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Original Research Article

Utility of clinico-hematological risk assessment and severity score (chase score) in covid-19 patients

Supriya Sandeepa[1], **Puneet K Nagendra**[2], **Bhargavi K N**[1], **Sandeepa H S**[3]*, **Narendra Umashankar**[2]

[1]*Dept. of Pathology, CDSIMER-Rural Health Training Center (Dayanand Sagar), Ramanagara, Karnataka, India*
[2]*Dept. of Respiratory Medicine, CDSIMER-Rural Health Training Center (Dayanand Sagar), Ramanagara, Karnataka, India*
[3]*Dept. of Respiratory Medicine, Adichunchanagiri Institute of Medical Sciences, B.G Nagara, Karnataka, India*

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ABSTRACT

Background: Treating COVID-19 during pandemic situations is a challenge to utilize the resources judiciously. A proper triage and prognostication are very helpful. We aim to formulate a combined clinico-hematological scoring system in COVID – 19 patients and check its utility in prognostication in terms of mortality and development of complications in COVID-19 patients.

Materials and Methods: This retrospective cross-sectional study included patients that were admitted to CDSIMER for treatment. Demographic, clinical, laboratory and outcome data were extracted from the respective patient files stored at medical records department. We formed a clinico hematological scoring system that included 8 parameters and each parameter was scored as 1 or 2. Based on total score (range 8 to 16) obtained they were categorized into low risk and high risk for treatment outcomes.

Results: We studied data of 451 COVID-19 patients admitted in CDSIMER from April 2021 to July 2021. We observed 100% recovery in the patients with score 8, 9 and 10. The mortality began to appear from score 11 onwards, showing increasing trend of mortality with higher scores. Therefore, score of ≥ 11 was established as the cut off to determine high risk for mortality. Out of the total 451 COVID patients, 70.10% (n=316 cases) came under the high-risk category, out of which 13.60% (n=43) had mortality and despite high risk as many as 86.40% patients (n=273) recovered with or without complications. Low risk category had demonstrated 100% (n=351) recovered cases. The p value was significant (0.00) on comparing the outcomes in the two categories of the proposed scoring system.

Conclusion: Chase score is a novel scoring system easy and feasible to use in any hospital setting. The score helps clinicians to triage patients at admission to determine the standard of care, the need to carry out selective follow up investigations but not compromising in implementing the standard of care. Future prospective studies which can measure the internal and external validity of the score is very important.

1. Introduction

The severe acute respiratory syndrome-coronavirus-2 (SARS-CoV-2) causes the novel coronavirus disease (COVID-19). The sickness can range from a simple cold to more serious conditions such as severe acute respiratory syndrome (SARS). A confirmed case is defined by epidemiological history and/or clinical aspects indicating that a suspected patient had contact with COVID-19 infected persons and/or had symptoms and signs of COVID-19 infection, as well as positive laboratory testing detecting virus nucleic acid.[1–3]

Infectious agents, such as COVID 19, have been shown to play a role in the development of infection to

* *Corresponding author*.
E-mail address: drsupriyasandeep123@gmail.com (Sandeepa H S).

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serious thrombotic events. A wide range of hematological abnormalities are found in affected patients, raising the risk of major thrombotic consequences in severe cases. Organ dysfunction, pulmonary embolism, septic shock, myocardial infarction, heart failure, and cerebral infarction are few of the fatal effects to list.[4,5] They accomplish this by establishing a coagulation cascade. They bind to the angiotensin converting enzyme-2 (ACE-2) receptor on Type II lung pneumocytes, causing the kallikrein-kinin system to become dysregulated. The hypercoagulable state is thought to be caused by ACE-2 downregulation, which results in angiotensin II-mediated vascular dysfunction. Various hematological parameters and their clinical manifestations are indicators of the systemic inflammatory response.[6]

The battery of biochemical and hematological parameters that are currently performed as part of standard of care in accordance with the respective National COVID treatment policies are critical in classifying the severity of infection at presentation and assisting in the selection of treatment strategies. Hematologic measures and their ratios have a high prognostic value, are low-cost, and simple to administer and monitor.[4,5] Researchers and physicians throughout the world can use this data to analyse and build a score system that will aid in the triage of COVID19 patients.

1.1. Added value of this study

Based on intensive data search, we were able to find a few studies that were based on clinical categories that can help us treat COVID-19 patients. There was a scarcity of information on simple prognostic tools' availability. Here, with the retrospective analysis of data on COVID-19 patients treated in our hospital, we propose a novel scoring system that can explore the available clinical information and hematological parameters to triage and prognosticate the COVID-19 patients even in resource-limited situations. The suggested 'CHASE' scoring system, which incorporates clinical and hematological data, is particularly useful in risk stratifying patients and guiding treating doctors in optimising therapy/referral to higher centres of healthcare and prognosticating disease.

2. Materials and Methods

2.1. Study design and participants

A cross-sectional study, retrospective data analysis of inpatients from Dr Chandramma Dayananda Sagar Institute of Medical education and Research (CDSIMER, Karnataka, India). Patients diagnosed with COVID-19 according to the Indian Council of Medical Research (ICMR) with positive SARS-COv-2 RNA detection in throat swab specimens, both male & female adults presenting with mild to severe categories were eligible. Exclusion criteria were pediatric and pregnant patients, missing hematology and clinical data, transfer to other medical facilities with unknown outcomes. The study was approved (number: CDSIMER/MR/0017/IEC/2021) by the institutional ethics committee of CDSIMER.

2.2. Definitions

According to Indian Council of Medical Research (ICMR), the mild form of severity of COVID-19 is without shortness of breath or hypoxia (SpO2 ≥94%), moderate cases are with cough, fever, dyspnea, SpO2 of 90 to 93% on room air and severe cases with severe respiratory distress, pneumonia, SpO2 <90% on room air.

CHASE Score is combination of clinical score and hematological score. Clinical Score= Age + Gender + Symptom duration + Comorbidity + SpO2; Hematology Score= Hb+NLR+PLR. The scoring was done randomly allocating 1 for the lower limit of reference range and 2 for the higher limit of the reference value in each parameter. The reference range for each of parameters were referenced from the previously published literature. The points to the hematological and clinical parameters are as follows:

1. A. Hemoglobin (Hb) expressed in gram % 1 for > 10 g%; 2 for ≤ 10 g%.
2. B. Neutrophil to Lymphocyte Ratio (NLR): Formula: (Absolute Neutrophil Count)/ (Absolute Lymphocyte count). 1 for < 3.13, 2 for ≥ 3.13.[7]
3. C. Platelet to Lymphocyte Ratio (PLR): Formula: (Platelet Count)/ (Absolute Lymphocyte count). 1 for <180.22, 2 for ≥180. 22.[8]
4. D. Age in years: 1 for <50 years, 2 for ≥50 years.
5. E. Gender: 1 for female, 2 for male.
6. F. Duration of symptoms (days): the day of presentation from the day onset of symptoms. 1 for < 5 days of symptoms, 2 for ≥ 5 days of symptom.
7. G. Comorbidity: 1 for absence of one or more comorbidities like DM, HTN, IHD, CVA, Asthma, COPD, obesity. 2 for presence of one or more comorbidities like DM, HTN, IHD, CVA, Asthma, COPD, obesity.
8. H. Oxygen saturation (SpO2) at room air on presentation, measured by fingertip pulse oximeter. 1 if SpO2 is ≥ 94 %, 2 if SpO2 is < 94%.

Chase Score Interpretation: low risk for complications/ morbidity, mortality < 11; high risk for complications/ morbidity, mortality ≥11.

2.3. Procedures

Hematology parameters were accessed from the laboratory Information system. The demographic, clinical and outcome data were extracted from respective patient files available at the Medical Records Department. A panel of laboratory parameters including hematological and other biochemical

parameters were done at admission to all the patients. They were repeated according to the clinician's discretion based on everyday clinical condition of the patient. All laboratory tests were done in the central laboratory of CDSIMER. The treating doctors judged the mode of treatment based out of the standard of care set by the ICMR. All data were entered into a microsoft excel sheet and checked by two physicians. Discharged patients were given written advice for isolation, treatment with appropriate drugs and advised to follow up after two weeks.

2.4. Statistical analysis

Categorical variables were presented as frequency rates and percentages and analysed using χ^2 test. The study outcomes were the survivors and non survivors. Complications in each group were also included. Ap value of 0.05 or less was considered statistically significant. We did statistical analysis using SPSS software.

2.5. Funding

The funder of the study had no role in study design, data collection, data analysis, data interpretation or writing the report. The researchers had full access to the data in the study and are responsible for the publication.

3. Results

We collected and analysed the data of 451 COVID-19 patients admitted in CDSIMER from April 2021 to July 2021. Table 1 shows distribution of cases with survivors and non survivors under each score. The score ranged from minimum of 8 to a maximum of 15, though 16 is the maximum according to the scoring system, we had no patients with the score 16. We observed 100% recovery in the patients with score 8, 9 and 10. The mortality began to appear from score 11 onwards, showing increasing trend of mortality with higher scores. Therefore, score of ≥ 11 was established as the cut off to determine high risk for mortality.

Out of the total 451 COVID patients, 70.10% (n=316 cases) came under the high-risk category, out of which 13.60% (n=43) had mortality and despite high risk as many as 86.40% patients (n=273) recovered with or without complications. Low risk category had demonstrated 100% (n=351) recovered cases. The p value was significant (0.00) on comparing the outcomes in the two categories of the proposed scoring system.

The development of complications in patients with high-risk and low risk categories was significantly different with a p vale of 0.000. We observed complications in 27.40 % (n=135) in the low-risk category, patients, in comparison to 81 % (n=256) of patients in high-risk category (Table 3).

4. Discussion

Traditionally, scoring systems have been utilized and proven to be an adjuvant to supplement physician judgement in different areas of medicine. They have also aided in indicating the susceptibility and prognosis.[6] A scoring system is needed to classify the patients in order to determine the need for follow-up, home isolation, quarantine or the conduction of further investigations.[9] A prognostic model can be generated using the hematological parameters, risk factors, clinical parameters and outcomes. This scoring system helps identify patients with better prognosis after infection with SARS-Cov2. We propose a novel scoring system that is simple and based on numerous clinical and hematological parameters which can be used in any basic hospital setting.

Our scoring system categorized the COVID-19 patients as low risk and high risk based on giving points (1 or 2) to each of the clinical parameters like age, gender, duration of symptoms, presence of comorbidity, oxygen saturation on room air at presentation and hematological parameters like hemoglobin, NLR and PLR. There are totally 8 parameters with a total score ranging from a minimum of 8 to a maximum of 16. The high risk was defined as a total score of ≥11. There was no mortality in low-risk patients and above 80 % of patients in high-risk group developed complications.

Let us look at few of the following scoring systems that were published in relation to the COVID-19. The scoring systems were a permutation and combination of clinical presentation, laboratory, and radiological parameters.

Jhala risk scoring system (JRSS) to assess the severity of disease risk was based on age, ethnicity, presence of any lung disease, presence of cardiovascular disease, smoking history, and diabetes history with laboratory parameters. The lab parameters that were used are D dimer, CRP, LDH, Troponin, Ferritin and CPK. A combined score of ≥7 was concluded to be an indication of intensive care.[10]

Zhang c et al inferred that age, white blood cell count, neutrophil count, glomerular filtration rate, and myoglobin were selected by multivariate analysis as candidates of scoring system for prediction of disease severity in COVID-19 with the result being probability of patients in high-risk group developing severe disease was 20.24 times than that in low-risk group.[11]

In a scoring system by Yang F et al, the disease severity and mortality risk were assessed using Acute Physiology and Chronic Health Evaluation II (APACHE II); Sepsis-related Organ Failure Assessment (SOFA); multilobular infiltration, hypo-lymphocytosis, bacterial coinfection, smoking history, hypertension and age (MuLBSTA); and pneumonia severity index (PSI) scores. They concluded that older, overweight, male patients with a history of chronic illnesses and continuously decreased lymphocyte proportions and increased D-dimer levels might have higher

Table 1: Distribution of cases under each score with outcomes.

Chase score	Non survivors		Survivors	
	Number	Percentage	Number	Percentage
8	0	0	16	100
9	0	0	44	100
10	0	0	75	100
11	2	2.8	70	97.2
12	12	16.4	61	83.6
13	17	17.3	81	82.7
14	9	16.4	46	83.6
15	3	16.7	15	83.3
Total	43	9.5	408	90.50
Chi square= 33.04, p value= 0.000				

Table 2: Distribution and comparison of mortality in high risk and low risk category

Chase score	Outcome		
	Non-Survivors	Survivors	Total
High risk (≥11)	43 (13.60%)	273 (86.40%)	316 (70.10%)
Low risk (<11)	0 (0.00%)	135 (100.00%)	135 (29.9%)
Total	43 (9.50%)	408 (90.50%)	451 (100.00%)
Chi square -20.30, p value- 0.000			

Table 3: Distribution and comparison of complications in high risk and low risk category

Chase score	Complications		
	No	Yes	Total
High risk (≥11)	60 (19.00%)	256 (81%)	316
Low risk (<11)	98 (72.60%)	37 (27.40%)	135
Total	158 (35.00%)	293 (65.00%)	451
Chi square -119.43, p value- 0.000			

risks of death owing to COVID-19. The combination of SOFA MuLBSTA and PSI systems after admission might be sensitive in assessing the mortality risk of patients with COVID-19 who are in critical condition.[12]

Jiwa N et al developed two models. Model A consisted of two variables, presence of pneumonia and ischemia. Model B consisted of three variables, age > 65 years, supplemental oxygen ≥4 L/min, and C-reactive protein (CRP) > 10 mg. According to their study, Model B was the better of the two models tested, yielding a moderate Area under curve and a more robust separation of mortality between the highest and lowest scores.[13]

Altschul DJ et al conducted a severity score ranging from 0 to 10. It consisted of age, oxygen saturation, mean arterial pressure, blood urea nitrogen, C-Reactive protein, and international normalized ratio. Based on the risk categorization, the probability of mortality was 11.8%, 39% and 78% for patients with low (0–3), moderate (4–6) and high (7–10) COVID-19 severity score respectively.[14]

Our CHASE scoring system included only those crucial clinical and important hematology parameters that were feasible in a resource limited setting. We did not include the biochemical parameters as most of them were expensive and not available in all the hospital set-ups in our country. Many of the studies arrived at scoring systems that triaged the patients at admission to decide on the treatment strategies and of less effective prognostic value. The CHASE scoring system not only helped in triaging but also could predict the outcome and development of complications effectively. This is important to implement strategies for more effective utilization of the limited medical resources during pandemic situations. CHASE score is the least complicated and very effective scoring system known so far.[15]

5. Conclusion

CHASE score is a novel scoring system easy and feasible to use in any hospital setting. The score helps clinicians to triage patients at admission to determine the standard of care, the need to carry out selective follow up investigations but not compromising in implementing the standard of care. The score is helpful as well during counselling the patients' caretakers as they can be conveyed with an objective assessment pattern to give them the ray of hope in the low-risk categories.

6. Recommendations and Limitations

Future prospective studies which can measure the internal and external validity of the score is very important. Studies are also required using this scoring system which can help us determine the place of treatment that is home or hospital-based treatment, follow-up protocol that can help strategize the treatment.

7. Source of Funding

None.

8. Conflict of Interest

None.

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Author biography

Supriya Sandeepa, Professor https://orcid.org/0000-0002-9548-3492

Puneet K Nagendra, Assistant Professor https://orcid.org/0000-0002-9887-3699

Bhargavi K N, Senior Resident https://orcid.org/0000-0002-1005-0904

Sandeepa H S, Associate Professor https://orcid.org/0000-0002-6424-4915

Narendra Umashankar, Assistant Professor https://orcid.org/0000-0002-3530-5096

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