Original Research Article

CT Chest findings and co morbid disease in mortality cases of COVID-19, in tertiary care centre - (Retrospective analysis)

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Abstract

Background: Since December 2019 Wuhan, China, has experienced an outbreak of COVID-19. The disease has spread to more than 150 countries around the world and the death number has constantly increased. CT scan finding with high severity score was increased and co-morbid disease was present in large number of death cases with COVID-19. We aimed to determine CT chest finding and co-morbid disease in mortality cases of COVID-19 in tertiary centre. **Methods:** 62 patients who died from COVID-19 were retrospectively included in this study. CT scan and co-morbid disease data of the patients were collected from medical records. The data was summarized. The CT severity score and associated co-morbid disease were analyzed.**Results:** Among 2892 patients in our hospital with COVID-19, 62 died. The mean age of patients was 65.35 years. Of which 43 (69%) were men and 19(31%) were women.GGO with consolidation was the most common feature for the lung. six lobes were divided into total 20 segments. Each segment were scored 0, 1 and 2 depending on the status of involvement. All segments total scored 40. Severity of disease was categorized into Mild <13 (Figure.1), Moderate 13-19.5 (Figure. 2,3), Severe >19.5 score (Figure. 4,5,6,7,8). The CT severity score was rated as severe in 73% (45) of patients, moderate in 16% (10) patients, and mild in 11% (7) of patients. 58 patients (93.5%) had co-morbid disease. Among co morbid disease, 12 (19%) had DM, 23(37%) had Hypertension and 23(37%) had both DM and HTN. 12(19%) had other chronic illness accompanied with above co morbid diseases. 54 (90%) had fever, 36 (58%) had cough, 18 (29%) had breathlessness.**Conclusion:** Our findings suggest co-morbid disease increases the risk of in-hospital mortality in spite of low CT severity score following COVID-19 infection in comparison with no co-morbid disease.

Keywords: COVID,disease

Introduction

In December 2019, an outbreak of new corona disease (COVID-19) caused by severe acute respiratory syndrome coronavirus 2 (SARS-COV-2) was initially reported in Wuhan City, China. The disease was then rapidly sweeping through the whole country and has spread to more than 150 countries and territories around the world. On March 2020 WHO declared the novel Coronavirus outbreak to be a pandemic[1]. and as on July 12,2020, accumulative 12,879917 confirmed cases and 568,546 deaths were reported in various countries.

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The infection of SARS CoV-2 causes acute, lethal respiratory pneumonia with typical clinical symptoms of fever and cough. According to an early report by WHO, most patients 80% experienced mild to moderate illness, and about 14% experienced severe disease and 5% were critically ill[2,3] ,The mortality in critically ill patients has been reported to be as high as 60%[4]. In this context early identification of risk factors for poor prognosis, accurate evaluation of disease severity and monitoring disease progression will be essential to reduce the mortality rate of patients with COVID-19.Chest CT imaging plays a valuable role in the screening and dynamic evaluation of patients with COVID-19[5,6]. Most patients with COVID-19 have typical CT imaging features of multiple ground glass opacities (GGO) and/or consolidation in a peripheral distribution, which also reflects the severity of pulmonary inflammation. We assumed the CT chest features

and dynamic changes may serve as an important biomarker for the risk stratification, prognosis prediction, and therapy decision of severe patients with COVID-19. Few studies regarding chest CT characteristics related to the mortality of patients with COVID-19 have been reported.In this study, we aimed to explore the chest CT imaging features of patients who died from COVID-19, correlating with coexisting morbidity. This study will contribute to clinician for, comprehensiond treatment plan of COVID-19, cases having co morbid disease.

Material and methods

Study design and participants

In this retrospective study, we included patients of all age group with RT-PCR positive and CT Scan confirmed cases of COVID-19 who died between 1 August 2020 and 31 October 2020 in LN Medical college & Research Institute Bhopal (MP). We excluded patients who were alive/cured during the above period.

Definitions

Radiological diagnosis of COVID-19 disease-CT imaging is more reliable, feasible, and rapid method to diagnose and assess COVID-19 in comparison to RT-PCR[7,8] It is routinely utilized as a primary and more sensitive tool for diagnosis of COVID-19 in our country. All in-patients underwent a Chest CT scan on admission.

Outcome-The outcome of interest was in-hospital mortality following COVID-19 infection.

Co morbidity-On admission, patients were asked if they had a history of physician diagnosis (of) or medication use for the co morbidities listed below: DM, HTN, DM + HTN and other disease.

Chest CT acquisition-All chest scans images were obtained with one CT system (Optima 660, GE). The patients were scanned in supine position during breath holding. The main imaging parameters were: tube voltage = 120 kVp, automatic tube current modulation (30-70 mAs), pitch = 0.99-1.22 mm, matrix = 512 x 512, slice thickness = 10 mm, FOV = 350 mm X 350 mm. All images were then reconstructed with a slice interval of 0.625 to 1.250 mm.

CT image analysis[11]-All CT images were analyzed by three chest radiologist in consensus The main features of CT images were described as the following four patterns: ground glass opacity, consolidation, ground glass opacity with consolidation and other (linear opacities, traction bronchiectasis, cysts, and reticular opacities). Each of the twenty segments of six lung lobes was visually scored for the degree of lung involvements using a 2-point scale: 0, no involvement; 1, < 50% segment involvement; 2, > 50% segment involvement. The total CT severity score (the extent of pulmonary disease) was the sum of the twenty segments of six lobes of lung and defined as follows: 0, none; < 13, mild; 13-19.5, moderate; > 19.5, severe involvement of lung (white lung)[9]Table[1]

Table 1:CT SEVERITY SCORING INDEX[9]

Right Lung Segments	SCORE	Left Lung Segments	SCORE
Upper Lobe – Apex	0	Upper Lobe – Apex	0
Upper Lobe – Anterior	0	Upper Lobe – Anterior	0
Upper Lobe – Posterior	0	Upper Lobe – Posterior	0
Medial Middle Lobe	0	Superior Lingula	0
Lateral Middle Lobe	0	Inferior Lingula	0
Lower Lobe - Superior	0	Lower Lobe - Superior	0
Anterior Basal	0	Anterior Basal	0
Posterior Basal	0	Posterior Basal	0
Medial Basal	0	Medial Basal	0
Lateral Basal	0	Lateral Basal	0
Right Lung Total	**0**	**Left Lung Total**	**0**

Ct Severity Score – 0/40 (0 % Lung Involvement)

Total score=40

Score Guide: -

Table 2:Score Guide

Area Of Involvement	Score
No Involvement	**0**
< 50% Involvement	**1**
> 50% Involvement	**2**

CT Severity Score: -

Severe: -	> 19.5	> 50% Lung Involvement
Moderate: -	13 – 19.5	30 – 50% Lung Involvement
Mild: -	<13	< 30 % Lung Involvement

Results

A total of 2892 radiological confirmed COVID-19 patients admitted between 1 August 2020 and 31 October 2020 in LN Medical college & Research Institute Bhopal (MP). In terms of the outcome, 2830 were alive and 62 died during above period.

CT imaging features-Of 62 patients who died from COVID-19, ground glass opacities with consolidation was the most common feature in each of the twenty segments in 43 (69%) patients, followed by GGO in 19 (31%) and Consolidation in 17 (28%) patients. The most affected segments were posterior basal segments of each side of lung. Table[2].

Co-morbidity and CT severity score association-In fatal cases (62), overall one or more co-morbidities were present in 93.5%(58) of patients; DM, HTN and DM with HTN were present in 19 % (12), 37 % (23) and 37 % (23) of patients, respectively. However 21 % (12) had other disease also accompanied with above co-morbid diseases. Average CT severity score were maximum 27-28(65-70% lung involvement) in 81-90 year age group and were minimum 13-15(30-35 % lung involvement) in 30-40 year age group. Table[3]. Overall mild lung involvement (score <13) were in 7 (11%) patients (3-male & 4-female)(Figure-1); moderate lung involvement were in 10 (16%) patients (6-male & 4-female)(Figure- 2,3); and severe lung involvement were in 45 (73%) patients (34-male & 11-female)(Figure-4,5,6,7,8). Table [4].

Table 2:Image characteristics and CT severity score[13]

Rt. Lung segments	GGO	GGO with Consolidation	Consolidation	Other	Avg. CT severity Score
(A)UPPER LOBE-					
1.Apex	**08**	**39**	**08**	**01**	**1**
2.Anterior	**11**	**40**	**10**	**02**	**1**
3.Posterior	**23**	**50**	**18**	**03**	**1**
(B)Middle Lobe					
1.Medial	**12**	**40**	**10**	**02**	**1**
2.Lateral	**11**	**35**	**09**	**02**	**1**
(C)Lower Lobe –					
1.Superior	**18**	**45**	**15**	**04**	**2**
2.Anterior Basal	**21**	**44**	**18**	**01**	**1**
3.Posterior Basal	**40**	**55**	**36**	**08**	**2**
4.Medial Basal	**25**	**45**	**24**	**04**	**2**
5.Lateral Basal	**21**	**40**	**18**	**05**	**1**
Lt. lung segments					
UPPER LOBE –					
1.APEX	**09**	**38**	**09**	**03**	**1**
2.Anterior	**09**	**40**	**09**	**03**	**1**
3.Posterior	**21**	**48**	**20**	**03**	**1**
Lingular Lobe					
1.Superior	**13**	**39**	**11**	**03**	**1**
2.Inferior	**14**	**36**	**11**	**02**	**1**
Lower Lobe –					
1.Superior	**20**	**44**	**20**	**03**	**2**
2.Anterior Basal	**19**	**43**	**19**	**03**	**1**
3.Posterior Basal	**43**	**53**	**38**	**10**	**2**

Table 3:CT severity score in age group associated with co-morbid disease

Age group	With Co-morbid disease				Without co-morbid disease	Average CT severity score		Average lung involvement	
	DM	HTN	DM + HTN	Other illness accompanied with co-morbid disease		With co-morbid disease	Without co-morbid disease	With co-morbid disease	Without co-morbid disease
Below 30 yr	0	0	0	0	0	0		0	
30-40 yr	0	1	0	0	1	13-15	36-38	30-35%	90-95%
41-50 yr	2	1	0	0	0	20-22		50-55%	
51-60 yr	3	5	8	3	3	24-26	31-33	60-65%	75-80%
61-70 yr	5	8	7	5	0	20-21		50-55%	
71-80 yr	2	4	3	1	0	22-23		55-60%	
81-90 yr	0	4	5	4	0	27-28		65-70%	
Above 90 yr	0	0	0	0	0	0		0	
TOTAL	**12 (19 %)**	**23 (37%)**	**23 (37%)**	**13 (21%)**		**22-24**	**32-34**	**55-60%**	**80-85%**

Total patient died from COVID-19 = 62
Total died patient had co-morbid disease = 58 (93.5%)
Total died patients had no co-morbid disease = 4 (6.5%)

Table 4:CT Severity score in death cases

Score <13 (mild lung involvement)		**Score 13-19.5 (moderate lung involvement)**		**Score >19.5 (severe lung involvement)**	
Male	Female	Male	Female	Male	Female
3	4	6	4	34	11
Total = 7 (11%)		**Total = 10 (16%)**		**Total = 45 (73%)**	

Discussion

With the rapid spread of COVID-19 around the world. This study preliminarily demonstrated the features of the chest CT imaging in patient died from COVID-19, by lung segment-based analysis, the typical imaging features of GGO with consolidation was found in 69% (43) patients died from COVID-19, with an average severity score in patient with co-morbid disease was 22-24 which was and average lung involvement was 55-60%. Average severity score in patient without co-morbid disease was 32-34 and average lung involvement was 80-85%. Table[3]. Most affected segments was posterior basal segment of each lower lobe and most affected lobe was lower lobe of each lung. Table [2]. In our study patients who died from COVID-19 with co-morbid disease had low CT severity score in comparison with patients who had not associated with co-morbid disease. Table[4].Chest CT imaging plays an important role in the diagnosis and evaluation of COVID-19. The severe CT severity score of lung involvement in patients who died from COVID-19 was also significantly greater than those patients with mild to moderate lung involvement. Table[3].The outbreak of COVID-19 has had a strong impact worldwide. Almost all countries have suffered huge losses in health, society and economy[10] Our results may be of help to clinicians to provide early interventions for these patients and improve their survival rate.

CT Images of representative cases -

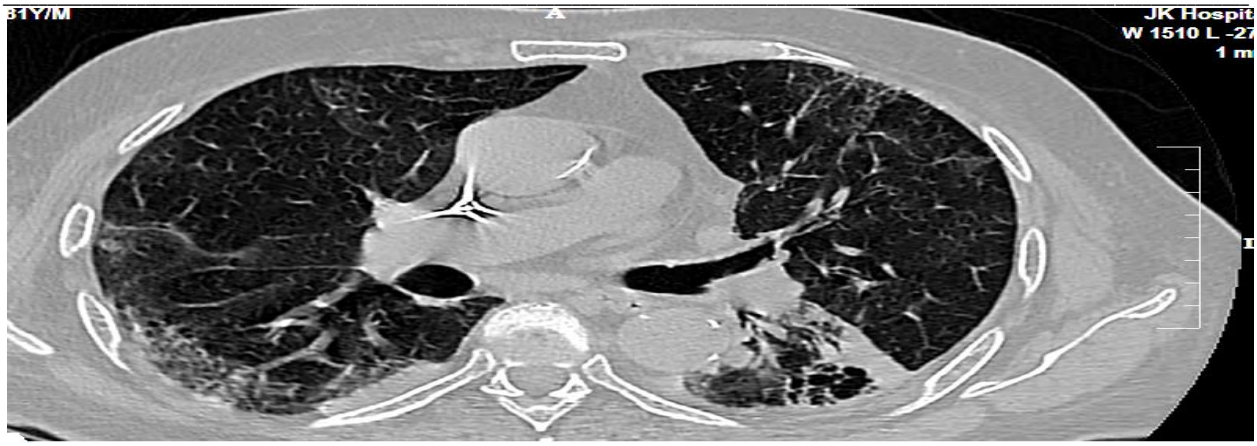

Fig 1:HRCT of co-morbid patient (HTN with CAD and Asthma) showing multiple discrete and confluent patches of GGO associated with cystic bronchiectasis in left lower lobe. CT severity score; 10-12 (Mild lung involvement).

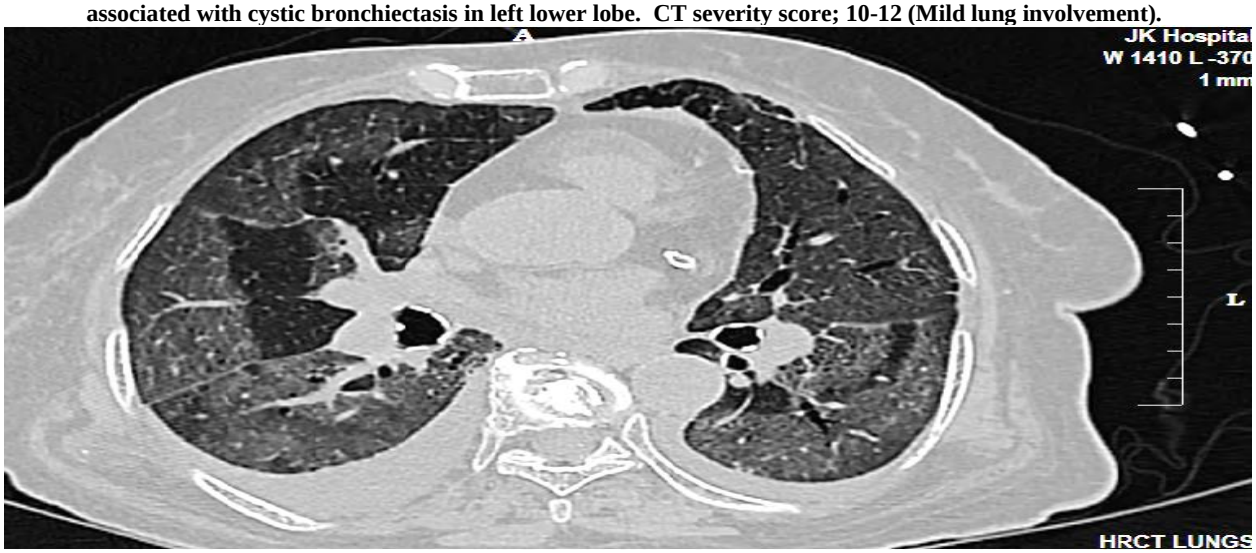

Fig 2:HRCT of co-morbid patient (DM with HTN) showing multiple confluent GGO with B/L Pleural effusion. CT severity score; 14-16 (Moderate lung involvement)

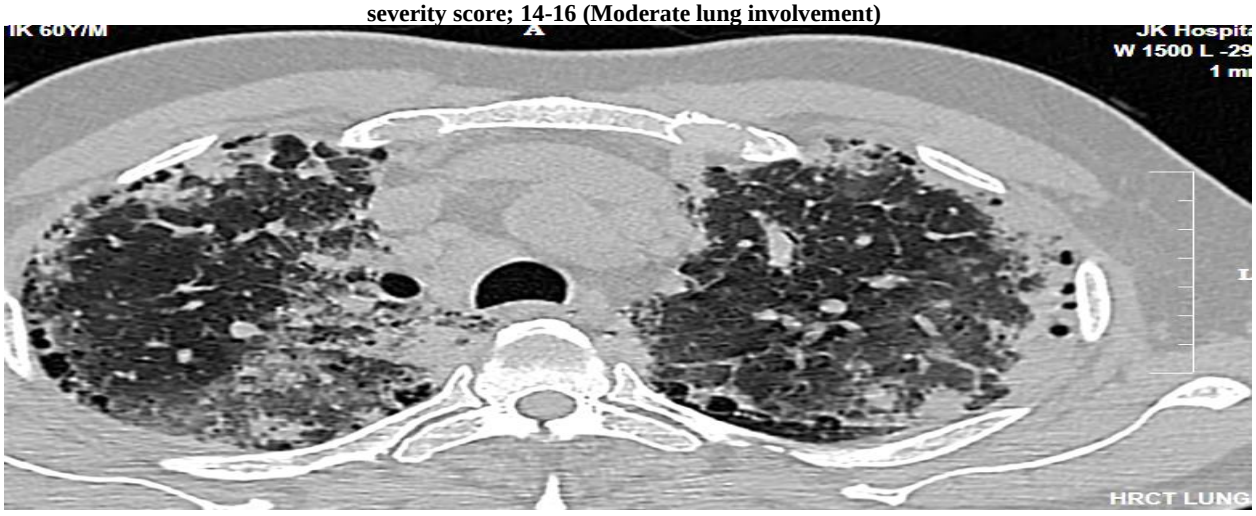

Fig 3:HRCT of co-morbid patient (DM) showing multiple discrete and confluent patches of GGO and paraseptal emphysematous changes in B/L upper lobe CT severity score; 16-18 (Moderate lung involvement).

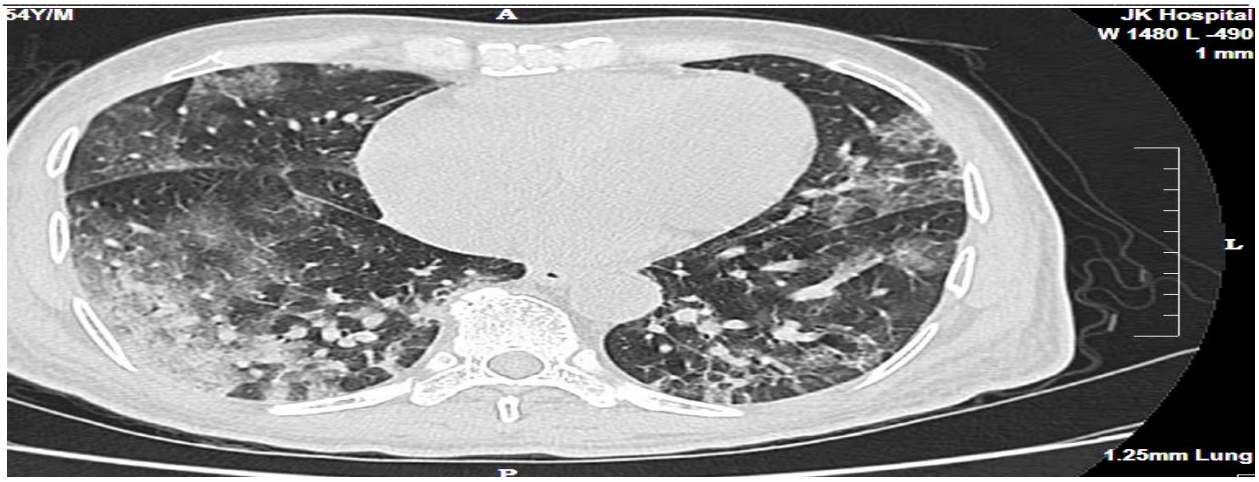

Fig 4:HRCT of co-morbid patient (DM) showing multiple confluent patches of GGO and consolidation. CT severity score; 28-30 (Severe lung involvement).

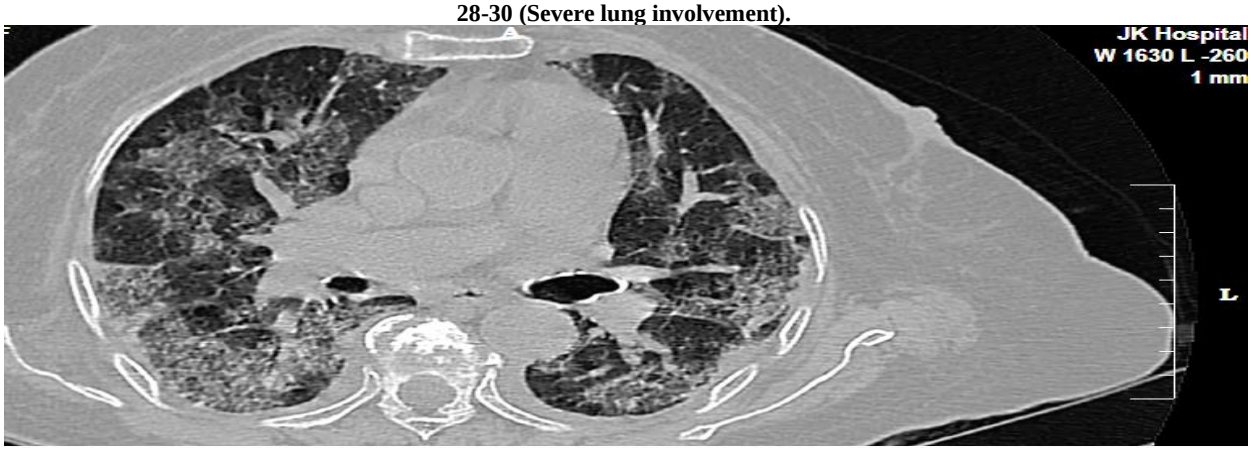

Fig 5:HRCT of co-morbid patient (HTN with CAD)showing multiple confluent patches of GGO and consolidation with interstitial septal thickening giving crazy paving appearance. CT severity score; 28-30 (Severe lung involvement).

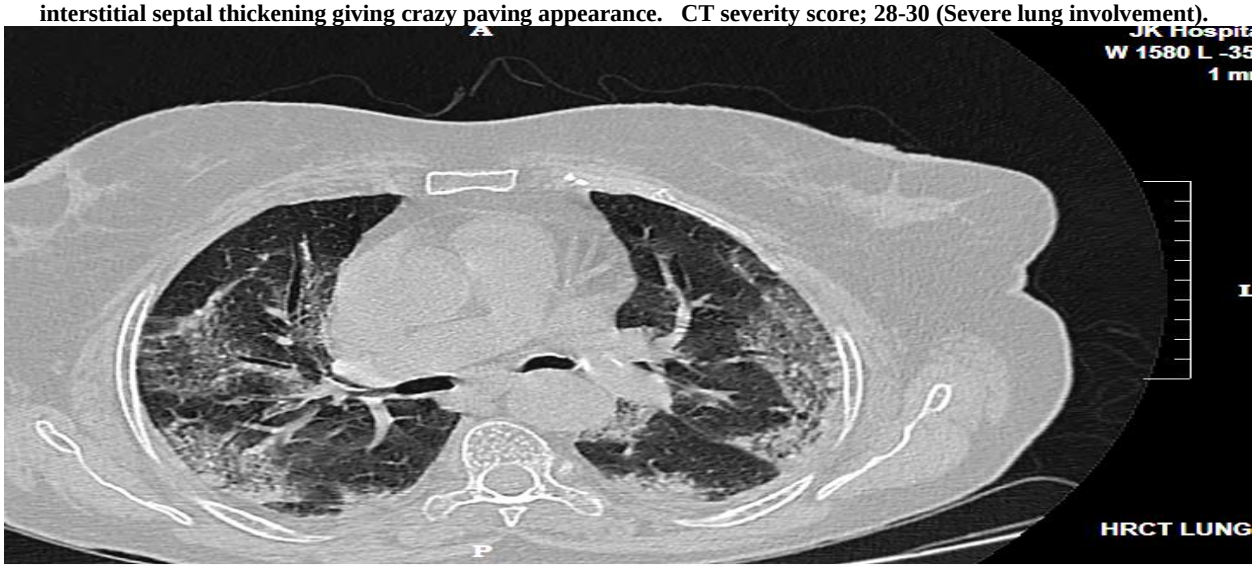

Fig 6:HRCT of co-morbid patient(HTN with CAD) showing multiple confluent patches of GGO and consolidation CT severity score; 22-24 (Severe lung involvement).

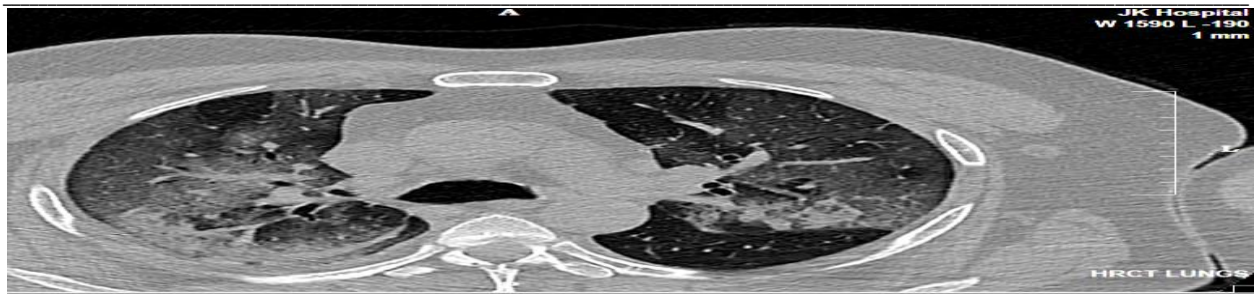

Fig 7:HRCT of co-morbid patient (DM with HTN) showing multiple confluent patches of GGO with minimal Pleural effusion along right oblique fissure. CT severity score; 28-30 (Severe lung involvement).

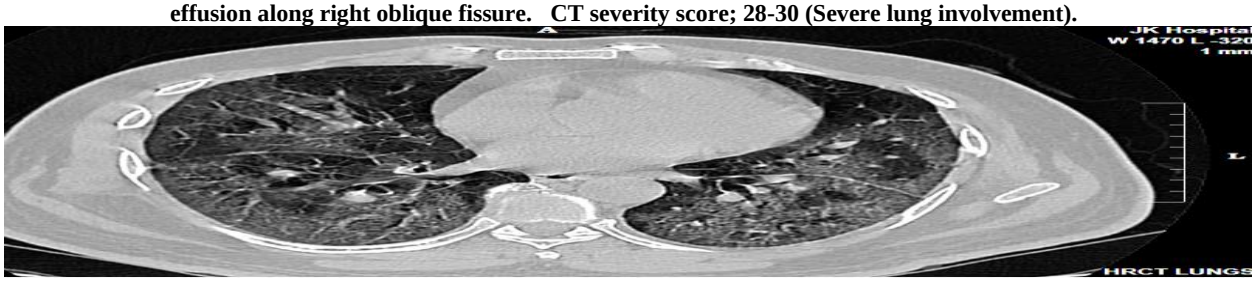

Fig 8:HRCT of Non co-morbid patient (HTN with CAD) showing multiple confluent patches of GGO and consolidation with interstitial septal thickening giving crazy paving appearance. CT severity score; 34-35 (Severe lung involvement).

Conclusion

Our findings suggest that increased CT severity score with co-morbid disease have an increased risk of in-hospital mortality following COVID-19. Severe lung involvement with no co morbid disease again had high incidence of mortality in COVID 19 cases. Overall our study suggest, association between CT severity score and co-morbid disease in mortality cases following COVID-19.

Abbreviations/Key words

DM: Diabetes Mellitus; HTN: Hypertension; COVID-19: Coronavirus disease 2019; CT: Chest Computed Tomography; RT-PCR: Real-time polymerase chain reaction; GGO: Ground glass opacity; WHO: World health organization; SARS-CoV-2: Severe acute respiratory syndrome coronavirus 2; CAD: Coronary artery disease.

.**References**

1. World Health Organization (WHO).https:// www.who.int/emergencies/diseases/novel-corona virus-2019/events-as-they-happen.
2. Wu z. and McGoogan J.M.,Characteristics of and important Lessos From the Coronavirus Disease 2019 (COVID-19) Outbreak in China: Summary of a Report of 72314Cases From the Chinese Center for Disease Control and Prevention. JAMA, 2020:1
3. Situation Report. https;//www.who .int/docs/ default-source/coronaviruse/situation-reports/ 202 00314-sitrep-54-covid-19.pdf? sfvrsn= dcd463 51_2.
4. Yang X., et al., Clinical course and outcomes of critically ill patients with SARS-CoV-2 pneumonia in Wuhan, China: a single-centered, retrospective, observational study. Lancet Respir Med, 2020;8(5):475-481
5. Pan F., et al., Time Course of Lung Changes On CT During Recovery From 2019 Novel Coronavirus (COVID-19) Pneumonia, Radiology, 2020:200370.
6. Shi H.,et al Radiological findings from 81 patients with COVID-19 pneumonia in Wuhan, China: a descriptive study. Lancet infect Dis, 2020; 20(4):425-235
7. Mahdavi A, Khalili N, Davarpanah AH, Faghihi T, Mahdavi A, Haseli et al. Radiologic management of COVID-19; preliminary experience of the Iranian Society of Radiology COVID-19 Consultant Group (ISRCC). Iran J Radiol 2020 (In Press).
8. 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; 2020 :200642.
9. Yang R., Li X, et al. Chest CT Severity Score:-An Imaging Tool for Assessing Severe COVID-19) RSNA Radiology:Cardiothoracic imaging.2020;2(2):1
10. Di Gennaro F., et al., Coronavirus Disease (COVID-19) Current Status and Future Perspectives: A Narrative Review. Int J Environ Res Public Health, 2020; 17(8):98
11. Hu Y, Zhan C, Chen C, Ai T, Xia L .Chest CT findings related to mortality of patients with COVID-19: A retrospective case-series study. PLoS ONE 2020;15(8):e0237302.
12. Zhou F., et al.,Clinical course and risk factors for mortality of adult in patients with COVID-19 in Wuhan,China: a retrospective cohort study.Lancet 2020;395:1054-62
13. Rastad h., Karim h., Ejtahed H. et al. Risk and predictors of in-hospital mortality from COVI D-19 in patients with diabetes and cardiovascular disease. Diabetol Metab syndr. 2020;12:57

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