International Journal of Advances in Medicine
Arvind MN et al. Int J Adv Med. 2022 Jul;9(7):770-774
http://www.ijmedicine.com
pISSN 2349-3925 | eISSN 2349-3933
DOI: https://dx.doi.org/10.18203/2349-3933.ijam20221568

Original Research Article

Chest-X-ray-based scoring, total leukocyte count, and neutrophil-to-lymphocyte ratio to predict in-hospital mortality in COVID-19 patients: a retrospective study

Arvind M. N.[1], Nishant Patil[1]*, Naveen K. G.[2]

[1]Department of Medicine, [2]Department of Radiology, Shri Atal Bihari Vajpayee Medical College and Research Institute, Shivajinagar, Bengaluru, Karnataka, India

Received: 18 May 2022
Accepted: 02 June 2022

***Correspondence:**
Dr. Nishant Patil,
E-mail: Nishantpatil183@gmail.com

ABSTRACT

Background: The objective of this study was to assess the demographical characteristic, laboratory and radiological findings associated with COVID-19 mortality in hospitalized patients and also to co-relate neutrophil-to-lymphocyte ratio (NLR) and chest x-ray (CXR) score with severity of the disease.
Methods: This is a retrospective study done in Bowring and Lady Curzon hospital between the period of May 2021 to July 2021. 100 patients who were tested positive for SARS-CoV2 with RT-PCR were taken for the study after fulfilling the inclusion criteria. On day 1 of admission, routine blood investigations including CBC with differential count and chest X ray is taken. From the above said data, NLR and CXR score is calculated and a comparison is made to determine severity and in-hospital mortality between mild, moderate and severe COVID pneumonia patients. This study is being carried out after obtaining institutional ethical committee approval clearance. All analysis were performed using SPSS software version 10.
Results: The sample size studied was 100. The mean age of patients was 28.3 in mild, 49.9 in moderate and 62.6 in severe COVID patients. Among these 67% were males and 33% were females. It was noted that, leukocytosis (mean-13245), neutrophilia (mean-83.05%), lymphocytopenia (mean-10.45%) and chest X-ray score (mean-4.98) was seen among severe group with p value being significant.
Conclusions: TLC, NLR and CXR score were significantly different between severe and non-severe patients, so assessment of these simple parameters may help identify high risk COVID-19 patients at an early stage in a resource limited setting from the data retrieved from our hospital, NLR and CXR Score showed an acceptable efficiency to separate COVID-19 patients among severe and non-severe patients with a significant p value thereby helping in triaging the patients and need for early ICU needs.

Keywords: COVID-19 patients, TLC, NLR, CXR

INTRODUCTION

The clinical manifestations of COVID-19 patients range from asymptomatic to severe disease. A minority (30%) progress into severe manifestations such as acute respiratory distress syndrome (ARDS), severe pneumonia, septic shock, coagulopathy, and death.[1] This rapid progression to severe conditions is caused by an overwhelming inflammation, known as cytokines storm.

Biomarkers allowing prediction of disease severity in COVID-19 are urgently needed to address the problem of resource scarcity in this pandemic.[2]

Early risk stratification for COVID-19 patients upon hospital admission is the key to providing optimal interventions and to carefully allocate the ongoing scarce human and technical resources.[3]This would ensure that the limited available resources are given to the right patients.

Neutrophil-to-lymphocyte ratio (NLR) is an inflammatory marker derived from combining absolute blood neutrophil and lymphocyte counts, 2 routinely performed parameters in clinical settings. Recently, studies reported that NLR levels higher in more severe patients and were suggested to confer a prognostic value in COVID-19 patients.[4,5]

It is an independent risk factor of the in-hospital death.[6] The underlying pathophysiology that justifies for the clinical use of this bio marker is that severe COVID-19 patients were more likely to present with higher levels of inflammation upon hospital admission. Therefore, obtaining NLR levels on hospital admission could allow early risk stratification, identifying patients who should be prioritized for scarce resources.

In this pandemic, an accurate radiological approach is necessary for a more rapid classification of COVID-19 patients. CXR may not be as sensitive as CT, but it still plays a major role in developing countries that lack more sophisticated modalities. Moreover, CXR can be brought to the patient's bedside, minimizing the risk of cross infections.[7]Although CXR has a low sensitivity to early-stage disease of COVID-19, it can be used for monitoring the advancement and preceding stages of COVID-19 especially in critical care.[8]

The American college of radiology notes that CT decontamination required after scanning patients with COVID-19 may disrupt radiological service availability, and suggests that portable chest x-ray(CXR) may be considered to minimize the risk of cross-infection.[9] The radiological quantification of the severity and progression of lung abnormalities is of great importance in determining the appropriate clinical management and respiratory support for infected patients in a resource limited settings where CT is not available. The study is being done to validate the use of chest x rays for lung change quantification and monitoring the progress in COVID-19 pneumonia, thus obviating the need for serial CT scans.

Aims and objectives

The aim and objectives of the study were to assess the demographical characteristic, laboratory and radiological findings associated with COVID-19 mortality in hospitalized patients and to correlate NLR and CXR score with severity of COVID-19 disease.

METHODS

Inclusion criteria

Patient of either sex with age more than 18 years and RT-PCR confirmed COVID-19 pneumonia were included.

Exclusion criteria

Patient of age less than 18 years and pregnant women were excluded from the study.

Methodology

This is a retrospective study done in Bowring and Lady Curzon hospital between the period of May 2021 to July 2021. The 100 patients who were tested positive for SARS-CoV2 with RT-PCR were taken for the study after fulfilling the inclusion criteria. On day 1 of admission, routine blood investigations including CBC with differential count and chest X ray is taken. From the above said data, NLR and CXR score is calculated and a comparison is made to determine severity and in-hospital mortality between mild, moderate and severe COVID pneumonia patients. This study is being carried out after obtaining institutional ethical committee approval clearance. All analysis were performed using SPSS software version 20.

Statistical analysis

SPSS (Statistical package for social sciences) version 20. (IBM SPASS statistics [IBM corp. released 2011] was used to perform the statistical analysis. Data was entered in the excel spread sheet. Descriptive statistics of the explanatory and outcome variables were calculated by mean, standard deviation for quantitative variables, frequency and proportions for qualitative variables. Inferential statistics like chi-square test was applied for qualitative variables. Level of significance is set at 0.05.

RESULTS

A total of 100 hospitalized patients with SARS COV-2 infection were included in the study. Among the study population, 25 patients fall in mild covid, 35 patients fall in moderate COVID and 40 patients fall in severe COVID group category. The age distribution of study population is as follows- 25 mild patients had a mean age of 28.3 years. 35 moderate COVID patients had a mean age of 49.91 and the remaining 40 COVID-19 severe patients had a mean age of 62.6 years. The age between the severe and non-severe groups were found to be significant (p=0.00*).

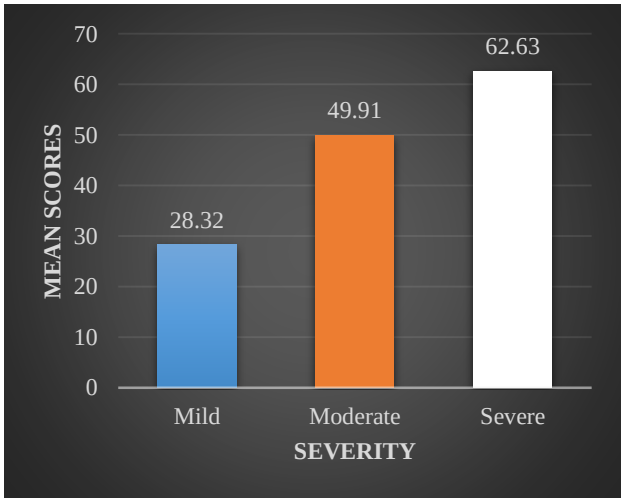

Figure 1: Mean age distribution of the patients.

As in the graph shown below, clearly depicting that the severity of COVID-19 increases with increasing age in Figure 1.

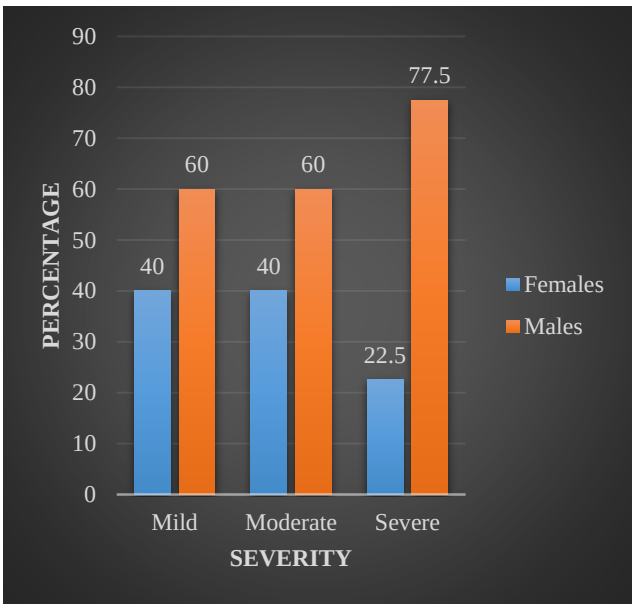

Figure 2: Distribution of the patients based on gender.

In this study population, 67 were found to be males and 33 were females. Among 67 males, 15 had mild, 21 had moderate and 31 had severe COVID pneumonia. Among 33 females, 10 had mild, 14 had moderate and 9 had severe COVID pneumonia. As shown in Figure 2, in this study population, the percentage of males were higher in both the severe and non-severe patients as compared to females showing a male predominance in a demographic picture.

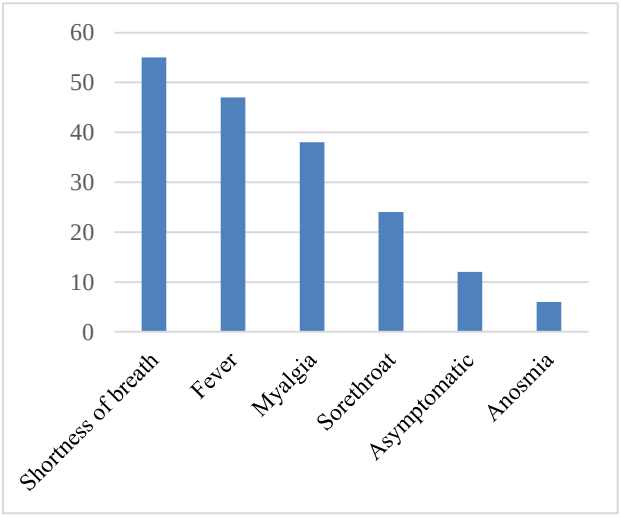

Figure 3: Common presenting symptoms

In this study population, most common presenting symptoms were shortness of breath followed by fever followed by myalgia, sore throat, asymptomatic, anosmia respectively in the descending order.

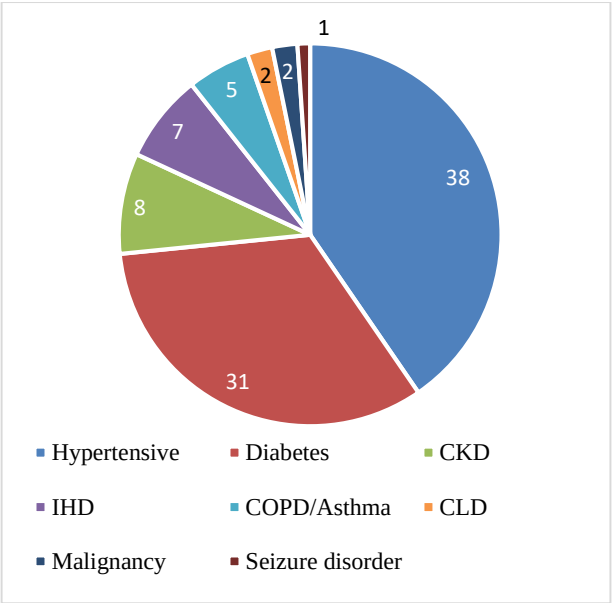

Figure 4: Distribution based on co-morbidities.

In this study population 43 had no comorbidities at all. Out of the remaining 57 patients who had one or multiple co-morbidities, hypertension and diabetes were the commonest. 67.6% had hypertension followed by diabetes 52.4%, followed by chronic kidney disease 14.2% ischemic heart disease 7.1%, COPD/bronchial asthma 7.1%, malignancy 4.7% and seizure disorder 2.3% respectively.

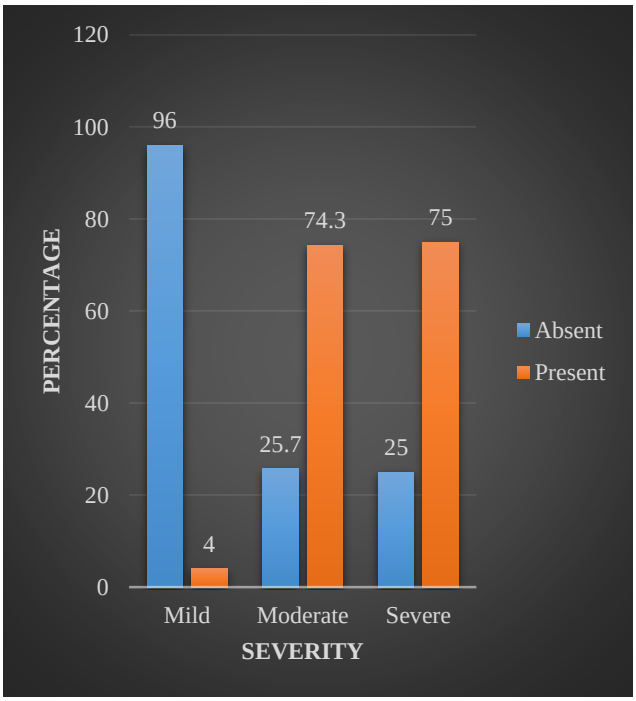

Figure 5: Severity-comorbid distribution.

Also, co-morbid conditions were found to be higher among severe population group as compared with non-severe group.

Table 1: Mean distribution of the lab investigations.

Variables		N	Minimum	Maximum	Mean	P value
Total WBC	Mild	25	3200	12600	7452.00	0.19
	Moderate	35	2600	14500	7611.43	0.07
	Severe	40	2800	30300	13245.00	0.01
Neutrophils	Mild	25	45	84	62.72	0.00
	Moderate	35	39	92	69.23	0.05
	Severe	40	39	98	83.05	0.01
Lymphocytes	Mild	25	10	42	27.84	0.00
	Moderate	35	7	51	22.63	0.00
	Severe	40	1	47	6.45	0.05
NLR	Mild	25	1	8	2.64	0.00
	Moderate	35	1	13	7.93	0.01
	Severe	40	1	98	17.21	0.01

In this study population, there was leucocytosis (mean-13245) in severe COVID patients compared to normal range of values in non-severe group. Similarly, there was also neutrophilia (mean-83.05), lymphocytopenia (mean-6.45) in severe group as compared to mild and moderate group. Most importantly the NLR ratio with a cut off of 17.21 is found in severe COVID-19 patients, cut off of 7.93 in moderate COVID pneumonia patients and 2.64 in mild COVID infections which were consistent and with a significant p value.

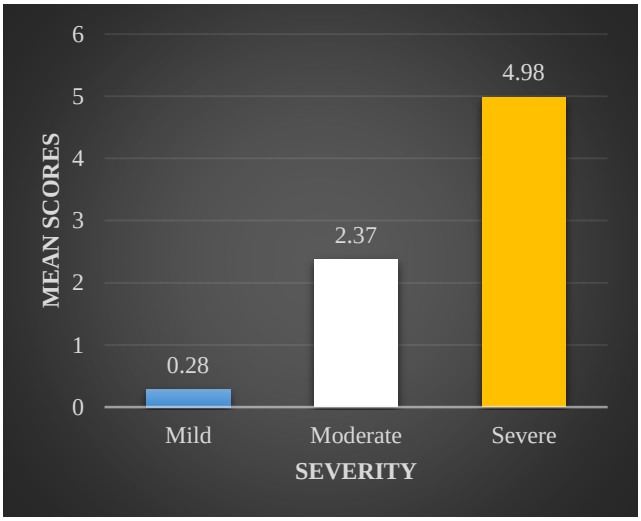

Figure 6: Chest X-ray scoring with respect to severity of COVID pneumonia.

A simple scoring chest x-ray-based scoring system is followed for this study with the following criteria. Each lung is awarded a minimum score of 0 and a maximum score of 4. So, in this scoring system minimum score being 0 and maximum is 8. <25% Lung involvement is given a score of 1, 25-50% lung opacity is given a score of 2, 50-75% lung involvement is given a score of 3 and >75% is given a score of 4 as assessed by a specialised experienced radiologist

In this study population CXR Score with a cutoff of 4.98 and above was seen in severe COVID pneumonia patients, a score with a cutoff of 2.37 was seen in moderate COVID pneumonia and 0.28 was seen in mild patients.

DISCUSSION

Patients with severe COVID-19 disease had high NLR and high CXR score values when compared to non-severe disease. The present study shows that levels of NLR and CXR score correlate with COVID-19 disease severity.

Patients with severe COVID-19 disease present with increased leukocytosis, neutrophilia and lymphocytopenia than those with non-severe disease. These patients were more likely to develop ARDS and require intensive care unit (ICU) level of care. NLR and CXR scores are easily obtained from a serum complete blood count with a differential profile and a simple bedside chest x ray. They serve as a function of relative neutrophilia and lymphopenia. Though CXR is not as sensitive as CT, but in majority of places where CT is not available, it helps as a quick guide with the above mentioned study cut off ratio to serve as a bridge for early triaging of the patients regarding the need for early ICU and mechanical ventilation.[9] In a retrospective study done by Sensusiati et al on 111 COVID-19 pneumonia patients has shown that mortality was seen with increased age which is coinciding without study showing that the mean age was 62.3% in severe groups. Fever and shortness of breath were the most frequent symptoms for all patients whereas shortness of breath followed and fever was seen only in severe groups in our study, majority of patients reported their first symptoms as myalgia followed by fever in mild to moderate group. However, among the patients who died, shortness of breath was the most frequent symptom which is coinciding without study also. The mean NLR score and RALE score were higher on the patient who died compared to patients who were discharged.[10] In our study the mean NLR and CXR score were higher in severe groups and the ones who died compared to a lower score which were seen in mild to moderate patients who got discharged coinciding with the previous study. In a study done by Kaleemi et al on 150 COVID-19 pneumonia patients, found that 30.6% patients underwent ICU admissions with

intubation had an Initial CXR severity score of 5-8. On the contrary in our study, we had 56.5% patients requiring ICU admission with intubation with a CXR score between 5-8. Lastly, age, Initial CXR severity score and ICU-intubation were found to be independent predictors of mortality in the studied patients which were coinciding without study. The mortality rate was 16.7%.[11] as compared to our study population where the mortality was 27.2% which was higher as seen in the previous study.

In a study done by Setiawati et al on a total of 225 COVID-19 pneumonia patients, based on the RALE scoring system, asymptomatic patients and those with mild pneumonia mostly scored as compared to our study which was less with a mean CXR score of 0.28 majority being less than 1. Patients with moderate pneumonia had a score between 2-5, whereas compared to in our study, patients scored a mean of 2.37 with majority being less than 4. and severe pneumonia and ARDS mostly scored in 5-8 which is same as in our study group top. Septic shock patients mostly scored 7-8 as compared to in our study all 11 septic shock patients had a score of 8; which showed a positive linear correction with NLR ratio.[12]

In a study done by Andrea et al, out of 302 COVID-19 patients, patients with high chest x ray score and at least one other predictive inflammatory lab parameter showed a statistical correlation and had the highest risk of in-hospital death, as satisfying with our study group with higher NLR ratio along with higher CXR score were found in severe group and patients who were deceased.[13] NLR ratio of more than 17.2 with CXR score of 5-8 had a significant in-hospital mortality in our study population.

CONCLUSION

This study establishes NLR and CXR score as a reliable prognostic marker to differentiate severe versus non-severe disease in COVID-19 patients. Early recognition of the severe cases allows for early triaging and timely initiation of management.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Arvind MN, Patil N, Naveen KG. Chest-X-ray-based scoring, total leukocyte count, and neutrophil-to-lymphocyte ratio to predict in-hospital mortality in COVID-19 patients: a retrospective study. Int J Adv Med 2022;9:770-4.