kits used to
confirm the presence of SARS-CoV-2, the sensi-
tivity of chest CT and rapid availability of its find-
ings may justify its use as an early diagnostic tool
in the acute setting. However, many radiological
organizations stated that chest CT should not be
relied upon as a primary diagnostic or screening
tool for COVID-19 but rather reserved for hospi-
talized, symptomatic patients with specific clini-
cal indications for CT, with appropriate infection
control measures when scanning subsequent pa-
tients. However, CT devices are often located in
multi-specialist hospitals where patients with can-
cer and other immunocompromised patients are
often examined, for whom contact with those with
COVID-19 poses a very serious threat. Thus, there
is a possible need for allocating dedicated diagnos-
tic units only for the purpose of imaging patients
suspected for COVID-19. Notwithstanding these
limitations, an easy access to CT scanning might
facilitate identification of patients with COVID-19.

| **TABLE 3** Pros and cons for a widespread use of chest computed tomography in coronavirus disease 2019 |
|-----------------------------|---------------------------------------------------------------------------------------------------------|
| **Pros**                  | • Evaluates the nature and extent of pulmonary lesions                                                   | • CT findings not specific for COVID-19 (only suggestive but not definitive) |
|                           | • May be used to monitor disease progress/regression                                                       | • Normal CT findings do not exclude infection                                      |
|                           | • Rapid presumptive diagnosis of COVID-19 when typical findings are seen on CT                           | • Cost                                                                           |
|                           | • Diagnostic result may be more rapidly available compared with RT-PCR, particularly in the settings of  | • Availability                                                                    |
|                           |   an epidemic disease outbreak with a shortage of RT-PCR tests and a limited capacity of diagnostic      | • Exposure to radiation                                                            |
|                           |   laboratories                                                                                           | • Need for stringent infection control measures in CT laboratories                 |
|                           | • May detect disease in asymptomatic and/or presymptomatic subjects                                        | • Possible need for allocating dedicated diagnostic units only for the purpose     |
|                           |                                                                                                           |   of imaging of patients suspected for COVID-19                                     |

Abbreviations: COVID-19, coronavirus disease 2019; RT-PCR, real-time reverse transcriptase–polymerase chain reaction; others, see **TABLE 1**
and contribute to reducing the burden of the epidemic in some healthcare settings. Pros and cons for a widespread use of chest CT in COVID-19 are summarized in **TABLE 3**.

**ARTICLE INFORMATION**

**CONFLICT OF INTEREST** None declared.

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