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RADIOLOGICAL PRESENTATIONS OF FIRST AND SECOND WAVES OF COVID- 19 INFECTION - COMPARATIVE STUDY

Radiodiagnosis

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KEYWORDS

INTRODUCTION

In December 2019, a large outbreak of a novel corona virus infection occurred in Wuhan, Hubei Province, China. In humans, corona viruses are among the spectrum of viruses that cause the common cold as well as more severe respiratory diseases specifically, Severe acute respiratory syndrome (SARS) and Middle East respiratory syndrome(MERS), which have mortality rates of 10% and 37%, respectively; both SARS and MERS are zoonotic infections. The novel corona virus that was named severe acute respiratory syndrome corona-virus 2 (SARS-CoV-2) by the International Committee on Taxonomy of Viruses caused a pneumonia outbreak in China.

In India the first case of COVID-19 infection was reported in Kerala on January 27, 2020, a 20 year old female who had returned to kerala from Wuhan city, China. It was declared a pandemic by the World Health Organization (WHO) on March 11, 2020. India started to experience a significant number of COVID-19 positive cases from March 2020. Daily cases peaked in mid September and then started to drop after that.

A second wave beginning in March 2021was much devastating then the first, with double mutant and triple mutant variants which are more pathogenic than the initial strains. Viral nucleic acid testing is playing an indispensable role in helping to prevent the spread of the COVID-19epidemic. However, nucleic acid testing has rigorous laboratory specifications and requires a long time before results are available. In addition, some patients with suspected COVID-19 may have initial nucleic acid test results that are false-negative for virus infection, which is harmful for the control of infectious disease.

The accurate diagnosis of viral pneumonia based on chest CT may indicate isolation and plays an important role in the management of patients with suspected SARS- CoV-2 infection. A Comprehensive understanding of the diagnostic imaging is essential for effective Patient management and treatment.

Review Of Literature

Caterina Balacchi, Nicolò Brandi conducted a study Comparing the CT findings of first and the second waves of COVID-19 in Italy. This study included 211 patients (mean age, 64.52 years ± 15.14, 144 males) evaluated during the first wave while 455 patients (mean age, 68.26 years ± 16.34, 283 males) studied during the second wave. The same prevalence of patterns was documented in both the first and the second waves (p = 0.916), with non-typical patterns always more frequently observed in elderly patients, especially the "indeterminate" pattern.

Edmund K.K.Brakohiapa[a]Benjamin D. Sarkodie conducted a study Comparing radiological presentations of first and second strains of COVID-19 infections in a low-resource country involving 50 patients infected with the first strain, and another 50 patients infected with the second strain of the SARS-CoV-2 virus, suggesting that the new strain of the virus caused more severe infections, which were manifested on high resolution CT (HRCT) scans as more widespread alveolar disease, most commonly presenting as large areas of consolidation.

AIMS AND OBJECTIVES

- To evaluate HRCT findings during COVID 19 first and second waves
- To detect any differences in HRCT patterns between COVID 19 first wave and second wave.

MATERIALS AND METHODS

Type Of Study: It is a Retrospective Hospital based study

Source Of Data:
Department of Radiodiagonosis at Santhiram medical college and general hospital, Nandyal, Andhra Pradesh.

Period Of Study: August 2020 to June 2021

Sample Size: Approximate sample size is 1000.

Sampling Criteria
Inclusion Criteria:

1. RTPCR Positive COVID 19 patients
2. Patients with symptoms of suspected COVID 19
3. Patients with high clinical suspicion of COVID-19 with RTPCR negative

Exclusion Criteria:

1. Patients with pre existing lung disease.

Equipment:
SIEMENS 32 slice SOMATOM SCOPE CT VC 40, H-SP spiral CT machine, at Santhiram Medical college and General Hospital

RESULTS.

Table 1- Distribution of Age

	No. of Patients			
Age	1st wave	1st wave percentage	2nd wave	2nd wave percentage
0-20	10	2%	22	3%
21-30	30	7%	68	10%
31-40	80	19%	182	28%
41-50	98	22%	146	22%
51-60	99	22%	124	19%
61-70	90	20%	84	13%
>70	33	8%	34	5%

Table 2 - Distribution of Sex

	No. of Patients			
Sex	1st wave	1st wave percentage	2nd wave	2nd wave percentage
Male	274	62%	402	61%
Female	166	38%	258	39%

Table 3 – RTPCR test

	No. of Patients			
RTPCR	1st wave	1st wave percentage	2nd wave	2nd wave percentage
Positive	362	82%	420	85%
Negative	52	12%	56	10%
Test Not Done	26	6%	84	5%

Table 4 – Presence and Absence of CT Findings of Covid 19

RTPCR	CT changes in 1st wave		RTPCR	CT changes in 2nd wave	
	Present	Absent		Present	Absent
Positive(310)	270	40	Positive(420)	380	40

Negative(52)	18	34	Negative(56)	20	36
Not Done(78)	54	24	Not Done(84)	58	26

Table 5 - Distribution of CT pattern of COVID 19 Disease

	No. of Patients			
CT pattern	1st wave	1st wave percentage	2nd wave	2nd wave percentage
Only Ground Glass Opacities	54	12%	64	11%
Only Patchy alveolar opacities	18	4%	32	5%
Both Ground glass and patchy alveolar opacities	270	61%	360	64%
Pleural Effusion	8	1.8%	44	8%
Lobar consolidation	4	1.2%	24	4%
Crazy Paving Pattern	80	20%	164	29%

Table 6 – Distribution of Lung involvement

	No. of Patients			
Lung involvement	1st wave	1st wave percentage	2nd wave	2nd wave percentage
Unilateral	55	16.4%	82	18%
Bilateral	287	83.6%	376	82%

Table 7 - Distribution of involvement of Lung Zones

	No. of Patients			
Lung Zone	1st wave	1st wave percentage	2nd wave	2nd wave percentage
Only peripheral zone	242	71%	311	68%
Only central zone	34	10%	41	9%
Both Peripheral and central zone	66	19%	106	23%

Table 8 - Distribution of CORADS Score

	No. of Patients			
Age	1st wave	1st wave percentage	2nd wave	2nd wave percentage
6	310	70%	420	75%
5	60	14%	60	11%
4	12	3%	18	3%
3	8	2%	10	2%
2	20	4%	22	4%
1	30	7%	30	5%

Table 9 - Distribution of CT Severity Score

	No. of Patients			
CTSS	1st wave	1st wave percentage	2nd wave	2nd wave percentage
1-5	62	18%	56	12%
6-10	80	23%	90	20%
11-15	98	28%	110	24%
16-20	78	23%	130	28%
21-25	24	8%	72	16%
Total	342	100%	458	100%

RESULTS

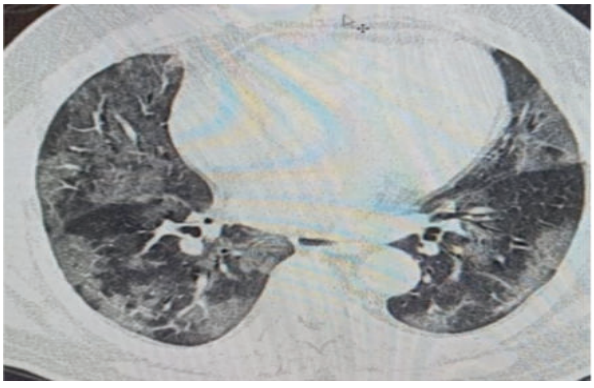
In our retrospective study, 1000 patients were analysed during both the first and second waves of the pandemic, to compare and detect any significant difference between the two groups

The study included 440 patients infected in first wave and 560 in second wave admitted and OP based to our institute. Patients underwent HRCT chest examination and CT images were evaluated for presence of lung lesions and CT severity score was assigned based on lung lobes involved In first wave out of 440 patients, 277 (62%) were males 166 were females(38%), in second wave out of 560 patients, 402 (61%) were male and 258 (39%)were female

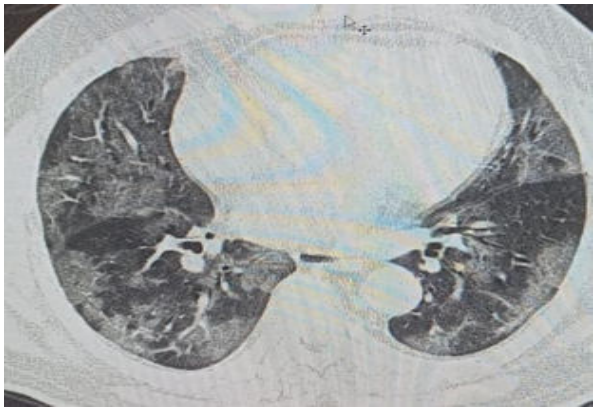
In first wave out of 440 patients 362 were RTPCR positive, out of which 270 showed CT changes of Covid 19 infection, 52 were RTPCR negative out of which 18 showed CT changes of covid 19 and 54 out 78 patients showed CT findings of covid 19 before availability of RTPCR results . In second wave out of 560 patients 420 were RTPCR positive, out of which 380 showed CT changes of Covid 19 infection, 56 were RTPCR negative out of which 20 showed CT changes of covid 19 and 58 out of 84 patients showed CT findings of covid 19 before availability of RTPCR results

HRCT findings of only ground glass opacities were present in 12% (54 patients) In first wave, 11% (64 patients) in second wave, only patchy alveolar opacities were present in 4% (18 patients) in first wave and 5% (32 patients) in second wave, both ground glass opacities and patchy alveolar opacities were present in 61% (270 patient) in first wave and 64% (360 patients) in second wave, pleural effusions were present in 1.8% (8 patients) in first wave and 8% (44 patients) in second wave, lobar consolidation was present 1.2% (4 patients) in first wave and 4% (24 patients) in second wave, crazy paving pattern was present in 20% (80 patients) in first wave and 29% (164 patients) in second wave

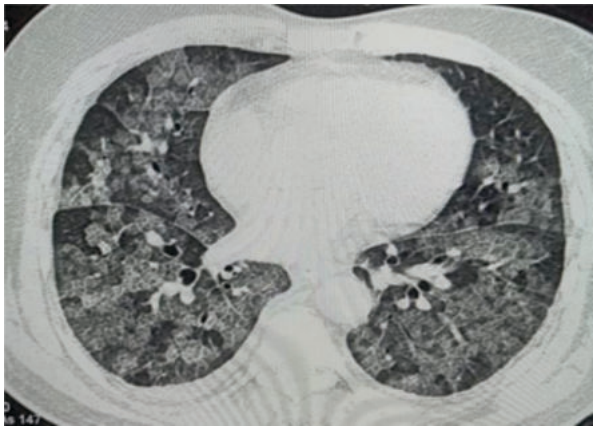
Bilateral involvement is seen in 83.6% (287 patients) in first wave and 82% (376 patients) in second wave, unilateral involvement is noted in 16.4% (55 patients) in first wave and 18% (82 patients) in second wave, only peripheral involvement is noted in 71% (242 patients) in first wave and 68% (311 patients) in second wave, only central involvement is noted in 10%(34 patients) in first wave and 9% (41 patients) in second wave, both central and peripheral involvement is noted in 19% (66 patients) in first wave and 23% (106 patients) in second wave.



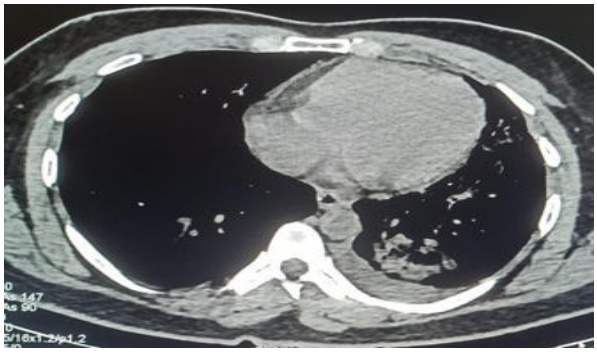
Non contrast CT axial image showing multifocal groung glass opacities in both lungs



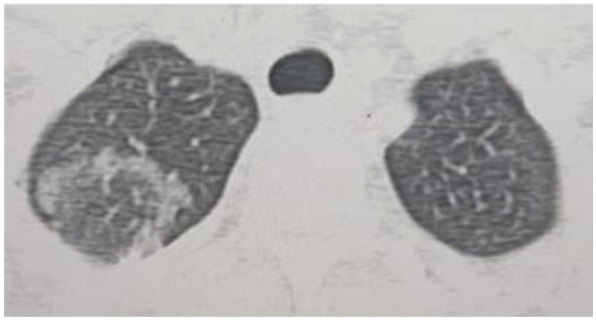
Non contrast CT axial image showing multiple peripheral patchy areas of consolidation



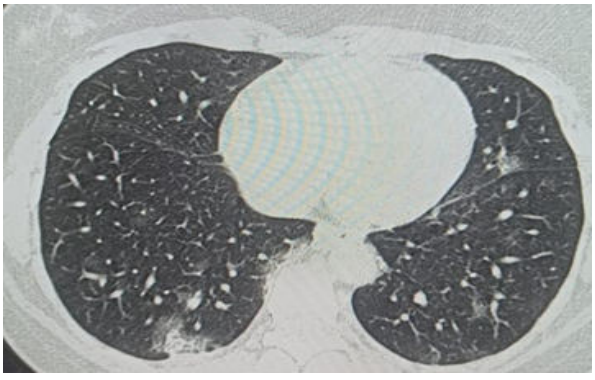
Non contrast CT axial image showing groung glass opacities with interlobular septal thickening (crazy paving pattern)



CT axial image in a covid 19 patient showing minimal left pleural effusion



Axila CT image in covid 19 patient showing central ground glass opacity surrounded by peripheral consolidation (Reverse halo sign or Atoll sign)



Axial CT image in a covid 19 patient showing patch area of consolidation surrounded by ground glass opacity (halo sign)

DISCUSSION

In our retrospective study a total of 1000 patients were included, 440 of them are from first wave and 560 are from second wave of pandemic.Predominant presenting symptoms during first and second waves were fever, cough and dyspnoea although some patients in the second wave were also presented with diarrhoea

During this pandemic time HRCT thorax was considered as gold standard for diagnosis as well as establishment of severity of covid 19 infection. HRCT helped in rapidly diagnosing covid 19 infection as RTPCR test results took 48 to 72hours to available.

In our study males are affected more than females although no difference in severity is found in both first and second waves.

CT had not only a diagnostic role but also served as a prognostic tool during second wave. evaluation of the CT score became essential for proper patient management, for deciding whether or not to hospitalize the patient depending on CT severity score.

In our study 40 patients had normal CT although RTPCR is positive in first wave and in second wave 40 patients had normal CT chest with RT-PCR positive. Chest CT therefore cannot be used as a reliable standard single tool to rule out COVID-19 infection. where as with RT-PCR test we could not get severity of infection.

Radiological findings suggestive COVID-19 infection were noted in the bilateral and peripheral lung distribution predominantly in lower lobes, during both the first and second waves of infection

The typical CT signs of COVID-19 infection encountered in our study are, ground-glass opacities (GGOs) in early disease followed by development of interlobular septal thickening (crazy paving pattern) and multifocal patchy consolidation later in the disease course in both first and second waves.

Few Patients showed atypical radiological findings in the second pandemic wave, including bronchiectasis changes, cavitation with bird nest pattern suggestive of mucor mycosis and pleural effusion

CT features were classified according to the four categories proposed by RSNA Expert Consensus

Imaging classification and CT features of COVID 19 Pneumonia		
Imaging Classification	Rationale	CT Features
Typical appearance	Commonly reported imaging features of greater specificity for COVID19 pneumonia	Peripheral, bilateral ground glass opacities with or without consolidation or visible intralobular lines(crazy paving pattern) Multifocal ground glass opacities of rounded morphology with or without consolidation or visible intralobular lines(crazy paving pattern) Reverse halo sign or other findings of organizing pneumonia(seen later in the disease)
Indeterminate appearance	Non specific imaging features of COVID 19 pneumonia	Absence of typical features and presence of following features: multifocal, diffuse , perihilar, or unilateral ground glass opacity with or without consolidation lacking a specific distribution and that are nonrounded or nonperipheral distribution
Atypical appearance	Uncommonly or not reported features of COVID 19 pneumonia	Absence of typical or indeterminate features and presence of following features: isolated lobar or segmental consolidation without ground glass opacities; discrete small nodules (centrilobular, tree in bud appearance);lung cavitation;smooth interlobular septal thickening with pleural effusion
Negative for Pneumonia	No features of pneumonia	No CT features to suggest pneumonia.

To quantify the extent of disease, a semi-quantitative score was assigned to every patient with typical COVID 19 pattern on chest CT on the basis of the area involved and presenting with the findings of viral pneumonia, i.e., GGO, interlobular thickening, crazy-paving pattern, consolidation, reverse halo sign, and double reverse halo sign. Each of the five lung lobes was assessed for degree of involvement and scored as

0 - no involvement 1- <5% involvement
2- 5-25 involvement
3- 26-49% involvement
4- 50-75% involvement
5- >75% involvement

leading to a total score ranging from 0 (no involvement) to 25 (maximum involvement)

The severity of the inflammatory process as depicted on HRCT images is presented and graded as none, mild, moderate and severe. We found

in our study moderate and severe CT severity score were more frequent in second wave COVID 19 infection than in first wave infection.

CONCLUSION

- The typical HRCT findings suggestive of COVID 19 infection during both first and second wave include Asymmetrical multifocal peripheral subpleural more often bilateral distribution of typical lung opacities.
- Ground glass opacities and consolidation are the commonest radiological presentation in both first and second waves, although few atypical presentations of COVID-19 are noted in second wave.
- HRCT Chest is increasingly used in COVID 19 pandemic for diagnosis as well as assessing the disease severity and prognosis.m
- With CT diagnosis of viral pneumonia, patients with suspected disease can be isolated and treated in time so that the management of patients will be optimized, especially for the hospitals or communities lacking nucleic acid testing kits.

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