CT scan Findings of COVID-19 in Patients with Fatty Liver

Israa Mohammed Sadiq[1], Kermanj Ismail Bakr[1]

[1]Lecturer in Kirkuk College of Medicine, MBChB (Tikrit University), FIBMS Radiology (Iraqi Board for Medical Specialization). Department of Surgery/ Radiology, College of Medicine, University of Kirkuk, Kirkuk/Iraq.

Abstract

Purpose: COVID 19) is a respiratory disease caused by a member of the coronaviruses family, named (SARS-CoV-2), discovered in December 2019 in China. This study aims to assess the association of the simple fatty liver disease with the severity of the chest computed tomography (CT) scan findings in COVID 19.

Materials and Methods: It was a cross-sectional study that enrolled 322 patients with positive (RT-PCR) tests and chest CT scan findings. Patients with chronic lung and liver disease, alcoholics, and abnormal liver function tests excluded from the study. The liver CT scan density assessed, accordingly the patients divided into fatty-liver and non-fatty liver groups. The severity of lung CT changes compared between them, using Chi-square test.

Conclusion: COVID patients with fatty liver have more progressive changes in the chest CT scan. They have similar lung lesion distribution to non- fatty liver patients. Crazy paving lesions, septal thickening, Lymphadenopathy and plural effusion in fatty liver patients occurs in the same frequency as non-fatty liver patients

Keywords: *CT scan, COVID 19, Fatty Liver.*

Introduction

(COVID 19) is a respiratory disease caused by a member of the coronaviruses family, named (SARS-CoV-2), discovered in December 2019 in China. [1, 2] The majority of patients have cough, fever, myalgia, with or without dyspnea. Certain groups of patients developed severe illness. [3] COVID-19 diagnosis depends on the real-time polymerase chain reaction (RT-PCR) test. [4] Chest computed tomography (CT) is used for early detection, assess severity, and for follow-up of the patients. [4-8] Typical findings appear when lung tissue early reacts to the insult as focal peripheral rounded ground-glass opacities (GGO), which may become more extensive, confluent, and may evolve to dense consolidation . [9] Other less common CT scan findings include linear and curvilinear opacities, vascular enlargement, and bronchial dilation. Pulmonary nodules, lymph node enlargement, cavities, and pleural effusions are rare findings. [6,10]

Findings associated with high mortality include extensive lung involvement and the presence of consolidations. [11-15] As published in recent studies, patients with cardiovascular disease, diabetes, chronic kidney disease, and older age are at a higher risk of infection and prone to a graver outcome once infected. [16-18] Non-alcoholic fatty liver disease (NAFLD) is another comorbidity that affects the severity of COVID-19. It is a chronic disease characterized by the presence of hepatic steatosis (intrahepatic lipid of more than 5% of liver weight) without a history of alcohol intake, with or without abnormal liver tests. It is the liver manifestation of the metabolic syndrome, which is characterized by

Corrospending author:
Israa Mohammed Sadiq
Lecturer in Kirkuk college of medicine .
MBChB (Tikrit University), FIBMS Radiology (Iraqi Board for Medical Specialization). Department of Surgery/ Radiology, College of Medicine, University of Kirkuk, Kirkuk/Iraq

the presence of obesity, insulin resistance, hypertension, and hyperlipidemia. NAFLD has a doubtful association with infections; recent studies reported an association with community-acquired pneumonia and a higher risk of evolving to severe disease in COVID-19 patients. [19-23]The study aims to assess the association of the simple fatty liver disease with the severity of the chest CT scan findings in COVID 19.

Materials and Methods

1. Study population: It is a cross sectional study done for 322 patients with COVID 19 at Azadi Teaching Hospital/Kirkuk city/Iraq, attending the CT scan unit for evaluation of their chests from march 2019- June 2019.

Inclusion criteria: adult Patients with positive CT scan findings and nasopharyngeal RT-PCR tests were enrolling in the study.

Exclusion criteria: Include patients with a known history of heart failure, pre-existing lung or liver disease, alcoholic persons, those with positive serology for hepatitis virus, and abnormal liver function tests. We collected the clinical information from the documentation of the clinicians.

2. Imaging: CT examinations without intravenous contrast medium achieved by a multidetector-row scanner (Siemens Brilliance), the energy level of 200–250 mA, and 120 kV. The patients imaged in the supine position. The slice thickness was 5 mm, images taken from the upper neck to the level of the umbilicus. The CT scan examinations in both lung and mediastinal windows evaluated by two radiologists with at least five years' experience in CT scan imaging, Any differences of opinion resolved with consent . The CT examinations were done at 3-10 days from the onset of the symptoms.3. CT interpretation: Liver density assessed to confirm the diagnosis of hepatic steatosis as liver attenuation less than 40 HU. [24] (Fig 1a)

The CT COVID changes attenuation classified as pure GGO, predominantly GGO), or consolidation (Fig 1b), and pure consolidation attenuation, while the degree of lung involvement assessment done as the following: both lungs divided into six regions, three equal zones for each one: upper, middle, and lower zones. Each zone graded into less than 5% involvement, 5-25%, 25–50%, 50–75%, and > 75% lung involvement, then the average percentage is calculated for each patient. [25]

4. Statistical analysis: Continuous variables expressed as mean (± SD) and categorical variables as frequency (percentage). The lung lesion densities and extension compared between two groups differentiated according to their liver involvement by the fatty change. A probability (p) value of less than 0.05 was considered statistically significant. Version 17, SPSS software was used for statistical analyses.

This study approved by the Faculty of Medicine's Research Ethics Committee/ Kirkuk University - Iraq. The individual data not explored in the study.

The patients gave verbal informed consent to participate in this study.

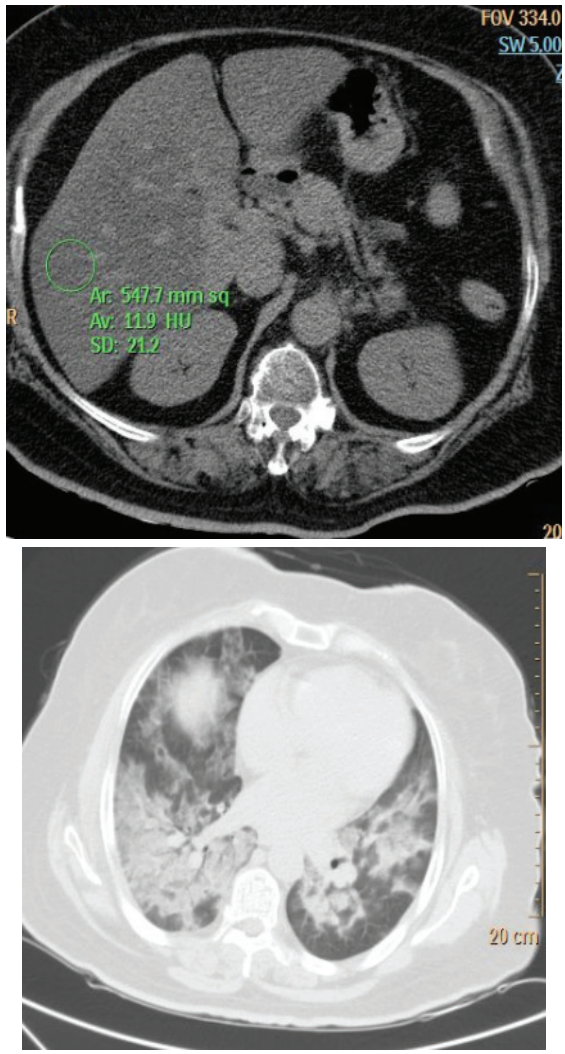

Figure 1. a, b. A 57-year-old woman with COVID-19, in the fatty liver group. Axial CT image (a) of the upper abdomen in abdominal window, average liver density is 11.9 HU (b) chest CT scan in the lung window, shows predominant consolidation in the both lower lobes

Findings

Three hundred twenty-two patients (160 males and 162 females) with laboratory diagnosed COVID19 had positive CT scan findings. Their age range was 18-70 years, and the mean was 50.25 (± 13.1), 66 (20.5%) of them had fatty liver and 256 (79.5%) had normal liver density. (Table 1)

Table 1 Demographic criteria of the study sample.

Category		Fatty liver	Non fatty liver	p-value
Number of patients		66 (20.5%)	256 (79.5%)	
Age		50.92(± 11.44)	50.08 (± 13.49)	0.32 (t =0.46) 1
Weight		81.42 ± 14. 3	76 ± 8.4	< 0.0001 (t = 3.97)
Gender	Male N3= 160	33	127	0.462
	Female N=162	33	129	

[1]Using student t test, [2]using chi-square test. The result is significant at $p < 0.05$. [3]Number.

In the fatty liver group, the CT scan findings were pure GGO in 24 patients (36.36%), predominantly (more than 50%) GGO in 12 (18.18%), predominantly consolidation in 25 (37.87%), and Pure consolidation in 5 (7.57%). While in the non-fatty liver group, the findings were pure GGO in 75 patients (29.29%), predominantly GGO in 90 (35.15%), consolidation in 69 (26.95%), and Pure consolidation in 22 (8.59%). There is no statistical difference in pure consolidation and GGO between both groups in contrast to mixed density lesions which is predominantly GGO in the non-fatty liver group (*P*=0.003) and predominantly consolidation in the fatty liver group (*P*=0.04). (Table 2)

Table 2: Relation between the lung lesions and liver density.

Category	Pure GGO[1]	Predominantly GGO	Predominantly consolidation	Pure consolidation	total
Fatty-liver	24 (36%)	11 (16.66%)	26 (39.39%)	5 (7.5%)	66
Non fatty-liver	75 (30%)	90 (35%)	69 (26%)	22 (8%)	256
p-value	0.26	0.003	0.04	0.79	

Using chi-square test. The result is significant at $p < 0.05$. [1]Ground glass opacity.

Patients whose lungs involved by 5-25% were statistically more in the non-fatty liver group (*P*=0.00011), while more extensive involvement (25-50 %) was more in the fatty liver group (*P*=0.00001). While they had no difference in >5% and 50-75% lung involvement. (Table 3)

Table 3 relation between the lung lesions extension and the liver density.

Category	Lungs percentage involvement				
	>5%	5-25%	25-50%	50-75%	Total
Fatty-liver	14 (21.21%)	27 (40.9%)	22 (33.33%)	3 (4.54)	66
Non fatty-liver	54 (21.09%)	171 (66.79%)	21 (8.2%)	10 (3.9%)	256
Non fatty-liver	0.98	0.000116	0.00001	0.814	

Using chi-square test. The result is significant at $p < 0.05$.

In both fatty liver and non-fatty liver groups, the distribution of the lesion were mainly peripheral (63.63% and 56.25%), in lesser degree diffuse in (33.33%) and (35.15%) and to the least was central (3.03%) and (8.59%). The lesions in both groups were bilateral rather than unilateral (87.87% and 86.71%) versus (12.12%) and (13.28%). There was no significant difference in the lesion distribution in both groups. (Table 4)

Table 4 Distribution of lung lesions in the both groups.

Category	Fatty-liver	Non fatty-liver	p-value
Peripheral	42 (63.63%)	144 (56.25%)	0.27
Central	2 (3.03%)	22 (8.59%)	0.12
Diffuse	22 (33.33%)	90 (35.15%)	0.78
Unilateral	8 (12.12)	34 (13.28%)	0.80
Bilateral	58 (87.87%)	222 (86.71%)	0.80

Using chi-square test. The result is significant at $p < 0.05$.

Other CT scan findings in the fatty-liver group were as the following: Crazy paving 24 (36%), Septal thickening 5 (5.57%). Plural effusion 22 (33.33%) and Mediastinal lymphadenopathy 1 (1.51%). While in non-fatty liver were 100 (39%), 10 (3.9%), 86 (33.56%), and 5 (1.95%) respectively. There was no significant difference in the incidence of these findings between the two groups.

There were no pericardial effusion, cavitation, neither nodule incidence in this study.

Discussion

In our study, 66 (20.5%) had fatty liver density, which approximates the global prevalence, which is about 25.24%. [26] This group of people had a chance to develop more severe and extensive lung changes in COVID 19, as they had predominantly consolidative lesions, in contrast to the non-fatty-liver group who had GGO more. COVID 19 damaged the lungs of the Fatty liver group more extensively (25-50 %) in comparison to the non-fatty-liver group as their lungs involved more in (5-25%). It was consistent with the result of a study done in China by Kenneth I. Zheng et al who stated that (fatty liver patients that were obese had more severe COVID-19 disease) [27] as the fatty-liver group's weight was significantly more in our study. (fatty-liver disease patients had significantly more recurrent

infections regardless of coexistent metabolic syndrome) a statement proved by William Nseir et al [22] The fatty liver patients had a higher risk of progressive COVID 19, a conclusion made out by Julie Lucifora et al. [28] This relation is probably due to the association of fatty liver change with low vitamin D serum levels, which in turn increases the susceptibility to infection and autoimmunity. [29, 30] In addition to the deficient innate immunity to the coronavirus representing by high M2 blood macrophages, which suppress the response to the infections.[31] In both groups, the distribution of the lung lesions was more frequently peripheral and bilateral, and to a lesser degree had a diffuse behavior, the least distribution pattern was unilateral and central lung involvement. The result was in line with much of the studies. [2, 6, 10,12]

In both groups, like other papers, other CT scan findings were seen almost in the same percentage. About one-third of the patient had crazy paving lesions and septal thickening. Lymphadenopathy and pleural effusion were relatively rare. [6, 10]

Limitation of the study: We did not consider the patients who may have received COVID 19 treatment, which might affect their CT scan findings.

Conclusion

COVID patients with fatty liver have more progressive changes in the chest CT scan.

The distribution of the lung lesions in both fatty and non- fatty liver are similar.

Crazy paving lesions, septal thickening, Lymphadenopathy and plural effusion in fatty liver patients occurs in the same frequency as non-fatty liver patients.

Conflict of Interest: None.

Funding: Self Funded.

References

1. Zhu N, Zhang D, Wang W, et al. A Novel Coronavirus from Patients with Pneumonia in China, 2019. N Engl J Med 2020; 382(8): 727-733.
2- Chen ZH, Li YJ, Wang XJ, et al. Chest CT of COVID-19 in patients with a negative first RT-PCR test: Comparison with patients with a positive first RT-PCR test. Medicine (Baltimore). 2020; 99(26):e20837.
3. Chen N, Zhou M, Dong X, et al. Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: a descriptive study. Lancet 2020; 395(10223):507-513.
4- Li Q, Guan X, Wu P, et al. Early Transmission Dynamics in Wuhan, China, of Novel Coronavirus-Infected Pneumonia. N Engl J Med. 2020; 382(13):1199-1207.
5. Corman VM, Landt O, Kaiser M, et al. Detection of 2019 novel coronavirus (2019-nCoV) by real-time RT-PCR. Euro Surveill. 2020; 25(3):2000045.
6. Ai T, Yang Z, Hou H, et al. Correlation of Chest CT and RT-PCR Testing for Coronavirus Disease 2019 (COVID-19) in China: A Report of 1014 Cases. Radiology. 2020; 296(2):E32-E40.
7- Das KM, Lee EY, Enani MA, AlJawder SE, Singh R, Bashir S, Al-Nakshbandi N, AlDossari K, Larsson SG. CT correlation with outcomes in 15 patients with acute Middle East respiratory syndrome coronavirus. AJR Am J Roentgenol. 2015; 204(4):736-742.
8. Bernheim A, Mei X, Huang M, et al. Chest CT Findings in Coronavirus Disease-19 (COVID-19): Relationship to Duration of Infection. Radiology. 2020; 295(3): 200463.
9. Chung M, Bernheim A, Mei X, et al. CT Imaging Features of 2019 Novel Coronavirus (2019-nCoV). Radiology. 2020; 295(1): 202-207.
10. Tamer F. Ali, Mohamed A. Tawab, and Mona A. ElHariri. CT chest of COVID-19 patients: what should a radiologist know? Egyptian Journal of Radiology and Nuclear Medicine. (2020) 51:120.
11. Yuan M, Yin W, Tao Z, Tan W, Hu Y. Association of radiologic findings with mortality of patients infected with 2019 novel coronavirus in Wuhan, China. PLoS One. 2020; 15(3):e0230548. Published 2020 Mar 19. Available from https://doi.org/10.1371/journal.pone.0230548.
12. Hani C, Trieu NH, Saab I, et al. COVID-19 pneumonia: A review of typical CT findings and differential diagnosis. Diagn Interv Imaging. 2020; 101(5):263-268.
13- Li K., Wu J., Wu F., Guo D., Chen L., and Fang Z. The clinical and chest CT features associated with

severe and critical COVID-19 pneumonia. Invest Radiol. 2020; 55(6): 327-331.

14. Huang, Y. Wang, X. Li, and et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China Lancet 2020; 395: 497-506.
15. Pan Y, Guan H, Zhou S, et al. 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; 30(6): 3306-3309.
16. Goyal N, Chung M, Bernheim A, et al. Computed Tomography Features of Coronavirus Disease 2019 (COVID-19) A Review for Radiologists. J Thoracic Imaging 2020; 35 (4): 211-219.
17- Guan WJ, Ni ZY, Hu Y, et al. Clinical characteristics of coronavirus disease 2019 in China. N Engl J Med. 2020; 382:1708-1720.
18- Abrishami A, Khalili N, Dalili N, et al. Clinical and Radiologic Characteristics of COVID-19 in Patients With CKD. Iranian Journal of Kidney Diseases 2020; 14 (4): 267-77.
19. Angulo P. Non-alcoholic fatty liver diseases. N Eng J Med 2002; 346:1221–31.
20. Qayyum A, Nystrom M, Noworolski SM, Chu P, Mohanty A, and Merriman R. MRI steatosis grading: development and initial validation of a color mapping system. AJR Am J Roentgenol. 2012; 198 (3): 582-588.
21. Nassir F, Rector RS, Hammoud GM, Ibdah JA. Pathogenesis and Prevention of Hepatic Steatosis. Gastroenterol Hepatol (N Y). 2015; 11(3):167-175.
22. Nseir W, Taha H, Khateeb J, Grosovski M, and Assy N. Fatty liver is associated with recurrent bacterial infections independent of metabolic syndrome. Dig Dis Sci 2011; 56: 3328–34.
23. Ren H, Yang Y, Wang F, et al. Association of the insulin resistance marker TyG index with the severity and mortality of COVID-19. Cardiovasc Diabetol. 2020; 19(1): 58.
24. Limanond P, Raman SS, Lassman C, et al. Macrovesicular hepatic steatosis in living related liver donors: correlation between CT and histologic findings. Radiology 2004; 230:276–280.
25. Hani C, Trieu NH, Saab I, et al. COVID-19 pneumonia: A review of typical CT findings and differential diagnosis. Diagn Interv Imaging. 2020; 101(5):263-268.
26. Sherif ZA, Saeed A, Ghavimi S, et al. Global epidemiology of nonalcoholic fatty liver disease and perspectives on US minority populations. Dig Dis Sci 2016; 61:1214-25.
27. Zheng KI, Gao F, Wang XB, et al. Letter to the Editor: Obesity as a risk factor for greater severity of COVID-19 in patients with metabolic associated fatty liver disease. Metabolism. 2020; 108:154244.
28. Dong Ji, Enqiang Qin, Jing Xu, et al. Non-alcoholic fatty liver diseases in patients with COVID-19: A retrospective study. Journal of hepatology 2020; 73 (2): 449–473.
29. Barchetta I, Angelico F, Del Ben M, et al. Strong association between non alcoholic fatty liver disease (NAFLD) and low 25(OH) vitamin D levels in an adult population with normal serum liver enzymes. BMC Med. 2011; 9:85.
30. Aranow C. Vitamin D and the immune system. J Investig Med. 2011; 59(6):881-886.
31. Lefere S, and Tacke F. Macrophages in obesity and non-alcoholic fatty liver disease: crosstalk with metabolism. JHEP Rep 2019; 1(1):30–43.