RADIOLOGICAL EVALUATION AND CORRELATION OF CT SEVERITY SCORING WITH THE CLINICAL OUTCOME IN RT-PCR CONFIRMED COVID-19 INFECTED PATIENTS

Radiodiagnosis

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ABSTRACT

BACKGROUND: Radiological evaluation of the severity of lung inflammation in Covid-19 patients could provide an objective approach to rapidly identify the treatment modalities and to calculate the duration of hospitalization, need for intubation and ICU stay thereby analyzing and managing the clinical outcome of the patient. **PURPOSE:** To identify the significant relationship between CT severity score and clinical outcome among RT-PCR confirmed Covid-19 infected patients. **MATERIALS AND METHODS:** Inclusion of 40 patients with COVID-19 confirmed by positive real-time reverse transcriptase polymerase chain reaction on throat swabs underwent High resolution chest CT (7 men and 33 women). The CT-SS was defined by summing up individual scores from 20 lung regions; scores of 0, 1, and 2 were respectively assigned for each region if parenchymal opacification involved 0%, less than 50%, or equal or more than 50% of each region (theoretical range of CT-SS from 0 to 40). The clinical and laboratory data were collected and analyzed. **RESULTS:** All patients (n=16) who underwent intubation died invariably. The lung findings in all patients who died consist of co-existence of Consolidation and ground glass opacities in periphery and central region of lungs. Age is a predominant determinant factor for the course and outcome of disease as 17 patients with a mean age of 62 died when compared to 23 patients alive with a mean age of 47. This implies that mortality has a direct relationship with age. Out of 19 patients who had a CT-Severity score of >19 (Severe), 17 were shifted to ICU and 15 patients died. Only 4 patients recovered. Out of 5 patients whose CT-SS score were < 19, 5 patients were shifted to ICU and 2 cases died. 95 % of Covid-19 positive patients had Fever as their predominant complaint. The results are statistically significant with a p value of <0.01 and specificity of 82.6% and sensitivity of 88.2%. **CONCLUSION:** Along with RT-PCR, CT severity scoring is invariably a valuable modality for the management and planning of treatment for the patients by predicting the prognosis. **SUMMARY:** The chest CT severity score could be used to rapidly identify patients with severe forms of COVID-19 and clearly impacts the outcome of the patients.

KEYWORDS

CT Severity Score- Covid-19- Clinical Outcome

INTRODUCTION

Covid-19 virus, which is a novel virus strain also called Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) was first identified in Wuhan city, China in the month of December 2019. This new strain which has never been found in humans in the history was initially named novel corona virus (nCoV)⁽¹⁾. WHO declared Covid-19 as pandemic in March 2020. The SARS virus is confirmed by real time reverse transcription polymerase chain reaction (RT-PCR) which is more sensitive than a conventional RT-PCR⁽²⁾. It can correctly identify the SARS-CoV genome of humans and animal viruses with higher sensitivity. However the drawbacks of this testing includes turnover time, type and quantity of the specimen, timing⁽³⁾. False negative results can occur due to poor quality of nucleic acid or the presence of RT-PCR inhibitors in the samples. On the other hand false positive results can occur due to introduction of contaminated viral RNA to the samples. The use of CT chest in the patients affected by Covid-19 has gained much attention due to the high incidence of ground glass opacities which are distributed in peripheral lungs giving a picture of atypical pneumonia. For all patients who are suspected or confirmed to have Covid infection, the protocol is to send RT-PCR sample and to do a CT chest screening⁽⁴⁾. In this study we are going to discuss about the CT-Chest findings of RT-PCR confirmed Covid-19 patients and its impact on the clinical outcome.

MATERIALS AND METHODS

The study is a retrospective, cross-sectional analysis of patients who were confirmed cases of Covid-19 or suspected and then diagnosed to be positive for Covid-19 by RT-PCR analysis who were admitted and treated in Chettinad hospital and Research Institute, Kelambakkam, Chennai in the month of July 2020. A total of 40 patients were included in the study (33 males and 7 females). Their chief complaints, past history and consent were obtained. All the patients undergone HRCT-chest screening using Philips Ingenuity 128 slice CT machine with slice thickness of 1 mm, increment of 0.5mm, Pitch 1.015, Voltage 120k, Planned mAs ~180 mAs/Slice, Image matrix 512 x 512, FOV ~400mm. The CT scoring was done on a total of 40 point scale. The score signifies the area of lung opacification involved. This tells about the extension of the disease. The main opacification features are ground glass opacities, consolidation. According to radiological

anatomy, the lungs are divided into 18 segments. In this study, the lung segments were divided into 20 regions where the apicoposterior segment of left upper lobe was separated into posterior and apical segments individually and anteromedial basal segment of the left lower lobe was sub classified into anterior and medial basal regions separately⁽⁵⁾. The opacity noted in each region of lung was subjectively quantified using attributing scores of 0, 1, 2 based on the parenchymal opacification of 0%, <50% and ≥50% respectively. The CT severity score was defined as the total of individual score of 20 lung segmental regions, which appears from 0 to 40 points.

Statistical analysis

The collected data were analysed with IBM.SPSS statistics software 23.0 Version. To describe about the data descriptive statistics frequency analysis, percentage analysis were used for categorical variables and the mean & S.D were used for continuous variables. To find the significant difference between the bivariate samples in Independent groups the Unpaired sample t-test was used. The Receiver Operator Characteristic (ROC) curve analysis was used to find the sensitivity, specificity to find the efficacy of CD score to predict the mortality. To find the significance in categorical data Chi-Square test was used. In all the above statistical tools the probability value .05 is considered as significant level.

Figure/Table 1: Axial HRCT lung thin section showing consolidation and ground glass opacities

Figure/Table 2:

CT FEATURES	FREQUENCY	PERCENTAGE
Nil	1	2.5
Consolidation	5	12.5

Consolidation>> GGO	10	25.0
GGO	15	37.5
GGO=Consolidation	3	7.5
GGO> Consolidation	6	15.0
Total	40	100.0

GGO=Ground Glass Opacities.

Figure/Table 3:

			Outcome		Total	X2 - value	p-value
			Dead	Alive			
Intubation	No	Count	1	23	24	36.078	0.0005 **
		%	5.9%	100.0%	60.0%		
	Yes	Count	16	0	16		
		%	94.1%	0.0%	40.0%		
Total		Count	17	23	40		
		%	100.0%	100.0%	100.0%		

** Highly Statistical Significance at $p < 0.01$ level

Figure/Table 4:

Variable	Outcome	N	Mean	SD	t-value	p-value
Age	Dead	17	62	8	4.302	0.0001 **
	Alive	23	47	13		

** Highly Statistical Significance at $p < 0.01$ level

Figure/Table 5:

			Outcome		Total	X2 - value	p-value
			Alive	Dead			
CT Severity	No findings	Count	1	0	1	19.720	0.0005**
		%	4.3%	0.0%	2.5%		
	Mild	Count	8	1	9		
		%	34.8%	5.9%	22.5%		
	Moderate	Count	10	1	11		
		%	43.5%	5.9%	27.5%		
	Severe	Count	4	15	19		
		%	17.4%	88.2%	47.5%		
Total		Count	23	17	40		
		%	100.0%	100.0%	100.0%		
** Highly Statistical Significance at p < 0.01 level							

** Highly Statistical Significance at $p < 0.01$ level

Figure/Table 6:

Outcome with CT - Severity score

Figure/Table 7:

Area Under the Curve			
Area	p-value	95% C.I	
		LB	UB
.919	0.0001 **	.832	1.000

** Highly Significant at $p < 0.01$ level

Cut off 19.5

Sensitivity 88.2

Specificity 82.6

RESULTS

Total patients studied were 40 which included 7 males and 33 females constituting 17.5% and 82.5% respectively. The predominant chief complaint was fever which was found in 38 patients constituting 95% in total. The other major complaints noted were cough and dyspnoea found in 42.5% and 40% of patients respectively. Myalgia and diarrhoea were noted in 15% and 10 % of our study population. Asymptomatic patients were only 2.5% of the total study group. Past history of co

morbidities like Diabetes, Hypertension, Coronary artery disease were present in 35% (n=14) and the remaining 65% (n=16) had no significant past history.

The CT findings noted were coexistence of ground glass opacities along with consolidation in 19 (47.5%) of total patients (Figure/Table 1). Consolidation was the only predominant finding in 5 (12.5%) of patients. Ground glass opacities were the only prominent feature in 15 (37.5%) of the study group. The lung findings in all patients who died consist of co-existence of Consolidation and ground glass opacities in periphery and central region of lungs. Percentage of patients with various lung findings were shown (Figure/Table 2). In total 23 (57.5%) patients recovered and got discharged while 17 (42.5%) patients died during the hospital stay. All patients n=16 (100%) who underwent intubation died invariably whereas among those (n=24) who were not intubated only one (2.5%) of them died. This data is highly statistically significant (Figure/Table 3). Age is a predominant determinant factor for the course and outcome of disease as 17 (42.5%) patients with a mean age of 62 died when compared to 23 (57.5%) patients alive with a mean age of 47. This implies that mortality has a direct relationship with age and is highly statistically significant (p value <0.01) (Figure/Table 4). Out of 19 patients who had a CT-Severity score of >19 (Severe), 17 were shifted to ICU and 15 patients died. Only 4 patients recovered. Out of 5 patients whose CT-SS score were <19, 1 and 4 patients with mild and moderate CT severity score respectively were shifted to ICU and 2 of them one in each category died. The comparison of CT severity score with the outcome was highly statistically significant with a p value of <0.01 (Figure/Table 5, 6). The area under the Receiver Operator Characteristic curve was statistically significant with a p value of <0.01 and specificity of 82.6% and sensitivity of 88.2% (Figure/Table 7).

DISCUSSION

The year 2020 started with the declaration of health emergency by WHO due to Covid-19 infection which started spreading rapidly across continents. The main challenge posed was the disease diagnosis, identification of infected patients from others having constitutional symptoms like fever, cough and myalgia⁽⁶⁾. Initially testing was difficult due to limited availability of RT-PCR kits. Early diseases can be overlooked in chest x-rays leading to a huge number of false negative results. High resolution CT for chest is more sensitive than conventional chest x-ray which can show early abnormal changes in the lung. Hence HRCT became the main supporting modality for the diagnosis of Covid-19 infection⁽⁷⁾.

The usual CT features of early infection due to Covid-19 include asymmetrical focal patchy ground glass opacities predominantly in the peripheral distribution which matched with our findings. Consolidation may or not be associated with ground glass opacities. It is seen that consolidation happens predominantly in moderate to severe grading of cases. There is no significant predilection for right or left lung.

In our study, the scoring was a semi-quantitative scoring which utilizes the findings of lung parenchymal involvement in the form of opacification of 20 lung regions. The study shows that there is a direct relationship between the severity of cases and CT severity scoring. In previous studies, a cut off of 19.5 scoring was declared as severe grading with a sensitivity of 83.3 percent, and a specificity of 94 percent, resulting in a negative predictive value of 96.3 percent⁽⁵⁾. We have visually classified the severity grading into mild, moderate and severe with scores from 1-8, 9-18, 19-40 respectively⁽⁵⁾. The severity grading is based on any opacification of lung parenchyma including ground glass opacities, consolidation⁽⁸⁾. We speculate that this relatively uncomplicated method could provide objective means to speed up the identification of patients with severe disease, especially in conditions of meager availability of healthcare resources and to provide proper treatment or referrals for those patients^(9,10).

Limitations

There are some limitations in this study. A large section of population particularly the young adults and children do not exhibit any symptoms. Since we have taken our sample size of admitted patients, the asymptomatic category is not studied much. The severity scoring of CT hypothesizes the extent of lung involvement. However there is no confirmation of the above findings through histology. It is advisable to take CT on the fifth day of the symptom⁽¹¹⁾. We didn't exactly calculate the day in which the CT was taken relative to the onset of symptom due to unclear and mismatching data from the patients and attenders. Since

it is a retrospective study, we don't know if the patients were reinfected in the longer run. So a prospective study with a bigger number of samples has to be done in the future and the CT scoring has to be regularized.

CONCLUSION

To conclude, this study provides a clear-cut data regarding the relationship between the CT severity scoring and the prognosis of the patient and the significance of age criteria in the patients. So along with RT-PCR, CT severity scoring is invariably a valuable modality for the management and planning of treatment for the patients by predicting the prognosis.

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