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Original Research Article

Correlation between Chest CT Severity Scores and the Clinical Parameters of Patients with COVID-19 Pneumonia

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ABSTRACT

Purpose: Our aim is to correlate the outcome of patients, RTPCR testing with COVID-19 infection with the 25-point CT severity score by Chang et al. (devised for assessment of ARDS in patients with SARS in 2005).

Materials and Methods: Data of 200 consecutive symptomatic patients who were suspected to have COVID-19 infection and presented to Internal Medicine wards, dedicated ICU of American international institute of medical sciences Bedwas and Pacific Medical College and Hospital Bhilon ka Bedla, Udaipur, Rajasthan were collected. All patients underwent two consecutive RT-PCR tests and had a noncontrast HRCT scan done at presentation.

Results: In the present study, from total number of participants (n=200) there are 55.50% male participants and 44.50% female participants. Age ranges of the patients from 35 year to 84year. The mean age of study participants was found to be 60.37± 11.30 years. In our study majority of patients belonged to moderate and severe CT category (45% and 44.5% respectively) and a small portion of mild category (10.5%). Our study showed significant association between CT severity grading and biomarkers level. The best outcomes were associated with milder CT findings, while death rate was increased among those with more severe scan results. 56(28%) patients out of 200 died in our study. In mild category death percent is 4.76% (1/21), in moderate and severe category its 23.33% (21/90) and 28% (34/89) respectively. (p value=0.003).

Conclusion: The 25-point CT severity score correlates well with the COVID-19 severity. Our data suggest that chest CT scoring system can aid in predicting COVID-19 disease outcome and significantly correlates with lab tests and oxygen requirements.

INTRODUCTION

COVID-19 is an infection that has widely and rapidly spread all over the world and became a pandemic with significant impacts upon the sociopolitical milieu and healthcare delivery systems [1]. The clinical presentations vary from asymptomatic carriers to patients requiring assisted ventilatory support, and ICU admissions with increased mortality made it an unusual and unprecedented challenge [2, 3]. The nasopharyngeal swab RT-PCR test has been the diagnostic test used as the standard of reference for disease confirmation [4]. The test is a powerful tool; however, there is a small but significant proportion of false-negative results reported [5]. A noncontrast high-resolution CT chest imaging plays a pivotal and essential role in the early disease detection, particularly in patients with false-negative RT-PCR results, as well as in managing and monitoring the course of disease [6]. Moreover, the disease severity can be ascertained from the imaging findings, significantly supporting the clinicians in their clinical judgment and ensuring effective and timely management [7]. Prognosis can also be affected by the severity of the disease in the critically ill patients allowing appropriate selection of early involvement of the intensive care [8, 9]. Multiple studies have explored the pulmonary involvement on the chest CT images using both visual and software quantitative assessments [10, 11]. To our knowledge, ours is the first comprehensive study to describe the correlation of chest CT severity scores and the clinical picture of patients with COVID-19 disease in the Gulf and Arab region. Our study correlates the CT severity score with the clinical severity of the patients who were confirmed to have COVID-19 disease using the 25-point visual quantitative assessment.

METHOD

Ethical approval was obtained from Institutional Review Board. The informed consent was waved off as per the

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ethics committee. A cross sectional study was conducted at Internal Medicine wards, dedicated ICU of American international institute of medical sciences Bedwas and Pacific Medical College and Hospital Bhilon ka Bedla, Udaipur, Rajasthan. We collected clinical and laboratory data for analysis, of 200 patients who presenting with atypical pneumonia in RNT medical and associated group of hospitals and underwent a chest HRCT scan. The results for the chest HRCT images were collected and evaluated using the Picture Archiving and Communication Systems (PACS).

A) INCLUSION CRITERIA

1.Patients giving consent and willing to participate in the study.

1. Patients presenting with atypical pneumonia and both COVID 19RTPCR positive and negative.
2. Patients giving consent for HRCT thorax.

a) EXCLUSION CRITERIA

i. Patients with serious mental illness.

ii. Patients with H_1N_1 status positive.

HRCT Inspection

All initial chest HRCT scans were performed on the day of patients' presentation using a VCT GE 64 scanner. Patients were placed in a supine position with single breath hold. Scanning parameters were as follows: scan direction (craniocaudally), tube voltage (120 kV), tube current (100–600 mA)-smart mA dose modulation, slice collimation (64 × 0.625 mm), width (0.625 × 0.625 mm), pitch [1], rotation time (0.5 s), and scan length (60.00–I300.00 s).

HRCT Image Analysis Radiologists evaluated the images to determine the disease severity score in each patient. The scans were first assessed whether negative or positive for typical findings of COVID-19 pneumonia (bilateral, multilobe, posterior peripheral ground-glass opacities). Severity then was assessed using the following scoring system which depends on the visual assessment of each lobe involved [12–15]

OBSERVATIONS & RESULTS:

Table 1: AGE DISTRIBUTION

AGE GROUP	Total		RTPCR Negative		RTPCR Positive	
	No.(n=200)	%	No.	%	No.	%
25-44	17	8.50%	10	8.00%	7	9.33%
45-65	110	55.00%	68	54.40%	42	56.00%
>65	73	36.50%	47	37.60%	26	34.67%
TOTAL	200	100%	125	100%	75	100%
MEAN AGE	60.37±11.30		60.29 ± 11.38		60.34 ± 11.30	

P VALUE= 0.891

The mean age of study participants was 60.37±11.30years. Age ranges from 35 to 84 year. In this study I have total 200 patients, out of which 125 patients were RTPCR negative and 75 were RTPCR positive. Age distribution of patient states that majority of covid 19 patients (RTPCR Negative,68 and RTPCR positive,42) belonged to 45–65year age group, followed by 47 and 26 patients of >65 year age group in RTPCR Negative and RTPCR positive respectively. Minimum patients belonged to 25 -44year age group.

TABLE NO: 2- SEX DISTRIBUTION OF STUDY PARTICIPANTS

SEX	**Total**		**RTPCR Negative**		**RTPCR Positive**	
	No. (n=200)	**%**	**No.**	**%**	**No.**	**%**
Male	111	55.50%	60	48.00%	51	68.00%
Female	89	44.50%	65	52.00%	24	32.00%
TOTAL	200	100%	125	100%	75	100%

P VALUE=0.005

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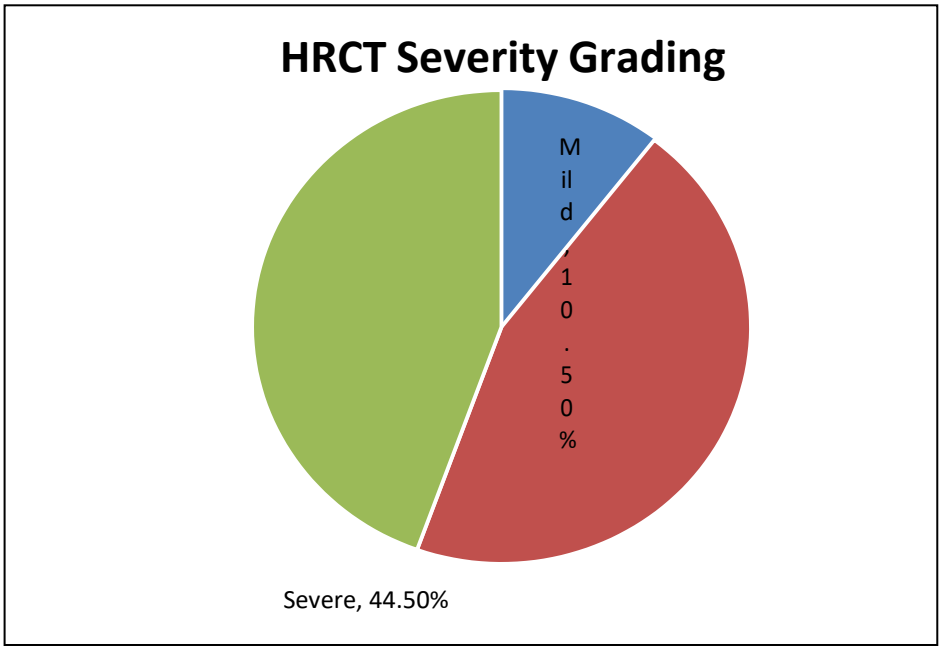
Sex distribution among patients stated that there is highly significant difference between males and females.65(52%) females and 60(48%) males had RTPCR negative test results, while 51 males(68%) and 24(32%) females had RTPCR positive.

Table 3: HRCT Grading

HRCT CTSS	RTPCR Negative(n=125)		RTPCR Positive(n=75)		Total (n=200)	
	No.	%	No.	%	No.	%
Mild	14	11.20%	7	9.33%	21	10.50%
Moderate	56	44.80%	34	45.33%	90	45.00%
Severe	55	44.00%	34	45.33%	89	44.50%

P VALUE=0.91

GRAPH 3(A)



In present study majority of patients belonged to moderate and severe category based on CT severity score (CTSS) (45% and 44.5% respectively) and small proportion made mild group (10.5%)

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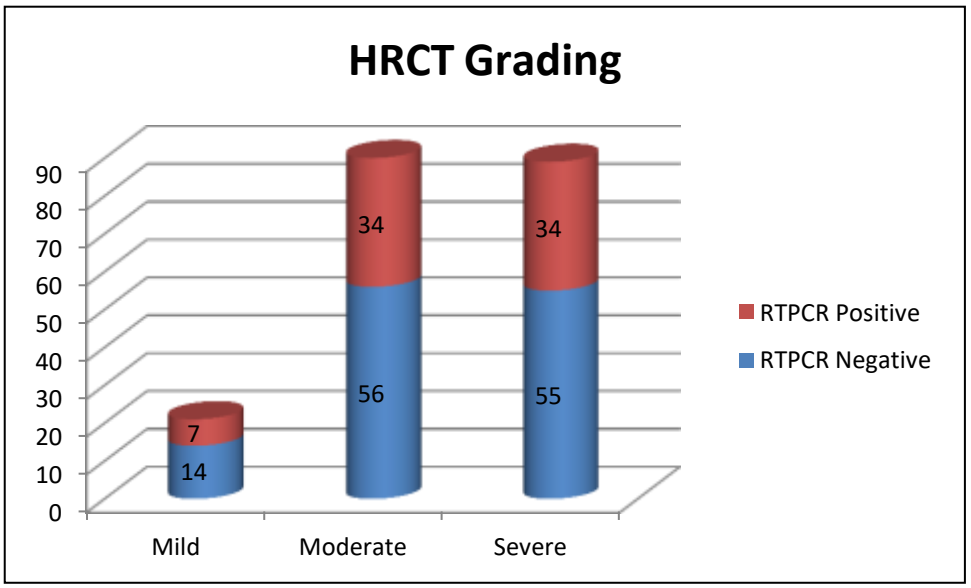
GRAPH 3(B)



There was non-significant difference between RTPCR test and HRCT CT severity score (CTSS). But proportional distribution states that majority of patients had severe HRCT CT severity score (CTSS) and 45% were RTPCR positive. Same was found with moderate changes in HRCT CT severity score (CTSS).

Table 4: Hrct Ctss and Outcome

	HRCT Score						
	Mild (n=17)		Moderate (n=22)		Severe (n=6)		P value
Biomarkers	Mean	SD	Mean	SD	Mean	SD	
CRP (in mg/L)	44.36	29.12	66.53	42.33	91.46	58.44	0.04
S. Ferritin (in ng/ml)	315.46	212.44	439.07	254.08	537.62	294.80	0.05
D. Dimer (in mcg/ml)	1.20	0.60	3.74	5.47	4.87	4.74	0.04

Graph 4 (a)

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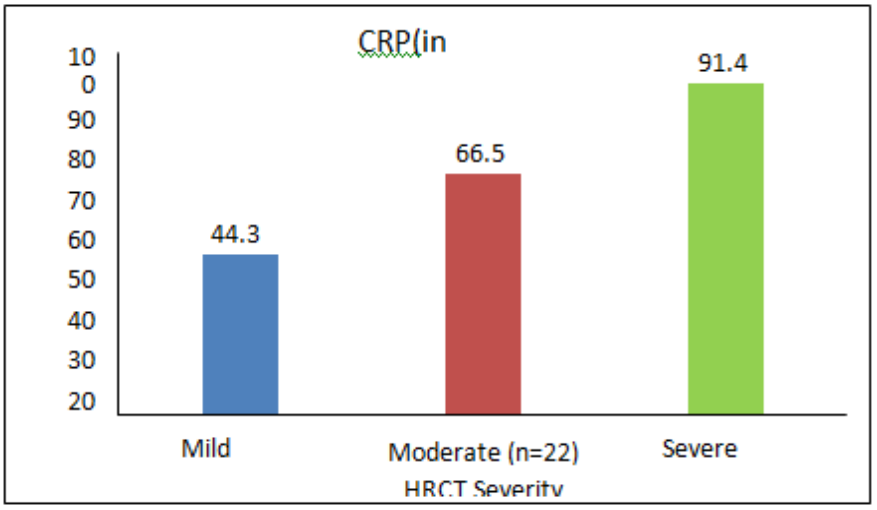
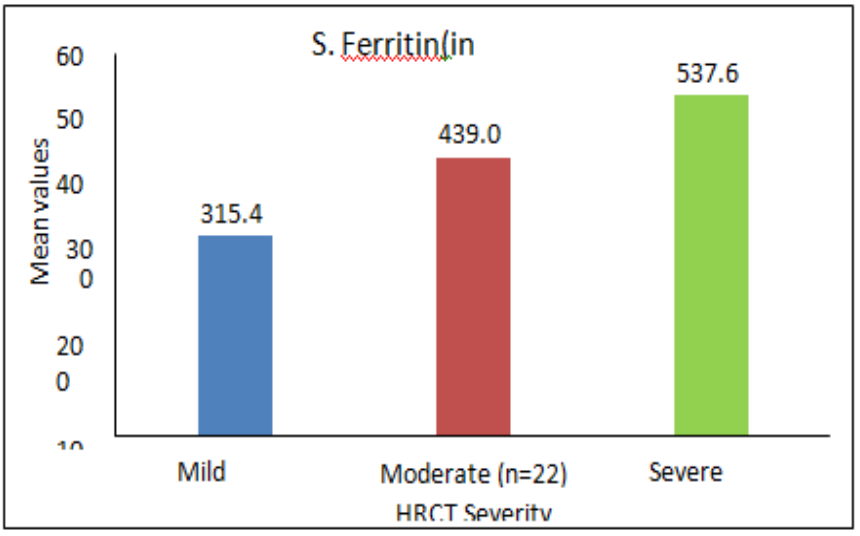
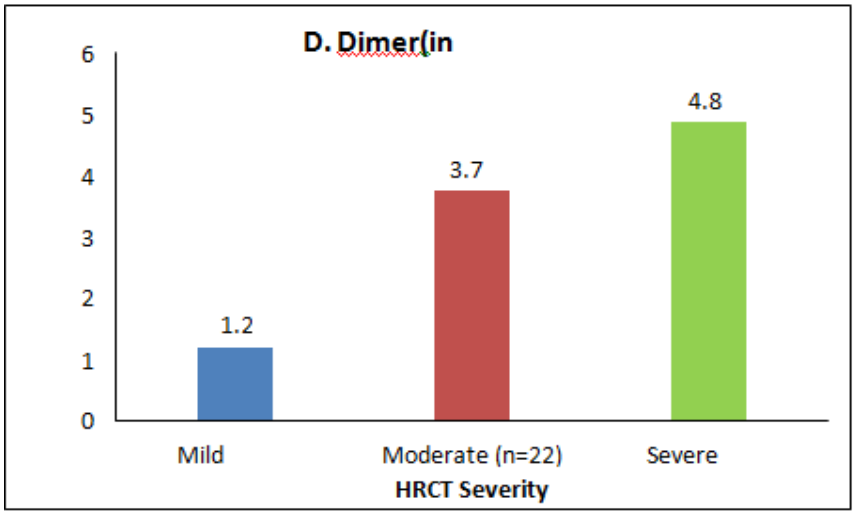
Graph 4 (b)



Graph 4 (c)



Graph 4 (d)



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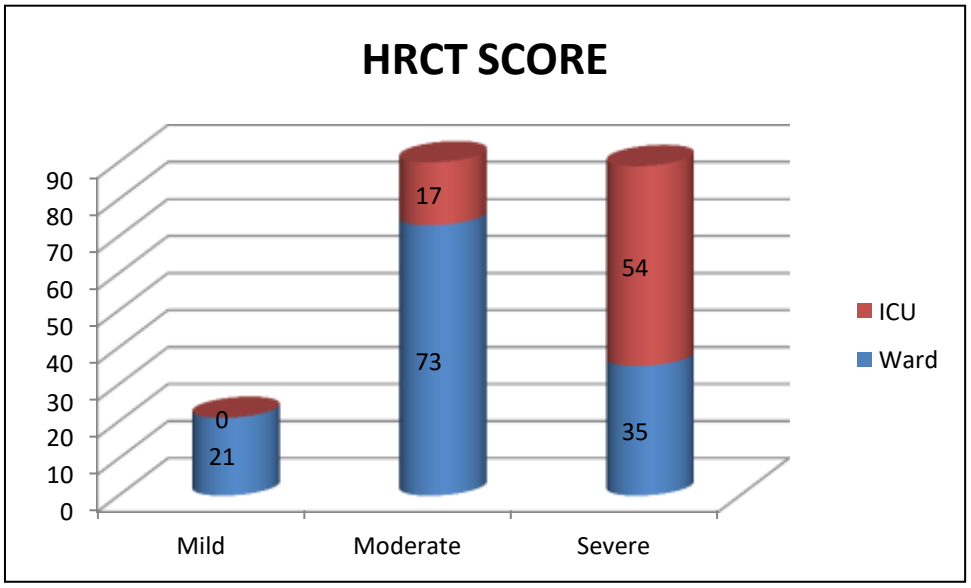
There is significant association between CT severity score (CTSS) and biomarkers. The mean value of CRP is 44.36 mg/L,66.5 mg/L and 91 mg/L in mild, moderate and severe category respectively in an increasing trend. Similar trend also seen in ferritin and d-dimers.

Table 5 : CT severity score (CTSS) and ICU Requirement

	HRCT Score								
Oxygen Supplementation	Mild		Moderate		Severe		Total		Mean CTSS
	No.	%	No.	%	No.	%	No.	%	
Ward	21	100%	73	81.11%	35	39.33%	129	64.50%	13.43
ICU	0	0%	17	18.89%	54	60.67%	71	35.50%	17.83

Pvalue=0.002

GRAPH 5-



There is significant association of CT severity score (CTSS) and ICU Requirement.(p value=0.002) All the patients with moderateandseverechangeswereadmittedinICU

Table 6: HRCT CTSS and Outcome

	HRCT Score								
Outcome	Mild		Moderate		Severe		Total		Mean
	No.	%	No.	%	No.	%	No.	%	CTSS
Survived	20	95.24%	69	76.67%	55	61.80%	144	72.00%	14.37
Death	1	4.76%	21	23.33%	34	38.20%	56	28.00%	16.59

P, VALUE -0.003

GPAPH6-

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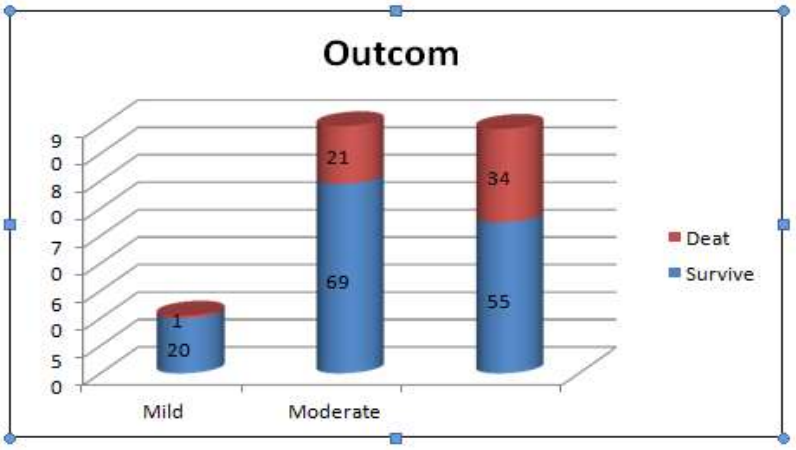

There is significant association of HRCT CT severity score (CTSS) andOutcome.

Discussion

In the present study, an attempt was made to outline distribution of age, gender, clinical, and laboratory features at presentation, severity of patients on the basis of CT imaging, and their correlation with clinical and laboratory parameters of patients to put diagnostic, and prognostic tools for COVID-19 disease In the present study from total number of participants (n=200) there are 55.5% male participants and 44.5% female participants. Almost half of them are males and half of them are females. But in RTPCR positive group 68% of them are male and 32% are females. Which is similar to studies done by Bhandari S. et al [16] and Sharma et al [17]. This is may be due to gender bias or due to the reduced susceptibility of females to viral infections which might be attributable to protection from X chromosomes and sex hormones, which play an important role in innate and adaptive immunity. [18-19]. Also, the severity of disease was not significantly associated with sex of the patient. The proportion of male patients in moderate and severe group is higher 53.3% and 59.5% respectively but this difference is not statistically significant. Which is similar to study done by Sharma et al [17]. In our study Age distribution of patient states that majority of atypical pneumonia patients (RTPCR Negative,68 and RTPCR positive,42) belonged to 45-65year age group, followed by 47 and 26 patients of >65- year age group in RTPCR Negative and RTPCR positive respectively. Minimum patients belonged to 25 – 44year age group. youngest participant was 31 and eldest being 84years old, mean age 60.3years. Participants in study done by Mardani R et al mimic our cases in sex and age composition. The result of RT-PCR for COVID-19 was positive in 70 (35%) cases and negative in 130 (65%). Groups of patients with positive and negative RT-PCR were similar regarding gender (p = 0.17) and age (p = 0.35) distribution.[20] In patients with negative CT scan, mean CRP levels were <50 mg/L in patients with mild scan results. In patients with moderate and severe CTscan, mean CRP levels were >50 mg/L this finding is found to have statistically significant correlation with the CT severity score (p = 0.04). Similarly, mean values of ferritin and d-dimer levels doubled and tripled from mild category to severe category. Studies have also suggested that early treatment at early disease stage can be considered using CRP as a predictive marker for likelihood of disease progression [21] Similarly, serum ferritin is a vital mediator of immune dysregulation, and its level was closely linked to the severity of the disease [22] D-dimer likewise can be used as a prognostic indicator, where higher levels are seen in more critical conditions. However, there is lack of evidence regarding the causal effect. It is not yet clear whether this increase is related to the direct effect of the virus or the systemic inflammatory response. [23,24] The findings of our present study show that CT scan can help prognosticate patients and identify those at higher risk of severe outcomes, including mortality, ICU requirement. Death rate increased from mere 4.7% (one death) in mild category to 23.3% and 38.2% in moderate and severe category respectively. Proving significant association between HRCT CTSS and outcome and ICU admissions. Mean CTSS of those patients who required ICU was significantly (p value=0.002) higher (17.83) than those who did not require ICU (13.43). Mortality rate of COVID-19 patients in this study was associated with higher CT severity grade. In our study 72%patients survived and 28% patients died. The mean CT severity score among patients who died was significantly higher (16.5) than patients who survived (14.37). Y.Li.Z .Yang et al in their study confirmed increased death rate among patients with severe CT findings.[25]. It is also known that CTSS determined by the percentage of disease involvement ineach lobe of the lung is associated with the need for ICU and mortality [26] Similar results were seen in study by Sharma et al,.[17]

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CONCLUSION

In the present study, from total number of participants (n=200) there are 55.50% male participants and 44.50% female participants. Age ranges of the patients from 35 year to 84year. The mean age of study participants was found to be 60.37± 11.30 years. In our study majority of patients belonged to moderate and severe CT category (45% and 44.5% respectively) and a small portion of mild category (10.5%). Our study showed significant association between CT severity grading and biomarkers level. The best outcomes were associated with milder CT findings, while death rate was increased among those with more severe scan results. 56(28%) patients out of 200 died in our study. In mild category death percent is 4.76% (1/21), in moderate and severe category its 23.33% (21/90) and 28% (34/89) respectively. (p value=0.003).

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