Original Research Article

Correlation of mortality in young COVID-19 patients with CT scoring of CT Chest, in tertiary care centre - (A Retrospective analysis)

Anoop Kumar Singh[1], Ratan Kumar[2], Pratipal Rajpali [3], Pranav Kumar Dave[4*], Narmada Patel[5]

[1] PG, Resident, Department of Pulmonary Medicine, L N Medical College and J K Hospital, Kolar Road, Bhopal, 462042, MP, India

[2] Professor & HOD,Department of Pulmonary Medicine, L N Medical College and J K Hospital, Kolar Road, Bhopal, 462042, MP, India

[3]PG, Resident, Department of Radio-Diagnosis, L N Medical College and J K Hospital, Kolar Road, Bhopal, 462042, MP, India

[4]Prof., Department of Radio-Diagnosis, L N Medical College and J K Hospital, Kolar Road, Bhopal-462042, MP, India

[5]Prof., Department of Medicine, L N Medical College and J K Hospital, Kolar Road, Bhopal-462042, MP, India

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Abstract

Background: Coronavirus disease 2019 (COVID-19) is the most recent global health emergency, which first developed at the end of 2019 in China, (Wuhan). It is caused by a beta-coronavirus called coronavirus 2 (SARS-CoV).Chest Computed Tomography (CT) plays an important role in screening, diagnosing, and evaluating the progress of the disease.Ground-glass opacification, consolidation, linear opacities, and crazy-paving pattern are the predominant patterns of COVID-19 on CT scan.We aimed to determine CT chest findings in mortality cases of COVID-19 patients up-to the age of 45 years in tertiary care centre. **Methods:-**37 patients up-to the age of 45 years who died from COVID-19 were retrospectively included in this study. CT scan data of the patients were collected from medical records. The data was summarized. The CT severity score was analyzed. **Results:** 1854 patients admitted in our hospital from 1April2021 to 31 May 2021 with COVID-19 disease, in which 214 patients died due to covid-19 disease .Out of 214 total deaths 37 deaths occur up-to the age of 45 years. The mean age of patients was 38.16 years. Of which 28 (76%) were men and 09(24%) were women.GGO with consolidation was the most common feature for the lung. Six lobes of lung were divided into total 20 segments. Each segment was scored 0, 1 and 2 depending on the status of involvement. All segments total scored 40.Severity of disease was categorized into Mild <13, Moderate 13-19.5, and Severe >19.5 score. The CT severity score was rated as severe in 84%(31) of patients, moderate in 16% (06) patients, and mild in 0% (0) of patients. **Conclusion**: Our findings suggest that in death cases due to covid-19 in 2nd wave, the CT chest pattern, CT severity score and percent of lung involvement is almost same irrespective of age group up-to the age of 45 years.

Introduction

Coronavirus disease 2019 (COVID-19) is the most recent global health emergency, which first developed at the end of 2019 in China, (Wuhan). It is caused by a beta-coronavirus called coronavirus 2 (SARS-CoV-2)[1,2].Early diagnosis of COVID-19 is very important for rapid clinical interventions and patient isolation[3].Fever, dry cough, sore throat, and fatigue are the main clinical manifestations of COVID-19. Also, acute respiratory distress syndrome (ARDS) may rapidly develop in seriously ill patients[4,5].

A specific viral test using real reverse transcriptase polymerase chain reaction (RT-PCR) was quickly developed to confirm the diagnosis of COVID-19. Although it is considered the gold standard test for diagnosis, however, some patients might have false-negative results[5].Chest Computed Tomography (CT) plays an important role in screening, diagnosing, and evaluating the progress of the disease.

**Correspondence*
Dr. Pranav Kumar Dave
Professor, Department of Radio-Diagnosis, L N Medical College & J K Hospital, Kolar Road, Bhopal- 462042, MP, India
E-Mail: pranavkdave@rediffmail.com

Also, it may manifest abnormalities earlier than RT-PCR testing and yields a typical pattern with 97% sensitivity[6,7].The Coronavirus disease reporting and data system (CO-RADS) classification was developed based on CT findings aiming to standardize CT report in different COVID-19 patients, which will be helpful in clinical diagnosis and research applications[8].Ground-glass opacification, consolidation, linear opacities, and crazy-paving pattern are the predominant patterns of COVID-19 on CT scan. However, other minor signs such as air bronchogram, pulmonary nodules, cavitation, pleural and pericardial effusion, bronchiectasis, pneumothorax, and mediastinal lymphadenopathy were also noted[9].Due to the high severity of the disease, clinicians should be aware of the different potential risk factors associated with fatal outcome[10,11], so a chest CT severity scoring system was designed for assessment of the severity of lung disease in COVID-19 patients[12]

In this study, we aimed to find out the chest CT imaging features of patients up-to the age of 45 years who died from COVID-19. This study will contribute to clinician, comprehension and treatment plan for COVID-19 patients.

Material and methods

Study design and participants

In this retrospective study, we included patients up-to the age of 45 years with RT-PCR positive and CT-Scan confirmed cases of COVID-19 who died between 1 April 2021to 31 May 2021 in LN

Medical college & Research Institute Bhopal (MP). We excluded patients who were alive/cured and patients who died above the age of 45 year during the above study 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[13,14]. 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 in patients up-to the age of 45 years following COVID-19 infection.

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[15]

All CT images were analyzed by three chest radiologists 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)[16]. Table[1]

Table 1:CT SEVERITY SCORING INDEX

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

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 1854 radiological confirmed COVID-19 patients admitted between 1 April 2021to 31 May 2021 in LN Medical college & Research Institute Bhopal (MP). In terms of the outcome, 1640 were alive and 214 died during above period. Out of 214 deaths 37 deaths occur up-to the age of 45 years of the patients.

CT imaging features

Of 37 patients who died from COVID-19 up-to the age of 45 years, ground glass opacities with consolidation was the most common feature in each of the twenty segments in 25 (68%) patients, followed by GGO in 11 (30%) and Consolidation in 10 (26%) patients. The most affected segments were posterior basal segments of each side of lung. Table[2].

CT severity score association

Average CT severity score was almost equal in all age group patients up-to the age of 45 years (23-25) and average lung involvement was 60-65% who died due to COVID-19 disease. Table[3]. Overall mild lung involvement (score <13) was in 0 (0%) patient, moderate lung involvement were in 06 (16%) patients (4-male &2-female)(Figure- 2,4); and severe lung involvement were in 31 (84%) patients (24-male &07-female)(Figure-1,3,5,6). Table [4].

Table 2:Image characteristics and CT severity score[17]

Rt. Lung segments	GGO	GGO with Consolidation	Consolidation	Other	Avg. CT severity Score
(A)UPPER LOBE-					
1.APEX	**05**	**24**	**05**	**01**	**1**
2.ANTERIOR	**07**	**24**	**06**	**01**	**1**
3.POSTERIOR	**14**	**30**	**11**	**02**	**1**

(B)MIDDLE LOBE					
1.MEDIAL	**07**	**25**	**06**	**02**	**1**
2.LATERAL	**06**	**20**	**05**	**01**	**1**
(C)LOWER LOBE –					
1.SUPERIOR	**11**	**27**	**09**	**02**	**2**
2.ANTERIOR BASAL	**12**	**26**	**10**	**02**	**2**
3.POSTERIOR BASAL	**24**	**33**	**22**	**04**	**2**
4.MEDIAL BASAL	**15**	**26**	**14**	**03**	**2**
5.LATERAL BASAL	**12**	**16**	**09**	**04**	**1**
Lt. lung segments					
UPPER LOBE –					
1.APEX	**06**	**23**	**04**	**02**	**1**
2.ANTERIOR	**06**	**25**	**04**	**03**	**1**
3.POSTERIOR	**13**	**29**	**12**	**03**	**1**
LINGULAR LOBE					
1.SUPERIOR	**08**	**24**	**06**	**01**	**1**
2.INFERIOR	**07**	**21**	**05**	**02**	**1**
LOWER LOBE –					
1.SUPERIOR	**12**	**26**	**10**	**02**	**2**
2.ANTERIOR BASAL	**11**	**25**	**09**	**03**	**1**
3.POSTERIOR BASAL	**25**	**32**	**21**	**05**	**2**
4.MEDIAL BASAL	**14**	**27**	**13**	**02**	**2**
5.LATERAL BASAL	**11**	**17**	**10**	**03**	**1**

Table 3:Average CT severity score and Average lung involvement in the mortality cases of different age groups

Age groups	No of dead patients	Average CT severity score	Average lung involvement
Below 20 yrs	2	22-24	55-60%
20-25 yrs	7	24-26	60-65%
26-30 yrs	6	25-27	65-70%
31-35 yrs	8	24-26	60-65%
36-40 yrs	6	22-24	55-60%
41-45yrs	8	23-25	60-65%
TOTAL	37	23-25	60-65%

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
0	0	4	2	24	7
Total = 00(00%)		**Total = 06(16%)**		**Total = 31(84%)**	

Discussion

With the rapid spread of COVID-19 around the world,this study preliminarily demonstrated the features of the chest CT imaging in patient who died from COVID-19 up-to the age of 45 years, by lung segment-based analysis, the typical imaging features of GGO with consolidation was found in 68% (25) patients, GGO in 11 (30%) patients and Consolidation in 10 (26%) patients who died from COVID-19, with an average severity score of 23-25 and average lung involvement was 60-65%. Table[3]. Most affected segment was posterior basal segment of each lower lobe and most affected lobe was lower lobe of each lung. Table [2].

1854 patients admitted in our hospital from 1April 2021 to 31 May 2021 with COVID-19 disease, in which 214 patients died due to covid-19 disease. Out of 214 total deaths 37 deaths occured up-to the age of 45 years. The mean age of patients was 38.16 years. Of which 28 (76%) were men and 09(24%) were women. Out of 37 dead patients the CT severity score was rated as severe in 84% (31) (24- males, 07- females) of patients, moderate in 16% (06) (4-males, 02-females) patients, and mild in 0% (0) of patients.

Chest CT imaging plays an important role in the early diagnosis and evaluation of COVID-19 patients. 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 help clinicians to provide an early intervention for these patients and improve their survival rate.

CT Images of representative cases

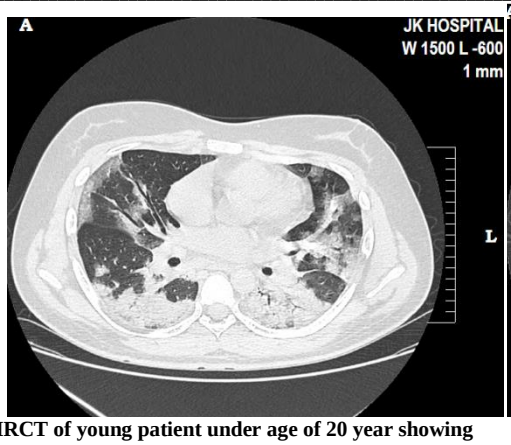

Fig 1:HRCT of young patient under age of 20 year showing multiple discrete and confluent patches of GGO with consolidation and septal thickening giving crazy paving appearance CT severity score; 24-26 (Severe lung involvement).

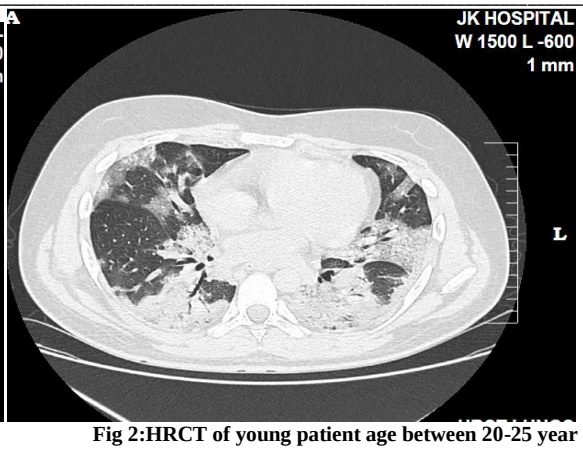

Fig 2:HRCT of young patient age between 20-25 year showing multiple confluent patches of GGO with consolidation CT severity score; 17-19 (Moderate lung involvement).

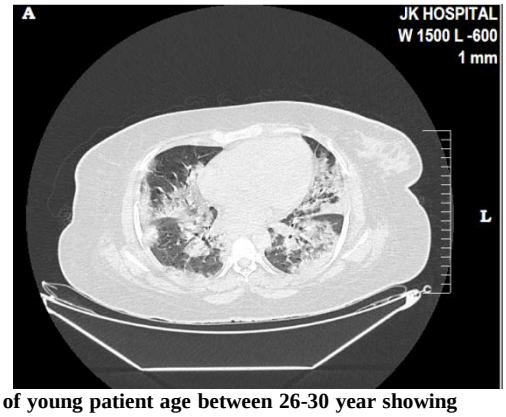

Fig 3:HRCT of young patient age between 26-30 year showing multiple discrete and confluent patches of GGO with consolidation and septal thickening and minimal pleural effusion along left oblique fissure CT severity score; 23-25 (Severe lung involvement).

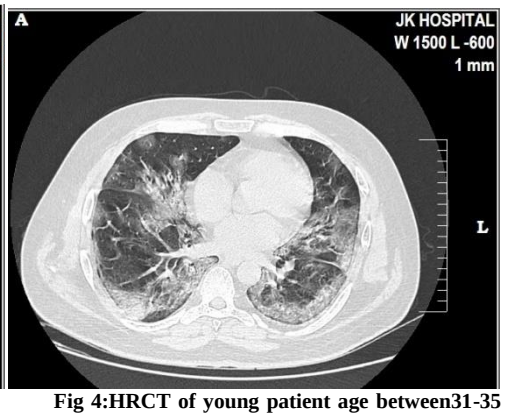

Fig 4:HRCT of young patient age between31-35 year showing multiple discrete and confluent patches of GGO with septal thickening CT severity score;16-18(Moderate lung involvement).

Fig 5-HRCT of young patientage between36-40 year showing multiple patches of consolidation and septal thickening giving crazy paving appearance. CT severity score; 24-26 (Severe lung involvement).

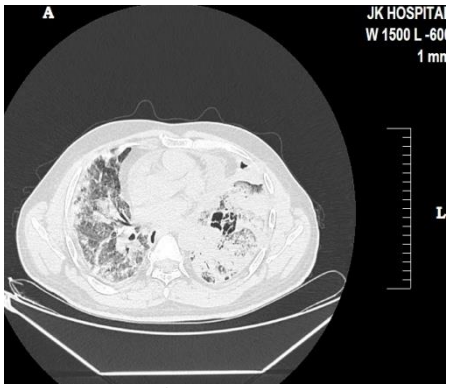

Fig .6-HRCT of young patient age between41-45 year showing multiple discrete and confluent patches of GGO with cavitatory consolidation and septal thickening CT severity score; 32-34 (Severe lung involvement).

Conclusion

Our findings suggest that in death cases due to covid-19 in 2nd wave, the CT chest pattern, CT severity score and percent of lung involvement is almost same irrespective of age group up-to the age of 45 years.

Abbreviations

COVID-19: Coronavirus disease 2019; CT: Chest computed tomography; RT-PCR: Real-time polymerase chain reaction; GGO: Ground glass opacity;SARS-CoV-2:Severe Acute Respiratory Syndrome coronavirus 2; ARDS: Acute Respiratory Distress Syndrome;CO-RADS:Corona Virus Disease Reporting And Data System

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