ORIGINAL RESEARCH PAPER

Radiodiagnosis

IMAGING MANIFESTATION OF COVID 19 IN RT-PCR POSITIVE CASES: WITH ASSOCIATED PULMONARY COMPLICATIONS.

KEY WORDS: CT (computed tomography), GGO's (ground glass opacities), SARS-CoV-2; COVID-19.

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ABSTRACT

INTRODUCTION:- COVID-19 is the infectious disease caused by the coronavirus, SARS-CoV-2, which is a respiratory pathogen. WHO first learned of this new virus from cases in Wuhan, People's Republic of China on 31 December 2019. It quickly spread to other countries and was declared a pandemic in March 2020 by the World Health Organization (1,2). With 46,963 new coronavirus infections being reported in a day, India's COVID-19 caseload rose to 81,84,082, while the number of people who have recuperated from the disease surged to 74.91 lakh, according to the Union Health Ministry on 2nd nov 2020. In this article, we review the typical imaging findings in COVID-19, the differential diagnoses, and common complications. **AIM AND OBJECTIVE:-** We aimed to explore the chest CT features of the patients who were RT-PCR positive, along with imaging of associated pulmonary complications. **RESULTS:-** In our study, out of 250 pateints who found to be RT-PCR positive, 203 patients (81.2%) had abnormal CT findings and 47 pateints(18.8%) had normal chest CT scan. In our study common imaging finding were GGO (81.20%), crazy paving (23.60%) , fibrosis (24.8%), nodes(7.2%) nodules(8.4%), pleural effusion(13.2%), cavity consolidation (5.2%) and pleural thickening (8.4%) were found. **CONCLUSION:-** In this study CT imaging helped in evaluation of common findings of COVID 19 infection and its associated pulmonary and vascular complications. Patients with confirmed COVID-19 pneumonia have typical imaging features that may be helpful in early screening of highly suspected cases and in evaluating the severity and extent of the disease.

Introduction

With 46,963 new coronavirus infections being reported in a day, India's COVID-19 caseload rose to 81,84,082, while the number of people who have recuperated from the disease surged to 74.91 lakh, according to the Union Health Ministry on 2nd nov 2020. In this article, we review the typical imaging findings in COVID-19, the differential diagnoses, and common complications. It has become apparent that although COVID-19 predominantly affects the respiratory system, many other organ systems can also be involved. Imaging plays an essential role in the diagnosis of all manifestations of the disease, as well as its related complications, and proper utilization and interpretation of imaging examinations is crucial. Although SARS-CoV-2 disease (or coronavirus disease 2019 [COVID-19]) primarily manifests as a lung infection, with symptoms ranging from those of a mild upper respiratory infection to severe pneumonia and acute respiratory distress syndrome (ARDS), other multisystemic manifestations of this disease and related complications are becoming more commonly recognized (3). With the growing global COVID-19 outbreak, a comprehensive understanding of the diagnostic imaging hallmarks, imaging features, multisystemic involvement, and evolution of imaging findings is essential for effective patient management and treatment.

Chest imaging should be carefully indicated in patients with suspected COVID-19 infection not only to reduce the patient´s radiation exposure but also to reduce unnecessary exposure of other patients and healthcare workers, and to rationalize the use of personal protective equipment and resources for disinfecting the patient care equipment (9).

CT should be performed in hospitalized and symptomatic patients with clinical worsening and/or patients who have comorbidities (4-5)

In these patients, CT is indicated mainly to assessthe extent of the disease and to identify complications, such as pulmonary thromboembolism or overlapping bacterial infection, and to evaluate differential diagnoses.

Aim and objective: to evaluate the CT features of the patients who were RT-PCR positive, along with imaging of associated pulmonary and vascular complications, in a single institute.

Materials and Methods

This study was approved by the Ethical Committee of Sri aurobindo medical college and PG institute, indore . Informed consent for this study was taken. The anonymous data was collected and analyzed.

A total of 250 patients confirmed COVID-19(RT-PCR POSITIVE) were undergone CT chest. The total CT severity score and quantitative CT features were calculated by expert radiologists. The clinical and CT imaging features of different types were analyzed.

Patients and Chest CT

From may 14, 2020, until dec. 29, 2020, patients admitted to single hospital, sri aurobindo medical college and PG institute, in indore, Madhya pradesh with confirmed COVID-19 and who underwent chest CT were enrolled in our study. Realtime fluorescence polymerase chain reaction of nasopharyngeal swab or sputum samples methods were positive for the COVID-19 twice. In addition to age and sex, clinical information collected included severity.

All scans were performed without intravenous contrast with the patient in the supine position during end-inspiration. And at least one chest CT is performed at the onset of the disease. Along with the initial chest CTs evaluated; if a patient had a follow-up CT during the study time window, it was also analyzed for this study.

Statistical Methods

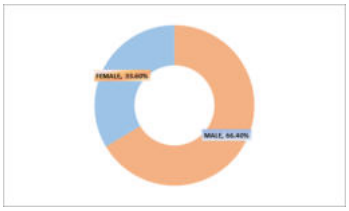
Statistical analyses were performed. Quantitative data were presented as mean±standard deviation (minimum-maximum) and the counting data were presented as the percentage of the total unless otherwise specified.

The comparisons of the counting data of clinical and CT features were evaluated using chi-square test or Fisher's exact test. A p-value of <0.05 was defined as statistical significance.

Results

Table no. 1 distribution on the basis of sex.

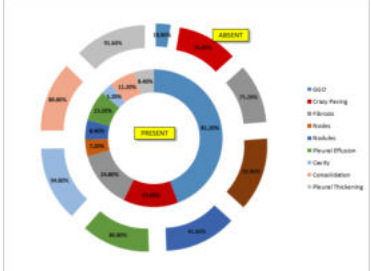
GENDER	NUMBER	PERCENTAGE
MALE	166	66.40%
FEMALE	84	33.60%



Graph no. 1 distribution on the basis of sex.

Table no. 2 imaging findings of covid 19

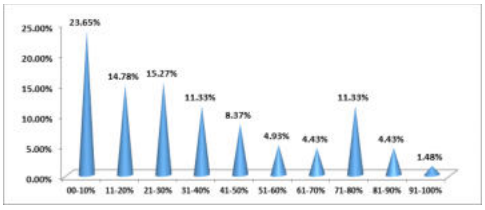
VARIABLE		AGE GROUP									TOTAL	%
		00-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	Above 80		
GROUND GLASS OPACITY	PRESENT	1	4	23	32	42	42	47	10	2	203	81.20 %
	ABSENT	1	3	10	7	10	10	3	2	1	47	18.80 %
CRAZY PAVING	PRESENT	0	1	0	5	13	18	17	4	1	59	23.60 %
	ABSENT	2	6	33	34	39	34	33	8	2	191	76.40 %
FIBROSIS	PRESENT	0	0	3	12	12	14	17	3	1	62	24.80 %
	ABSENT	2	7	30	27	40	38	33	9	2	188	75.20 %
NODES	PRESENT	0	2	3	2	6	3	1	1	0	18	7.20 %
	ABSENT	2	5	30	37	46	49	49	11	3	232	92.80 %
NODULES	PRESENT	1	3	3	2	7	2	2	0	1	21	8.40 %
	ABSENT	1	4	30	37	45	50	48	12	2	229	91.60 %
PLEURAL EFFUSION	PRESENT	0	1	2	3	8	10	7	2	1	33	13.20 %
	ABSENT	2	6	31	36	45	42	43	10	2	217	86.80 %
CAVITY	PRESENT	1	3	3	0	2	3	0	0	1	13	5.20 %
	ABSENT	1	4	30	39	50	49	50	12	2	237	94.80 %
CONSOLIDATION	PRESENT	1	2	5	1	6	6	5	2	0	28	11.20 %
	ABSENT	1	5	28	38	46	46	45	10	3	222	88.80 %
PLEURAL THICKENING	PRESENT	0	0	2	2	7	6	4	0	0	21	8.40 %
	ABSENT	2	7	31	37	45	46	46	12	3	229	91.60 %



graph no.2 imaging findings of covid 19

Table no. 3 distribution according to the lung parenchymal involvement.

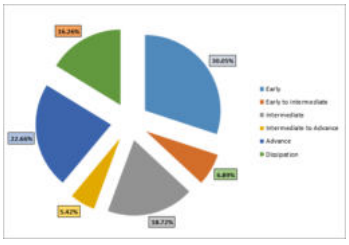
PARENCHYMAL INVOLVEMENT	NUMBER	PERCENTAGE
00-10%	48	23.65%
11-20%	30	14.78%
21-30%	31	15.27%
31-40%	23	11.33%
41-50%	17	08.37%
51-60%	10	04.93%
61-70%	9	04.43%
71-80%	23	11.33%
81-90%	9	04.43%
91-100%	3	01.48%
TOTAL	203	100.00%



Graph no. 3 distribution according to the lung parenchymal involvement.

Table no. 4 distribution on the basis of stages of lung parenchymal involvement

STAGES OF INVOLVEMENT	NUMBER	PERCENTAGE
Early	61	30.05%
Early to Intermediate	14	6.89%
Intermediate	38	18.72%
Intermediate to Advance	11	5.42%
Advance	46	22.66%
Dissipation	33	16.26%
TOTAL	203	100.00%



Graph no. 4 distribution on the basis of stages of lung parenchymal involvement

Discussion- We comprehensively evaluated and analyzed the radiographic characteristics of 250 patients with COVID-19 pneumonia from the dept of radiodiagnosis, sri aurobindo medical college and PG institute indore. 66.4% were males and 33.6%were females in our study. In our study, typical imaging features, such as GGO (81.20%), crazy paving (23.60%) , fibrosis (24.8%), nodes(7.2%) nodules(8.4%), pleural effusion(13.2%), cavity consolidation (5.2%) and pleural thickening (8.4%) were found. Regarding lesion distribution, patients with COVID-19 were more likely to have peripheral distribution (87.1%), bilateral involvement (82.2%), lower lung predominance (54.5%), and multifocal distribution (54.5%), which are consistent with results of previous studies [6].

All patients were divided into early (61 cases 30%), early to intermediate(14 cases, 6.8%), intermediate (38 cases 18.7%), intermediate to advance (11 cases, 5.4%), advanced (46 cases 22.6%), dissipation(33 cases 16.2%) , according to the

percentage of lung parenchymal involvement.We call stage of dissipation on the basis of comparative study,as the previous scan was available for comaprision.

Pneumonia assessment, the lesion and lobe information were extracted to realize quantitative analysis of pneumonia. A CT severity score was used to quantitatively estimate the pulmonary involvement of all these abnormalities based on the area involved (7)

Each of the 5 lung lobes was scored, from 0 to 4 as:
0, no involvement;
1, 1%~25% involvement;
2, 26%~50% involvement;
3, 51%-75% involvement;
4, 76%~100% involvement.

The overall lung "total severity score" was the sum of the 5 lobe scores and ranged from 0 (no involvement) to 20 (maximum involvement). In this experiment, we also calculated the distribution of these quantitative analysis results and lung severity score of patients with different clinical types.

Common findings-
CT of patients with COVID-19 may also show signs of organizing pneumonia,reversed halo sign, reticular pattern, subpleural curvilinear lines, parenchymal bands, pseudocavities, and nodules, sometimes configuring the halo sign (8-10). Airway centered disease such as bronchial wall thickening, centrilobular and tree in bud opacities, pleural effusion, and lymphadenopathy are not frequently encountered at the initial presentation of COVID-19 (8).

Mediastinal lymphadenopathy
Although a very uncommon finding, according to our recent systematic review, mediastinal lymphadenopathy can be seen in patients with COVID-19 [11,12].

Lancet infectious disease describes mediastinal lymph nodes enlargementasacommon ndingincriticallyillCOVID-19patients.Therefore, lymphadenopathy should not be considered as an atypical feature of COVID-19, particularly in severely ill patients [13]

GGO's and crazy paving-
Unless pulmonary edema is also present, septal lines and pleural effusions are not expected findings. In the acute exudative phase of ARDS, within the first week, CT demonstrates diffuse GGOs in a posterior and basal predominance, and a crazy-paving pattern may also be depicted (Fig 13). The crazy-paving appearance is thought to be attributable to superimposition of thick interlobular septa on GGOs and was detected in 36% of patients with COVID-19 (14).

IMAGING CLASSIFICATION	RATIONALE	CT FEATURES
TYPICAL APPEARANCE	Commonly reported imaging features of greater specificity for covid 19 Pneumonia	• Peripheral bilateral GGOs with or without consolidation or visible interlobular line (crazy paving pattern.) • Multifocal GGOs or rounded morphology with or without Consolidation or visible interlobular line (crazy paving pattern} • Reverse halo sign or other findings or • Organizing pneumonia (seen latter in the disease)
INTERMEDIATE APPEARANCE	Nonspecific imaging features	Absence of typical features & presence of the following features • multifocal,diffuse,perihilar,or unilateral GGO with or without consolidation, • Lacking a specific distribution and that are nonrounded or nonperipheral • Few small GGOs,with a nonrounded and nonperipheral distribution.
ATYPICAL APPEARANCE	Uncommonly or not reported features of covid 19 pneumonia	Absence of typical and intermediate features and the presence of the following features • Isolated lobar or segmental consolidation without GGO's, discrete small nodules (centrilobular,"tree in bud" appearance); • lung cavitation , • smooth interlobular septal thickening with pleural effusion.
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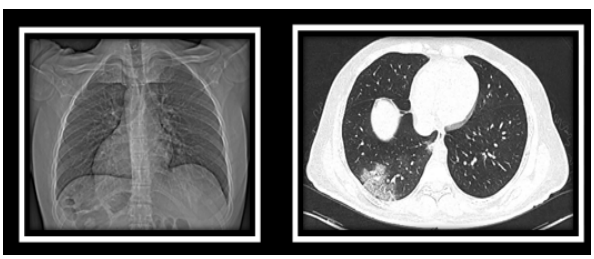

Figure 1- 28 year old male presented with complaints of high grade fever, and headache. (A) xray chest was normal. (B) CT chest showed patchy areas of ground glasss attenuation in posterior and medial segments of right lower lobe(crazy paving)- early stage with 10-15 % lung parenchymal involvement.

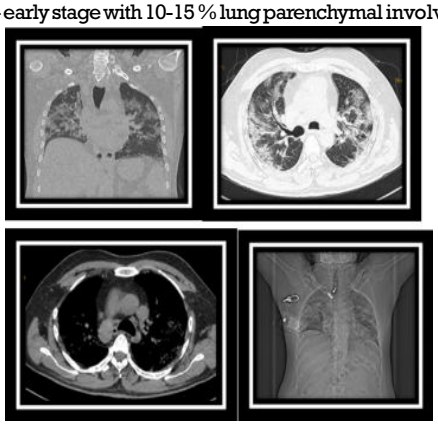

Figure 2- Diffuse areas of ground-glass attenuation (crazy paving pattern) seen in the entire both lung segments, with bilateral minimal pleural thickening and mediastinal lymphadenopathy. Advance stage, Aprrox 70-75 % lung parenchymal involvement.
CT score 24/25
Corad -6

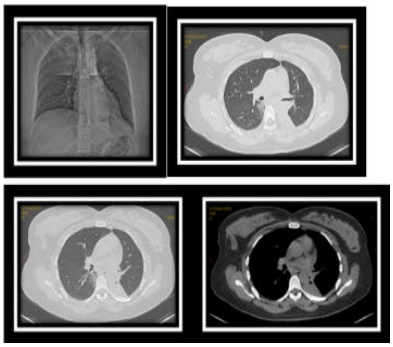

Figure 3 - Few small patches of ground glass attenuation , seen in medial segment of right lower lobe. Changes of collapse consolidation in left lower lobe, early stage – aprrox 5-8 % lung parenchymal involvement.

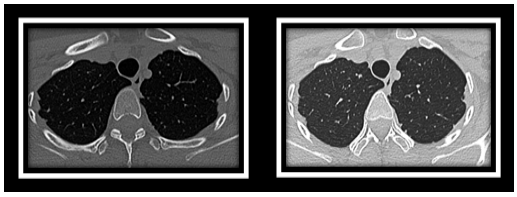

Figure 4- Few small subpleural band shaped areas seen in both upper lobe segments (along pleura).

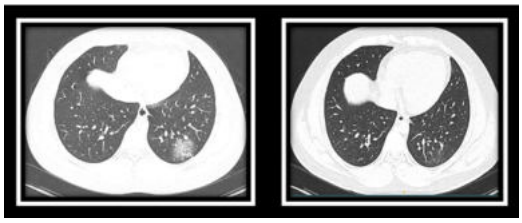

Figure 5- (A) few patchy areas of ground glass attenuation is seen in posterior segment of left lower lobe (B) follow up scan after 50 days showed, Still seen, small residual area (2.6 x 1.6 cm) of high attenuation with inter/intra-lobular septal thickening in posterior segment of left lower lobe. Rest of the ground glass attenuation area has been resolved as mention in previous report. Above described findings reveals small patch of residual high attenuation area suggest resolution stage of Covid infection (1-2 % of lung parenchymal involvement).

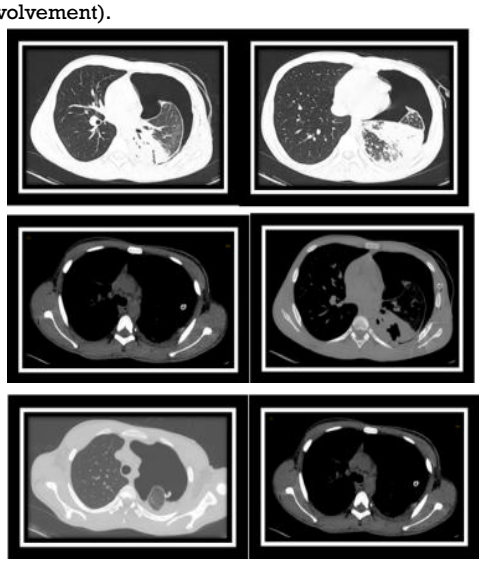

Figure 6- in a RT-PCR positive patient, Cavitatory lesion in the apical segment of left lower lobe. Also seen adjacent dense consolidation and centrilobular nodules in rest of the left lower lobe segment. Mild bilateral pleural effusion and moderate left pneumothorax.

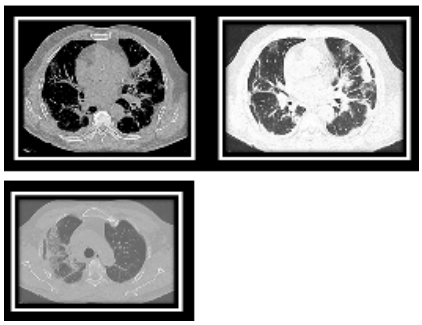

Figure 7- Dense areas of ground glass attenuation with irregular areas of thick fibrotic stranding seen scattered in entire both lung segments sparing the left upper lobe segments. Minimal bilateral pleural effusion is seen. Above described findings suggest active Covid infection .(intermediate to advanced stage -approx 45-50% lung parenchymal involvement).

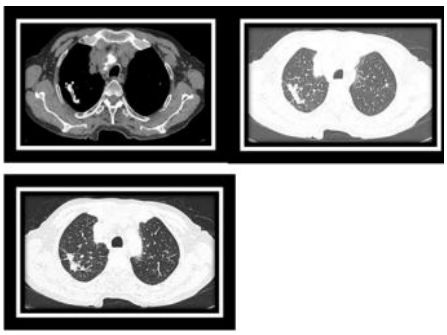

Figure 8- Few tiny nodules are seen scattered in both lung apex.Irregular areas of fibrosis in right lung apex and left lingula. Centriacinar emphysematous changes predominantly in upper lobes.

Figure 9- Partially occluding thrombus seen in lower lobe segmental branches of right pulmonary artery.

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