INTRODUCTION

Coronavirus disease 2019 (COVID-19) cases were first reported from Wuhan, Hubei province of China towards the end of 2019 and spread rapidly across the globe with a sustained human-to-human transmission. According to the situation report-136 of World Health Organization (WHO), COVID-19 has rapidly spread across the world, infecting 6.4 million people and causing 382,867 deaths. India has reported 216,919 cases with 6075 deaths as of June 4, 2020. The causative organism is a novel enveloped single-stranded RNA betacoronavirus known as severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). The main symptoms of COVID-19 are fever, cough, fatigue, myalgia, expectoration, shortness of breath and sore throat. Other less common symptoms attributable to gastrointestinal tract are anorexia, nausea, vomiting, abdominal pain, diarrhea and mesenteric ischemia. Symptoms of neurological dysfunction have also been reported with headache,
anosmia, dysguesia, dizziness, altered sensorium and seizures being the commonly reported symptoms.\(^6\)

Many infected patients are asymptomatic. The frequency of asymptomatic infections has been reported in the range of 19–56%.\(^7,8\) Arons et al reported a high frequency (56%) of asymptomatic infections at the time of diagnosis in their cohort.\(^9\) These infected asymptomatic patients known as “asymptomatic carriers or covert transmitters,” represent a potential contagious source of SARS-CoV-2, as they unknowingly transmit the infection to others.\(^10,11\) It is essential to have in-depth knowledge about these asymptomatic or mild symptomatic cases for formulating strategies for epidemiological control of COVID-19. The high infective potential of asymptomatic cases supports the case of wide use of face masks by the general public especially in crowded places to contain the spread of disease. This holds more value in congregate living conditions like old age homes, prisons, orphanages, inpatient hospitalized patients, mental health facilities where many people with fragile immune systems live together.\(^12,13\)

The aim of this endeavor was to study the clinicoradiological course in reverse transcriptase polymerase chain reaction (RT-PCR) positive patients who were asymptomatic at the time of admission in order to understand the clinical course, temporal course of imaging findings and the final outcome.

**METHODS AND MATERIALS**

**Cases and study design**

This was a retrospective observational study conducted at a designated COVID-19 Care Centre in Kashmir, India. Institutional review board (IRB) approval was obtained. The requirement for patient’s informed consent was waived. RT-PCR confirmed non-consecutive COVID-19 patients who were asymptomatic, diagnosed from March 21 to June 14, 2020 were enrolled. CT was done on the following grounds: (a) previous reports describing positive imaging findings in asymptomatic cases\(^7\) (b) previous reports describing asymptomatic carrier transmission\(^9,10\) (c) to understand the behavior of the virus and response of our population in view of divergent courses of disease in different ethnic populations. CT parameters were optimized to minimize radiation exposure to the patients.

Patients who had a positive initial CT at the time of admission and one or more follow-up CT during the hospital stay were included in the final study. The demographics like age, gender, history of exposure/travel, clinical data including symptoms, comorbidities, laboratory results, chest CT findings, clinicoradiological
course and outcome data during the hospital stay were collected and analyzed retrospectively.

**CT acquisition protocol and image analysis**

CT scans were performed on 16-row multidetector CT scanner (SOMATOM, Emotion; Siemens, Erlangen, Germany). Patients were set-up in a head-first supine position in the CT gantry and scans were obtained in a single breath-hold in a caudocranial direction starting from below the level of inferior end of costophrenic angle up to the thoracic inlet. Scanning parameters used were: slice thickness 1–1.5 mm, tube voltage 100–120 kVp, tube current of 90-130 mAs and a beam pitch of 1.5. The Automatic Exposure Control (AEC) system was used to minimize the radiation exposure to the patients. Images were reconstructed using reconstruction increment of 0.7 mm into a slice thickness of 1 mm. The images were viewed in lung window settings (width of 1200–1600 HU and level of –600 HU) and mediastinal window (width of 400 HU and level of 40 HU).

The CT images were independently assessed by two experienced radiologists who were blinded to the clinical data. Any disagreements between the interpreting radiologists were resolved by discussion and consensus. The following CT imaging characteristics were studied: (a) presence or absence of lung opacities (b) distribution of lung opacities: single lung (left, right lung) or bilateral lungs; (c) location of pulmonary opacities: peripheral, central or both; (d) number of lobes affected; (e) type of the lung opacity: ground glass opacity (GGO), consolidation, crazy-paving pattern, reticulation, halo sign, reverse halo sign, nodules (f) additional signs like air bronchogram sign, bronchial wall thickening, bronchial dilatation, air bubble sign and segmental or subsegmental vascular enlargement; (g) extra pulmonary findings like pleural thickening, pleural effusion, pericardial effusion and mediastinal or hilar lymphadenopathy.

Lung opacities were categorized using Fleischner society glossary of terms for thoracic imaging.14 GGO was defined as hazy pulmonary opacity that did not obscure underlying bronchial and vascular structures; consolidation was defined as a pulmonary opacity with non-visualization of bronchial and vascular structures; reticulation was defined as a collection of numerous thin lace-like opacities; halo sign was defined as a ground-glass haze surrounding a nodule or mass; crazy-paving pattern represents thickened interlobular septa and intralobular lines on the background of GGO, resembling pavement stones.

**Statistical analysis**

Data were analyzed using the Statistical Package for the Social Sciences (SPSSInc. Chicago, IL, v. 21.0) and Open source epidemiologic statistics for public health (EPI; Dean AG, Sullivan KM, Soe MM, MIT). Mean value and standard deviation was used to express continuous variables whereas counts and percentages were used to express categorical variables. Fisher’s exact test was used to compare the categorical variables and the two sample Student’s t test was used for comparison of continuous variables. A P-value less than 0.05 were considered statistically significant.
### Table 1. Demographics and clinical characteristics of asymptomatic COVID-19 infected patients

| Parameter                                | Complete lesion resolution | Partial lesion resolution/lesion improvement | Stable (no change) | Lesion worsening/progression | Overall |
|------------------------------------------|----------------------------|---------------------------------------------|--------------------|-------------------------------|---------|
| (n = 61)                                 | (21/61; 34.4%)             | (22/61; 36%)                               | (5/61; 8.2%)       | (13/61; 21.4%)               |         |
| Mean age (years) ± SD                    | 42.6 ± 13.2                | 37.7 ± 18.2                                | 41.6 ± 13.6        | 54 ± 19.7                    | 43.1 ± 17.2 |
| Gender                                   |                            |                                             |                    |                               |         |
| Male                                     | 11                         | 14                                          | 3                  | 10                            | 38 (62.3%) |
| Female                                   | 10                         | 8                                           | 2                  | 3                             | 23 (37.7%) |
| History of exposure                      |                            |                                             |                    |                               |         |
| Present                                  | 21 (100%)                  | 22 (100%)                                  | 5 (100%)           | 13 (100%)                    | 61 (100%) |
| Absent                                   | 0                          | 0                                           | 0                  | 0                             | 0       |
| Co-morbid illness                        |                            |                                             |                    |                               |         |
| None                                     |                            |                                             |                    |                               |         |
| Hypertension                             | 19 (90.4%)                 | 19 (86.4%)                                 | 0                  | 7 (53.8%)                     | 45 (73.7%) |
| Diabetes Mellitus                        | 1 (4.7%)                   | 2 (9%)                                      | 0                  | 2 (15.4%)                     | 6 (9.8%) |
| COPD                                     | 1 (4.7%)                   | 1 (4.5%)                                   | 0                  | 1 (7.7%)                      | 3 (4.9%) |
| CAD                                      | 0                          | 0                                           | 0                  | 2 (15.4%)                     | 2 (3.3%) |
| CAD                                      | 0                          | 0                                           | 0                  | 1 (7.7%)                      | 1 (1.6%) |
| Subsequent symptoms                      | 0                          | 4 (18.2%)                                  | 1 (20%)            | 9 (69.2%)                     | 14 (22.9%) |
| Duration from admission to symptom onset (days) |                |                                             |                    |                               |         |
| Fever                                    | --                         | 4.6 ± 2.98                                 | 4.3 ± 2.62         | 3.1 ± 2.36                    | 4.1 ± 2.2 |
| Sore throat cough                        |                            |                                             |                    |                               |         |
| Fatigue/Malaise                          |                            |                                             |                    |                               |         |
| Shortness of breath                      |                            |                                             |                    |                               |         |
| Headache/Headache                        | 0                          | 3 (13.6%)                                  | 1 (20%)            | 6 (46.1%)                     | 10 (16.4%) |
| Diarrhea                                 | 0                          | 1 (4.54%)                                  | 0                  | 1 (7.7%)                      | 2 (3.3%) |
| Dysguesia                                | 0                          | 2 (9.09%)                                  | 1 (20%)            | 4 (30.7%)                     | 7 (11.4%) |
|                                            | 0                          | 1 (4.54%)                                  | 1 (20%)            | 2 (15.4%)                     | 4 (6.6%) |
|                                            | 0                          |                                             |                    | 2 (15.4%)                     | 2 (3.3%) |
|                                            | 0                          | 2 (9.09%)                                  |                    | 4 (30.7%)                     | 6 (9.8%) |
|                                            | 0                          |                                             |                    | 1 (7.7%)                      | 1 (1.6%) |
|                                            | 0                          |                                             |                    | 1 (7.7%)                      | 1 (1.6%) |
| Duration of hospital stay (days)          | 15.6 ± 6.61                | 16.4 ± 5.62                                | 17.1 ± 3.1         | 27.1 ± 6.3                    | 18.46 ± 6.3 |

(Continued)
the upper lobes. In terms of number of lobes involved, single lobe (34; 55.8%) involvement was more common than ≥2 lobe involvement (Table 3).

GGO was the commonest type of lung opacity, observed in 48/61 (78.7%). GGO with crazy paving pattern was seen in 9 (14.7%) and GGO admixed with patchy consolidation in 2 (3.3%). Pure consolidation was seen in 1 (1.64%). Additional signs observed on CT included intralobular or perilesional segmental or subsegmental pulmonary vessel enlargement in 11 (18%) and subpleural lines in 5 (8.1%). None of the patients showed pleural effusion, pericardial effusion or mediastinal lymphadenopathy (Table 4).

Comparison between the admission CT and follow-up CT during the course of hospitalization revealed evolution of CT findings in 13 (21.4%) patients. The evolution of lesions included increase in the size of opacity, involvement of other lung lobes and increase in the density of lung opacities in the form of progression of GGO into crazy paving pattern or formation of consolidation. The patients in progression group (54 ± 19.7 years) were older and had higher frequency of co-morbidities (46.2%) compared to the other three groups (10.4%). The patients in progression group had a significantly higher C-reactive protein ($p = 0.029$), higher lactate dehydrogenase ($p = 0.002$) and lower lymphocyte count ($p = 0.008$) at the time of admission than the other groups. The average hospital stay of 27.1 ± 11.4 days in the progression group was significantly longer than others ($p = 0.016$) (Table 1). All the patients recovered and were discharged at the time of writing of this manuscript.

**DISCUSSION**

SARS-CoV-2, a single-stranded RNA virus belonging to the family of betacorona viruses is the culprit virus responsible for the ongoing pandemic of COVID-19. SARS-CoV-2 is believed to have originated from bats which act as the natural reservoir.
The disease spreads through human-to-human contact via respiratory route. The clinical manifestations of the disease vary from no symptoms to mild symptoms to severe illness and death. There are limited data available on the combined clinical and imaging follow-up of asymptomatic cases. In the present study, 61 (44.5%) asymptomatic cases had abnormal lung findings on chest CT. It has been observed that asymptomatic cases can have a positive CT. Inui et al. reported 56% of asymptomatic COVID-19 cases with abnormal lung findings in Diamond Princess Cruise Ship. Bandirali et al. reported pulmonary parenchymal abnormalities in 59% (100/170) of asymptomatic or minimally symptomatic patients. Multiple other cases of asymptomatic COVID-19 patients with pulmonary findings consistent with COVID-19 have been reported. The converse has also been reported where symptomatic cases can have a negative CT.

The distribution and type of pulmonary opacities in asymptomatic cases may resemble the CT findings in symptomatic cases. However, asymptomatic and mildly symptomatic cases have a lower percentage of lung involvement with low CT severity score. It has been widely reported that the percentage of the total lung involvement signifying the disease burden determines the severity of the disease and the final clinical outcome. Inui et al. in the famous Diamond Princess Cruise Ship made a comparison of total CT score (determined visually as the percentage of total lung involvement) and found a significantly lower CT score in asymptomatic cases compared to the symptomatic cases (p-value < 0.05). They also reported that consolidations were more common in symptomatic cases (41%) compared to asymptomatic cases (17%), whereas GGOs predominated in asymptomatic cases (83% vs 59%). We observed GGOs in 93.4% asymptomatic cases whereas consolidation was observed in only 4.94%.

Parry et al. reported that the percentage of lung opacification is a surrogate of clinical outcome in COVID-19 pneumonia with a higher percentage of lung involvement suggesting an adverse outcome. Similarly, Tabatabaei et al. also reported that the percentage of total lung involvement determines the severity of the disease.

Imaging follow-up of the clinically asymptomatic cases with abnormal lung findings at admission revealed almost all possible changes in lung opacities which included, complete resorption (34.4%), partial resorption or improvement (36%), stable lesion (no change) (8.2%) and worsening or progression (21.4%).

The patients in progression group were older and had a significantly higher C-reactive protein, higher lactate dehydrogenase and lower lymphocyte count at the time of admission than the other groups. Older age, co-morbidities, lower lymphocyte count, higher CRP and LDH seem to represent the potential

### Table 3. Distribution of lung findings on chest CT in asymptomatic patients

| Lung parenchymal abnormalities on CT | Number of patients (n = 137) | % |
|--------------------------------------|-------------------------------|---|
| Present                              | 61                            | 44.5 |
| Absent                               | 76                            | 55.5 |
| Laterality of lung involvement       |                               |     |
| Bilateral                            | 37                            | 60.7 |
| Right lung                           | 13                            | 21.3 |
| Left lung                            | 11                            | 18   |
| Lobar involvement                    |                               |     |
| Right upper lobe                     | 39                            | 63.9 |
| Right middle lobe                    | 23                            | 37.7 |
| Right lower lobe                     | 49                            | 80.3 |
| Left upper lobe                      | 35                            | 57.3 |
| Left lower lobe                      | 54                            | 88.5 |
| Number of lobes involved             |                               |     |
| Five lobes                           | 1                             | 1.6  |
| Four lobes                           | 3                             | 4.9  |
| Three lobes                          | 9                             | 14.8 |
| Two lobes                            | 14                            | 22.9 |
| One lobe                             | 34                            | 55.8 |
| Anteroposterior location             |                               |     |
| Anterior                             | 2                             | 3.3  |
| Posterior                            | 52                            | 85.2 |
| Anterior and posterior               | 7                             | 11.5 |

### Table 4. Type of lung opacities on chest CT

| Lung opacity                        | Number of patients (n = 61) | % |
|-------------------------------------|-------------------------------|---|
| GGO                                 | 48                            | 78.7 |
| GGO with crazy paving pattern       | 9                             | 14.7 |
| Pure consolidation                  | 1                             | 1.64 |
| Mixed pattern (GGO with consolidation) | 2                             | 3.3  |
| Sub pleural linear/curvilinear lines | 5                             | 8.1  |
| Nodules                             | 1                             | 1.64 |
| Reticulations                       | 1                             | 1.64 |
| Halo sign                           | 1                             | 1.64 |
| Segmental vessel enlargement        | 11                            | 18   |
| Bronchial wall thickening           | 3                             | 4.9  |
| Bronchial dilatation                | 1                             | 1.64 |
| Air bronchogram sign                | 3                             | 4.9  |
| Air bubble sign                     | 2                             | 3.3  |

GGO, ground glass opacity.
risk factors leading to clinicoradiological progression. Yu et al. in their study reported that age, presence of co-morbidities, low lymphocyte count, presence of consolidations, crazy-paving pattern, larger size of pulmonary opacities and pleural effusion were associated with severe illness. Older age has been found to an important risk factor for severe disease and adverse outcome. Yang et al. in their study reported that asymptomatic patients were younger (median age of 37 years) compared to symptomatic patients (56 years) \((p < .001)\) and had a higher CD4 + T lymphocyte count and showed a faster lung recovery on CT scans \((9 \text{ vs } 15 \text{ days}) \ (p = .003)\).

Our results corroborate the clinical and imaging findings in asymptomatic cases reported by these studies. However, in view of small number of patients in the progression group in our study further clinical studies with larger sample sizes may be undertaken to validate the results of our study.

Intralesional or perilesional segmental or subsegmental vascular enlargement was observed in 18% of cases. This is a unique finding which has not been reported earlier in any infectious pneumonia. This intriguing vascular finding can have a diagnostic value. The presence of intralesional vascular enlargement can differentiate COVID-19 pneumonia from other causes of infectious pneumonia. Though, the exact pathophysiological mechanism underpinning this intralesional vascular enlargement is unclear at present but it has been suggested that three possible mechanisms could account for this finding. Cascading effect of inflammatory cytokines may result in intralesional vascular enlargement. Alternately, microvascular thrombosis (immunothrombosis) has also been suggested as the underlying cause.

Though CT has helped us in the understanding of the disease but the guidelines issued by various radiological societies do not recommended CT as a screening or diagnostic tool in lieu of nucleic acid testing for COVID-19 pneumonia. European Society of Radiology and the European Society of Thoracic Imaging do not recommend performance of CT in asymptomatic or mildly symptomatic COVID-19 patients. According to the joint statement of European Society of Radiology and European Society of Thoracic Imaging, CT should be reserved for the evaluation of patients with severe respiratory symptoms such as dyspnoea and desaturation. However, in selected circumstances CT may also be helpful in patients with milder symptoms who have co-morbidities, such as diabetes, obesity, chronic respiratory disease, etc. Repeat CTs are not indicated in patients that are recovering. However, a repeat examination may be indicated in cases with suspected complications (e.g. superinfection, pulmonary embolism).

According to American College of Radiology guidelines, CT should be reserved for hospitalized, symptomatic patients with specific clinical indications like deteriorating respiratory status.

There are a few limitations to this study. First, there may have been a selection bias as imaging was performed in non-consecutive asymptomatic cases. Second, the small size of study population especially lesser number of patients in the progression group is also a limitation.

**CONCLUSION**

In conclusion, asymptomatic cases with COVID-19 pneumonia have abnormal lung findings on CT. The clinicoradiological course of these asymptomatic cases is variable. Clinically, some recover without developing symptoms, some present few mild symptoms and others deteriorate. Similarly, imaging follow-up may reveal resolution (partial or complete), progression or no change. Older age, lower lymphocyte count, higher CRP and LDH and presence of co-morbidities are more commonly associated with clinicoradiological progression of the disease.

**REFERENCES**

1. World Health Organization Coronavirus disease 2019 (COVID-19): situation report. 136.
2. Chen Y, Li L. SARS-CoV-2: virus dynamics and host response. *Lancet Infect Dis* 2020; 20: 515–6. doi: https://doi.org/10.1016/S1473-3099(20)30235-8
3. Guan W-J, Ni Z-Y, Hu Y, Liang W-H, Ou C-Q, He J-X, ZY N, CQ O, JX H, et al. Clinical characteristics of coronavirus disease 2019 in China. *N Engl J Med* 2020; 382: 1708–20. doi: https://doi.org/10.1056/NEJMoa2002392
4. Jin X, Lian J-S, Hu J-H, Gao J, Zheng L, Zhang Y-M, et al. Epidemiological, clinical and virological characteristics of 74 cases of coronavirus-infected disease 2019 (COVID-19) with gastrointestinal symptoms. Gut 2020; 69: 1002–9. doi: https://doi.org/10.1136/gutjnl-2020-320926
5. Parry AH, Wani AH, Yaseen M. Acute mesenteric ischemia in severe coronavirus-19 (COVID-19): possible mechanisms and diagnostic pathway. *Acad Radiol* 2020;23 May 2020. doi: https://doi.org/10.1106/acr:a.2020.05.016
6. Parry AH, Wani AH, Yaseen M. Neurological dysfunction in coronavirus Disease-19 (COVID-19). *Acad Radiol* 2020. doi: https://doi.org/10.1106/acr.a.2020.05.024
7. Inui S, Fujikawa A, Jitsu M, Kunishima N, Watanabe S, Suzuki Y, et al. Chest CT findings in cases from the cruise ship “Diamond Princess” with coronavirus disease 2019 (COVID-19). *Radiology: Cardiothoracic Imaging* 2020; 2: e200110.
8. Black JRM, Bailey C, Przeworcka J, Dijkstra KK, Swanton C. COVID-19: the case for health-care worker screening to prevent Hospital transmission. *Lancet* 2020; 395: 1418–20. doi: https://doi.org/10.1016/S0140-6736(20)30917-X
9. Arons MM, hatfield KM, Reddy SC, kimball A, James A, Jacobs JR, et al. Presymptomatic SARS-CoV-2 infections and transmission in a skilled nursing facility. *N Engl J Med* 2020; 382: 2081–90. doi: https://doi.org/10.1056/NEJMo2008457
10. Bai Y, Yao L, Wei T, Tian F, Jin D-Y, Chen L, et al. Presumed asymptomatic carrier transmission of COVID-19. *JAMA* 2020;
323: 1406–7. doi: https://doi.org/10.1001/jama.2020.2565

11. Meng H, Xiong R, He R, Lin W, Hao B, Zhang L, et al. Ct imaging and clinical course of asymptomatic cases with COVID-19 pneumonia at admission in Wuhan, China. J Infect 2020; 81: e33–9. doi: https://doi.org/10.1016/j.jinf.2020.04.004

12. Qiu J. Covert coronavirus infections could be seeding new outbreaks. Nature 2020;20 Mar 2020. doi: https://doi.org/10.1038/d41586-020-00822-x

13. Gandhi M, Yokoe DS, Havlir DV. Asymptomatic transmission, the Achilles’ heel of current strategies to control COVID-19.

14. Hansell DM, Bankier AA, MacMahon H, McLoud TC, Müller NL, Remy J. Fleischner Society: glossary of terms for thoracic imaging. Radiology 2008; 246: 697–722. doi: https://doi.org/10.1148/radiol.2462070712

15. Kong WH, Li Y, Peng MW, Kong DG, Yang XB, Wang L, et al. SARS-CoV-2 detection in patients with influenza-like illness. Nature Microbiology 2020; 7: 1–4.

16. Bandirali M, Sconfienza LM, Serra R, Brembilla R, Albano D, Pregliasco FE, et al. Chest radiograph findings in asymptomatic and minimally symptomatic quarantined patients in Codogno, Italy during COVID-19 pandemic. Radiology 2020; 295: E7. doi: https://doi.org/10.1148/radiol.202021102

17. Barajas RF, Rufener G, Starkey J, Duncan T, Fuss C. Asymptomatic COVID-19: what the Neuroradiologist needs to know about pulmonary manifestations. AJNR Am J Neuroradiol 2020; 41: 966–8. doi: https://doi.org/10.3174/ajnr.A6561

18. Parry AH, Wani AH, Yaseen M, Dar KA, Choh NA, Khan NA, et al. Spectrum of chest computed tomographic (CT) findings in coronavirus disease-19 (COVID-19) patients in India. Eur J Radiol 2020; 129: 101947-Jun 24. doi: https://doi.org/10.1016/j.ejrad.2020.101947

19. Salehi S, Abedi A, Balakrishnan S, Gholamrezaeehadi A, disease C. COVID-19): a systematic review of imaging findings in 919 patients. American Journal of Roentgenology 2019; 14: 1–72020 Mar.

20. Ai T, Yang Z, Hou H, Zhan C, Chen C, Lv W, et al. Correlation of chest CT and RT-PCR testing in coronavirus disease 2019 (COVID-19) in China: a report of 1014 cases. Radiology 2020; 200642. doi: https://doi.org/10.1148/radiol.2020200642

21. Parry AH, Wani AH, Shah NN, Yaseen M, Jehangir M. Chest CT features of coronavirus disease-19 (COVID-19) pneumonia: which findings on initial CT can predict an adverse short-term outcome? BJR|Open 2020; 2:20200016:20200016: . doi: https://doi.org/10.1259/bjro.20200016

22. Tabatabai SM, Talari H, Moghaddas F, Rajebi H. Computed tomographic features and short-term prognosis of coronavirus disease 2019 (COVID-19) pneumonia: a single-center study from Kashan, Iran. Radiology: Cardiothoracic Imaging 2020; 2: e200130.

23. Yu M, Xu D, Lan L, Tu M, Liao R, Cai S, et al. Thin-section chest CT imaging of coronavirus disease 2019 pneumonia: comparison between patients with mild and severe disease. Radiology: Cardiothoracic Imaging 2020; 2: e200126.

24. Yang R, Gui X, Xiong Y. Comparison of clinical characteristics of patients with asymptomatic vs symptomatic coronavirus disease 2019 in Wuhan, China. JAMA Netw Open 2020; 3: e2010182-e2010182. doi: https://doi.org/10.1001/jamanetworkopen.2020.10182

25. Parry AH, Wani AH. Segmental pulmonary vascular changes in COVID-19 pneumonia. American Journal of Roentgenology 2020; 8: W1. doi: https://doi.org/10.2214/AJR.20.23443

26. Parry AH, Wani AH, Yaseen M, Dar MI. Demystifying pulmonary vascular complications in severe coronavirus disease-19 pneumonia (COVID-19) in the light of clinico-radiologic-pathologic correlation. Thromb Res 2020;27 Jun 2020. doi:https://doi.org/10.1016/j.thromres.2020.06.043

27. Revel M-P, Parkar AP, Prosch H, Silva M, Sverzellati N, Gleeson F, et al. COVID-19 patients and the radiology department – advice from the European Society of radiology (ESR) and the European Society of thoracic imaging (ESTI. Eur Radiol 2020; 3Apr 20:1. doi: https://doi.org/10.1007/s00330-020-06865-y

28. https. Available from: //www.acr. org/Advocacy-and-Economics/ACR-Position-Statements/Recommendations-for-Chest-Radiography-and-CT-for-Suspected-COVID19-Infection [Accessed 13/07/2020].