Iran J Public Health, Vol. 51, No.12, Dec 2022, pp.2717-2723

Original Article

HATCH Score for Predicting Mortality in COVID-19 Patients

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(Received 20 Feb 2022; accepted 19 Apr 2022)

Abstract

Background: We aimed to evaluate the relationship between HATCH score [hypertension, age >75 yr, previous transient ischemic attack (TIA) or stroke (doubled), chronic obstructive pulmonary disease, heart failure (doubled)] and in-hospital mortality in COVID-19 patients.

Methods: Overall, 572 COVID-19 patients hospitalized between Mar 15 and Apr 15, 2020, were included in this multicenter retrospective study, in Turkey. The HATCH score of each patient was calculated. Mortality results were followed for 50 days. The patients were divided into 2 groups developing mortality (n=267) and non-mortality (n=305). Clinical outcomes were defined as in-hospital mortality improvement status.

Results: HATCH scores in non-survivors of COVID-19 were significantly higher than in survivors (P<0.001). In logistic regression analysis, HATCH score (OR: 1.253, 95% CI: 1.003–1.565; P=0.047), platelet count (OR: 0.995, 95% CI: 0.993-0.998; P<0.001), C-reactive protein level (OR: 1.010, 95% CI: 1.007-1.013, P<0.001) and estimated glomerular filtration ratio (eGFR) level (OR: 0.963, 95% CI: 0.953-0.973; P<0.001) were independent predictors of in-hospital mortality in COVID-19 patients.

Conclusion: The HATCH score is useful in predicting in-hospital mortality in patients hospitalized with COVID-19.

Keywords: SARS-CoV-2; Score; Mortality

Introductıon

The COVID-19 pandemic, which caused billions of deaths worldwide, poses a major challenge to most healthcare systems around the world. While respiratory failure remains the most common cause of death, SARS-CoV-2 infection has proven to be a multidisciplinary clinical condition with multiorgan involvement (1).

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The HAT2CH2 score, calculated by the patient's scores based on the patient's age, presence of hypertension, stroke or transient ischemic attack, chronic obstructive pulmonary disease (COPD), and heart failure, is a relatively new scoring system developed in 2010 to identify patients likely to progress to persistent atrial fibrillation (AF) forms (2).

In patients with SARS-CoV-2 infection, there is still a need for a straightforward and practical way to predict clinical prognosis, particularly for mortality risk. Many prognostic scores have been proposed for clinical management and decision-making (3), but there is no study on the prognostic value of the HATCH score in patients with COVID-19.

We think that all factors included in this score are also important because they are high mortality markers for COVID-19 morbidity and mortality and collect the risk scores of related systemic diseases in a single scoring system. We aimed to evaluate the importance of the HATCH score for predicting all-cause mortality in patients with COVID-19.

Methods

This retrospective study comprised 572 patients hospitalized in 6 different centers, in Turkey with symptoms and laboratory or radiological findings of COVID-19 between Mar 15 and Apr 15, 2020. The diagnosis of SARS-CoV-2 RNA was determined by real-time reverse transcription polymerase chain reaction (rRT-PCR) after taking oropharyngeal and nasal samples with the same swab in accordance with the protocols recommended by the National Ministry of Health Public Health Microbiology Reference Laboratory. The management and treatment of patients were arranged in line with the guidelines on COVID-19 prepared by the National Ministry of Health (4).

Epidemiological, demographic, clinical, laboratory, and mortality outcome data were obtained from patient medical records using a hospital registry system specific to each patient. Mortality results were followed for 50 days. We excluded patients with severe liver and kidney disease, hereditary coagulation disorders, active cancer or chemotherapy-radiotherapy treatment, rheumatologic disease, and age <18 years.

Each patient's HATCH score was calculated using clinical data obtained from the electronic medical health record history and hospitalization files at the time of their hospitalization. The HATCH score was calculated by two cardiologists blinded to patient survival data (1 point for hypertension, 1 point for age >75 years, 2 points for transient ischemic attack (TIA) or stroke, 1 point for COPD, and 2 points for heart failure.). The study population was divided into 2 groups according to in-hospital mortality: the survivor group (n=367) and the deceased group (n=205).

The study was conducted in accordance with the Helsinki Declaration and the study protocol was approved by the local Ethics Committee and the Ministry of Health (date: 05.15.2020, decision number: 99).

Statistical analysis

Data analyzes were performed using IBM SPSS Statics for Windows, Ver. 22.0 software (IBM Corp., Armonk, NY, USA). Continuous variables with normal distribution were expressed as mean ± standard, while those with abnormal distribution were expressed as median and IQR. Categorical variables were expressed as frequency and percentage. Student-t-test or Mann-Whitney U-test was used for the comparison of continuous variables. The Chi-square test or Fisher's exact test was used to compare categorical variables. Statistical significance was determined as $P<0.05$.

All key parameters in the univariate analysis were selected for the multivariate model, and forward stepwise logistic regression analysis was used to identify independent predictors of in-hospital mortality of COVID-19 patients. The odds ratio (OR) and 95% confidence interval (CI) for each independent variable were calculated. *P*-value <0.05 was considered significant. Receiver operating characteristic curves (ROC) analysis was used to determine the predictive accuracy and performance of HATCH for in-hospital mortali-

ty. Survival by HATCH score was compared using Kaplan-Meier survival analysis and log-rank test.

Results

Overall, 572 hospitalized COVID-19 patients (258 men, mean age: 60.3±17.6 yr) were included in this study. Demographic, clinical characteristics, and laboratory data of the patients are summarized in Table 1.

Table 1: Demographic, admission, clinical, and laboratory parameters of the study

Variable	*All (n=572)*	*Survivors (n=305)*	*Non-survivors (n=267)*	*P-value**
Age (yr), mean±SD	60.3±17.6	52.0 ±17.9	69.8 ±11.4	<0.001
Male gender, n (%)	258 (45.1)	138 (45.2)	120 (44.9)	0.942
HATCH score	1 (0-1.5)	0 (0-1.0)	1 (0-2.0)	<0.001
HATCH score point				
HT, n (%)	267 (46.7)	103 (38.6)	164 (61.4)	<0.001
HF, n (%)	39 (6.8)	15 (4.9)	24 (9.0)	0.054
CVA, n (%)	20 (3.5)	9 (3)	11 (4.1)	0.448
COPD, n (%)	72 (12.6)	23 (7.5)	49 (18.4)	<0.001
Age >75 yr, n (%)	117 (20.5)	26 (8.5)	91 (34.1)	<0.001
Laboratory parameters				
CRP (nmol/L), median (IQR)	72 (3.2-169)	6.1 (0.4-71)	152 (90-219)	<0.001
Hemoglobin (mmol/Ll), median (IQR)	12.1±24.1	11.2±22.1	13.0±22.4	<0.001
eGFR, median (IQR)	78 (35-95)	95 (77-99)	37 (18-70)	<0.001
D-Dimer, µg /mL, median, (IQR)	814 (0.4-2540)	0.8 (0.1-90)	1840 (815-4032)	<0.001
hs- TnI, pg/mL, median, [IQR]	13.2 (3-55)	4.4 (2.3-17)	34 (13-135)	<0.001
Platelet count, $\times 10^3$/uL	218.1± 98.3	226.3± 79.1	208.4± 116.1	0.031
Albumin, g/L, median, [IQR]	4.2 (3.7-25.0)	4.1 (3.8-26.0)	20 (3.3-24.0)	0.397

Values are presented as n (%), median (interquartile range [IQR]), or mean± standard deviation. *P*-value was calculated using an independent samples t-test or the Mann-Whitney U-test for continuous variables and the chi-squared test or the Fisher's exact test for categorical variables, as appropriate. **P*-value <0.05 was considered significant. *Abbreviations*: COPD, chronic obstructive pulmonary disease; CVA, cerebrovascular accident (stroke or transient ischemic attack); eGFR, estimated glomerular filtration rate; CRP, C-reactive protein; hs-TnI, high-sensitive troponin I; HF: heart failure; HT: hypertension

The HATCH score was significantly higher in non-surviving COVID-19 patients than in the surviving group patients (*P*<0.001). In addition, in the ROC analysis, the HATCH score performed well in predicting mortality with AUC: 0.694 (95% CI 0.650-0.737, *P*<0.001, Fig. 1).

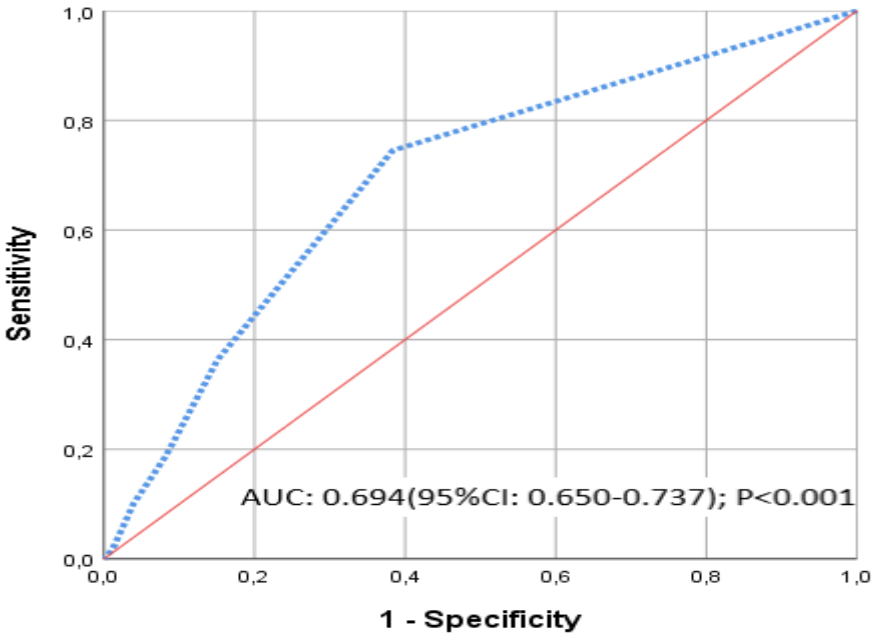

Fig. 1: Receiver operating characteristic curves for HATCH scores to predict mortality

A forward stepwise logistic regression analysis was performed to identify independent predictors of in-hospital mortality. The analysis included HATCH score (OR: 1.253, 95% CI: 1.003–1.565; *P*=0.047) and platelet count (OR: 0.995, 95% CI: 0.993-0.998; *P*<0.001), C-reactive protein level (OR: 1.010, 95% CI: 1.007-1.013, *P*<0.001) and eGFR level (OR: 0.963, 95% CI: 0.953-0.973; *P*<0.001) were independent predictors of in-hospital mortality of COVID-19 patients (Table 2).

Table 2: Univariate and multivariate analysis of in-hospital mortality

Variable	***Univariate analysis***		***Multivariate analysis***	
	OR (95% CI)	*P-value*	*OR (95% CI)*	*P-value*
HATCH score	1.698 (1.454–1.983)	<0.001	1.253 (1.003–1.565)	0.047
eGFR	0.955 (0.948–0.962)	<0.001	0.963 (0.953-0.953)	<0.001
Hemoglobin	1.036 (1.029–1.043)	<0.001		
Platelet count	0.998 (0.996–1.00)	0.032	0.995 (0.993-0.998)	0.002
Albumin	1.019 (0.999-1.039)	0.066		
CRP	1.014 (1.012–1.017)	<0.001	1.010 (1.007-1.013)	<0.001
D-Dimer	1.001(1.000-1.002)	<0.001		
hs- TnI	1.001(1.000-1.001)	0.007		

A *P*-value <0.05 was considered significant. -2Log-likelihood: 358.376, Nagelkerke R Square:0.603, Omnibus test: *P*<0.001.
Abbreviations: CI, Confidence Interval; OR: Odds ratio; eGFR, estimated glomerular filtration; CRP, C-reactive protein; hs-TnI, high-sensitive troponin I.

In the survival analysis, patients with a high HATCH score have a higher mortality rate than those without a high HATCH score. Kaplan-Meier survival curves according to HATCH scores are shown in Fig. 2

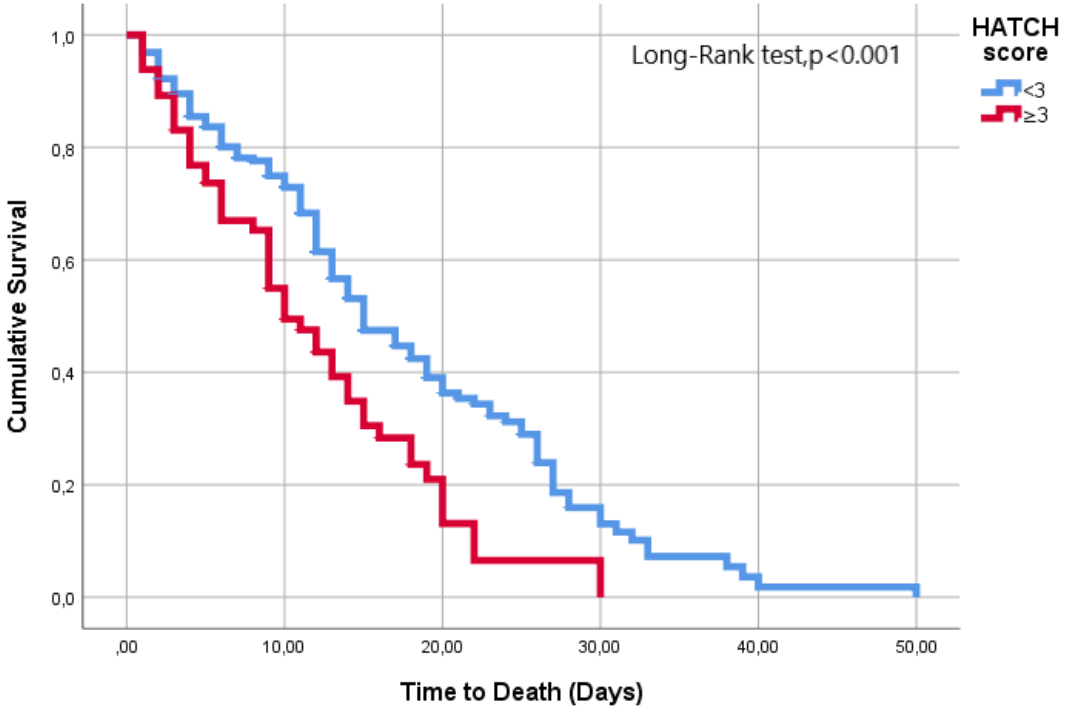

Fig. 2: Kaplan–Meier survival curves according to HATCH score in COVID-19 patients

Discussion

COVID-19 is a new strain not previously identified in humans. After being identified in Wuhan, China's Hubei province, in December 2019, it quickly spread to the rest of the world (5). Although vaccination studies for the disease have been completed, it remains an important public health problem in the world. Mortality is higher in the elderly and those with high comorbidities (6). The majority of patients have at least one comorbidity in the severe groups, and Hypertension, diabetes, COPD, heart diseases, malignancies, and cerebrovascular disease are the most common comorbidities in this population (7). This study evaluated the predictive power of the HATCH score for mortality in patients with COVID-19. The main findings of our study were as follows: i) HATCH scores in COVID-19 patients who did not survive were significantly higher than those who survived (P<0.001), ii) In the Kaplan–Meier survival analysis; mortality was significantly increased in patients with a higher HATCH score (P< 0.001 by log-rank test), iii) blood platelets, eGFR, and CRP levels at admission were independently associated with mortality, except for the HATCH score in the regression analysis.

The HATCH score is scoring based on the risk factors related to chronic disease and advanced age, on the basis that risk factors in the structural and electrical remodeling process of the atria, without relying on any laboratory results, may cause the progression of AF (2), as a predictor score in the transition of paroxysmal AF to persistent AF. Many individual risk factors in the HATCH score used are risk factors associated with COVID-19 morbidity and mortality. Apart from the HATCH score, there are many studies in the literature on the prediction of mortality in COVID-19 patients by many scoring systems frequently used in routine cardiology practice (8-11).

Our study results showed that higher HATCH scores were associated with worse clinical outcomes. In addition, the HATCH score had a good discriminative ability to predict hospital mortality in COVID-19 patients. Many risk fac-

tors included in the HATCH score are risk factors known to be associated with COVID-19 morbidity and mortality. Cerebrovascular and cardiovascular diseases have been associated with an increased risk for poor outcomes in patients with COVID-19 (12, 13). The association of COPD and hypertension, which are other parameters of the HATCH score, with a higher risk of severe and fatal COVID-19 has been shown in studies (14, 15). Advanced age, which is a risk factor, was an independent risk factor for COVID-19-related mortality (15, 16). Documenting the presence of advanced age, cardiovascular, cerebrovascular, and pulmonary system diseases with proven high mortality relationships in COVID-19 patients with a concise scoring system makes the HATCH score important in this patient group.

Platelet, C-reactive protein, and eGFR levels at hospitalization are significantly associated with higher in-hospital mortality (17-19). In our study, platelet count, C-reactive protein, and eGFR levels at admission were found to be independently associated with in-hospital mortality of COVID-19 patients.

The HATCH scoring system can serve as a simplified tool for rapid risk assessment on admission, which can contribute to identifying high-risk patients, guiding early treatment, and close monitoring.

The present study has some limitations. Our results are based on a retrospective study with a relatively small number of patients. We reported only in-hospital deaths because of the retrospective design. Detailed laboratory parameters that may affect the primary outcome were not included in the study, which is another limitation. Further survival studies are required for data on short- and long-term outcomes.

Conclusion

COVID-19 patients who did not survive had higher HATCH scores than survivors. In addition, a high HATCH score at hospitalization predicted in-hospital mortality of COVID-19 patients. Evaluation of the HATCH score at hospital admission may contribute to risk classification in the COVID-19 pandemic.

Journalism Ethics considerations

Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

Acknowledgements

None of the authors involved in the study received any financial support.

Conflict of interest

The authors declare that there is no conflict of interest.

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