

Imaging Features with Clinical Correlation of Covid 19, A Literature Review.

Abdulrahman Hakami

College of Medicine, Jazan University, Jazan, Saudi Arabia.

Article Info

Received: July 04, 2021

Accepted: July 10, 2021

Published: July 12, 2021

***Corresponding author:** Abdulrahman Hakami, College of Medicine, Jazan University, Jazan, Saudi Arabia.

Citation: Abdulrahman Hakami "Imaging features with clinical correlation of COVID 19, A literature Review.". *Clinical Case Reports and Clinical Study*, 5(2); DOI: 10.61148/2766-8614/JCCRCS/087.

Copyright: © 2021 Abdulrahman Hakami. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Abstract

To date COVID-19 pandemic remains treatment challenge worldwide. Chest CT is an important tool in evaluation of COVID-19 and according to the literature, it has a high diagnostic sensitivity in diagnosis of COVID 19. The Typical imaging findings seen in PCR positive patients, Ground glass opacity and Consolidation. Mostly appeared in multiple lobes, particularly the basal part of lung. The atypical imaging findings such as pneumothorax, fibrosis, mediastinal lymphadenopathy, cavitation lesion and nodules, also seen in few cases.

Here we review comprehensively the correlated imaging finding, CT Chest and Chest X-ray with clinical picture in COVID 19 patients.

Key Words: coronavirus disease; covid 19; ct chest; imaging; covid 19 pneumonia

Abbreviation:

COVID 19 = coronavirus disease 2019, CT = computerized tomography, GGO = ground glass opacity.

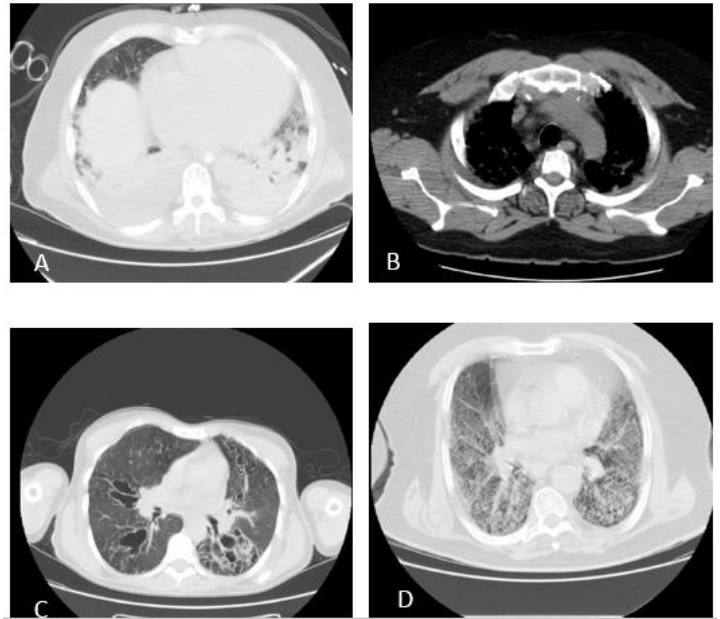
Introduction

Coronavirus 2019 caused by a novel coronavirus which cause severe acute respiratory syndrome, COVID-19. It was first declared to the WHO on December 31, 2019 in Wuhan City, Hubei Territory, China (1,2,3,4,5). On March 11, 2020, the WHO announced COVID-19 a worldwide pandemic (6). Clinical manifestation of COVID-19 ranged from asymptomatic or mild to severe infection. The symptoms of COVID-19 usually occur between 2 days to 2 weeks following exposure to the virus either directly or indirectly (7).

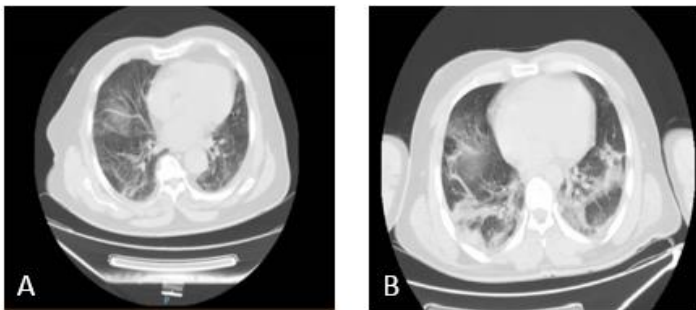
The median incubation period was 5.1 days, whereas 97.5% of patients developed the symptoms within 11.5 days of infection, this is according to a Chinese study, which included 181 patients with confirmed COVID-19 infection (8). Furthermore, Wu and colleagues studied a large number (n=72,314) of COVID-19 cases in China and found that 81 % have had mild pneumonia, 14% had severe pneumonia complicated with dyspnea and hypoxemia, while, 5% had critical illness characterized by shock, respiratory failure or multi-organ failure, overall mortality rate was 2.3% (9,10). According to the literature, the common symptoms of COVID-19 are fever (98%), tiredness (44%), dry cough (76%), dyspnea (21.9%), nasal congestion, sore throat or smell and taste loss (28%), nausea, vomiting and diarrhea (3.9%) generalized aches (8%) (11,12,13,14,15). Some COVID-19 patients reported gastrointestinal symptoms in a form of vomiting, diarrhea and abdominal pain and gastrointestinal symptoms might be the first presentation of the disease (16). Although few cases reported of acute hepatitis and liver injury consisting of elevation in serum bilirubin and liver enzymes mainly ALT, AST and GGT (17,18,19). However, the majority of COVID-19 induced hepatitis are mild. Few patients developed acute liver failure especially those with critical disease (17,19). The most serious manifestation of COVID-19 infection is pneumonia which is characterized by fever, cough, dyspnea and bilateral chest infiltrate on chest imaging (20,21). Old-aged patients with comorbidities are more prone to develop severe COVID-19 disease (9). Few patients developed severe COVID pneumonia while had no comorbidities (22). COVID-19 patients with severe disease usually require hospital admission and ICU care and has high fatality rate (23,24,25). The radiological abnormalities in COVID-19 can be detected using either chest x-ray or chest CT scan. The most common radiological abnormalities in COVID-19 are



ground glass appearance and consolidation (figure 1 A, E Consolidation is usually bilateral involving the lower lung zone and towards the periphery (figure 2 A, B, C, D) (26). The le common findings include pleural effusion, pneumothorax, lu cavitation, fibrosis, pleural thickening and hilar lymphadenopat (figure 3 A, B, C, D) (27). In mild COVID-19 disease and befo development of symptoms, the chest radiography might be qui normal (28). However, with progression of the disease th radiological findings will likely develop (figure 4 A, B) (29,30 On the other hand, radiological findings were detected asymptomatic or pre-symptomatic adults with confirmed COV -19 (31,32). RT-PCR test currently considered the gold standa for the diagnosis of COVID-19 (33,34). However, RT-PCR ma yield a false-negative result in some cases, possibly because inadequate viral material in the sample or technical issues durin nucleic acid extraction (35). For these reasons, the recent clinic guidelines strongly recommend chest CT scan for patients wi suspected COVID-19 (35,36,37).



(A) Male patient, 40 years old, COVID 19, developed bilateral pleural effusion.
 (B) Female patient, 60 years old, COVID 19 patient with mediastinal lymphadenopathy.
 (C) Male patient, 57 years old, COVID 19 case with cystic changes and lung cavitations.
 (D) Male patient, 66 years old, Severe COVID 19 with reticulations and fibrotic changes.



CT chest (A) shows ground-glass exudation in both lungs, also bilateral consolidation in lower lobes as in (B).

Objective:

The aim of this study is to present covid-19 cases who presented with typical radiological features and to provide an overview of existing literature on clinical and radiological manifestations of this disease.

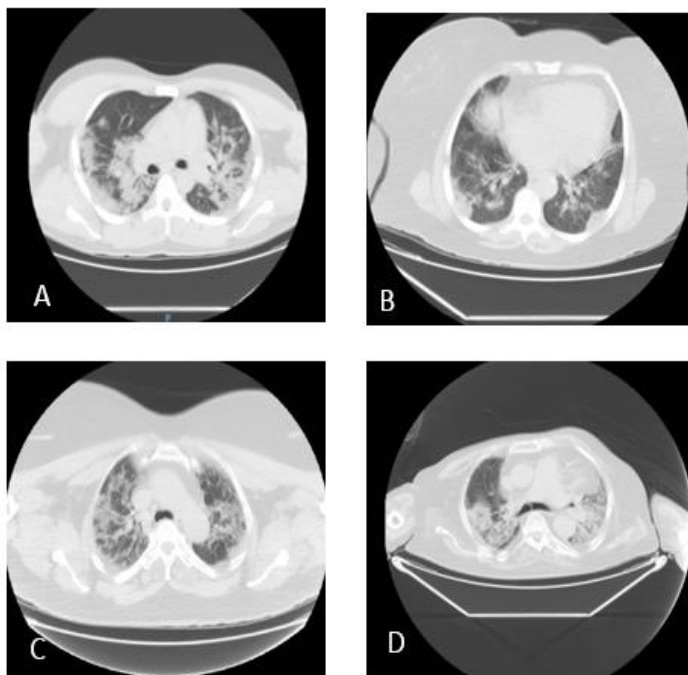
Methodology:

A literature review comprehensively was carried out in online database search (PubMed, Google Scholar, Scopus and Web of Science) searching for articles submitted during COVID 19 pandemic, using the terms “Novel coronavirus2019”, “COVID-19”, “SARS COVID-2” “Imaging, CT chest”. An extensive manual search was performed for the referenced articles that concern with radiological role in diagnosis of COVID 19 and the clinical pictures of COVID 19.

The inclusion criteria were cross sectional studies, observational studies and retrospective or prospective studies. Case reports, case-series, letters to editor and the preprint manuscripts that not peer reviewed were excluded, as well articles in non-English languages or those not related to COVID-19 not involved in this review.

Result:

Based on recent literature chest CT can play an important role in the early diagnosis and disease stratification of COVID-19 and this CT imaging not only helps in the diagnosis of the disease but



Bilateral multilobar subsegmental and peripherally subpleural ground glass opacities with consolidations in (A,B,C,D).



also for other coexisted complications

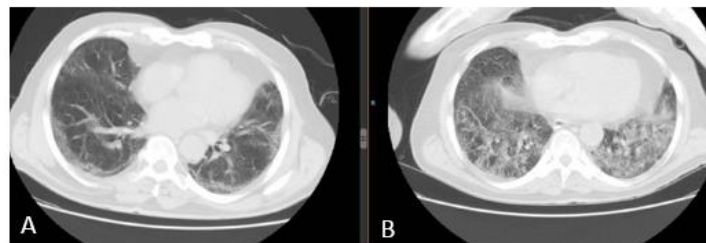
Discussion:

The novel Coronavirus (SARS-COV-2), recently named as COVID 19, caused by β -coronavirus, a novel strain of coronavirus (2019-nCoV), similar to the previous two coronavirus outbreaks SARS-COV-1 and MERS-COV (2,4). This novel Coronavirus likely has a zoonotic origin, was first identified in Wuhan, in December 2019 and widespread human-to-human transmission has notified (2). Within a few months, the virus has spread from China and affecting 188 countries and territories around the world (38). On March 11, 2020, the World Health Organization (WHO) declared this global outbreak as a pandemic. Because the Coronavirus is highly contagious, the epidemic had spread worldwide and the number still increasing. Coronavirus Disease is an acute infectious disease that causes inflammation in the respiratory system and recently noted other systems can affected (12). The spectrum of this disease ranges from mild to severe, even life-threatening consequences (39,40). In a large cohort of patients with COVID-19, 81% had mild disease, 14% had severe disease, and 5% became critically ill with organ failure (39). The diagnosis of COVID-19 requires comprehensive consideration of exposure history, clinical manifestations, laboratory tests, and imaging examinations (40,41). The clinical diagnosis of COVID-19 is confirmed by the real-time reverse-transcription-polymerase-chain-reaction (RT-PCR) assay through combined oropharyngeal and nasopharyngeal swab samples. RT-PCR assay considered as the standard of diagnosis (11,12,39). Chest CT imaging is a conventional, non-invasive imaging with limited accuracy but recently in the observational studies reported with high sensitivity and specificity for diagnosis of COVID-19 (41,42,43).

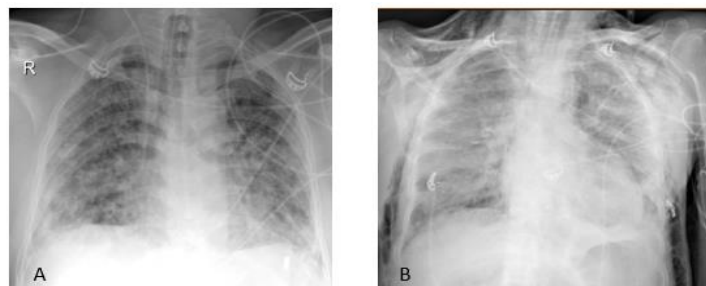
Regarding the clinical findings, disease progression and treatment response can be monitored with serial CT examinations. According to the recent literature about COVID19, chest x-ray has low sensitivity, it can be widely used for monitoring the progression and later stages of COVID-19, especially in critical patients (figure 5 A, B) (43). Pulmonary ultrasonography instead of its lower cost, absence of radiation exposure, and the fact that it does not require sedation or transportation of unstable patients, but not used widely in COVID 19 outbreak due to limitation in sensitivity. The characteristic CT features, pattern of multifocal peripheral GGO, mixed GGO with predominance in the lower lung, with more extensive mixed opacity than GGO and bilateral multiple lobular and subsegmental areas of consolidation. Crazy-Paving pattern and reverse halo sign, cavities, enlarged mediastinal lymph nodes, or pleural effusions can present in advanced stage (45,46,47). In a retrospective analysis reported GGO were the most common CT manifestation and consolidation with fibrotic changes mostly found in severe and critical types of patients (48). The peak for lung abnormalities that are detected in patients with COVID-19 around 6-11 days after the onset of the symptoms (48,49). The improvement of CT findings appears around 14 days, the absorption stage may extend beyond 26 days (49). In another retrospective study fort 121 patients, reported the time between initial onset of symptoms and subsequent chest CT was known for 94 patients and assigned as early (0-2 days), intermediate (3-5 days), or late (6-12 days) (49). Those typical imaging features were also observed in patients with negative RT-

PCR results but have clinical symptoms (50).

Therefore, in patients with negative RT-PCR tests or delay result, a combination of history, clinical symptoms, typical CT imaging features, and dynamic changes should be used to identify COVID-19 with higher sensitivity (36,37,51,52,53).



(A) A 38-year-old male COVID-19 patient presenting fever and dyspnea for 4 day. CT scan shows a pure ground glass opacity in both lower lobes, after 5 days developed severe dyspnea and CT chest revealed progressive ground glass opacity (B).



Chest X-ray for two COVID 19 patients in progressive stage in critical care, revealing bilateral infiltration in both lower lobes (A)(B).

Chest X-ray for two COVID 19 patients in progressive stage in critical care, revealing bilateral infiltration in both lower lobes (A)(B).

Conclusion:

The imaging characteristics of COVID 19 has high sensitivity especially if correlated with clinical findings. CT chest is the best modality for imaging. The hallmarks imaging features are bilateral and peripheral ground glass with consolidative pulmonary opacities.

Source of funding: This research did not receive any specific grant from funding agencies in the public, commercial, or not for-profit sectors.

Conflict of interest: The authors declare that they have no conflict of interest.

Ethical approval: not included in this article review.

References

1. CDC. 2019 Novel Coronavirus, Wuhan, China. CDC. Available at <https://www.cdc.gov/coronavirus/2019->



- ncov/about/index.html. January 26, 2020; Accessed: January 27, 2020.
- World Health Organization website. Pneumonia of unknown cause: China. www.who.int/csr/don/05-january-2020-pneumonia-of-unknown-cause-china/en/. Accessed February 13, 2020
 - Gallegos A. WHO Declares Public Health Emergency for Novel Coronavirus. Medscape Medical News. Available at <https://www.medscape.com/viewarticle/924596>. January 30, 2020; Accessed: January 31, 2020.
 - WHO Director-General's opening remarks at the media briefing on COVID-19-11 March 2020 n.d. <https://www.who.int/dg/speeches/detail/who-director-general-s-openingremarks-at-the-media-briefing-on-covid-19-11-march-2020>. (accessed March 22, 2020)
 - Ramzy A, McNeil DG. W.H.O. Declares Global Emergency as Wuhan Coronavirus Spreads. The New York Times. Available at <https://nyti.ms/2RER70M>. January 30, 2020; Accessed: January 30, 2020.
 - The New York Times. Coronavirus Live Updates: W.H.O. Declares Pandemic as Number of Infected Countries Grows. The New York Times. Available at <https://www.nytimes.com/2020/03/11/world/coronavirus-news.html#link-682e5b06>. March 11, 2020; Accessed: March 11, 2020.
 - CDC. 2019 Novel Coronavirus, Wuhan, China: Symptoms. CDC. Available at <https://www.cdc.gov/coronavirus/2019-ncov/about/symptoms.html>. January 26, 2020; Accessed: January 27, 2020.
 - Lauer SA, Grantz KH, Bi Q, Jones FK, Zheng Q, Meredith HR. The Incubation Period of Coronavirus Disease 2019 (COVID-19) From Publicly Reported Confirmed Cases: Estimation and Application. *Ann Intern Med*. 2020 Mar 10. [Medline].
 - Wu Z, McGoogan JM. Characteristics of and Important Lessons From the Coronavirus Disease 2019 (COVID-19) Outbreak in China: Summary of a Report of 72 314 Cases From the Chinese Center for Disease Control and Prevention. *JAMA*. 2020. Feb 24. [Medline].
 - Holshue ML, DeBolt C, Lindquist S. First Case of 2019 Novel Coronavirus in the United States. *N Engl J Med*. 2020; 382: 929-36.
 - Huang C, Wang Y, Li X, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. *Lancet* 2020 Feb 15; 395 (10223). DOI: 10.1016/S0140-6736(20)30183-5.
 - Wang D, Hu B, Hu C. Clinical Characteristics of 138 Hospitalized Patients With 2019 Novel Coronavirus-Infected Pneumonia in Wuhan, China. *JAMA* 2020 Feb 07. DOI: 10.1001/jama.2020.1585.
 - CDC. Symptoms of Coronavirus. CDC. Available at <https://www.cdc.gov/coronavirus/2019-ncov/symptoms-testing/symptoms.html>. March 20, 2020; Accessed: April 28, 2020.
 - Rabin RC. Lost Sense of Smell May Be Peculiar Clue to Coronavirus Infection. The New York Times. Available at <https://www.nytimes.com/2020/03/22/health/coronavirus-symptoms-smell-taste.html>. March 22, 2020; Accessed: March 24, 2020.
 - Spinato G, Fabbris C, Polesel J, Cazzador D, Borsetto D, Hopkins C, et al. Alterations in Smell or Taste in Mildly Symptomatic Outpatients With SARS-CoV-2 Infection. *JAMA*. 2020 Apr 22.
 - Holshue ML, DeBolt C, Lindquist S. First Case of 2019 Novel Coronavirus in the United States. *N Engl J Med*. 2020; 382: 929-36.
 - Guan WJ, Ni ZY, Hu Y. Clinical Characteristics of Coronavirus Disease 2019 in China. *N Engl J Med*. 2020.
 - Chen N, Zhou M, Dong X. Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: a descriptive study. *Lancet*. 2020; 395: 507-13.
 - Huang C, Wang Y, Li X, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. *Lancet*. 2020; 395: 497-506.
 - Guan WJ, Ni ZY, Hu Y, et al. Clinical Characteristics of Coronavirus Disease 2019 in China. *N Engl J Med* 2020; 382:1708.
 - Huang C, Wang Y, Li X, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. *Lancet* 2020; 395:497.
 - Onder G, Rezza G, Brusaferro S. Case-Fatality Rate and Characteristics of Patients Dying in Relation to COVID-19 in Italy. *JAMA* 2020.
 - Richardson S, Hirsch JS, Narasimhan M, et al. Presenting Characteristics, Comorbidities, and Outcomes Among 5700 Patients Hospitalized With COVID-19 in the New York City Area. *JAMA* 2020.
 - Docherty AB, Harrison EM, Green CA, et al. Features of 20 133 UK patients in hospital with covid-19 using the ISARIC WHO Clinical Characterisation Protocol: prospective observational cohort study. *BMJ* 2020; 369:m1985.
 - Petrilli CM, Jones SA, Yang J. Factors associated with hospital admission and critical illness among 5279 people with coronavirus disease 2019 in New York City: prospective cohort study. *BMJ* 2020; 369:m1966.
 - ACR Recommendations for the use of Chest Radiography and Computed Tomography (CT) for Suspected COVID-19 Infection <https://www.acr.org/Advocacy-and-Economics/ACR-Position-Statements/Recommendations-for-Chest-Radiography-and-CT-for-Suspected-COVID19-Infection> (Accessed on April 01, 2020).
 - Ai T, Yang Z, Hou H. Correlation of Chest CT and RT-PCR Testing in Coronavirus Disease 2019 (COVID-19) in China: A Report of 1014 Cases. *Radiology* 2020; :200642.
 - Wong HYF, Lam HYS, Fong AH. Frequency and Distribution of Chest Radiographic Findings in COVID-19 Positive Patients. *Radiology* 2019; :201160.
 - Pan F, Ye T, Sun P. Time Course of Lung Changes at Chest CT during Recovery from Coronavirus Disease 2019 (COVID-19). *Radiology* 2020; 295:715.
 - Bernheim A, Mei X, Huang M. Chest CT Findings in Coronavirus Disease-19 (COVID-19): Relationship to Duration of Infection. *Radiology* 2020; 295:200463.
 - Shi H, Han X, Jiang N. Radiological findings from 81 patients with COVID-19 pneumonia in Wuhan, China: a descriptive study. *Lancet Infect Dis* 2020; 20:425.
 - Xie X, Zhong Z, Zhao W. Chest CT for Typical 2019-nCoV Pneumonia: Relationship to Negative RT-PCR Testing. *Radiology* 2020; :200343.



33. Huang C, Wang Y, Li X, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. *Lancet* 2020 Feb 15;395(10223). DOI: 10.1016/S0140-6736(20)30183-5.
34. Wang D, Hu B, Hu C, et al. Clinical Characteristics of 138 Hospitalized Patients With 2019 Novel Coronavirus-Infected Pneumonia in Wuhan, China. *JAMA* 2020 Feb 07. DOI: 10.1001/jama.2020.1585.
35. Sana Salehi, Aidin Abedi, Sudheer Balakrishnan, and Ali Gholamrezanezhad. Coronavirus Disease 2019 (COVID-19): A Systematic Review of Imaging Findings in 919 Patients *American Journal of Roentgenology* 2020, July. 215:1, 87-93.
36. Wu J, Wu X, Zeng W. Chest CT Findings in Patients With Coronavirus Disease 2019 and Its Relationship With Clinical Features. *Invest Radiol.* 2020;55 (5):257-261. doi:10.1097/RLI.0000000000000670.
37. Bai HX, Hsieh B, Xiong Z. Performance of radiologists in differentiating COVID-19 from viral pneumonia on chest CT [published online ahead of print, 2020 Mar 10]. *Radiology*. 2020; 200823. doi:10.1148/radiol.2020200823.
38. Johns Hopkins Whiting School of Engineering website. Coronavirus COVID-19 globalcases. <https://gisanddata.maps.arcgis.com/apps/opsdashboard/index.html#/bda7594740fd40299423467b48e9ecf6>.
39. Wu Z, McGoogan JM. Characteristics of and important lessons from the coronavirus disease 2019 (COVID-19) outbreak in China: summary of a report of 72 314 cases from the Chinese Center for Disease Control and Prevention. *JAMA* 2020 February 24 (Epub ahead of print)
40. Li K, Wu J, Wu F, Guo D, Chen L, Fang Z. The Clinical and Chest CT Features Associated with Severe and Critical COVID-19 Pneumonia. *Invest Radiol* 2020; DOI: 10.1097/RLI.0000000000000672.
41. Salehi S, Abedi A, Balakrishnan S, Gholamrezanezhad A. Coronavirus Disease 2019 (COVID-19): A Systematic Review of Imaging Findings in 919 Patients [published online ahead of print, 2020 Mar 14]. *AJR Am J Roentgenol* 2020; 1-7.
42. Pan Y, Guan H, Zhou S.. Initial CT findings and temporal changes in patients with the novel coronavirus pneumonia (2019-nCoV): a study of 63 patients in Wuhan, China. *Eur Radiol* 2020 Feb 13
43. Ng MY, Lee EY, Yang J. Imaging profile of the COVID-19 infection: radiologic findings and literature review. *Radiol Cardiothorac Imaging* 2020; 2:e200034
44. Ying Zhu , Yang-Li Liu , Zi-Ping Li , Jian-Yi Kuang , Xiang-Min Li , You-You Yang , Shi-Ting Feng , Clinical and CT imaging features of 2019 novel coronavirus disease (COVID-19), *Journal of Infection* (2020), doi: <https://doi.org/10.1016/j.jinf.2020.02.022>
45. Guan C.S., Lv Z.B., Yan S., Du Y.N., Chen H., Wei L.G., Xie R.M., Chen B.D. Imaging Features of Coronavirus disease 2019 (COVID-19): Evaluation on Thin-Section CT. (2020) *Academic Radiology*, 27 (5) , pp. 609-613.
46. K. Wang, S. Kang, R. Tian, X. Zhang, X. Zhang, Y. Wang, Imaging manifestations and diagnostic value of chest CT of coronavirus disease 2019 (COVID-19) in the Xiaogan area, *Clinical Radiology*, Volume 75, Issue 5, 2020
47. Zhao W, Zhong Z, Xie X, Yu Q, Liu J. Relation Between Chest CT Findings and Clinical Conditions of Coronavirus Disease (COVID-19) Pneumonia: A Multicenter Study. *AJR Am J Roentgenol* 2020; 1-6. [CrossRef]
48. Liu KC, Xu P, Lv WF. CT manifestations of coronavirus disease-2019: A retrospective analysis of 73 cases by disease severity. *Eur J Radiol.* 2020;126:108941. doi:10.1016/j.ejrad.2020.108941
49. A. Bernheim, X. Mei, M. Huang, Y. Yang, Z.A. Fayad, N. Zhang, K. Diao, B. Lin, X. Zhu, K. Li, S. Li, H. Shan, A. Jacobi, M. Chung, Chest CT findings in coronavirus disease-19 (COVID-19): relationship to duration of infection, *Radiology* (February) (2020) 200463.
50. Xie X, Zhong Z, Zhao W, Zheng C, Wang F, Liu J. Chest CT for Typical 2019-nCoV Pneumonia: Relationship to Negative RT-PCR Testing [published online ahead of print, 2020 Feb 12]. *Radiology*. 2020;200343. doi:10.1148/radiol.2020200343
51. Pan F, Ye T, Sun P, Gui S, Liang B, Li L. Time Course of Lung Changes On Chest CT During Recovery From 2019 Novel Coronavirus (COVID-19) Pneumonia. *Radiology* 2020; DOI: 10.1148/radiol.2020200370.
52. Ai T, Yang Z, Hou H, Zhan C, Chen C, Lv W. Correlation of Chest CT and RT-PCR Testing in Coronavirus Disease 2019 (COVID-19) in China: A Report of 1014 Cases. *Radiology* 2020; DOI: 10.1148/radiol.2020200642.
53. Wang Y, Dong C, Hu Y, Li C, Ren Q, Zhang X. Temporal Changes of CT Findings in 90 Patients with COVID-19 Pneumonia: A Longitudinal Study. *Radiology* 2020 DOI: 10.1148/radiol.2020200843.