A practical approach to coronavirus disease 2019 pneumonia imaging

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Coronavirus disease 2019 (COVID-19) was first recognized in China in December 2019 and then was declared as a pandemic by the WHO in March 2020. The most established diagnostic tool is the real-time reverse transcription-PCR, which is highly specific but has a relative low sensitivity. False-negative results and consequently the need to repeat the test and relative delay in conclusive results are a real diagnostic problem. Other laboratory marker tests are more suggestive than diagnostic. All these factors have made computed tomographic (CT) imaging in cases of clinically suspected COVID-19 a routine and an integral part of the algorithm for disease diagnosis in many countries including Egypt.

The role of CT is well established in detecting the presence of a lesion, discriminating different types of lesions, and assessing distribution, severity, complications, associated extrapulmonary chest manifestations, and follow-up of cases. The CT picture of COVID-19 is known to reflect atypical pneumonia and/or organizing pneumonia. The presence of ground-glass opacities, consolidation, or crazy paving in bilateral subpleural distribution with predominant lower lobes affection is considered typical for COVID-19.

Based on our experience, in the context of the current pandemic, the presence of CT inflammatory changes in a patient with clinical suspicion of COVID-19 should be considering as an alarming sign for the presence of COVID infection as the cause of ground-glass opacities. A negative CT report for COVID-19 should only be considered in cases of normal CT or if CT lesions do not represent inflammatory changes.

Keywords:
COVID-19, corona virus, CT chest, pneumonia

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Names and dates

In December 2019, China declared the first cases of a new viral disease that was confirmed by the WHO on January 2020 to be caused by severe acute respiratory syndrome coronavirus 2 (SARS-COV-2), a member of the coronaviridae family of viruses [1–3].

In February 2020, the disease was named coronavirus disease 2019 (COVID-19) by the WHO, short for COVID-19. On the March 11, 2020, the WHO declared this disease as a pandemic [4].

The previously used names of the virus and the disease, 2019 novel corona virus (2019-nCov) and novel coronavirus-infected pneumonia, respectively, are no more in use [5].

On the July 26, the WHO announced 16 226 400 cases of COVID-19 worldwide, with 6 49 361 deaths. Egypt was declared the second country after South Africa to report the maximum number of cases in Africa, reaching 91 583 cases [6].

Role of imaging in the management of coronavirus disease 2019

Computed tomography as a diagnostic tool

The role of imaging in the management of any disease can be summarized into diagnosing the disease, follow-up, and detection of complications. The diagnosis of a disease will entail detection of lesion(s) and determining its type, extent, and severity. Regarding COVID-19, computed tomography (CT) chest is the modality of choice to answer those questions, follow-up of the cases, and detect complications. CT has long been well established as the gold standard for diagnosing chest disease and thus is the modality of choice in diagnosis of COVID-19 affection of the chest. This point, however, in spite of wide agreement by many authors, has been debated by others [7–9]. Some authors even suggested limiting the use of CT to detection the complications [10] and/or worsening of the respiratory status [11,12].

However, as the pandemic peaks up with the increasing numbers of cases since May 2020, and since the most established diagnostic tool which is the real-time reverse transcriptase (RT)-PCR is highly specific but with a relative low sensitivity [9], thus false-negative results and consequently the need to repeat the test and the relative delay in conclusive results, with other laboratory marker tests being more suggestive than diagnostic, all these factors have made CT imaging in cases of clinically suspected COVID-19 a routine and an integral part of the algorithm for diagnosis of the disease in many countries including Egypt.

The role of CT was well established in detecting the presence of a lesion; discriminating different types; and assessing distribution, extent, and severity, complications, associated extrapulmonary chest manifestations, and follow-up of cases. However, in using CT chest for diagnosing COVID-19, few diagnostic challenges were considered. The first was that CT was considered as sensitive but nonspecific for the diagnosis of COVID-19 having a similar pattern to other causes of viral or atypical pneumonia [9]. Another challenge is no abnormalities may be present on CT performed in early course of the disease (Fig. 1). The cause for this was not clear; however, in such conditions, which mounted in some studies to 50% of cases in the early disease (first 2 days), the diagnosis was mostly dependent on the clinical condition and laboratory findings [9].

Computed tomographic protocol

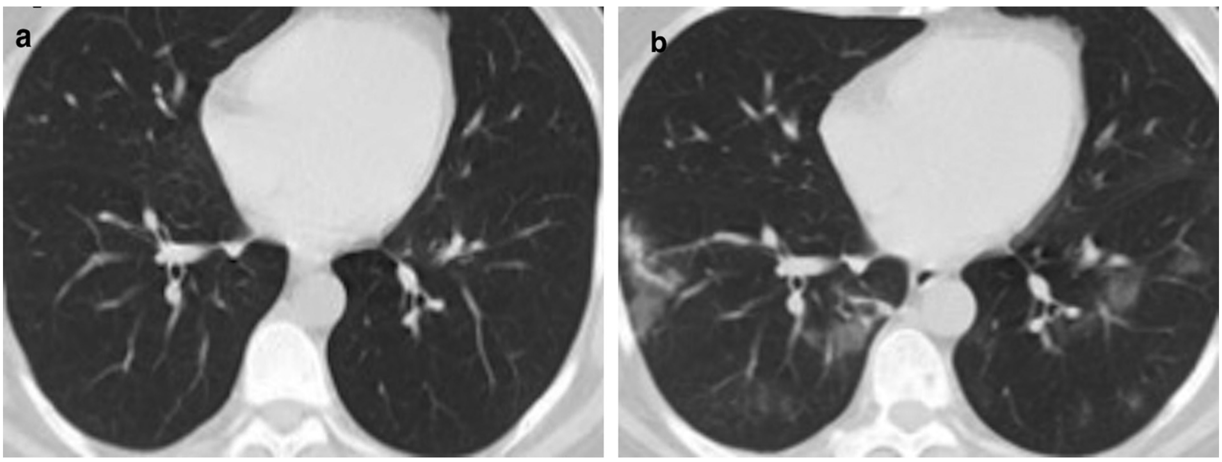
Low-dose CT is usually performed to provide a balance between minimizing the radiation burden to large number of patients and assuring adequate diagnostic quality images satisfactory to detect slight abnormalities. Contrast-enhanced CT may confuse patterns of ground glass. Thus, when a CT pulmonary angiogram is required in a suspected COVID-19-infected patient, a precontrast scan should be performed first [8].

Chest radiography

Some publications and institutes have recommended the use of plain radiograph chest instead of CT in the algorithm of COVID-19 management based on the facts that the technique is relatively more available and is much cheaper [12,13]. The appearance on chest radiograph is affected by the severity and length of infection at the time of image acquisition, in addition to the clinical findings like symptomatology and oxygen saturation [14].

The most frequent plain radiograph findings are hazy opacities which are the radiographic correlate of ground-glass opacities (GGOs) seen on CT [15] They often have a bilateral and peripheral distribution with lower zone predominant [8].

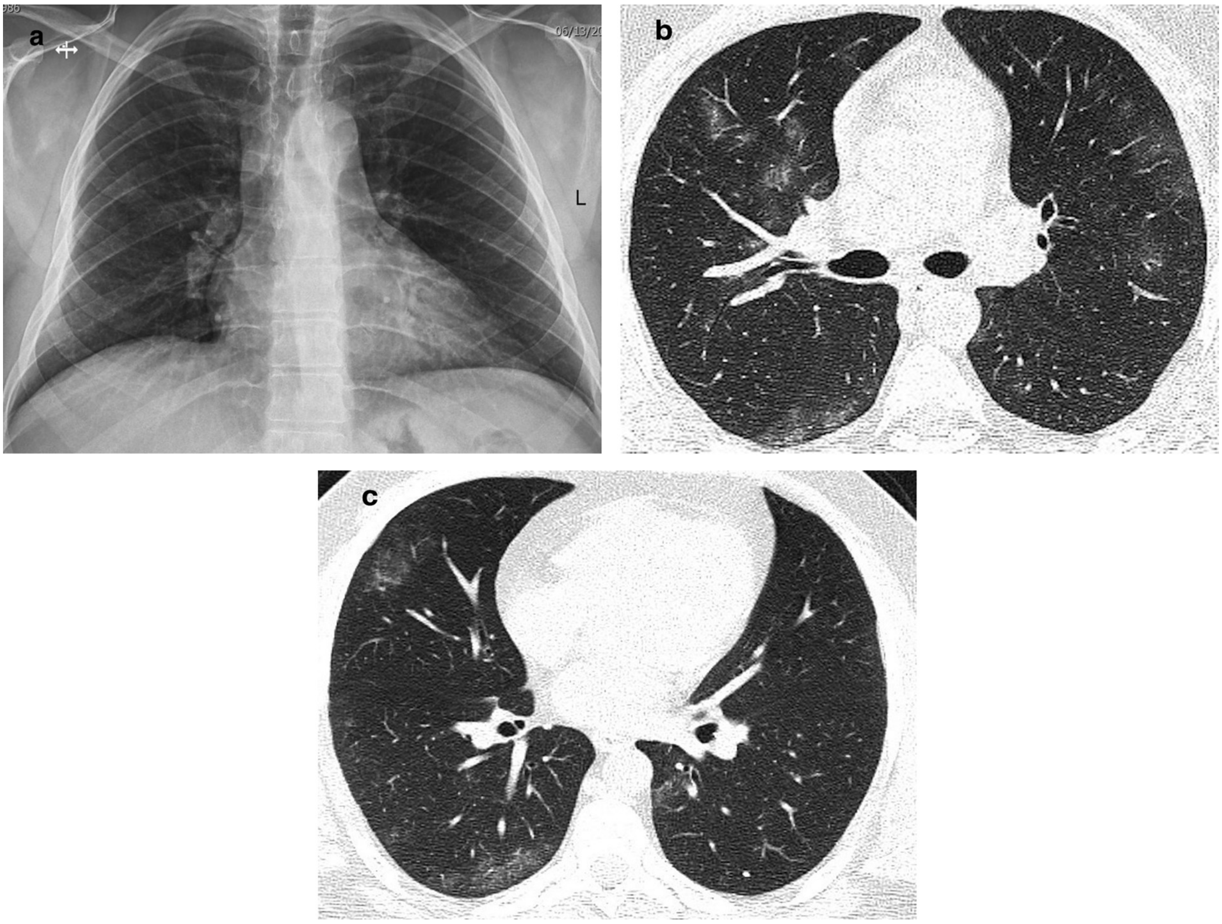
Figure 1



A 35-year-old male patient diagnosed with COVID-19. (a) Initial CT performed at presentation was normal and (b) follow-up CT performed 14 days after the onset of symptoms demonstrates bilateral subpleural patchy GGOs and trivial consolidation. COVID-19, coronavirus disease 2019; CT, computed tomography; GGO, ground-glass opacity.

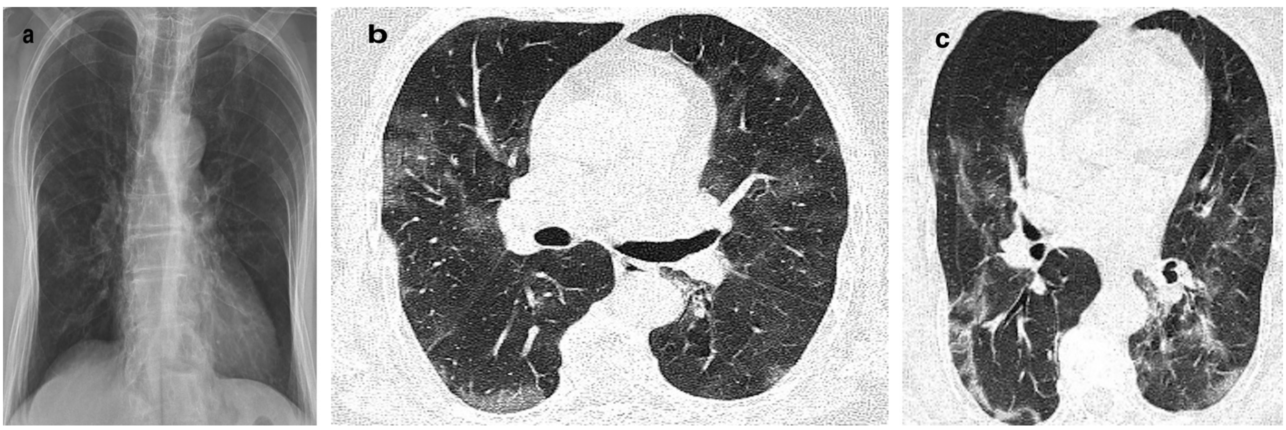
However, in our experience and according to many other authors, plain radiograph is not able to detect mild or even sometimes moderately severe cases [16–18] (Figs 2 and 3). The reasons for a false-negative chest radiograph results include imaging in early course of the disease, absence of pulmonary involvement at the time of presentation together with subtle findings on chest radiograph,

Figure 2



A 35-year-old male patient with COVID-19. Digital plain radiograph (a) no significant abnormality. (b–c) CT axial images demonstrate bilateral multifocal areas of GGOs of predominantly subpleural distribution. COVID-19, coronavirus disease 2019; CT, computed tomography; GGO, ground-glass opacity.

Figure 3



A 72-year-old male patient with COVID-19. (a) Digital plain radiograph shows right midzonal small area of patchy veiling. (b–c) Axial CT images demonstrate bilateral multifocal subpleural areas of GGOs showing thickened interlobular septal thickening and crazy paving pattern. Right posterior basal subpleural band is noted in (c). COVID-19, coronavirus disease 2019; CT, computed tomography; GGO, ground-glass opacity.

especially on more limited portable anteroposterior radiograph [14]. The reported sensitivity of initial chest radiograph in patients who were tested positive on RT-PCR was 69% [19]. Negative chest radiograph findings have been reported in 40–66.7% of cases in spite of positive CT chest findings [9,20].

Consequently, chest radiograph is not recommended for routine diagnosis of COVID-19, but may be useful for follow-up to assess the disease progression or diagnose complications such as pleural effusion, pneumothorax, and pneumomediastinum [12,21].

Ultrasound

The use of ultrasound (US) in the diagnosis of COVID-19 has been proposed by many authors [18,22,23].

Commonly detected abnormalities include B lines (discrete, multifocal, or confluent), thickened pleural lines, consolidation with or without air bronchograms), as well as A lines during the recovery phase [23].

However, US of the chest still holds many drawbacks. In addition to being operator dependent, it is mostly limited only to detection of subpleural lesions. Thus, a negative US cannot exclude the presence of COVID-19, and positive examination cannot detect the extent and severity of the disease, as well as it cannot accurately discriminate the different types of lesions in COVID-19. However, the use of US in ICUs in the follow-up of critically ill patients is considered [22,23].

Positron emission tomography/computed tomography

The use of positron emission tomography/CT in the diagnosis of COVID-19 has been previously reported [24,25]. It can detect pulmonary inflammatory changes, assess disease progression, and can be used for follow-up assessment [14]. The characteristic areas of ground-glass attenuation show high fluorodeoxyglucose (FDG) uptake with reported maximum standardized uptake values ranging from 4.6 to 12.2 (Fig. 4) [24,26]. Additionally, it can detect FDG uptake in normal-sized hilar and mediastinal lymph nodes [26].

In our opinion, because of high cost–benefit relationship of this technique and difficult availability in emergency setting, it cannot compete with CT or be used in routine algorithm of COVID-19 diagnosis. However, as positron emission tomography/CT is commonly indicated in staging of neoplasms, there is potential increase in incidental discovery of COVID-19 pneumonia [14].

Computed tomography findings of coronavirus disease 2019

The CT picture of COVID-19 is known to reflect atypical pneumonia and/or organizing pneumonia [5].

CT appearance of COVID-19 pneumonia shows a rather mixed pattern. According to the findings of the previous studies, GGOs (Figs 1 and 2) are the commonest lesions encountered in CT in cases of COVID-19, followed by consolidation (Fig. 5) and crazy paving (Fig. 6) [3,7,9,21,27].

GGOs are detected in 88% of the patients with COVID infection [28]. They may be multifocal, patchy, or rounded. Those initial changes most likely indicate early stage of alveolar damage and correspond to pulmonary edema with hyaline membrane formation [29].

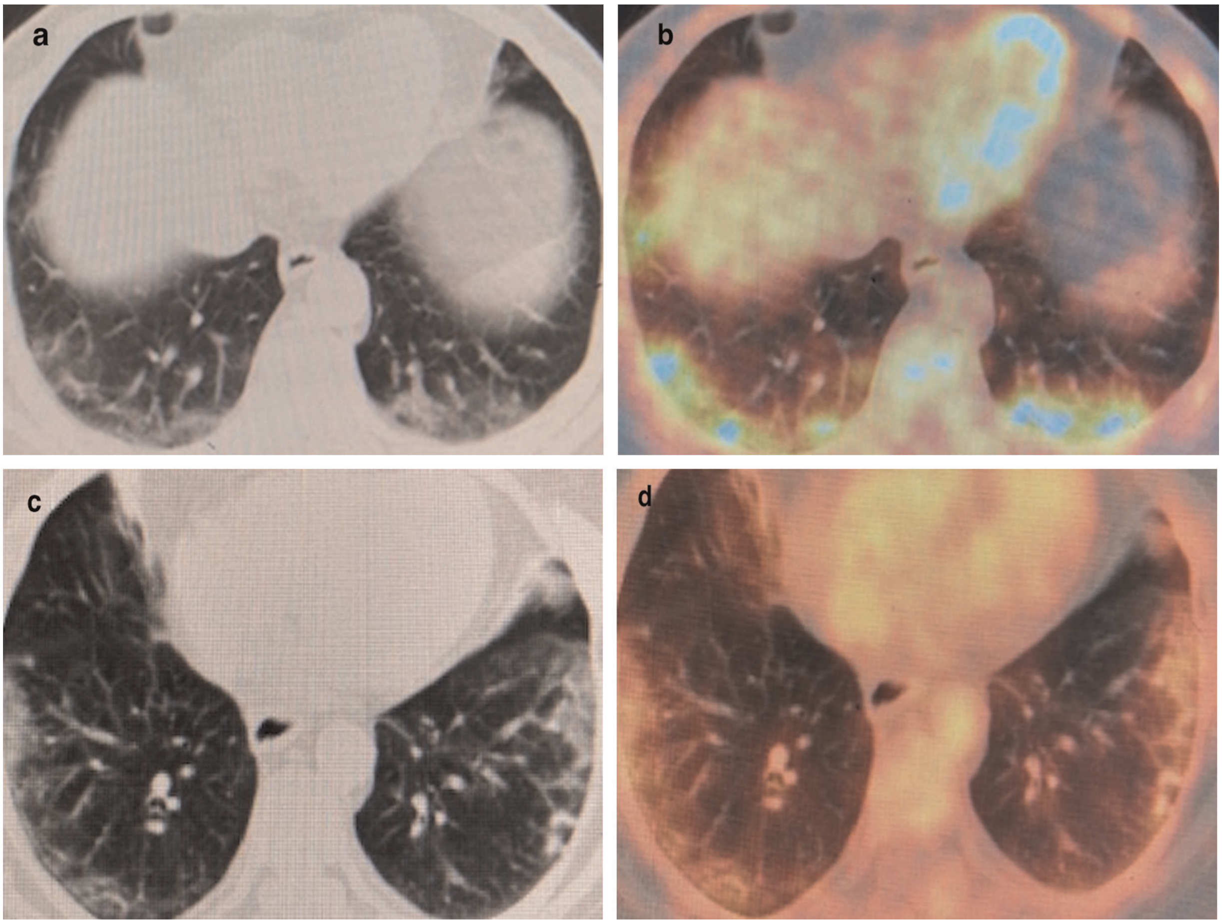
These areas of GGO may be associated with superimposed intralobular reticulations, resulting in a crazy paving pattern, which is particularly detected when the disease progresses [30]. On initial CT, pulmonary consolidations are detected in approximately one-third of the cases, with increasing frequency as the disease progression [28]. Consolidation may represent further infiltration of the lung parenchyma. Air bronchogram is formed by bronchus containing air in consolidation.

Bilateral subpleural distribution of any of those lesions with predominant lower lobes affection is considered typical for COVID-19 [5,9,14,21]. Occasionally, they occur centrally in a bronchovascular distribution (12%) or a combination of peripheral and central distribution (44–59%) [15,31,32].

Vascular thickening with engorgement of the intralesional and perilesional pulmonary vessels is detected in some patients and indicates an increased perfusion of these areas [18,33].

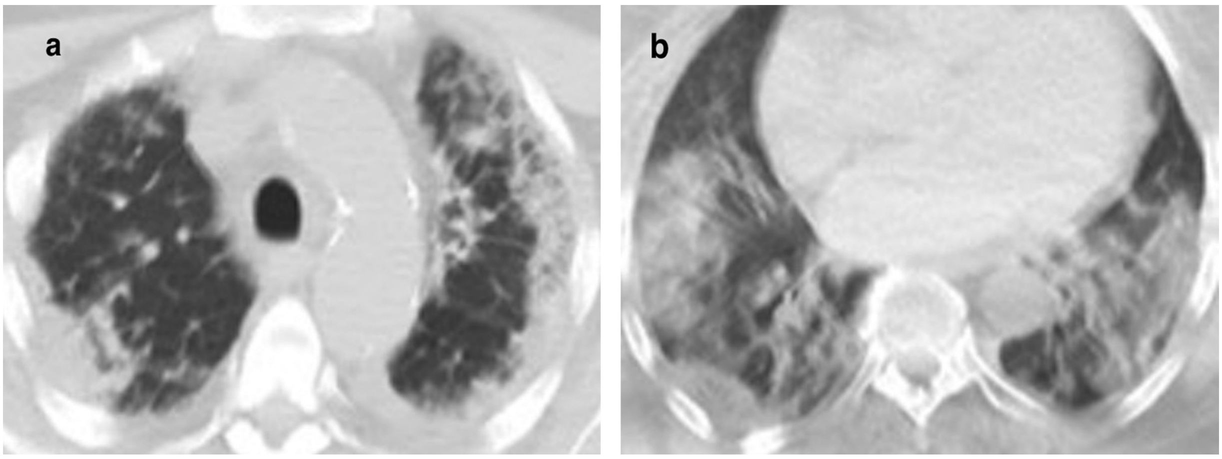
Traction bronchiectasis and vacuolar sign have also been seen in association with those lesions. The vacuole sign is caused by an incompletely filled alveolar cluster in the exudative lung parenchyma (Fig. 5) [34].

Figure 4



PET/CT findings in patients with COVID-19 infection. (a–b) Axial CT and fused PET-CT images in a 65-year-old male patient with NHL demonstrate bilateral multifocal subpleural areas of GGOs that show FDG uptake (SUVmax range, 3.7–4.2). (c–d) Axial CT and fused PET-CT images in a 55-year-old female patient with breast carcinoma demonstrate bilateral lower lobar FDG-avid GGOs (SUVmax range, 6.8–7.6). COVID-19, coronavirus disease 2019; CT, computed tomography; FDG, fluorodeoxyglucose; GGO, ground-glass opacity; PET, positron emission tomography; SUV, standardized uptake value.

Figure 5



Bilateral extensive subpleural consolidation in two patients with COVID-19. Note the vacuolar sign in (a) and air bronchogram in (b). COVID-19, coronavirus disease 2019.

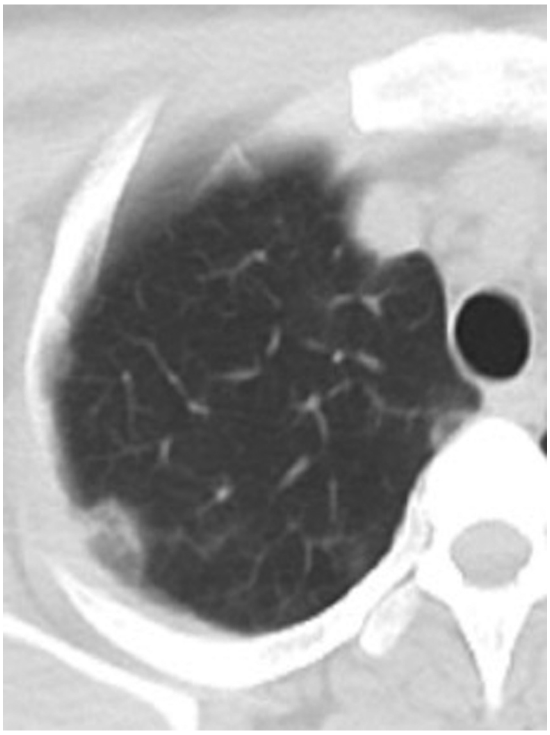
The pleura involvement is characterized by thickening and retraction resulting from the inflammatory reaction [34].

In the healing stage, signs of architectural distortion and organizing pneumonia are noted as reversed halo sign (Fig. 7), perilobular thickening and arcade-like

Figure 6

Crazy paving appearance in a patient with COVID-19. Axial CT images demonstrate left upper and lobes subpleural GGOs that show prominent interstitium and thickened interlobular septae with characteristic crazy paving appearance. Note vascular thickening related to the lesion. COVID-19, coronavirus disease 2019; CT, computed tomography; GGO, ground-glass opacity.

Figure 7



Reversed halo sign in the right upper lobe in a patient with COVID-19. COVID-19, coronavirus disease 2019.

opacities (Fig. 8), fibrous stripes (Fig. 9a), spider web (Fig. 9b), subpleural fibrous bands (Fig. 8c), subpleural lines (Fig. 9d), and subpleural transparent line (Fig. 9d) [34].

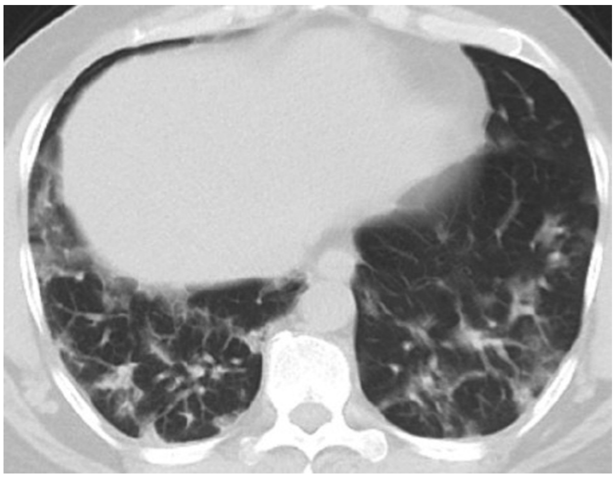
Pulmonary nodules have been encountered in cases of COVID-19. Multifocal solid irregular nodules were detected in 3–13% of COVID-19 patients [16,35] sometimes associated with a 'halo sign' [36] (Fig. 10). Masses may be seen in some cases (Fig. 11), likely representing organizing pneumonia. Centrilobular nodules and tree-in-bud pattern may be seen alone or among other lesions of COVID-19 (Fig. 12). Air-containing cysts (Fig. 13) were rarely noted in few cases of COVID-19 infection [37].

In severe cases, there are diffuse heterogeneous consolidation with GGOs, air bronchogram, and bronchiectasis involving all five lung lobes showing dense consolidative appearance 'white lung' (Fig. 14) [38]. This condition is characterized by diffuse alveolar damage and usually associated with poor prognosis [39,40].

Pleural thickening, effusion, mediastinal and hilar lymphadenopathy, and pulmonary cavitation are not typical imaging findings in COVID-19 pneumonia (Figs 15 and 16) [41].

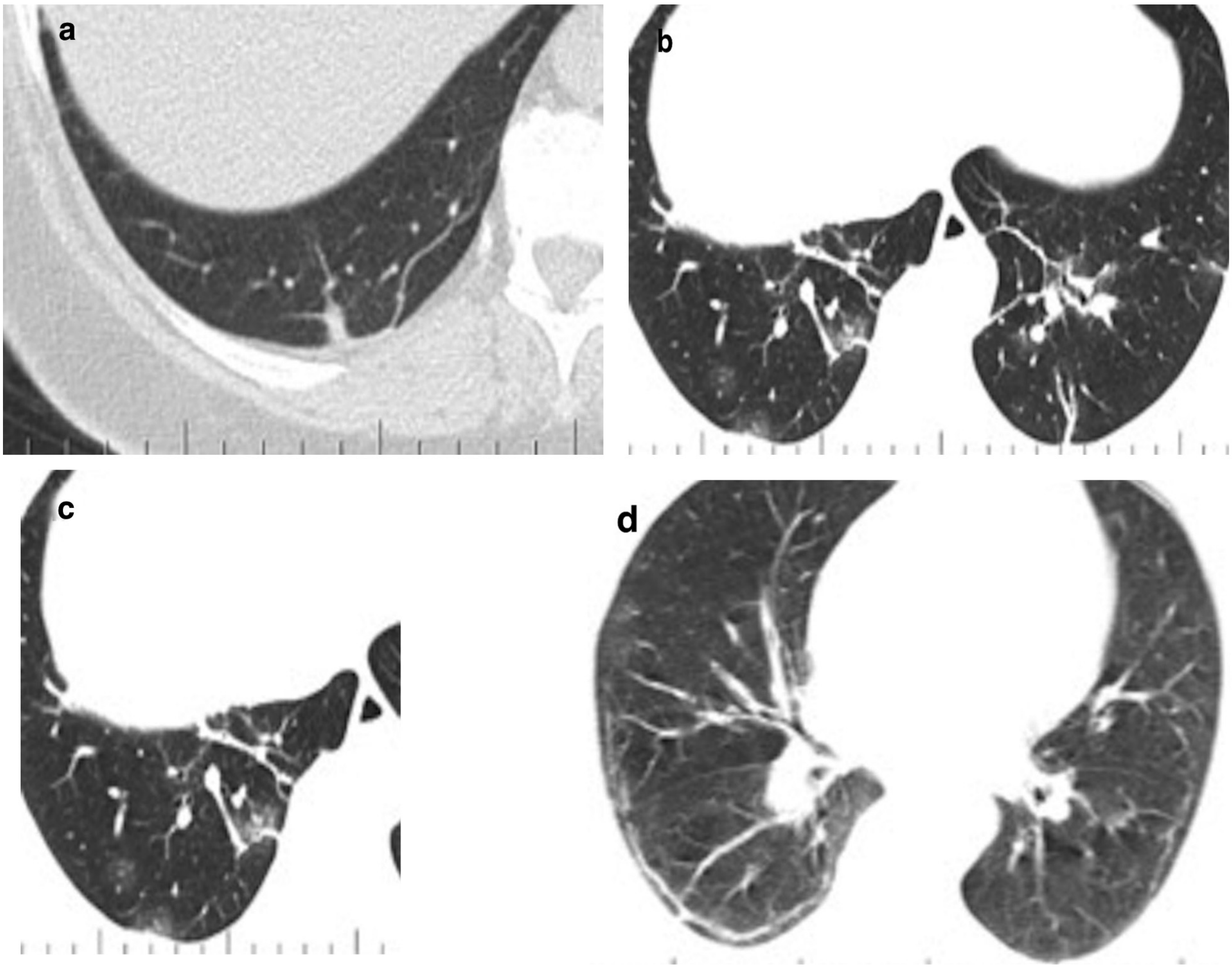
There are few reports described the chest CT findings encountered in pediatric patients with COVID-19 [42–47] who usually have lower rate of positive CT findings and less extensive abnormalities compared with adults. The largest study included 30 patients, and only seven (23%) of them had positive chest CT

Figure 8



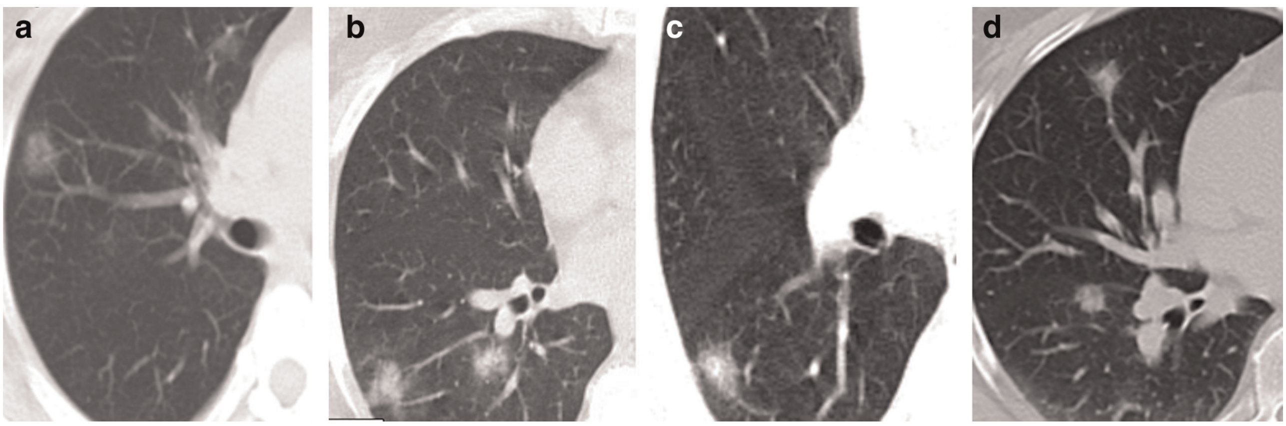
Extensive lower lobes perilobular thickening with arcade-like opacities and architectural distortion in a patient with COVID-19. COVID-19, coronavirus disease 2019.

Figure 9



Axial CT images of four patients in healing stage of COVID-19 infection showing: subpleural fibrous bands (a), spider web by the intersecting fibrous bands (b), subpleural fibrous band (c), and subpleural line and subpleural transparent line (d). COVID-19, coronavirus disease 2019; CT, computed tomography.

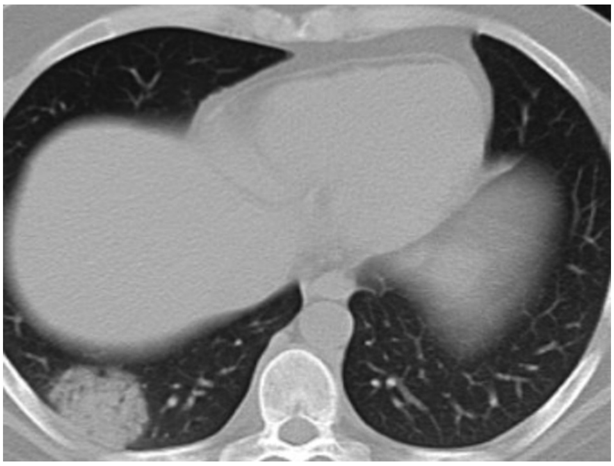
Figure 10



Axial CT images of four patients with COVID-19 infection showing a peripheral fairly well-defined ground-glass nodule (a), dense subpleural and central nodules (b), a subpleural nodule with halo sign (c), and a central and an angiocentric irregular nodules (d). COVID-19, coronavirus disease 2019; CT, computed tomography.

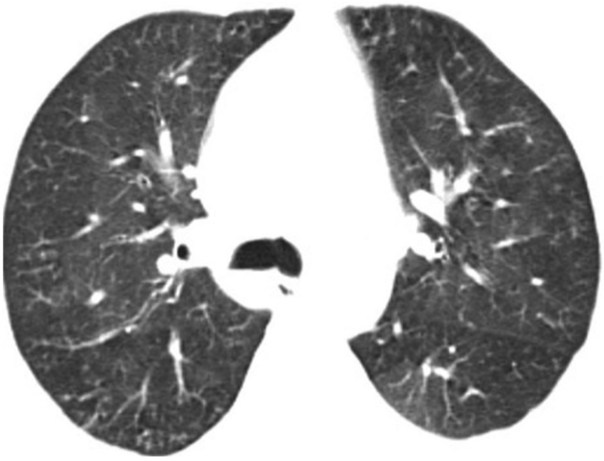
findings, with GGOs, consolidation, or both observed in at least one lobe (Fig. 17) [46]. Two out of the seven (29%) children had a halo sign (consolidation with a surrounding halo), which has been reported as a typical finding in children with COVID-19 [47]. Additionally, bronchial wall thickening was found to

Figure 11



Axial CT image of a patient with COVID-19 showing a right lower lobe consolidation with vacuolar sign and traction bronchiectasis. COVID-19, coronavirus disease 2019; CT, computed tomography.

Figure 12



Axial CT image of a patient with COVID-19 showing a left lower lobe typical subpleural GGO with vascular thickening. Bilateral subpleural centrilobular nodules and tree-in-bud pattern is seen with vascular thickening and traction bronchiectasis. COVID-19, coronavirus disease 2019; CT, computed tomography; GGO, ground-glass opacity.

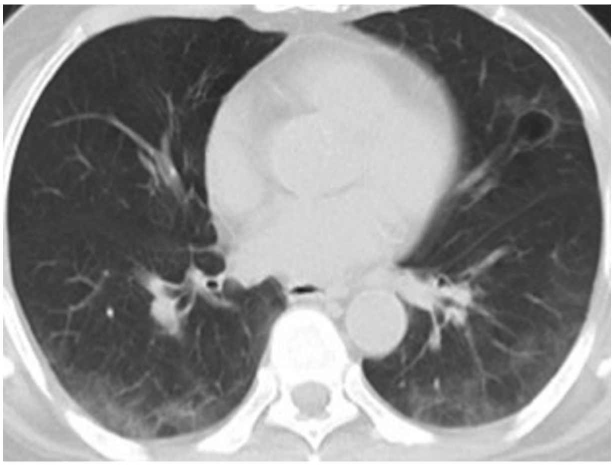
be relatively more frequent in pediatric patients compared with adult patients [47].

Computed tomography-based classifications of coronavirus disease 2019

As soon as the WHO declared the COVID-19 pandemic on March 2020, many classifications were published based on the CT findings (Fig. 18). The classifications mostly assessed the probability of the disease [5,9,14,17,48].

COVID-19 Reporting and Data System (CO-RADS) is a CT scoring system for COVID-19 infection developed by the 'COVID-19 standardized reporting working group' of the Dutch Radiological society to

Figure 13



A lingular air-containing lung cyst seen in an axial CT image of a patient with COVID-19. Lower lobes typical subpleural GGO with vascular thickening are noted. COVID-19, coronavirus disease 2019; CT, computed tomography; GGO, ground-glass opacity.

ensure uniform, structural, and replicable CT reporting [48].

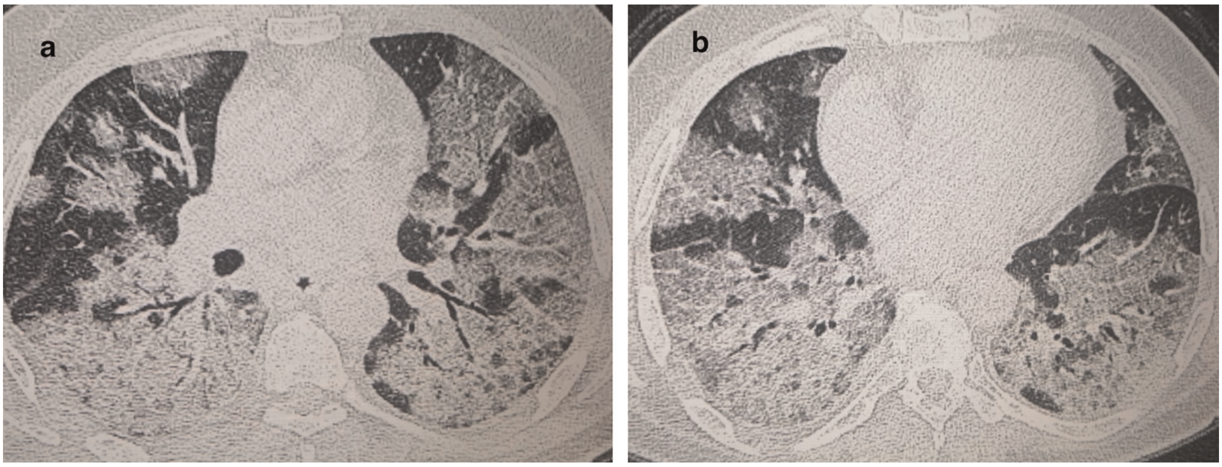
Based on the findings of abnormities in nonenhanced CT scan, CO-RADS provides a level of suspicion for pulmonary involvement of COVID-19. The level of suspicion increases from very low (CO-RADS 1) to very high (CO-RADS 5). However, two additional categories may be assigned in some cases: if the CT examination is technically insufficient (CO-RADS 0) and if there is a confirmed positive RT-PCR test at the time of examination (CO-RADS 6) [48].

Prokop *et al*. [48] have investigated the utilization of CO-RADS in prediction of COVID-19 infection; they have found high diagnostic performance of CO-RADS, with area under the receiver operating characteristic curve of 0.91 (95% confidence interval: 0.85, 0.97) for positive RT-PCR results. They have also reported substantial interobserver agreement, especially for CO-RADS categories 1 and 5 with a Fleiss' kappa score of 0.47 (cf. 0.24 for PI-RADS and 0.67 for Lung-RADS) [48].

Another study performed by Hermans *et al*. [49] found that CT chest using CO-RADS scoring is sensitive and specific tool for diagnosing COVID-19, especially if there is shortage of RT-PCR tests.

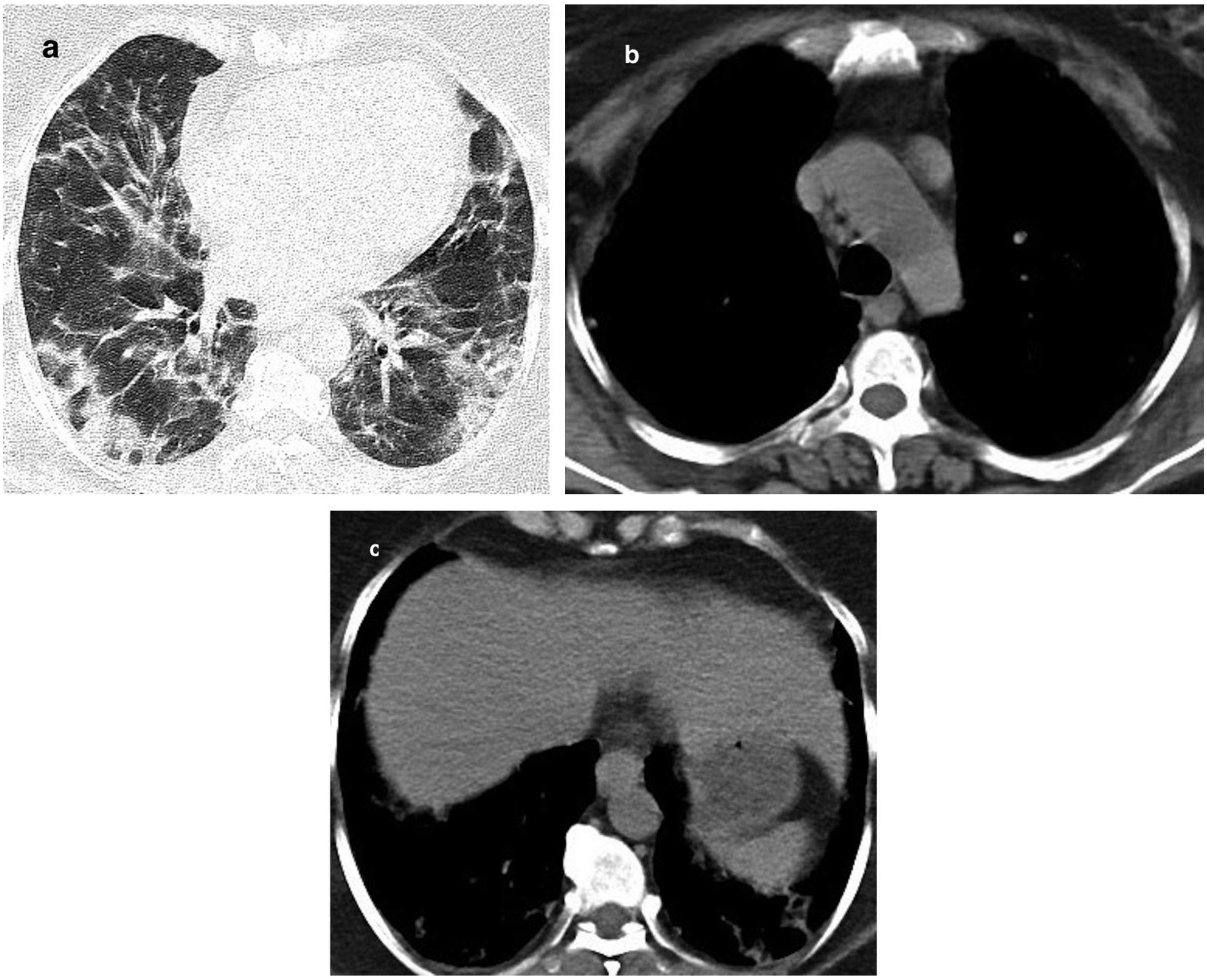
COVID-RADS, which has a confusingly similar nomenclature to CO-RADS, is another grading system that was developed by the American radiologists based at the University of Southern

Figure 14



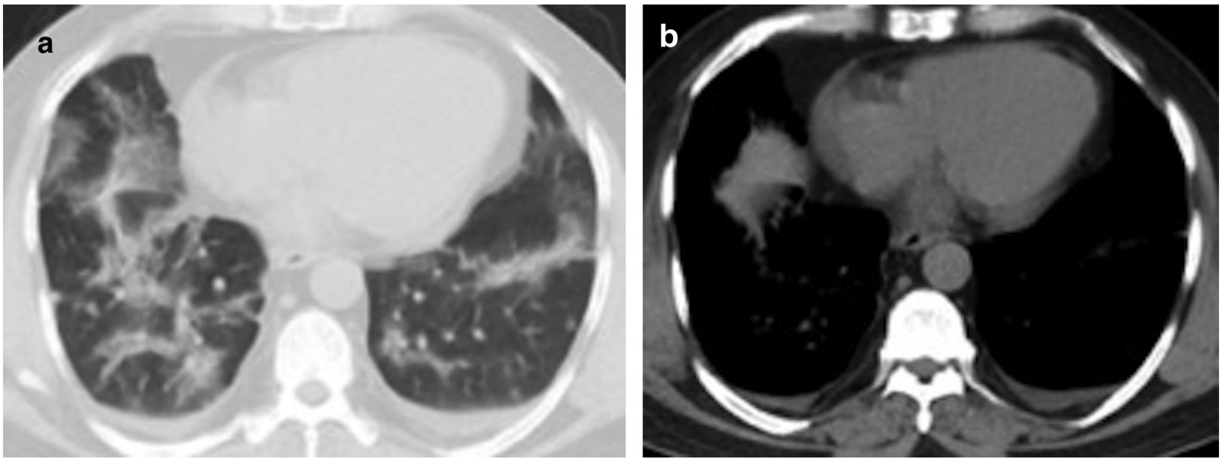
(a–b) Axial CT image of a 'white lung' appearance in a 72-year-old male patient with respiratory distress due to COVID-19 pneumonia. There are bilateral extensive GGOs and consolidation involving both lung fields with air bronchogram. COVID-19, coronavirus disease 2019; CT, computed tomography; GGO, ground-glass opacity.

Figure 15



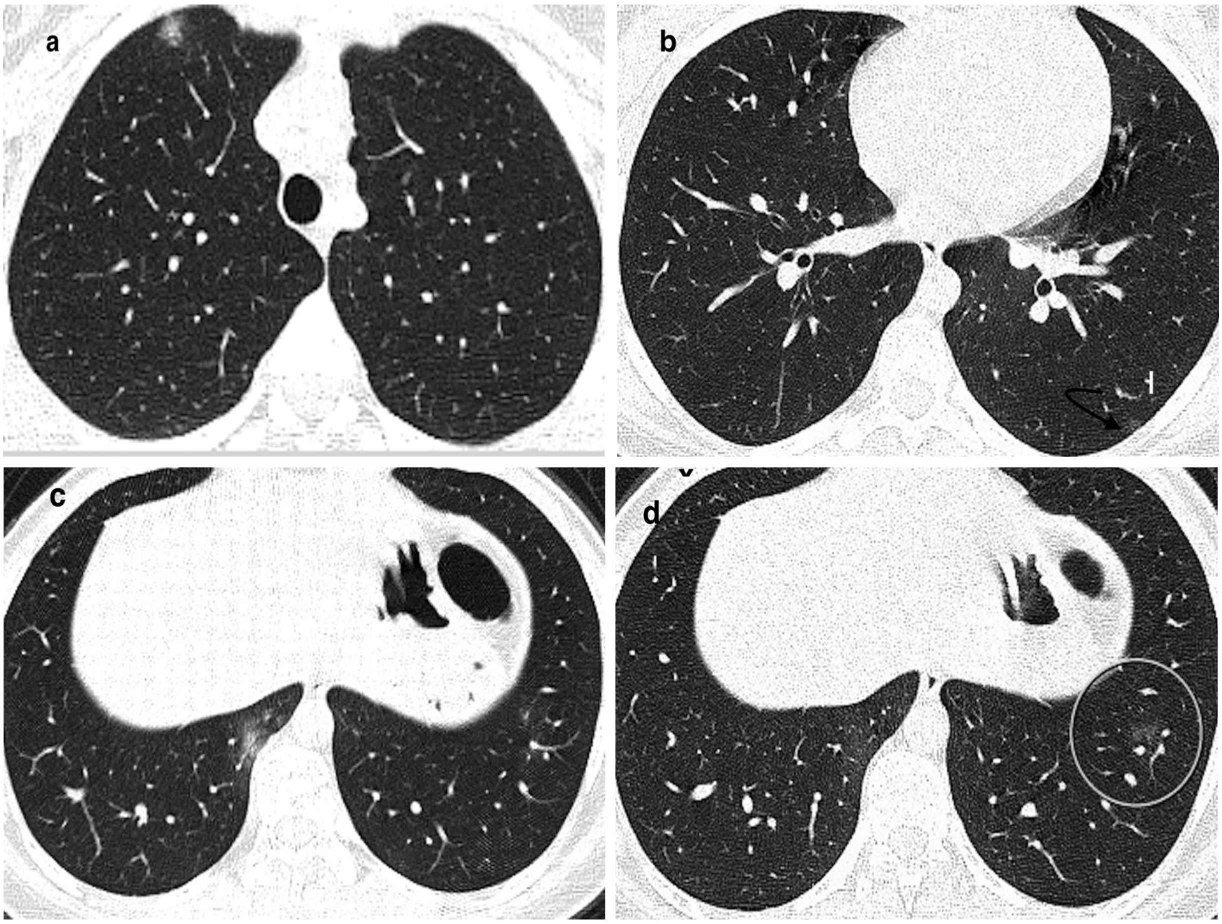
(a–c) Axial CT images in a 62-year-old female patient diagnosed with COVID-10 pneumonia demonstrate bilateral multifocal areas of GGOs (a) together with enlarged mediastinal lymph nodes and bilateral mild pleural thickening (b–c). COVID-19, coronavirus disease 2019; CT, computed tomography; GGO, ground-glass opacity.

Figure 16



(a–b) Axial CT images in a 40-year-old male patient diagnosed with COVID-19 infection demonstrate bilateral multifocal areas of GGOs (a) and bilateral mild pleural effusion (b). COVID-19, coronavirus disease 2019; CT, computed tomography; GGO, ground-glass opacity.

Figure 17



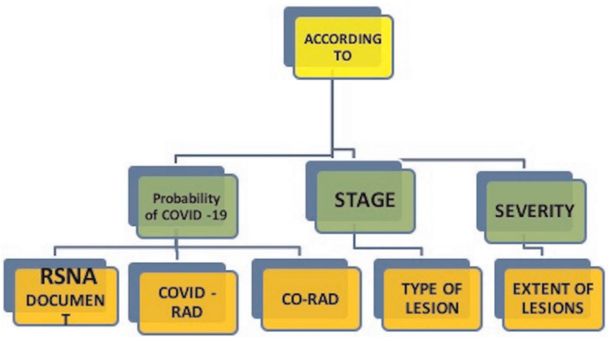
Chest CT findings of pediatric patients (siblings) confirmed with COVID-19 infection. (a–b) Axial CT images of a 16-year-female patient demonstrate right upper lobe small subpleural nodule (a) with left lower lobe small area of faint GGO (b). (c–d) Axial CT images of a 13-year-old female patient demonstrate bilateral lower lobar small areas of GGOs. COVID-19, coronavirus disease 2019; CT, computed tomography; GGO, ground-glass opacity.

California [17]. They have proposed five COVID-RADS categories (0, 1, 2A, 2B, and 3), with grades 0 and 1 correspond to a low level of suspicion for pulmonary involvement, grades 2A and 2B correspond to moderate level, and grade 3 corresponds to high level of suspicion [17]. The diagnosis of COVID-19 infection should be made based on the complete clinical picture and verified based on the results of RT-PCR test.

However, based on our experience, in the context of the current pandemic with marked peaking of the cases in Egypt since May 2020, the presence of inflammatory changes in a patient with clinical suspicion of COVID-19 should be considering as an alarming sign for the presence of COVID infection.

In the presence of typical findings of bilateral multifocal GGOs with crazy paving appearance and peripheral distribution, CT should be considered positive for COVID infection. Nevertheless, in the presence of atypical/ intermediate findings such as isolated lobar or segmental consolidation, centrilobular nodules, or tree-in-bud pattern, the patient is considered a possible case of COVID-19 (Fig. 19). A negative CT report for COVID-19 should only be considered in cases of normal CT or if CT lesions do not represent inflammatory changes.

Figure 18



A diagram of the CT-based classifications of COVID-19. COVID-19, coronavirus disease 2019; CT, computed tomography.

Evolution during follow-up

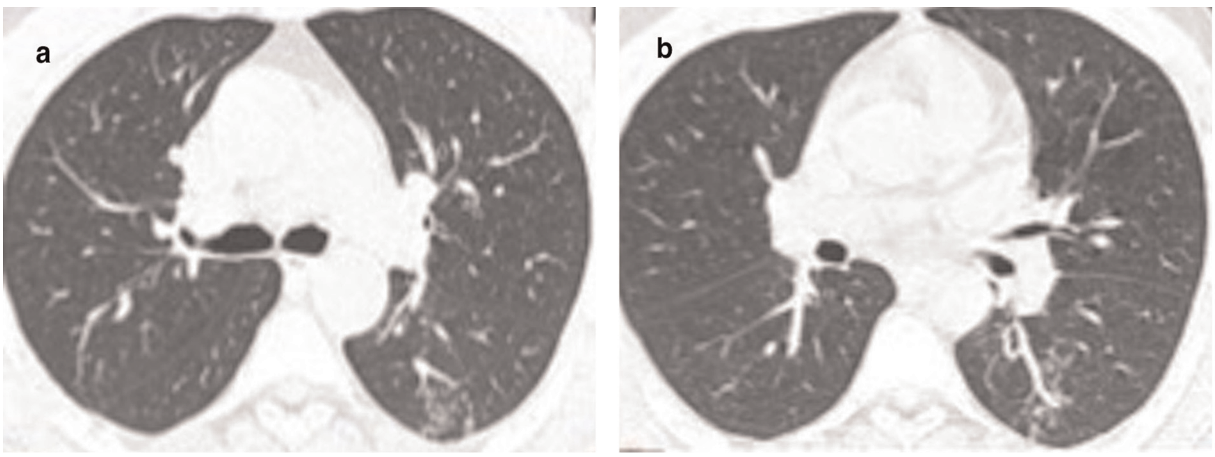
Several studies have described the temporal evolution of CT findings in patients with COVID-19 infection. Evolution of lung abnormalities is classified into four stages [35,40,50,51]. During the early stage (0–4 days), CT may be normal or show GGO. In the progressive stage (5–8 days), there are increase GGOs and crazy paving appearance. The peak stage (9–13 days) consolidation is detected on CT. Lastly, the absorption stage starts after 14 days and extends to 1 month or beyond. It shows improvement of the disease with detection of fibrous stripes (Fig. 20).

In our study on 220 Egyptian patients confirmed with COVID-19 infection, mixed patterns were detected across different stages of the disease in the same patient (Fig. 21). Additionally, different patterns of temporal evolution of the CT findings were encountered in serial CT scan that sometimes did not follow this four-stage characterization. Moreover, in some cases, the resolution CT findings lagged behind the clinical and laboratory recovery, a condition that is generally known in follow-up in cases of pneumonia [16].

Computed tomographic severity assessment

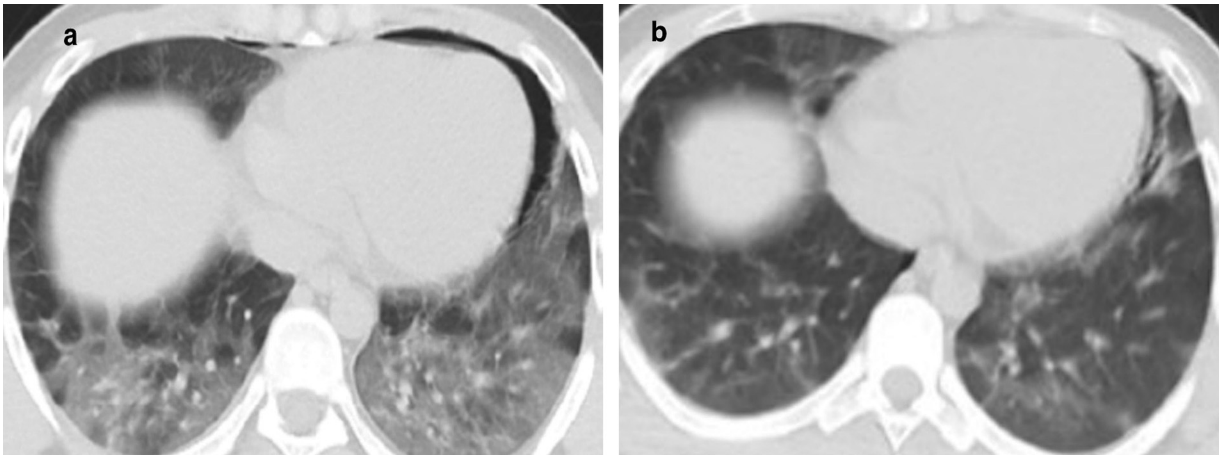
Assessing the severity of the disease was proposed based on the CT pulmonary involvement. Many severity score assessments were introduced [32,52,53]. All of them have the same drawbacks of being based on visual assessment, subjective, time consuming, and of limited use to certain institutes. Additionally, they reflect one entity of the severity which is the distribution extent of disease, which is considered as a drawback as sometimes the lesions improve by decreasing in density not in extent. However, the use of a severity score is still

Figure 19



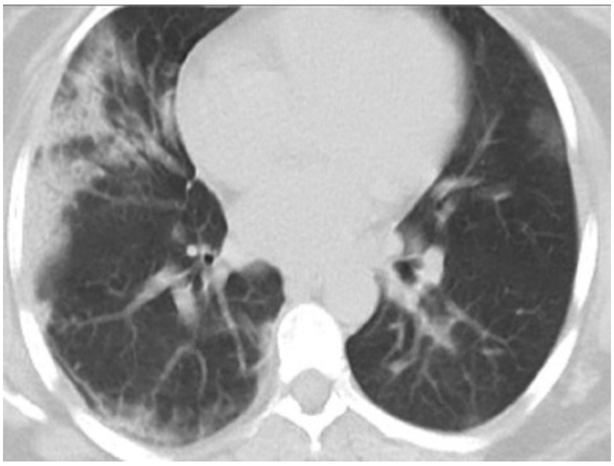
(a–b) Axial CT images demonstrate left lower lobe apical segment centrilobular nodules and tree-in-bud pattern in a case of COVID-19. The case was initially misdiagnosed as possible tuberculous. COVID-19, coronavirus disease 2019; CT, computed tomography.

Figure 20



CT images showing temporal change in a case of COVID-19 infection. (a) Initial CT study and (b) is a follow up CT preformed 4 days later as the patient clinically improved. There is marked regression of the extent and CT density of the initial lesions. Pneumomediastinum (not shown here) and pneumo-pericardium also have markedly improved. COVID-19, coronavirus disease 2019; CT, computed tomography.

Figure 21



A case of COVID-19 showing mixed pattern of imaging findings. Axial CT image demonstrates GGO, crazy paving, consolidation, fibrous stripes, subpleural line, and subpleural transparent line. COVID-19, coronavirus disease 2019; CT, computed tomography; GGO, ground-glass opacity.

recommended to assess the disease extent, guide the clinical treatment by combining with the clinical data, as well as to follow-up the disease [53].

Several studies have suggested that CT may help to predict severity of COVID-19 disease [32,52–57]. Zhao *et al*. [32] have found that 79% of the severe/fatal cases demonstrated more extensive and diffuse pulmonary involvement with more frequent bronchiectasis and architectural distortion compared with mild/common cases. Another study has found that 68% of patients with disease extent more than 25% of the lung parenchyma were intubated or deceased in the 3 weeks following CT [57].

Yuan *et al*. [55] have stated that CT scores were able to predict mortality with a sensitivity and a specificity of 85.6 and 84.5%, respectively.

Yet, more data are needed, especially with comparing the CT findings with blood tests, for example, cytokine levels [21].

Challenges in the computed tomography diagnosis of coronavirus disease 2019

Overlapping CT chest findings with viral pneumonia and other respiratory diseases pose a diagnostic dilemma and also make an exclusion diagnosis difficult.

It is difficult to differentiate COVID-19 from pneumonia from other viral origin. This is mostly owing to a large overlap of their CT findings, despite the fact that CT abnormalities in COVID-19 pneumonia usually demonstrate a peripheral predominance, greater GGO with more frequent fine reticular opacities, vascular enlargement, and a ‘reverse-halo sign’ [21,58].

The CT findings that are less frequent in COVID-19 pneumonia compared with other viral pneumonias include centrilobular nodules, air bronchograms, tree-in-bud opacities, bronchial wall thickening, and a reticular pattern and bronchial wall thickening [59,60].

In a study performed by Bai *et al.* [58] to assess the performance of radiologists in differentiating COVID-19 pneumonia from other viral pneumonias based on the presence of typical CT features of COVID-19 infection, they reported moderate to high accuracy of the performance of the radiologists, as they were capable of distinguishing COVID-19 infection from other viral pneumonia with moderate sensitivity (67–93%) but high specificity (93–100%) [58].

COVID pneumonia also needs to be differentiated from a variety of noninfectious lung diseases such as pulmonary alveolar edema, pulmonary hemorrhage, drug-induced lung disease, and interstitial lung disease [10,61].

In pulmonary alveolar edema, chest CT demonstrates diffuse GGOs which are characterized by central predominance and sparing of the lung periphery contrary to COVID-10 pneumonia. It is usually associated with other ancillary findings such as smooth interlobular septal thickening due to interstitial pulmonary edema, pleural effusion, and cardiomegaly suggestive of congestive heart failure [61].

Alveolar hemorrhage owing to small-vessel vasculitis is also characterized by diffuse GGO with no subpleural predominance contrary to that seen in COVID-19. Additionally, the patients usually present with mild hemoptysis with associated acute renal failure, especially in Goodpasture syndrome [62].

Drug-induced lung diseases may have a variety of imaging appearance presentations, ranging from an adult respiratory distress syndrome to pulmonary fibrosis [61,63]. History of drug exposure and subpleural sparing may help in the diagnosis [64].

It is worth noting that the presence of underlying pulmonary disease, for example, interstitial pneumonia (CDILD), pulmonary edema, or chronic obstructive pulmonary disease, may pose a diagnostic difficulty. This requires careful analysis of CT images to detect lesions typical for COVID-19 infection.

Conclusion

The importance of CT chest in the diagnosis of COVID-19 infection continues to increase. Chest CT can play a pivotal role in early diagnosis, categorization, and initial follow-up of COVID-19 infection. Typical CT findings include GGOs, consolidation, intralobular and interlobular septal thickening, with a peripheral and lower lobar distribution.

As CT chest may be negative in very early stages of the disease; with variable and nonspecific imaging findings, thus the integration of clinical history and laboratory tests is essential for accurate assessment of the disease.

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Conflicts of interest

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