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CHEST CT-SCAN FINDING AFTER ONE YEAR FOLLOW UP IN THE PATIENTS WITH PERSISTENT RESPIRATORY SYMPTOMS OF PREVIOUS MILD – MODERATE COVID-19 INFECTION

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Abstract:

Background: Although PCR is the golden test for proving infection[1]. Chest CT has been shown to be more sensitive for the detection of COVID-19.[2] Ground glass opacities or consolidation or both by chest CTs assessment.[3] CT-scan findings after one year linked with continuous symptoms after primary mild- moderate Covid-19 infection.[4,5,3]

Aim of the study: Following -up the included patients of mild-to-moderate COVID-19 infections with persistent respiratory symptoms by the chest CT findings after **12** months with from before evaluating the association of these symptoms with CT scan findings.

Methodology: An observational, cross-sectional study conducted on 150 patients who attended the Respiratory Diseases Consultation Clinic in Al-Hussien Teaching Hospital during the period from June 2023 to January 2024 in Al Nasiriyah City, Thi-Qar Province, Iraq. All patients suffered from continuing SARS-CoV-2 symptoms post mild or moderate disease -severity.

Results: The male participants accounted for about (62%) of the total population. Those with aged group between (26 -50) years accounted for about (66.67%). Symptomatic cases with dry cough and dyspnea form about (52.67%) and (63.33%) respectively while those with thoracic pain formed about (63.67%). Normal chest CT scan findings accounted for (58.67%) while abnormal formed about 41.33%. It distributed as unilateral and bilateral findings by (16.67% and 24.67%) respectively. Only 17.33% of patients had

interlobular septal thickening; 20% had ground glass opacities (GGO); 12.67% had fibrotic-like changes; 7.33% had reticulation; 4% had consolidation; 7.3% had honeycombing; and 4% had bronchiectasis.

Conclusion: Mild and moderate Covid-19 infections were established with distinct chest CT scans abnormalities after one year later. Persistent post Covid 19 respiratory symptoms, especially cough, and thoracic pain, was pretrained to underline radiological changes by CT--scan modality.

Recommendations: There Regular chest CT follow-up in the patients may be helpful in patients with persistent post Covid-19 infection symptoms. An increasing the sample size in different degree of the disease severity is a feasible concern for similar research.

Keywords: *Chest CT-scan, Mild – Moderate Covid-19 Infection, Persistent Respiratory Symptoms.*

Introduction

Introduction: Chest CT is a gold standard modality of (COVID-19) infection diagnosis.[6] The long-term following -up of Covid-19 still justifies a continuous medical attention.[7] In December 2019, an outbreak of pneumonia of unknown origin was reported.[2] Pneumonia cases were epidemiologically linked to severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2).[8] COVID-19 infection is identified to trigger acute injure to the alveolar-capillary barrier, including to both alveolar epithelium and vessel endothelium. This damage is precisely due to viral-mediated or due to the subsequent inflammatory response. [9]

Although PCR is the golden test for validating infection, chest CT has been appeared to be more sensitive for the revealing of COVID-19.[10] PCR–negative patient with positive CT results and high clinical suggestive may aid from repetition of PCR testing.[11] Despite the greater sensitivity of CT, about (15% - 20%) of the cases with definite infection will have no parenchymal changes on chest CT within the initial-stage of the disease. The reported specificity was about (93%-100%) of CTs in distinguishing the Covid-19 infection from other types of viral pneumonia.[12]

However, the approved CT-Scan sensitivity is (70 - 93%). On the other hand, the chest radiographs can be done in checking the disease advancement, coinfection, or p parenchymal stability mainly in critically ill patients.[6]

Lung damages were evaluated in each lung lobe for the existence of either ground glass opacities GGO (blurred areas of enhanced attenuation without clouding of the original vasculature) or consolidation (consistent opacify with hiding the underlying vasculature) or both. Other chest CT features were considered as: presence of ≥ 10-mm lymph node pathology (LAP), pleural effusion, nodules, and airway abnormalities.[13,14,15]

Each one of all lung-tissue lobes was grossly examined to assess the existence of GGO or consolidation and even the extent of presence of either GGO alone or GGO areas with compensatory opacities.[16] Therefore, each lung lobe involvement areas was graded as having 0, 1, 2, 3, or 4 grades that: none, minimal (1–25%), mild (26–50%), moderate (51–75%), or severe (> 75%) were grossly evaluated, correspondingly. [1] The involved lung- lobes number per patient by GGO, or consolidation changes was also appreciated as a first visible CT- mark to evaluate the extent of lung tissue destruction.[17] Researchers are still seeking to unfamiliar mechanisms that lead to the continuing of the health effects which lastly called the "**post-COVID-19 syndrome".** Up to now, the continuous inflammatory process, stimulated autoimmunity, or viral isolation has been hinted as possible drivers. [18]

The available clinical knowledge exhibited that chest CT scans have been achieved mostly in this patient group, without any organized examination.[19] After a mild or moderate infection, it is feasible and crucial for thoroughly evaluation for those whom are complaining from persisting post-COVID-19 respiratory symptoms.[20] They could also have developed continuing changes of the lung parenchyma which linked to current respiratory symptoms.[21]

Coronavirus disease 2019 (COVID-19) frequently produces radiological and functional lung -tissue sequelae. However, evident-data on one-year monitoring for pulmonary changes after mild to moderate COVID-19 infection is limited.[22]

This study aimed to elucidate the relation of continuing respiratory symptoms with the exist of lung tissue changes on chest CTs in post-COVID-19 cases who initially experienced from a mild or moderate COVID-19 infection.[23] The ratio of remainder (CT) changes after mild to moderate COVID-19 remission to the characteristics of the residual CT changers at 1-year follow-up.[24]

Methodology: An observational, cross-sectional study conducted on **150** patients, 93 males and 57 females. Their ages arranged between (26 – 50) years. The participants were attending to the Respiratory Diseases Consultation Clinic in ***Al-Hussien Teaching Hospital*** during the period from June **2023** to January **2024** in Al Nasiriyah City, Thi-Qar Province, Iraq.

All patients experienced from remaining respiratory symptoms after an mild or moderate Covid -19 -infection. A cross -sectional post one- year chest CT scans were done.

Only (**40)** of them had a previous CT-Scan films at the time of Covid -19 infection. The rest participants had no initial CT-scan films. It was not done for them due to either their clinically based diagnosis or by PCR modality as they had mild or moderate symptoms. Others had a previous CT-Scan examination but lost their disease documents. These **40** cases comparative findings add an additional beneficial strength for the baseline radiological data to compare with post one-year findings for mentioned 40 participants only.

Inclusion Criteria: All patients, over the age of 15, regardless of gender, they had been confirmed to have Covid-19 infection with positive PCR result and had mild to moderate symptoms according to WHO classification.

All patients who were able to participate and complete the CT examination and willing to give a written informed consent form to participate in the clinical study. **Exclusion Criteria:** Any patients who had inconstant with inclusion criteria. Those with a history of severe restrictive or obstructive lung disease before Covid-19 infection. Patients with an initial severe sequence of COVID-19 disease requiring prolonged hospital admission or intense management. Those with alternative diagnosis for stated signs and symptoms. Any patient with acute respiratory distress syndrome and/or required intubation/mechanical ventilation. Immune compromised and patient with malignancy Patients who did not complete the entire information sheet for this investigation.

For all patients, single-energy CT was performed on Revolution EVO (GE Healthcare, Japan), which is computed tomography (CT) scanner, without the use of (IV) contrast at deep inspiration in with supine posture.

In this study results were provided as mean ± SD and frequencies as percentages. We did not perform an a priori sample size calculation due to the explanatory study design. The Chi-square test, multivariable logistic regression, and ANOVA test were used to analyses the variables. All statistical tests were two-tailed, probability levels less than 0.05 were deemed physiologically significant, and p-values less than 0.01 were deemed extremely significant.

Result: Most of the patients in this study were male (62%), aged between 26 and 50 years (66.67%). Those with dry cough (52.67%), and dyspnea (63.33%), while thoracic pain accounted

about (**63.67%).** The resultant chest CT-scan findings were (58.67%). Only 41.33%of the participants had abnormal chest CT scan findings. This radiological finding distributed as unilateral and bilateral findings with about **16.67**% and **24.67%,** respectively.

Only **17.33%** of the patients had interlobular septal thickening. About **21.33%** had ground glass opacities (GGO); **12.67%** had fibrotic-like changes; **7.33%** had reticulation**; 4%** had consolidation; **7.3%** had honeycombing; and **4%** had bronchiectasis.

After one years, the interlobular septal thickening decreases for about **(12.5%)** as a compared to its percentage at initial infection which was **(30%).** Reticulation and GGO was decreased (7.5% vs. 25%), and (25% vs. 92.8%) respectively while consolidation (2.5% vs. 7.5%).

The interlobular septal thickening and fibrotic-like changes were significantly related to cough and dyspnea while GGO, reticulation, bronchiectasis was significantly related to chest pain.

Discussion: This study investigated the chest CT findings after 12 months of follow-up in patients with persistent respiratory symptoms from previous mild-to-moderate COVID-19 infections to evaluate the association of these symptoms with CT scan findings.

Some patients who initially had a mild or moderate SARS-CoV-2 infection may continue to experience respiratory signs and symptoms such as difficulty breathing or chest pain.

In the study by Zhao, Yu-miao, et al.[25] reported that people who have fully recovered from a COVID-19 infection may experience long-term lung damage and pulmonary function impairment after 3 months of discharge. Most of the patients in our study were male (62%), aged between 26 and 50 years (66.67%), and those had at least a pre-existing comorbidity (68%). These results were like others by Yin, Xi, et al., [26] who reported that most COVID-19 patients with dyspnea were elderly males. Prior research on SARS has indicated that males and older patients who have survived the disease are more prone to developing fibrosis.[26]

A previous study found that 83% of patients showed radiological abnormalities within 7 days of being admitted [27] , [28],[29] indicating that radiological abnormalities produced by SARS-CoV-2 may improve as time progresses.

Only 41.33% of the patients in our study had abnormal chest CT scan findings, they distributed as unilateral and bilateral findings (16.67% and 24.67%, respectively).

In the study cohort conducted by Tarraso, Julia, et al., it was shown that 27% of patients continued to have radiological abnormalities in the 12-month period. Pan et al. achieved a comparable proportion of 53 out of 209 cases.[30]

In this study, the percentages of post one-year radiological findings were distributing as **17.3%** of the patients had inter-lobular septal thickening; **20%** had ground glass opacities (GGO); **12.67%** had Fibrotic- like changes. Also, **7.33**%had reticulation; **4%** had consolidation, **7.3%** had Honey combing and finally about **4%** had Bronchiectasis.

Based on a prior report by Hui, et al., (2005), 33 patients (30%) exhibited aberrant CT findings, while (17) cases (15.5%) suffered from impaired DLCO six months after recovering from SARS. David et al., analyzed 97 cases who had improved from SARS. They found that even after one-year, there were still aberrant CT results and DLCO anomalies present.[31]

A previous study found that 83% of patients showed radiological abnormalities within 7 days of being admitted [28],[29] indicating that radiological abnormalities produced by SARS-CoV-2 may improve as time progresses.

The results of this research align with earlier studies which indicate that dry cough and shortness of breath are the prevailing lingering symptoms experienced by individuals who have recovered from COVID-19.

Abdallah et al. found that 81.6% of non-hospitalized COVID-19 survivors experienced ongoing fatigue and dyspnea after physical activity. However, their lung function and performance on cardiopulmonary exercise tests were not affected.[32] Logue et al. found that 65.3% of 150 outpatients with moderate illness experienced chronic symptoms. [33]

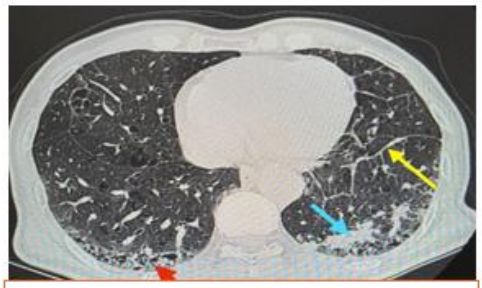
Other studies have reported comparable results. [32], [34],[35] ,[36].

Another study by Yin, Xi, et al., [19] demonstrated that around 50% of the reticulations identified on CT scans upon discharge, suggesting that not all reticulations appropriately indicate fibrosis. That difference might be because some abnormalities are easy to hide, leaving only reticulations visible. On the other hand, for some COVID-19 patients who have survived, reticulations may show that their lesions are in their later stages. Prior investigations with limited duration have indicated that reticulations are a sign of fibrosis. [37] ,[38] .

About 41.33% of post- SARS-CoV-2 patients who initially had a mild or moderate illness established distinct abnormalities in their chest CT scans 12 months after the COVID-19 infection. The presence of persistent respiratory symptoms, especially cough, and thoracic pain, was found to be associated with various chest CT results. Regular chest CT follow-up in the patients group appears to be beneficial for routine clinical evaluations in the absence of additional causes.

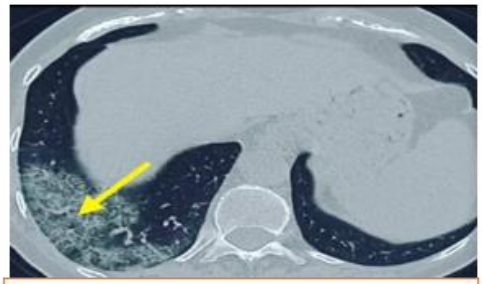
As a comparative analysis with retrospectives monitoring for the **(40)** cases, the patients with interlobular septal thickening have the largest percentage **(41%)** of the residual radiological changes after of one year post Covid-19 infection. Although the (GGO) accounted for about **(92.8%)** of initial CT-films, only **(25%)** of them were still showing this finding in post one-year CTs. This agrees with (Stefan Malesevic 2023)[39] study.

Two third of reticulation and consolidation cases were healing. The study of (Pooja Toshniwal Paharia Feb 15, 2023)[40] followed the cases after one and two years, about **61%** of the patients showed complete resolution. In this study about (**45**%**)** of **(40)** cases resolved their findings.



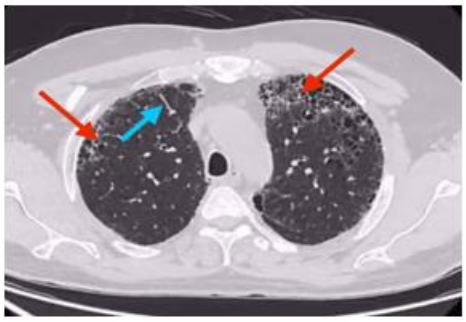
Axial CT examination in supine position of 55 years old male patient with post COVID-19 syndrome.

The lung parenchyma shows Bilateral scattered interlobular septal thickening (yellow arrow) with clustered of subpleural small reticular densities mainly involving lower lung lobes with honeycomb (red arrow) with fibrous streak (blue arrow).



Axial CT examination in supine position of 48 years old male patient with post COVID-19 syndrome.

The lung parenchyma shows Ground glass opacity with reticulation in the right lower lobe (yellow arrow).



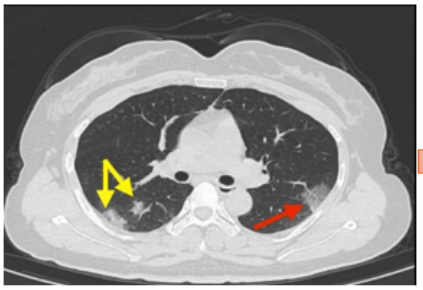
Axial CT examination in supine position of 56 years old male patient with post COVID-19 syndrome.

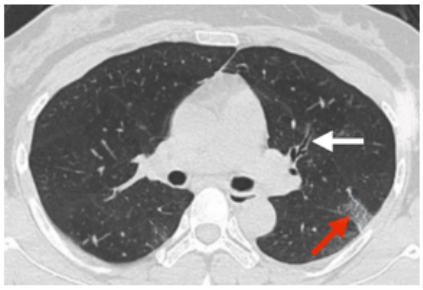
The lung parenchyma shows Honeycomb (red arrow) interlobular septal thickening (blue arrow)

Axial CT examination in supine position of 48 years old male patient with post COVID-19 syndrome.

The lung parenchyma shows fibrosis (red arrow).

Axial -CT examination in supine position of female patient with COVID-19.





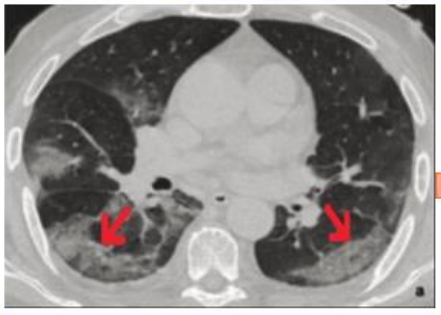
A: (Before)

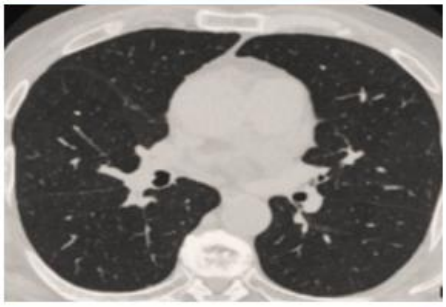
Before one year the lung parenchyma shows the consolidation surrounded by GGO in the right upper lobe of the lung (yellow arrow) and GGO in the left upper lobe (red arrow).

B: (After)

After one year Remain only small GGO in the left upper lobe (red arrow) and Traction bronchiectasis (white arrow).

Axial -CT examination in supine position of male patient with post COVID-19





A: (Before)

Before one year the lung parenchyma shows Bilateral GGO (red arrow).

B: (After)

After one year the lung parenchyma is normal.

Table 1: The sociodemographic characteristics of patients

Variables	Parameters	Frequency	Percent
Gender	Male	93	62.00%
	Female	57	38.00%
Age Categories	≤25yrs	8	5.33%
	26-50yrs	100	66.67%
	51-75yrs	37	24.67%
	>75yrs	5	3.33%
Weight	55-75kg	89	59.33%
	76-95kg	58	38.67%
	>95kg	3	2.00%
Education Level	Illiterate	6	4.00%
	Primary	18	12.00%
	Secondary	23	15.33%
	College	103	68.67%
Smoking	Current	3	2.00%
	Former	29	19.33%
	Never	118	78.67%
Total		**150**	**100.00%**

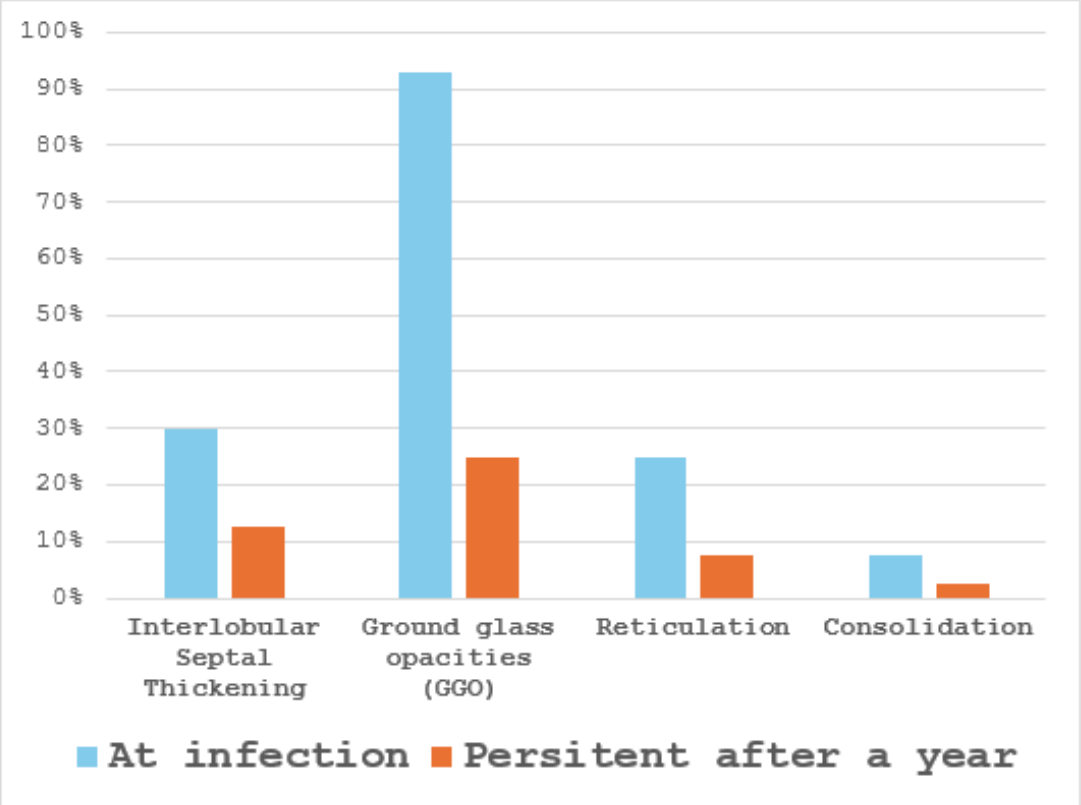


Figure: Comparaive CT changes for Selected Full documented (40) cases.

Table 2: Chest CT scan findings of patients

Variables	Para-meters		Abnormal CT findings Unilateral	Bilateral	Total	
Interlobular Septal Thickening	None	n			36	
		%			24.%	
	Yes	n	11	15	26	
		%	7.3%	10%	17.33%	
Ground Glass opacities (GGO)	None	n			32	
		%			21.33%	
	Yes	n	18	12	30	
		%	12%	8. %	20.%	
Fibrotic like changes	None	n			43	
		%			28.67%	
	Yes	n	3	16	19	
		%	2.0%	10.67%	12.67%	
Reticulation	None	n			51	
		%			34. %	
	Yes	n	5	6	11	
		%	3.3%	4. %	7.33%	
Consolidation	None	n			56	
		%			37.33%	
	Yes	n	4	2	6	
		%	2.6%	1.33%	4. %	
Honey Combing	None	n			59	
		%			39.33%	
	Yes	n	8	3	11	
		%	5.3%	2%	7.30%	
Bronchiectasis	None	n			56	
		%			37.33%	
	Yes	n	3	3	6	
		%	2. %	2%	4.0%	
Total Abnormal CT findings		n	25	37	62	
		%	16.6%	24.67%	41.33%	
Normal CT findings		n			88	
		%			58.67%	
Total					150	100%

Table 3: Comparaive CT changes for Selected Full documented (40) cases.

Variables (n=40)	At infection	Persistent after a year
Interlobular Septal Thickening	12 (30%)	5 (12.5%)
Ground glass opacities (GGO)	37 (92.8%)	10 (25%)
Reticulation	10 (25%)	3 (7.5%)
Consolidation	3 (7.5%)	1 (2.5%)

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