BENHA MEDICAL JOURNAL bmj
Print ISSN 1110-208X
Online ISSN 2357-0016

Original article

Multi Detector Computed Tomography (MDCT) of the Chest in Post Covid Patients and Its Correlation with Clinical Data

Amira H. Allam [a], Sara A. Sadek [b], Etemad A. Mohammad [a], Sherif A. Abdelsatar [b]

[a] Department of Chest Diseases, Benha faculty of medicine, Benha University, Egypt.
[b] Department of Radiology, Benha faculty of medicine, Benha University, Egypt

Correspondence to: Sara A. Sadek, Department of radiology, Benha faculty of medicine, Benha University, Egypt.

Email:

saraabdelaal1989@gmail.com

Received: 25 January 2023

Accepted: 25 February 2023

Abstract

Background: Radiologic imaging, especially thin slice CT, has important roles in the diagnosis, management, and follow-up of patients with COVID-19 pneumonia. **This study aimed to** assess the role of MDCT in the diagnosis and follow up of radiological changes of post-covid patients and correlating them to clinical data. **Methods:** This prospective cohort study included 50 patients with confirmed covid 19 admitted to Benha university hospitals over a period of 6 months. MDCT was done for all patient group after COVID 19 infection and after at least 3 months to evaluate and diagnose post COVID symptoms **Results**: Incidence of Post COVID symptoms was 14 (28%), **Post covid clinical grading**; Grade 0 was found in 36 (72%) patients, Grade1 in 7(14%) patients, Grade 2 in 5 (10%) patients, Grade 3 in 1 (2%) patient and Grade 4 in 1 (2%) patient. Post covid MDCT finding was normal in 32 (64%) patients, pulmonary fibrosis in 10(20%) patients, residual consolidation in 1 (2%) patient, residual GGO in 5 (10%) patients and fibrosis with consolidation in 2(4%). Correlation between acute stage COVID- MDCT findings and incidence of Post covid Symptoms was significant for Consolidation. There was a statistically significant correlation between post COVID MDCT findings and clinical grading (P<0.0001). **Conclusion:** this study confirms the Correlation between Post COVID MDCT findings and clinical grading. Follow up MDCT is necessary and may help in applying early medical treatment strategies. Early detection of potential cases of post-COVID-19 pulmonary fibrosis may prevent or modify such disabling complication.

Keywords: MDCT; Chest; Covid-19; Post- covid.

Introduction

COVID-19 is a highly infectious sickness that produces serious respiratory distress syndrome. It was found for the first time in late 2019 in Wuhan, China, and has since expanded worldwide (1). Chest CT is the best imaging modality that detects different parenchymal patterns and disease severity in COVID-19 patients (2). Chest CT may detect infection in its earliest stages, allowing for immediate patient isolation (3).

After an average delay of 5 days, a high-resolution chest CT shows 97 percent sensitivity for COVID-19 pneumonia diagnosis. Ground glass opacity (GGO) that is often characterized as peripheral, bilateral, sub-pleural and patchy, consolidation and air bronchogram, reticulation and crazy paving are characteristic chest CT findings in COVID-19 pneumonia. Furthermore, chest CT abnormalities involve predominance of the central or upper lobe, masses, nodules, cavitation, lymphadenopathy, pleural effusion and the tree-in-bud sign (4).

Most patients who have coronavirus disease 2019 (COVID-19) will recover completely within a few weeks. But some people continue to experience symptoms after their initial recovery; COVID-19 sequelae may range from mild form of fatigue to serious forms requiring long-term oxygen therapy or even lung transplantation owing to pulmonary fibrosis (5).

Common symptoms in people with “Long COVID” are profound fatigue, breathlessness, cough, chest pain, palpitations, headache, joint pain, myalgia and weakness, insomnia, pins and needles, diarrhea, rash or hair loss, impaired balance and gait, neurocognitive issues including memory and concentration problems and worsened quality of life. In people with “Long COVID” one or more symptoms may be present (6).

In cases of covid19 pneumonia, BTS advises CT scans for patients with abnormal chest X-rays, prolonged respiratory symptoms, and PFT abnormalities. CT is conducted with high-resolution reconstructions and contrast according to protocol of pulmonary embolism (PE) 12 weeks following hospital release, at which point acute lesions would be cleared and any observable abnormalities might be deemed chronic. Others suggest a high-resolution investigation with no contrast (7).

The most common CT findings in follow up of post covid patient are bronchial dilation and parenchymal bands (localized subpleurally or spreading to surface of pleura)

regularly with lung architecture deformation. Other observations include coarse subpleural reticulation with irregular interfaces owing to deformation of architecture, without honeycombing (termed interstitial involvement of subpleural with no honeycombing), ground-glass opacity areas, and areas of subpleural interstitial involvement with honeycombing (8).

Yet not all the radiological changes correspond to the disease severity and duration of symptoms. Some patients may show clinical improvement, yet their CT findings remain aggressive with high CT severity score even after the symptoms have subsided (8).

This research aimed to assess MDCT role in the diagnosis and follow up of radiological changes in the chest of post-covid patients and correlating these changes to clinical data.

Patients and methods

This prospective cohort study included 50 individuals with laboratory confirmed covid 19-infection who attended Benha university hospitals over period of 6 months from January 2022 to June 2022. The study was done after being approved by the institutional ethical committee, Benha University **(Approval code: Ms.24.7.2021).** All involved participants gave their informed permission.

Inclusion criteria: patients of both sexes who were more than 18 years old suspected to have covid-19 infection who had positive RT-PCR and CT findings for covid pneumonia. **Exclusion criteria:** were CT scan of bad quality, presence of general contraindication of CT such as pregnancy, patient who died in acute phase and insufficient follow up.

All patients were given a comprehensive medical history including symptoms of covid (fever, cough, chest pain, dyspnea, diarrhea, etc.), history of any systemic diseases e.g., Liver disease, diabetes mellitus, hyper lipidemia, hypertension, chronic chest or heart disease, history of drug intake, previous hospitalization, history of previous infection, complications of the disease (chronic fatigue, cardiovascular complications, neurological complications, renal, etc.). General clinical examination including assessment of vital signs (pulse, BLP, temperature, oxygen saturation, ABG). Clinical illness severity grading: It was constructed during hospitalization according to the standards established by the Chinese Center for Disease Control (CDC): mild disease involving non-pneumonia ;moderate disease including mild

pneumonia (mild symptoms without dyspnea; respiratory frequency < 30/min; blood oxygen saturation (SpO2) > 93%); severe disease including dyspnea (respiratory frequency ≥ 30/min, SpO2 ≤ 93%); and critical disease including adult respiratory distress syndrome (ARDS) or respiratory failure, septic shock, and/or multiple organ dysfunction (MOD) or failure (MOF) (11)**.**

Follow up assessment of disease symptoms and signs: In the follow up period 4-6 weeks and 9-12 weeks. Radiological assessment: All patients were examined with a Toshiba Aquilion Prime 160 (Toshiba medical system Japan) CT chest scanner. All images were rebuilt with a 1-mm slice thickness using the traditional filtered back-projection approach, with all volumetric chest CT images examined at a lung window of 1500 WW and 500 WL and a mediastinal window of 400 WW and 60 WL. For a more accurate evaluation of the disease's scope, coronal and sagittal multi-planar reconstructions were analyzed. From the level of the thoracic inlet to the top pole of the right kidney, patients were assessed while lying supine during complete inspiration and breath hold.

Assessment of post COVID syndrome: After at least 3 months of confirmed COVID-19 infection, our patient group was followed up for post- Covid symptoms and signs.

CT scoring: each of the relevant lung was examined; parenchymal observations: consolidation, crazy paving, GGO, pulmonary nodules, vacuolar sign, lung cavitation and lobar pneumonia in addition to vascular thickening and traction bronchiectasis. The patterns of peripheral, peripheral and central, patchy, and diffuse distribution of lung lesions were evaluated. Additionally, fibrosis, sub-pleural bands, a reversed halo sign, pleural effusion, and lymphadenopathy were reported. The CT results were classified based on one of the CT severity grading systems. On a scale ranging from 0 to 5, each of the five lung lobes was visually rated, as following 5 for more 75 percent involvement; 4, from 51 till 75 percent; 3, from 26 till 50 percent; 2, from 5 till 25 percent; 1 for less than 5 percent and 0 for no involvement. Global CT rating will be the total lobar score, ranging between 0 and 25. The total CT score was sum of lobar values and varied from 0 (no participation) to 25 (Maximum involvement).

Clinical scoring of post-covid patients**:** Grade 0 indicates the lack of any functional restriction, while grade D indicates the patient's demise. Grade 1 complaints have

little influence on the actions of patients. In Grade 2, a lower level of activity intensity is necessary. Grade 3 indicates the incapacity to execute specific tasks, requiring patients to physically adapt them. Grade 4 is allocated for people with significant functional impairments who need help with everyday tasks.

Statistical analysis:

The gathered information was coded and analyzed utilizing the statistical software SPSS (Statistical Package for the Social Sciences) version 26 using appropriate statistical methodologies (IBM Corp., Armonk, NY, USA). Categorical data were expressed as standard deviation and mean. Suitable tests of significance were used. 0.05 was the recognized threshold of significance.

Correlation between radiological changes by MDCT and clinical data regarding disease severity during follow up were done.

Results

Baseline characteristic, Co-morbidities, Initial symptoms in the patients' group were shown in Table 1. Laboratory investigations were illustrated in Table 2. MDCT was done in the acute stage showed that Pulmonary lesions were bilateral in (92%) of cases. Table 3, GGO was reported in 36 (72%), 27 (54%) showed Consolidation, 24(48%) showed Halo sign and Crazy paving was reported in 18(36%) cases.

After at least 3 months, Incidence of Post COVID symptoms was found in 14 (28%) patients. Clinical presentation of patients with post covid syndrome was ; as post-COVID fatigue and neuropathy in 7 (14%) patients, Vertigo and headache in 4 (8%) patients, Flaring of asthma in 4 (8%) patients, Anxiety symptoms in 9 (18%) patients, Arthralgia/Muscle pain in 3 (6%) patients, Skin lesions in 1 (2%) patient, Dry cough in 4 (8%) patients, Chronic dyspnea in 5 (10%) and Low-grade fever in 1 (2%) patient, Table 4.

Regarding Post covid clinical grading, Grade 0 was found in 36 (72%) patients, Grade1 in 7(14%) patients, Grade 2 in 5 (10%) patients, Grade 3 in only 1 (2%) patient and Grade 4 in only 1 (2%) patient, Table 5. Post covid MDCT was normal in 32 (64%) patients, post covid19 pulmonary fibrosis was present in 10(20%) patients, residual consolidation in 1 (2%) patient, residual GGO in 5 (10%) patients and fibrosis and consolidation in 2(4%), Table 6. Correlation between acute stage COVID- MDCT findings and incidence of Post covid Symptoms was significant for

Consolidation while no statistically significant correlation was found with other MDCT findings. Figure 1 Most of patients with grade 0 had normal CT 32(64%) patients while 3 patients had residual GGO, grade1had pulmonary fibrosis in 6 patients (P<0.0001). Figure 2

Cases

Case 1: Clinically: A 56-year-old cigarette smoker male patient presented with fever, dyspnea, and dry cough diagnosed as positive for COVID-19 by PCR. MDCT chest was done after 3 m from start of symptoms Clinical manifestations of post Covid: fatigue, neuropathy and dry cough. **Figure 3**

Case 2: Clinically: A 50-year-old asthmatic female patient presented with dyspnea and dry cough, proved to be COVID-19 (positive by PCR) and other symptoms, Arthralgia/Muscle pain, Flaring of asthma and Vertigo and headache. **Figure 4**

Table 1: Baseline characteristics, co-morbidities and initial symptoms in the patients group

Age (years)	Mean ±SD	57.1 ±11.9 y
	< 30 n(%)	5 (10%)
	30-60 n(%)	31 (62%)
	> 60 n(%)	14 (28%)
Gender	Males n (%)	29 (58%)
	Females n (%)	21 (42%)
	Hospitalization time (days)	22 ± 8.53
Characters	Mild type	26 (52%)
	Moderate type	19 (38%)
	Severe type	5 (10%)
	Recovery	50 (100%)
	Death	0 (0%)
Co-morbidities	Hypertension	11 (22%)
	Diabetes Mellitus	9 (18%)
	Chronic Kidney Disease	2 (4%)
	Bronchial Asthma	3 (6%)
	Ischemic Heart Disease	3 (6%)
Initial symptoms	Fever	48 (96%)
	Cough	36 (72%)
	Shortness of breath	7 (14%)
	Tachypnea	6 (12%)
	Headache	11 (22%)
	Malaise	12(24%)
	Diarrhea	9 (18%)
	Nasal congestion	8 (16%)
	Sore throat	10 (20%)

Table 2: Lab investigations in the patient group

			Normal range
Lab investigation	Hb (g/dl)	12.1 (10.5-15.2)	11.5 – 15
	WBC (109 /L)	4.52 (0.83–14.69)	4.5 – 11
	LYM (109 /L)	1.09 (0.38–3.72)	0.8- 4.8
	LDH (U/L)	225.22 (153.48–576.53)	60–160
	CRP (U/ML)	20.43 (0.37–121.22)	0 – 8
	ESR (mm/h)	30.00 (3.01–220.00)	0–20
	ALT (U/L)	32.7 (29.5-112.4)	< 35
	AST (U/L)	31.3 (22.4-71.47)	< 35
	Creatinine (mg/dl)	1.4 (0.8-5.1)	0.7–1.2

Table 3: Lesion distribution according to MDCT

Laterality	Unilateral	4 (8%)
	Bilateral	46 (92%)
Lesion distribution	Peripheral	24 (48%)
	Peripheral and central	26 (52%)
Site of Pulmonary involvement	Right upper lobe	31 (62%)
	Right middle lobe	33 (66%)
	Right lower lobe	39 (78%)
	Left upper lobe	34 (68%)
	Left lower lobe	42 (84%)

Table 4: Initial MDCT findings, Incidence of Post covid Symptoms in the patient group

Initial MDCT findings	GGO	36 (72%)
	Consolidation	27 (54%)
	Halo sign	24(48%)
	GGO and Consolidation	5 (10%)
	Ground glass opacities and reticular patterns	3 (6%)
	Crazy paving	18(36%)
	White lung	1 (2%)
	Pleural hypertrophy	1 (2%)
	Pleural effusion	1 (2%)
	Fibrosis	2 (4%)
	Cavitation	2 (4%)
Incidence of Post covid Symptoms	Yes	14 (28%)
	No	36 (72%)
	Total	50(100%)
Post covid Signs and symptoms	Post-COVID fatigue and neuropathy	7 (14%)
	Vertigo and headache	4 (8%)
	Flaring of asthma	4 (8%)
	Anxiety symptoms	9 (18%)
	Arthralgia/Muscle pain	3 (6%)
	Skin lesions	1 (2%)
	Dry cough	4 (8%)
	Chronic dyspnea	5 (10%)
	Low-grade fever	1 (2%)

Table 5: Post covid clinical grading

Post covid Grading	Grade 0	36 (72%)
	Grade1	7(14%)
	Grade 2	5 (10%)
	Grade 3	1 (2%)
	Grade 4	1 (2%)

Table 6: Post COVID MDCT findings

Post covid MDCT findings	Normal	32(64%)
	Post-COVID-19 pulmonary fibrosis	10 (20%)
	residual consolidation	1 (2%)
	residual GGO	5 (10%)
	Fibrosis and consolidation	2 (4%)
	Total	50 (100%)

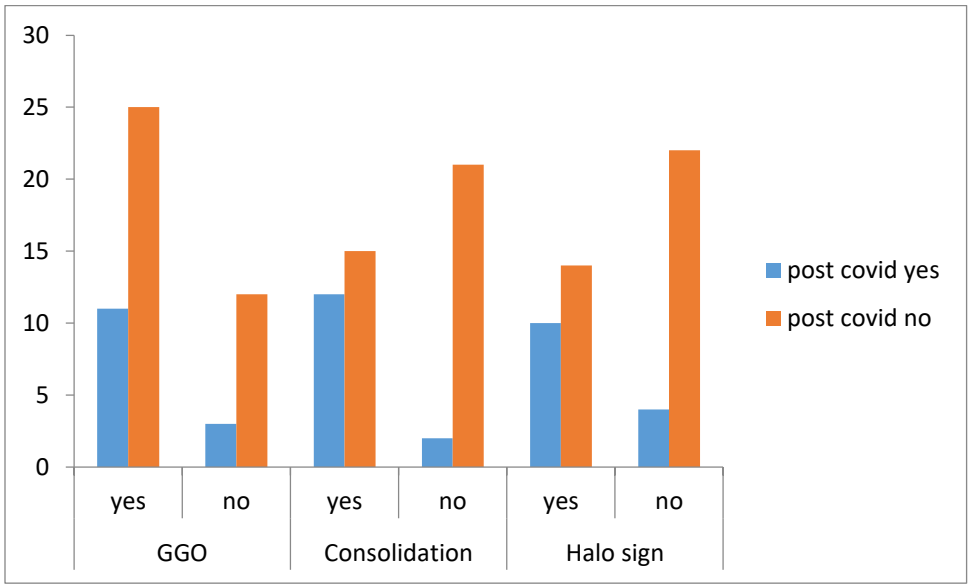


Figure 1: Correlation between acute stage COVID most common MDCT findings and incidence of Post covid Symptoms

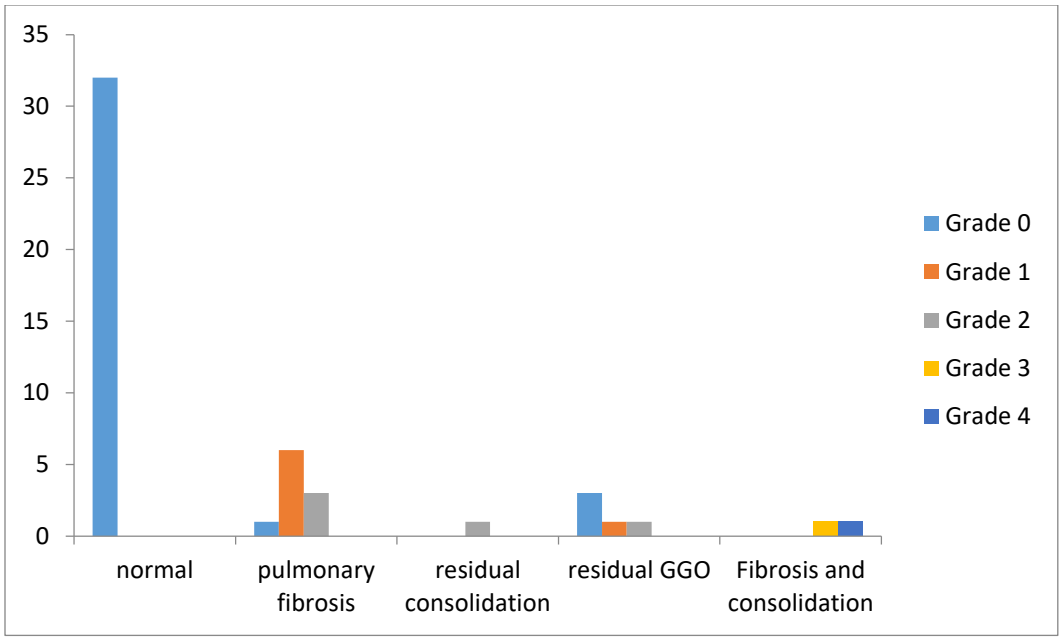
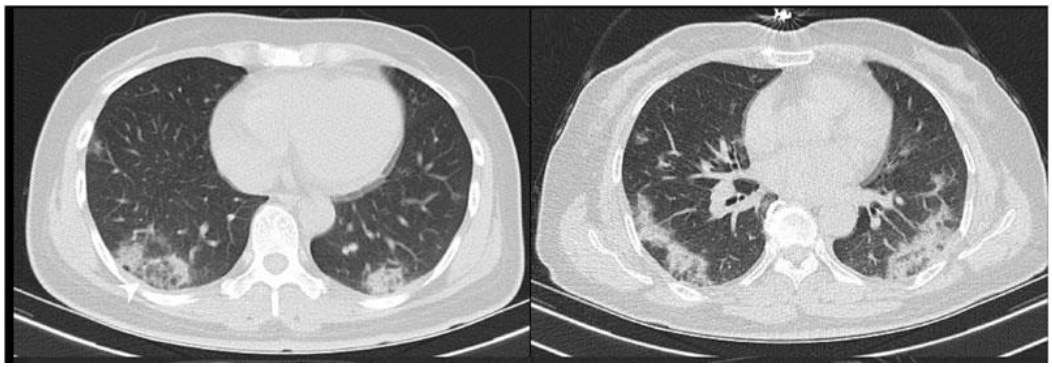
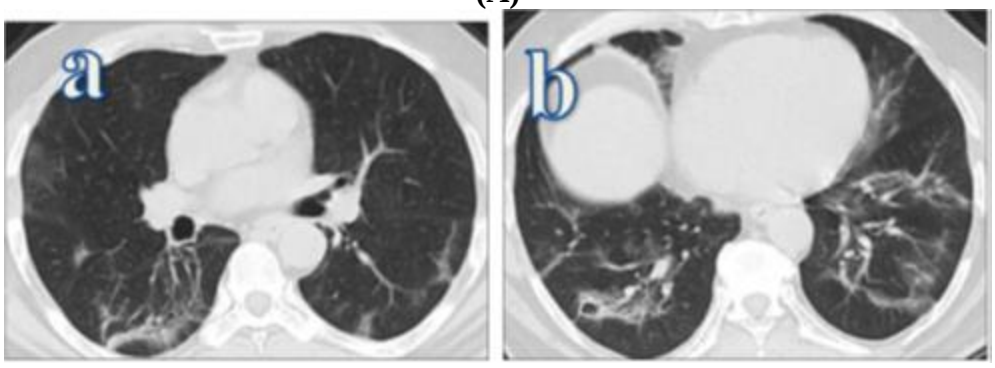


Figure 2: Correlation between Post COVID MDCT findings and clinical grading,

Case 1



(A)



(B)

Figure 3: A) Initial MDCT findings: Axial MDCT shows bilateral ground glass opacity B) 3 m MDCT findings: axial (a, b) revealed bilateral pulmonary fibrotic changes in the form of fibrotic bands. CT-SS on admission was 16/25 (**Error! Reference source not found.**).

Case 2

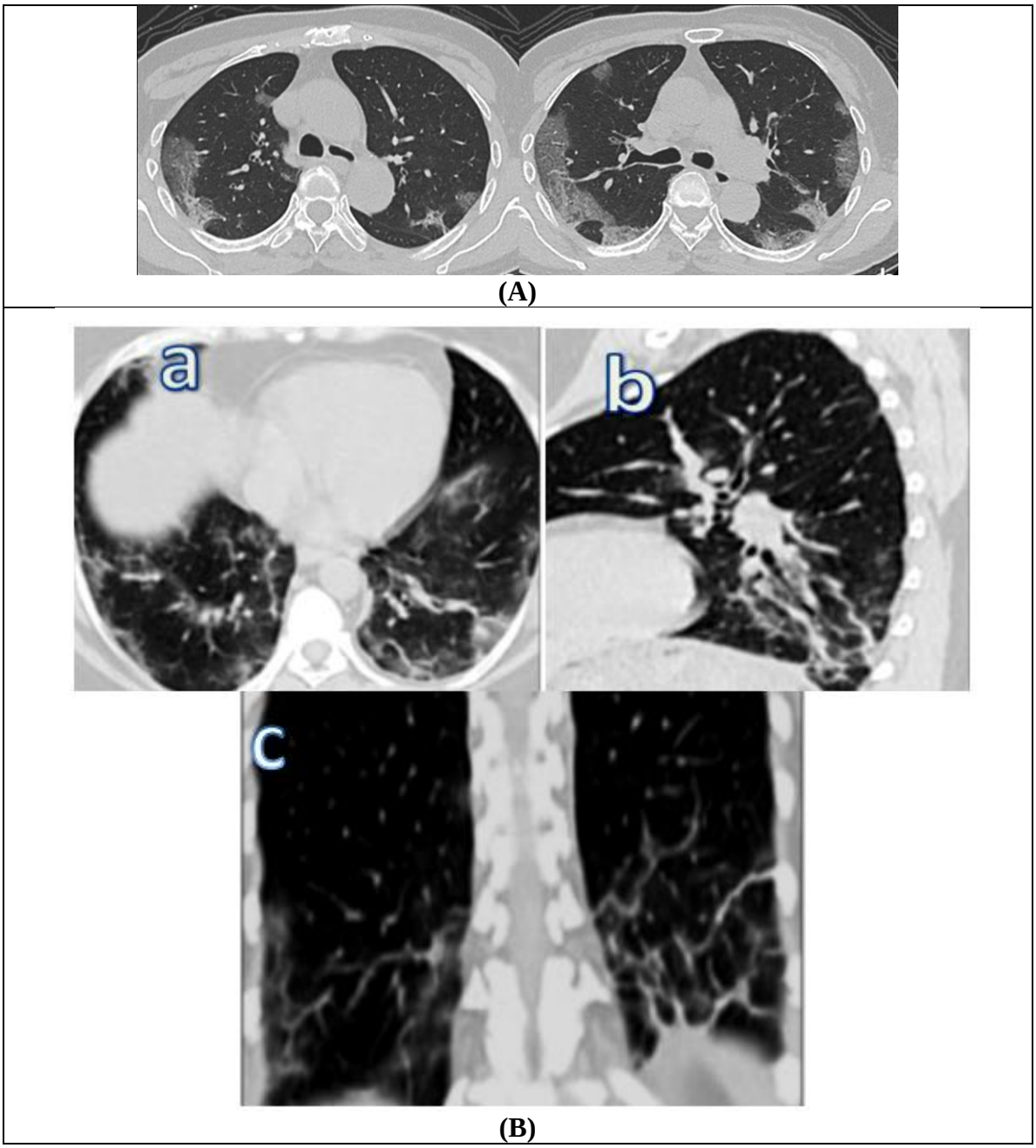


Figure 4: A) Initial MDCT findings: Axial MDCT signs of GGO, B) 3 m MDCT findings: CT-SS on was 13/ 25. MDCT chest (a, b, c) revealed bilateral lower lobar fibrotic changes.

Discussion

In late December 2019, the rapid outbreak of coronavirus disease 2019 (COVID-19) caused by SARS coronavirus 2 (SARS-CoV-2) (previously named 2019-nCoV) in Wuhan, Hubei Province, has attracted worldwide attention (9).

After the COVID-19 pandemic, clinical description centered on the acute clinical manifestations of patients. Recent evidence suggests that some individuals continue to have COVID-19-related symptoms after the acute phase of infection has passed. Within a few weeks, the majority of patients with COVID-19 will recover entirely. However, some individuals keep suffering symptoms following early healing (10).

Post-COVID-19 radiological sequelae vary widely. High-resolution computed tomography (HRCT) represents the reference examination used for the diagnosis and classification of these sequelae (11).

HRCT allows a fine analysis of the parenchyma and the detection of pulmonary fibrosis, among other lesions. Three main categories of post-COVID-19 sequelae can be distinguished: so-called irreversible lesions, reversible lesions and lesions of undetermined evolution (12).

This study was done aiming to assess the role of MDCT in the diagnosis and follow up of radiological changes in the chest of post-covid patients and correlating these changes to clinical data. The study included 50 patients, their mean age was 57.1 ±11.9 y, 5 (10%) of them was < 30 years old, 31 (62%) of them 30-60 years and 14 (28%) was > 60 years old. 29 (58%) were males and 21 (42%) were females. According to CDC classification of COVID severity, 26 (52%) were Mild type, 19 (38%) were Moderate type and 5 (10%) were Severe type. According to co-morbidities in our patient group, 14 (28%) were smokers, 11 (22%) had Hypertension, 9 (18%) had Diabetes Mellitus, 2 (4%) had chronic kidney disease, 3 (6%) patients had Bronchial Asthma and three of them (6%) had ischemic heart disease. A similar study was done by Saad et al., 2021, 85.0% of cases were mild, while severe cases were found in 8.6%, and critical cases in (6.4%) (13), While in Yang et al. study, 84 out of 102 patients were mild and 18 were in the severe group (14).

In the present study, Initial symptoms were Fever 48 (96%), 36 (72%) had Cough, 7 (14%) Shortness of breath, 6 (12%) had Tachypnea, 11 (22%) had Headache, 12(24%) had Malaise, 9 (18%) had Diarrhea, 8 (16%) had Nasal congestion, 10 (20%) had Sore throat. The most common clinical symptoms in Yang et al. study were cough (72 of 102, 70.59%) and fever (86 of 102, 84.31%) (14). Another study by Pan et al.,2019 who reported, fever (18 of 21 patients [86%]) and cough (12 of 21 patients [57%]) were the most prominent symptoms (15).

Initial MDCT findings in the present study were GGO in 36 (72%) cases, 27 (54%) showed Consolidation, 24(48%) showed Halo sign and Crazy paving was reported in 18(36%) cases. After at least 3 months MDCT was done for patients with an Incidence of Post COVID symptoms of 28%.

In a recent study, baseline chest CT features of COVID-19 pneumonia mainly comprised GGOs and consolidations, with a diffuse distribution in 96% and 42% of CT scans analyzed, respectively. Focal consolidations were reported in 35 participants, with a marked predilection for the lower lung lobes (89%) (16).

The most common CT findings in stage 1 in Pan et al., 2020 study were GGO (18 of 24 scans [75%]) with partial crazy-paving pattern (six of 24 scans [25%]) and consolidation (10 of 24 scans [42%]) (15).

In the present study, clinical presentation of patients with post covid syndrome was post-COVID fatigue and neuropathy in 7 (14%) patients, Vertigo and headache in 4 (8%) patients, Flaring of asthma in 4 (8%) patients, Anxiety symptoms in 9 (18%) patients, Arthralgia/Muscle pain in 3 (6%) patients, Skin lesions in 1 (2%) patient, Dry cough in 4 (8%) patients, Chronic dyspnea in 5 (10%) and Low-grade fever in 1 (2%) of patients.

In a recent metanalysis, overall prevalence for neurological symptoms three months after COVID-19 onset was: brain fog (32 percent), fatigue (37 percent), attention disorder (22 percent), memory issues (28 percent), anosmia (12 percent), myalgia (17 percent), dysgeusia (10 percent) and headache (15 percent). The prevalence of neuropsychiatric symptoms was sleep disturbances (31 percent), anxiety (23 percent), and depression (17 percent) (17).

In the present study, Post covid clinical grading showed Grade 0 in 36 (72%) patients, 7(14%) patients in grade 1, 5 (10%) patients in grade 2, only 1 (2%) patient in grade 3 and only 1 (2%) patient in grade 4.

Post covid MDCT findings were normal was in 32 (64%) patients, pulmonary fibrosis was in 10(20%) patients, residual consolidation was in 1 (2%) patients, residual GGO was in 5 (10%) patients and fibrosis and consolidation was in 2(4%)

Most of patients with post covid 19 clinical grade 0 had normal CT 32 (64%) of patients while 3 patients had residual GGO, clinical grade 1 had pulmonary fibrosis in 6 patients. A critical association existed between post-COVID MDCT results and clinical grading ($P<0.0001$).

This result was similar to a study in 2022 study that reported that CT severity score was positively correlated with disease severity and some lab parameters. A significant statistical correlation was also found between CT severity grade and patient survival (18).

Patients who had experienced severe COVID-19 had the largest decline in health-related quality of life. Prevention of aggravating COVID-19 with vaccination might be an effective measure to prevent long-term functional decline (19).

It is unknown why certain COVID-19 individuals develop chronic symptoms. Viral load as well as host-dependent variables, like genetic vulnerability or activation of anti-inflammatory cells, may contribute to diverse infection outcomes (20).

Advancing age, female sex, illness severity, and body mass index were features and predictors of chronic COVID19 infection. Similar to the present study, a recent study done 10 months after the patients (mean age, 37.8 years) had recovered from an acute COVID-19 infection found that older age was related with an increased risk of symptom persistence (21).

Conclusions

The present study confirms the Correlation between Post COVID MDCT findings and clinical grading. Early diagnosis of possible instances of post-COVID-19 pulmonary fibrosis may provide the opportunity to avoid or, at the very least, minimize this debilitating consequence. A follow up MDCT is necessary for this group of patients that may aid in the implementation of early medical treatment solutions. MDCT plays a vital role in evaluating post COVID symptoms which is correlated with residual pulmonary lesions. As it causes irreversible lung damage, post-COVID-19 pulmonary fibrosis is one of the most alarming pulmonary consequences.

References

1. Huang C, Wang Y, Li X, Ren L, Zhao J, Hu Y, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. Lancet. 2020;395:497-506.
2. Simpson S, Kay FU, Abbara S, Bhalla S, Chung JH, Chung M, et al. Radiological Society of North America Expert Consensus Statement on Reporting Chest CT Findings Related to COVID-19. Endorsed by the Society of Thoracic Radiology, the American College of Radiology, and RSNA - Secondary Publication. J Thorac Imaging. 2020;35:219-27.
3. Wang Y, Dong C, Hu Y, Li C, Ren Q, Zhang X, et al. Temporal Changes of CT Findings in 90 Patients with COVID-19 Pneumonia: A Longitudinal Study. Radiology. 2020;296:E55-e64.
4. Chen L, Xiong J, Bao L, Shi Y. Convalescent plasma as a potential therapy for COVID-19. Lancet Infect Dis. 2020;20:398-400.
5. Carfì A, Bernabei R, Landi F. Persistent Symptoms in Patients After Acute COVID-19. Jama. 2020;324:603-5.

6. Raveendran AV, Jayadevan R, Sashidharan S. Long COVID: An overview. Diabetes Metab Syndr. 2021;15:869-75.
7. George PM, Wells AU, Jenkins RG. Pulmonary fibrosis and COVID-19: the potential role for antifibrotic therapy. Lancet Respir Med. 2020;8:807-15.
8. Alarcón-Rodríguez J, Fernández-Velilla M, Ureña-Vacas A, Martín-Pinacho JJ, Rigual-Bobillo JA, Jaureguízar-Oriol A, et al. Radiological management and follow-up of post-COVID-19 patients. Radiologia (Engl Ed). 2021;63:258-69.
9. Zhu N, Zhang D, Wang W, Li X, Yang B, Song J, et al. A Novel Coronavirus from Patients with Pneumonia in China, 2019. N Engl J Med. 2020;382:727-33.
10. Saad MA, El Khateeb AF, Ahmed MI, Magdy AM. Semi-quantitative CT severity scoring as a predictor of development of post-COVID syndrome. Egypt J Radiol Nucl Med. 2021;52:1-7.
11. Rubin GD, Ryerson CJ, Haramati LB, Sverzellati N, Kanne JP, Raoof S, et al. The Role of Chest Imaging in Patient Management During the COVID-19 Pandemic: A Multinational Consensus Statement From the Fleischner Society. Chest. 2020;158:106-16.
12. Montani D, Savale L, Noel N, Meyrignac O, Colle R, Gasnier M, et al. Post-acute COVID-19 syndrome. Eur Respir Rev. 2022;31.
13. Saad MA, El Khateeb AF, Ahmed MI, Magdy AM. Semi-quantitative CT severity scoring as a predictor of development of post-COVID syndrome: Egypt J Radiol Nucl Med. 2021;52(1):102. doi: 10.1186/s43055-021-00483-4. Epub 2021 Apr 13.; 2021.
14. Yang R, Li X, Liu H, Zhen Y, Zhang X, Xiong Q, et al. Chest CT Severity Score: An Imaging Tool for Assessing Severe COVID-19. Radiol Cardiothorac Imaging. 2020;2:200047.
15. Pan F, Ye T, Sun P, Gui S, Liang B, Li L, et al. Time Course of Lung Changes at Chest CT during Recovery from Coronavirus Disease 2019 (COVID-19). Radiology. 2020;295:715-21.
16. Bocchino M, Lieto R, Romano F, Sica G, Bocchini G, Muto E, et al. Chest CT-based Assessment of 1-year Outcomes after Moderate COVID-19 Pneumonia. Radiology. 2022;305:479-85.
17. Premraj L, Kannapadi NV, Briggs J, Seal SM, Battaglini D, Fanning J, et al. Mid and long-term neurological and neuropsychiatric manifestations of post-COVID-19 syndrome: A meta-analysis. J Neurol Sci. 2022;434:120162.
18. Sharma S, Aggarwal A, Sharma RK, Patras E, Singhal A. Correlation of chest CT severity score with clinical parameters in COVID-19 pulmonary disease in a tertiary care hospital in Delhi during the pandemic period. Egypt J Radiol Nucl Med. 2022;53:166.
19. Walle-Hansen M, Ranhoff AH, Mellingsæter M, Wang-Hansen MS, Myrstad M. Health-related quality of life, functional decline, and long-term mortality in older patients following hospitalisation due to COVID-19. BMC Geriatr. 2021;21:1-10.
20. Seeßle J, Waterboer T, Hippchen T, Simon J, Kirchner M, Lim A, et al. Persistent Symptoms in Adult Patients 1 Year After Coronavirus Disease 2019 (COVID-19): A Prospective Cohort Study. Clin Infect Dis. 2022;74:1191-8.
21. Perlis RH, Green J, Santillana M, Lazer D, Ognyanova K, Simonson M, et al. Persistence of symptoms up to 10 months following acute COVID-19 illness. MedRxiv. 2021.

To cite this article: Amira H. Allam, Sara A. Sadek, Etemad A. Mohammad, Sherif A. Abdelsatar. Multi Detector Computed Tomography (MDCT) of the Chest in Post Covid Patients and Its Correlation with Clinical Data. BMFJ 2023;40 (annual conference issue):111-124.