

Electronic supplementary materials

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Initial chest CT findings in COVID-19: correlation with clinical features^{*#}

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CT Scanning

Twenty-two patients imaged with 1-mm slice thickness CT on a PHILIPS Brilliance CT Big Bore 16 scanner (Philips; Amsterdam, Netherlands). Five patients imaged with 1.25-mm slice thickness CT on a GE Medical Systems optima CT540 scanner (GE medical Systems; Milwaukee, WI). Three patients imaged with 1-mm slice thickness CT on a SIEMENS SOMATOM Definition AS scanner (Siemens Healthineers; Erlangen, Germany). One patient imaged with 2-mm slice thickness CT on a SIEMENS SOMATOM Definition AS scanner (Siemens Healthineers; Erlangen, Germany). Two patients imaged with 2-mm slice thickness CT on a Philips Brilliance 16 scanner (Philips; Amsterdam, Netherlands). One patient imaged with 1.3-mm slice thickness CT on a GE BrightSpeed 16 scanner (GE medical Systems; Milwaukee, WI). One patient imaged with 5-mm slice thickness CT on a GE Medical Systems optima CT660 scanner (GE medical Systems; Milwaukee, WI). One patient imaged with 1-mm slice thickness CT on a uCT760 scanner (United Imaging; Shanghai, China).

CT evaluation

A recent study (Bernheim *et al.*, 2020) defined the stage of the illness based on the interval between initial symptom and CT; two days or less was the early stage, three to five days was the intermediate stage and six days or more was late stage. Accordingly, 12 of 36 patients were in the early stage, 14 of 36 patients were in the intermediate stage and 10 of 36 patients were in the late stage, when they underwent the initial chest CT.

For each patient, the chest CT scan was evaluated for the following characteristics: (1) presence of GGO,

(2) presence of consolidation, (3) distribution of lung lesions, (4) number of lesions, (5) number of lobes affected, (6) opacity characteristics (including parenchymal band, “crazy-paving” pattern, “halo” sign, “reverse halo” sign, rounded opacities and cavitation), (7) airway abnormalities (including bronchial wall thickening, bronchiectasis and airway secretions), (8) presence of underlying lung disease such as emphysema or fibrosis, (9) other abnormalities, including pleural effusion, pleural thickening and lymphadenopathy.

Results

Chest CT images obtained at presentation were abnormal in 34 of 36 (94%) patients. Seventeen (47%) patients had pure GGO, 2 (6%) had pure consolidation, 15 (42%) had mixed GGO and consolidation. Parenchymal band, a “crazy-paving” pattern, a “halo” sign, a “reverse halo” sign, rounded opacities and pleural thickening were present in 13 (36%), 5 (14%), 16 (44%), 2 (6%), 18 (50%) and 4 (11%) patients, respectively. There was no evidence of cavitation, airway secretions, lymphadenopathy, or pleural effusion on any chest CTs at initial presentation. Four (11%) patients had opacities in one lobe, four (11%) patients had two affected lobes, six (17%) patients had three affected lobes, one (3%) patients had four affected lobes and 19 (53%) patients had five affected lobes. In terms of lesion distribution, a peripheral pattern was observed in 14 (39%) patients, a central pattern was observed in 4 (11%) patients, a mixed peripheral and central pattern was observed in 8 (22%) patients and a diffuse pattern was observed in 8 (22%) patients (**Supplementary Table 1**).

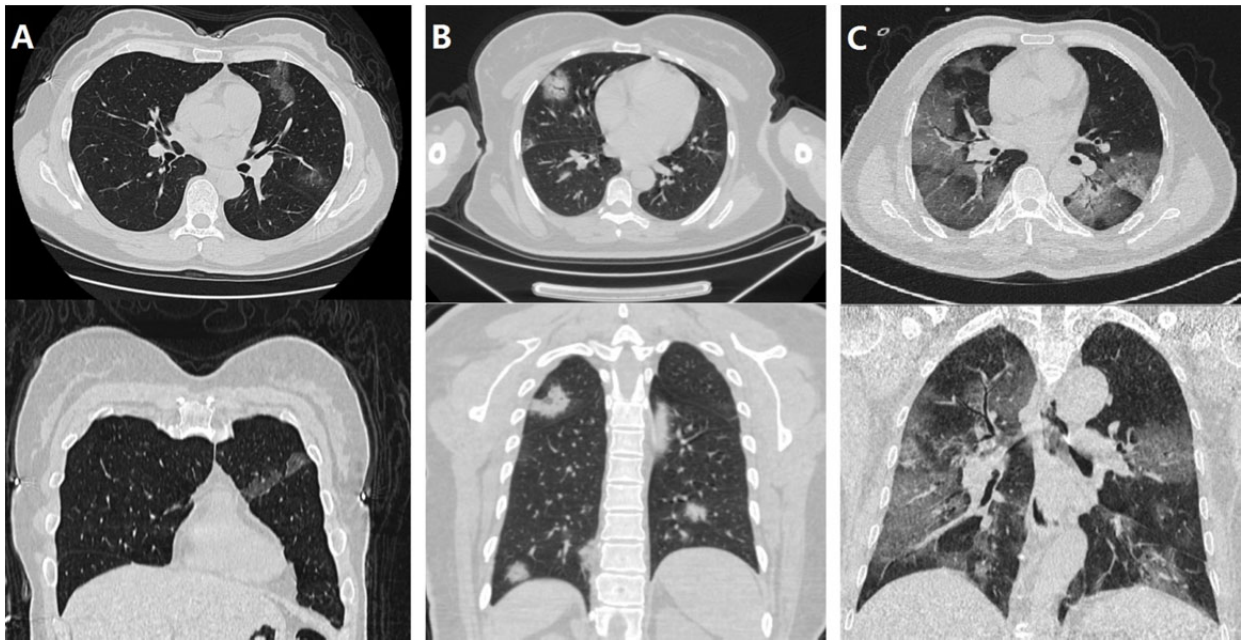
According to the duration between onset and CT scanning, 12 patients were in early stage (≤ 2 days), 14 patients were in intermediate stage (3-5 days) and 10 patients were in late stage (≥ 6 days) (**Supplementary Fig. 1**). Pure GGO was more common in the early stage (75%) than intermediate (50%) and late stage (10%), while mixed GGO and consolidation was more common in the late stage (90%) than early (8%) and intermediate stage (36%). From the early to late stage of COVID-19, the lung lesions tended to affect bilaterally and more lobes, with a diffuse pattern. Parenchymal band was noted in 17% early patients, 36% intermediate patients and 60% late patients (**Supplementary Fig. 2**). The median CT score was 3 (IQR, 1-6) for early patients, 3 (IQR, 2-5) for intermediate patients and 16 (IQR, 8-17) for late patients (**Supplementary Table 1**).

Our results showed that lung abnormalities in COVID-19 deteriorated along with its clinical course with following characteristics. (1) Followed by the presence of consolidation, pure GGO in the early stage progressed to mixed GGO and consolidation in the late stage. (2) The peripheral air-space opacifications in the early stage tended to be a diffuse pattern in the late stage, with bilateral involvement and five lobes affected. (3) Parenchymal band was more common in the late stage than early stage, which might reflect fibrosis. The appearance and location of lung opacities in different stages might represent the underlying pathophysiology of COVID-19, and further studies were needed to explore the correlation.

Supplementary Table 1 Imaging features of 36 patients with COVID-19

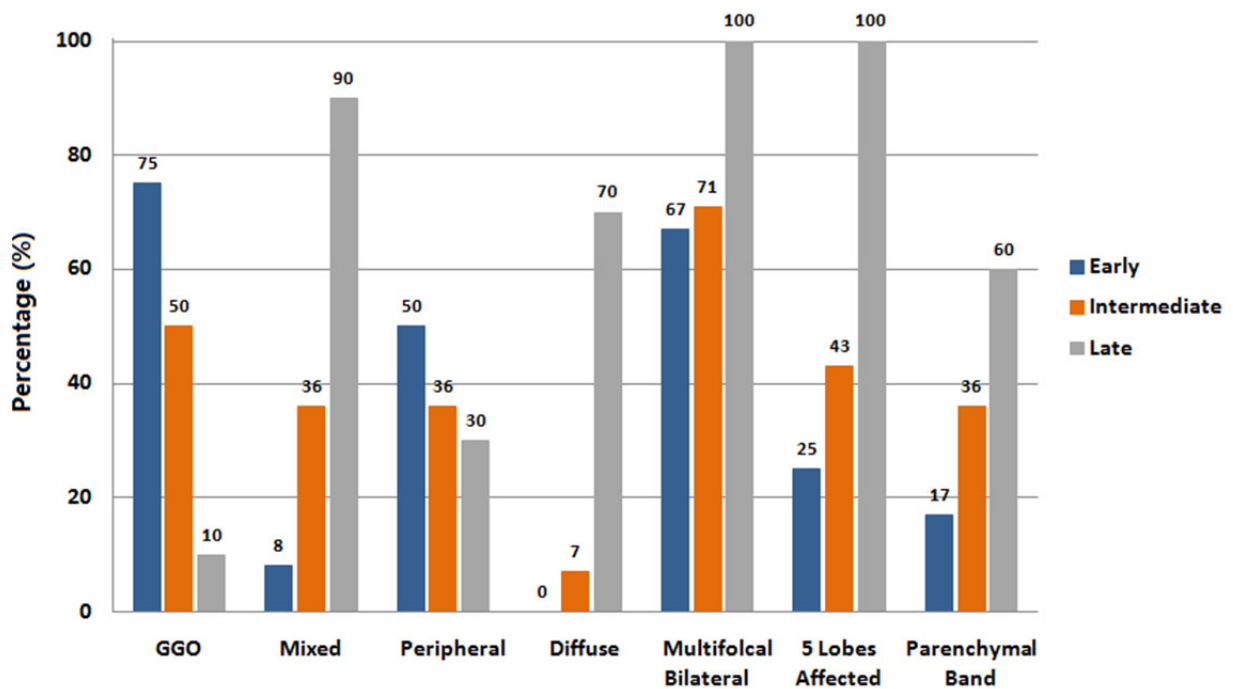
OPACITIES	Total (<i>n</i> =36)	Early (<i>n</i> =12)	Intermediate (<i>n</i> =14)	Late (<i>n</i> =10)
GGO	17(47)	9(75)	7(50)	1(10)
Consolidation	2(6)	1(8)	1(7)	0(0)
Mixed	15(42)	1(8)	5(36)	9(90)
None	2(6)	1(8)	1(7)	0(0)
DISTRIBUTION				
Peripheral	14(39)	6(50)	5(36)	3(30)
Central (Peribronchovascular)	4(11)	1(8)	3(21)	0(0)
Distribution				
Mixed	8(22)	4(33)	4(29)	0(0)
Diffuse	8(22)	0(0)	1(7)	7(70)
NUMBER OF LESIONS				
Unifocal	4(11)	2(17)	2(14)	0(0)
Multifocal Unilateral	2(6)	1(8)	1(7)	0(0)
Multifocal Bilateral	28(78)	8(67)	10(71)	10(100)
NUMBER OF INVOLVED LOBES				
0	2(6)	1(8)	1(7)	0(0)
1	4(11)	2(17)	2(14)	0(0)
2	4(11)	2(17)	2(14)	0(0)
3	6(17)	3(25)	3(21)	0(0)
4	1(3)	1(8)	0(0)	0(0)
5	19(53)	3(25)	6(43)	10(100)
OPACITY CHARACTERISTICS				
Parenchymal Band	13(36)	2(17)	5(36)	6(60)
“Crazy-Paving” Pattern	5(14)	1(8)	1(7)	3(30)
“Halo” Sign	16(44)	6(50)	9(64)	1(10)
“Reverse Halo” Sign	2(6)	1(8)	0(0)	1(10)
Rounded Opacities	18(50)	7(58)	9(64)	2(20)
Cavitation	0(0)	0(0)	0(0)	0(0)
AIRWAY				
Bronchial Wall Thickening	25(69)	9(75)	11(79)	5(50)
Bronchiectasis	4(11)	1(8)	0(0)	3(30)
Airway Secretions	0(0)	0(0)	0(0)	0(0)
UNDERLYING LUNG DISEASE				
Pulmonary Emphysema	3(8)	2(17)	1(7)	0(0)
Pulmonary Fibrosis	3(8)	2(17)	1(7)	0(0)
OTHER FINDINGS				
Pleural Effusion	0(0)	0(0)	0(0)	0(0)
Pleural Thickening	4(11)	1(8)	1(7)	2(20)
Lymphadenopathy	0(0)	0(0)	0(0)	0(0)
CT Score	5(2-10)	3(1-6)	3(2-5)	16(8-17)

Data is presented as numbers (%) or median (IQR).



Supplementary Fig. 1 Initial CT images of patients in different stages

(A) Early stage: CT scan of a 52-year-old woman obtained one day after onset shows patchy areas of GGO in the left upper lobe. (B) Intermediate stage: CT scan of a 49-year-old woman obtained three days after onset shows multifocal round consolidation, distributed in peripheral and central zone. (C) Late stage: CT scan of a 57-year-old man obtained ten days after onset shows diffuse GGO and subsegmental areas of consolidation in bilateral lungs



Supplementary Fig. 2 Frequency of chest CT findings as a function of time course from symptom onset