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Original Research Paper — Radio-Diagnosis

STUDY OF ANALYSIS OF COMPUTED TOMOGRAPHY SCORE IN COVID 19 SEVERE PATIENTS

Dr. Suhas Ghule — Professor, Department of Radio-Diagnosis, DVVPFs Medical college and Hospital Ahmednagar

Dr. Dhananjay Wagh — Associate Professor, Department of Radio-Diagnosis, DVVPFs Medical college and Hospital Ahmednagar

Dr. Venkatesh Chilgar — Junior Resident doctor, Department of Radio-Diagnosis, DVVPFs Medical college and Hospital Ahmednagar

ABSTRACT

Introduction: Computerized tomography (CT) is a crucial technique for determining the severity of COVID-19. Ground glass opacities (GGO), crazy-paving patterns, and parenchymal consolidations are the most frequent patterns. Fibrosis, subpleural lines, the reversed "halo sign," pleural effusion, and lymphadenopathy are additional related CT features. The course and severity of the disease are related to CT results in COVID-19 patients. For patients with COVID-19, evaluation of laboratory and chest CT imaging features for prognostic prediction would be beneficial for a better knowledge of disease pathogenesis, risk stratification, and the development of early treatment plans that ultimately minimise mortality **Materials and Methods:** Present study was performed on 100 laboratory confirmed cases of COVID–19 diagnosed on reverse transcriptase-quantitative polymerase chain reaction (RT-qPCR). Cases were divided into two groups based on clinical disease severity scoring based on the criteria provided by Chinese Centre of Disease Control (CDC)5 as Group A (Disease presenting with dyspnoea, respiratory rate ≥ 30/min and SpO2 ≤ 93%) and Group B (Disease presenting with mild symptoms without dyspnoea, respiratory rate < 30/ min and SpO2 > 93 %). Patients Information on demography, clinical data with symptoms, comorbidity and disease severity were collected. CT Chest was sent in every patient at the time of admission. **Observations and Results:** Right and left lower lobe was affected in majority i.e 47 (47 %) and 52 (52 %) respectively. In group A moderate 25 (25 %) and severe CT 17 (17 %) score was found in majority whereas in group B mild 33 (33 %) CT score was in majority. Result was statistically significant (P<0.00001). Ground glass opacity was the main CT pattern found in majority 47 (47 %). In group B compared to group A maximum patients got discharged within 10 days. Also ICU admissions were less 1 (1 %). Result was statistically significant (P=0.008) **Conclusion:** Temporal changes of chest CT features and severity scores were closely associated with the outcome of COVID-19, which may be valuable for early identification of severe cases and eventually reducing the morbidity of COVID-19

KEYWORDS : Computed Tomography, COVID 19

INTRODUCTION

The world health organisation (WHO) has named the new coronavirus infection COVID-19, which stands for coronavirus disease 2019, and it first appeared in Wuhan, Hubei Province, China, in December 2019[1]. Since then, it has spread quickly throughout the entire world. The coronavirus that causes COVID-19 is a beta coronavirus, a positive-stranded RNA virus with an envelope. Person-to-person transmission (within six feet) by respiratory droplets, particularly those produced during coughing or sneezing, is the main method of infection[2]. Fever, coughing, dyspnoea, myalgias, diarrhoea, and smell or taste problems are among the clinical manifestations. The most common and dangerous symptom of pneumonia is bilateral infiltrates on chest imaging. The COVID-19 virus is suspected to be the cause of new-onset fever and/or respiratory symptoms (cough, dyspnoea). The preferred initial diagnostic test is nucleic acid amplification testing (NAAT) utilising a reverse-transcription polymerase chain reaction (RT-PCR) assay[3]. COVID-19 progresses largely as a result of inflammatory reactions. Macrophages and monocytes are attracted by inflammatory reactions brought on by SARS-fast CoV-2's viral multiplication and cellular devastation. They trigger the production of cytokines and chemokines, which draw in immune cells and activate immunological responses, causing cytokine storms and aggravations. Computerized tomography (CT) is a crucial technique for determining the severity of COVID-19. Ground glass opacities (GGO), crazy-paving patterns, and parenchymal consolidations are the most frequent patterns. Fibrosis, subpleural lines, the reversed "halo sign," pleural effusion, and lymphadenopathy are additional related CT features. In the pulmonary parenchyma, lobar involvement, lesion distribution, and disease location are also noted. Less frequently affected by pathology were the inferior lobes, the right lower lobe (RLL), and the left lower lobe (LLL)[4]. The course and severity of the disease are related to CT results in COVID-19 patients. For patients with COVID-19, evaluation of laboratory and chest CT imaging features for prognostic prediction would be beneficial for a better knowledge of disease pathogenesis, risk stratification, and the development of early treatment plans that ultimately minimise mortality. With this perspective present study was undertaken to investigate association between CT chest finding and COVID–19 disease severity

MATERIAL AND METHODS

Present study is a cross sectional prospective study conducted from duration____2022 to ____2022. Institutional ethics committee permission was taken prior to commencement of present study. 100 laboratory confirmed cases of COVID–19 fulfilling inclusion & exclusion criteria were enrolled for present study

Inclusion Criteria

COVID 19 patients of age > 18 years of both gender diagnosed on nucleic acid amplification tests such as reverse transcriptase-quantitative polymerase chain reaction (RT-qPCR)

Exclusion Criteria

1. Patients less than 18 years old.
2. Patients with significant artefacts on CT images

Patients Information on demography, clinical data with symptoms, comorbidity and disease severity were collected. CT Chest was sent in every patient at the time of admission. Clinical disease severity scoring based on the criteria provided by Chinese Centre of Disease Control (CDC)[5] was applied to all cases and they were divided into two groups as

A)Group A (N=50):
Disease presenting with dyspnoea, respiratory rate ≥ 30/min and SpO2 ≤ 93%;

B) Group B (N=50):
Disease presenting with mild symptoms without dyspnoea, respiratory rate < 30/ min and SpO2 > 93 %

CT procedure
All patients were examined using the same CT scanner (Toshiba Aquilion Prime 160; Toshiba medical systems, Japan). All patients underwent supine scanning while holding an inspiratory breath.

The scans covered the area from the base of the neck to the level of the right kidney's upper pole (cranio-caudally). 120 kVp, 100–300 mAs, pitch–1.5, collimation–0.625–5 mm, and slice–1-3 mm were the CT acquisition parameters. An algorithm for sharp reconstruction was used.

There was no IV contrast administered. With proper cleaning of CT facilities and patient isolation, strict infection control guidelines for COVID were implemented. On the PACS system, studies were transmitted, processed, and reviewed (Paxera Ultima version 6.0.0.1).

On lung window (1500 WW and 500 WL) and mediastinal window (400 WW and 60 WL) settings, respectively, volumetric CT chest images were reviewed. Processing and reconstruction of CT chest images were done in the axial, coronal, and sagittal planes (multi-planar reconstruction). Sante DICOM Viewer Pro was used to review semi-quantitative coloured images

CT-severity score:
Semiquantitative CT severity scoring system (CT-SSS), developed by **Yang et al**[6] and **Pan et al**[7] was utilised to assess the burden of pulmonary affection. The degree of pathogenic involvement is determined for each of the two lungs' five lobes. The left lung has two lobes while the right lung has three. Scores range from 0 to 5 for each lobe.. Scoring consist of

1. **Score 0:** No parenchymal involvement
2. **Score 1:** 1 to 5 % parenchymal involvement
3. **Score 2:** 5 to 25 % parenchymal involvement
4. **Score 3:** 26 to 50 % parenchymal involvement
5. **Score 4:** 51 to 75 % parenchymal involvement
6. **Score 5:** > 75 % parenchymal involvement.

Total CT score of bilateral lungs is equal to sum of scores of five lobes with maximum total score of 25 and minimum score of 0. Severity then was assessed using the following scoring system[149,150,151]

a. Mild: 7 or less score
b. Moderate: 8 to 17 score
c. Severe: 18 or more score

Statistical analysis
Statistical analysis was performed using SPSS software, version 20. Data are expressed as mean ± SD and frequency with percentages N (%). 2-test was used to evaluate qualitative data and to study association between two variables. Statistical significance was assumed if P value less than 0.05.

Observation and Result
Table 1: Distribution of clinical history

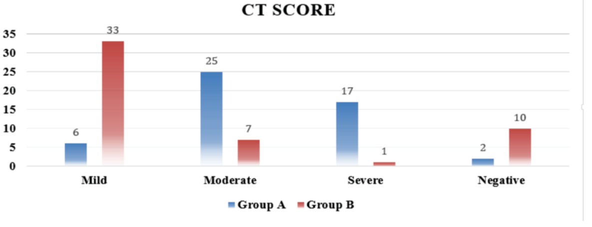
Sr No.	Characteristic	Group A (N=50)	Group B (N=50)	Total (N=100)
1	Age (Mean ± SD)	42.74 ±13.77	40.72 ±13.41	100 (100 %)
2	Gender			
	1. Male	36 (36 %)	27 (27 %)	87 (64 %)
	2. Female	14 (14 %)	23 (23 %)	49 (36 %)
3	Symptoms N (%)			
	1.Fever	25 (25 %)	15 (15 %)	45 (45 %)
	2. Cough/Sore Throat	47 (47 %)	35 (35 %)	82 (82 %)
	3.Nausea/Vomiting/Diarrhoea	7 (7 %)	4 (4 %)	11 (11 %)
	4. Myalgia	26 (26 %)	19 (19 %)	45 (45 %)
	5. Shortness of Breath	38 (28 %)	8 (8 %)	46 (46 %)
	6. Headache	22 (16 %)	7 (7 %)	29 (29 %)
4	Comorbidity N (%)			
	1. Diabetes (Type II)	10 (10 %)	6 (6 %)	16 (16 %)
	2. Hypertension	6 (6 %)	4 (4 %)	10 (10 %)
	3. COPD	6 (6 %)	2 (2 %)	8 (8 %)
	4. Neoplasm	7 (7 %)	3 (3 %)	10 (10 %)
	5.Chronic kidney disease	4 (4 %)	3 (3 %)	7 (7 %)

Table 1 showing distribution of clinical history. Mean ± SD age in group A was 42.74 ± 13.77 and in group B was 40.72 ± 13.41. Males were in majority 87 (87 %). Cough/Sore Throat 82 (82 %), Shortness of Breath 46 (46 %), fever 45 (45 %) and myalgia 45 (45 %) were main symptoms. Diabetes (Type II) 16 (16 %) was present in majority as comorbidity.

Table 2: Distribution of CT findings

Sr No.	Characteristic	Group A (N=50)	Group B (N=50)	Total (N=100)	Chi square	P Value
1	Lobes Involved				-	-
	a. Right Upper Lobe (RUL)	25 (25 %)	16 (16 %)	41 (41 %)		
	b. Middle Lobe (ML)	39 (39 %)	20 (20 %)	59 (59 %)		
	c. Right Lower Lobe (RLL)	47 (47 %)	42 (42 %)	89 (89 %)		
	d. Left Upper Lobe (LUL)	28 (28 %)	19 (19 %)	47 (47 %)		
	e. Left Lower Lobe (LLL)	52 (52 %)	43 (43 %)	95 (95 %)		
2	CT score				58.9884	< 0.00001
	a. Mild (≤ 7)	6 (6 %)	33 (33 %)	39 (39 %)		
	b. Moderate (8 to 17)	25 (25 %)	7 (7 %)	32 (32 %)		
	c. Severe (≥ 18)	17 (17 %)	1 (1 %)	18 (18 %)		
	d. Negative (0)	2 (2 %)	10 (10 %)	12 (12 %)		
3	CT pattern				14.2843	002543
	a. Ground glass opacity	14 (14 %)	27 (27 %)	41 (41 %)		
	b.Crazy paving	16 (16 %)	10 (10 %)	26 (26 %)		
	c.Consolidation	18 (18 %)	6 (6 %)	24 (24 %)		
	d.No Pattern	2 (2 %)	7 (7 %)	9 (9 %)		

Table 2 shows CT findings. Right and left lower lobe was affected in majority 47 (47 %) and 52 (52 %) respectively. In group A moderate 25 (25 %) and severe CT 17 (17 %) score was found in majority whereas in group B mild 33 (33 %) CT score was in majority. Result was statistically significant (P<0.00001). Ground glass opacity was the main CT pattern found in majority 47 (47 %).

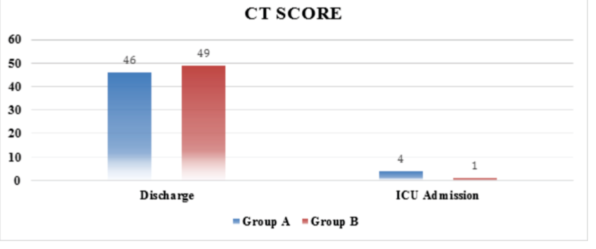


Graph 2: Distribution of CT findings

Table 3: Distribution of outcome variables

Sr No.	Characteristic	Group A (N=50)	Group B (N=50)	Total (N=100)	Chi square	P Value
1	hospital stay (days) a. < 10 b. 10 to 20 c. > 20	 25 (25 %) 16 (16 %) 9 (9 %)	 39 (39 %) 9 (9 %) 2 (2 %)	 64 (64 %) 25 (25 %) 11 (11 %)	9.477	0.008
2	Morbidity a.Discharged b.ICU admission	 46 (46 %) 4 (4 %)	 49 (49 %) 1 (1 %)	 95 (95 %) 5 (5 %)	1.8947	0.168

Table 3 shows outcome variables. In group B compared to group A maximum patients got discharged within 10 days. Also ICU admissions were less 1 (1 %). Result was statistically significant (P=0.008)



Graph 3: Distribution of outcome variables

DISCUSSION

Present study was performed on 100 laboratory confirmed cases of COVID–19 diagnosed on reverse transcriptase-quantitative polymerase chain reaction (RT-qPCR). Cases were divided into two groups based on clinical disease severity scoring based on the criteria provided by Chinese Centre of Disease Control (CDC)[5] as **Group A** (Disease presenting with dyspnoea, respiratory rate ≥ 30/min and SpO2 ≤ 93%) and **Group B** (Disease presenting with mild symptoms without dyspnoea, respiratory rate < 30/ min and SpO2 > 93 %). Patients Information on demography, clinical data with symptoms, comorbidity and disease severity were collected. CT Chest was sent in every patient at the time of admission. Results showed Right and left lower lobe was affected in majority i.e 47 (47 %) and 52 (52 %) respectively. In group A moderate 25 (25 %) and severe CT 17 (17 %) score was found in majority whereas in group B mild 33 (33 %) CT score was in majority. Result was statistically significant (P<0.00001). Ground glass opacity was the main CT pattern found in majority 47 (47 %) **(Table 2).** In group B compared to group A maximum patients got discharged within 10 days. Also ICU admissions were less 1 (1 %). Result was statistically significant (P=0.008) **(Table 3).**

In similar study by **Shuchang Zhou et al (2020)**[8] found when selecting the chest CT images with peak severity from both groups, the total CT score of lung involvement was significantly greater in the deceased patients than that in the recovered patients as well as the CT scores for each of the five lung lobes (all P<0.001). On chest CT scans, the crazy-paving pattern and vacuolar sign were substantially more frequently seen in the deceased patients than the living patients (all P0.05, with the exception of the right lower lobe). However, in the recovered patients, lower lobe bilateral lung GGO and linear opacities were more frequently seen. The overall CT severity scores in the died patients were substantially higher than those in the recovered patients for the corresponding disease stages 1 to 3 when comparing CT scores and imaging features between the two groups at various disease stages (all P 0.001). Additionally, the two groups' CT results for each of the five lobes showed statistically significant differences. **Ahmed M. Magdy et al (2021)**[9] evaluated and analysed CT scan images were for all examined cases. Twenty patients' CT scans of their chests were normal, with no radiological indications of pulmonary disease. Ground glass opacities were the dominant radiological characteristic in the remaining 246 individuals. A total of 147 patients (59.8% of cases with positive pulmonary affection) had pure ground glass opacities, 94 patients (38.2%) had pure consolidation, and 5 patients had pure consolidation alone. The majority of individuals who tested positive for pulmonary affection had bilateral pulmonary involvement (79%) and a preference for the periphery or subpleural region (89%). The CT severity score had a mean value of 6.89 6.18 with a range of 0 to 22. **Ghufran Aref Saeed et al (2021)**[10] found CT scans were negative in 203/202 (22.5%) of patients (75.9% males, 24.1% females). Patients with mild disease made up 329/209 (36.5%), moderate patients made up 309/902 (34.3%) (90.6% men, 9.4% females), and severe patients made up 61/209 (6.8%) (93.4% males, 6.6% females). After a follow-up scan, the 30- to 39-year-old age group had negative and mild scans, the 40- to 49-year age group primarily had intermediate disease severity, and the 50- to 59-year age group primarily had severe disease. **Zhang et al (2020)**[11] reported that the chest CT score was a reliable indication of the severity of systemic inflammation and had a favourable connection with inflammation indicators. **Qin et al (2020)**[12] reported that certain CT features such as the distribution of lesions in the periphery and the crazy-paving pattern can help differentiate between COVID-19 pneumonia and non-COVID-19 pneumonia more effectively (23). We have made a tentative identification of the severity scores and CT imaging features as independent risk factors for the poor prognosis in COVID-19 patients despite the fact that the predictive significance of CT scores on the severity of this disease has not yet been examined.

CONCLUSION

To conclude total CT severity scores (≥16) are independent risk factors for poor prognosis in patients with COVID-19. Temporal changes of chest CT features and severity scores were closely associated with the outcome of COVID-19, which may be valuable for early identification of severe cases and eventually reducing the morbidity of COVID-19

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