ORIGINAL ARTICLE
https://doi.org/10.1590/1806-9282.20200983

The ATRIA score is superior to the m-CHA_2DS_2-Vasc score in predicting in-hospital mortality in COVID-19

Ozge Ozcan Abacioglu[1]*, Arafat Yildirim[1]

SUMMARY

OBJECTIVE: Coronavirus disease 2019 (COVID-19) has become a health and social problem all over the world. Most of the deaths occur from embolism and thrombus formation. We aimed to compare the predictive value of the anticoagulation and risk factors in atrial fibrillation (ATRIA) and m-CHA_2DS_2-Vasc scores in in-hospital mortality in COVID-19.

METHODS: Three-hundred and ninety-four patients who were hospitalized due to COVID-19 between 10 June 2020 and 10 September 2020 were included. Three-hundred and sixty patients who survived were defined as the non-mortality group and the remaining 34 whose hospitalizations resulted in death were defined as the mortality group. The anticoagulation and risk factors in atrial fibrillation and m-CHA_2DS_2-Vasc scores of the patients were calculated.

RESULTS: A total of 394 patients, mean age 66.2±9.7 (221 male [56.1%]) were included in this retrospective study. The median values of the anticoagulation and risk factors in atrial fibrillation and m-CHA_2DS_2-Vasc scores were different between the groups ($p<0.000$ for both). The multivariate logistic regression analysis showed that both the m-CHA_2DS_2-Vasc and anticoagulation and risk factors in atrial fibrillation scores were independent predictors of in-hospital mortality ($p=0.024$, 95%CI 1.039–1.704 for anticoagulation and risk factors in atrial fibrillation and $p=0.043$, 95%CI 1.012–2.088 for m-CHA_2DS_2-Vasc). In the receiver operating characteristic curve analysis, the anticoagulation and risk factors in atrial fibrillation score was superior to the m-CHA_2DS_2-Vasc score with an AUC 0.774 and SE:0.037, and $p<0.001$.

CONCLUSIONS: In our study, we showed that the anticoagulation and risk factors in atrial fibrillation and m-CHA_2DS_2-Vasc scores can be used as predictors of thrombosis and mortality in COVID-19 patients. In addition, the predictive value of the anticoagulation and risk factors in atrial fibrillation score was higher than that of m-CHA_2DS_2-Vasc. The use of the anticoagulation and risk factors in atrial fibrillation score to assess high-risk patients in COVID-19 may be recommended.

KEYWORDS: Anticoagulants. Risk score. Coronavirus.

INTRODUCTION

The mortality rate of COVID-19, which emerged in Wuhan, China in the last quarter of 2019, varies between 2–3%[1-2]. This rate can go up to 50% in those who are hospitalized in intensive care units[3]. Possible complications of COVID-19, a viral infection, can be listed as septic shock, acute cardiac injury, arrhythmia, cardiovascular collapse, ARDS, and multiple organ failure[4]. Although most of the fatal cases included patients who died due to respiratory failure, in addition to this outcome, myocardial damage or heart failure findings were observed in some cases[5,6]. In COVID-19 patients, it is stated that the risk for coagulopathy increases especially in the elderly, or those

[1]Adana City Training and Research Hospital, Cardiology – Adana, Turkey.
*Corresponding author: ozgeozcan83@yahoo.com.tr
Conflicts of interest: the authors declare there are no conflicts of interest. Funding: none.
Received on February 15, 2021. Accepted on February 18, 2021.

with comorbid diseases, due to endothelial damage caused by the virus that binds to ACE_2, endothelial damage due to sepsis, activation of inflammatory and microthrombotic mechanisms, and stasis due to prolonged hospitalization[7,8]. Considering that thromboembolism increases mortality, the importance of determining which patients are at a greater risk for thromboembolism can be clearly justified. Congestive heart failure-Hypertension-Age ≥75 years-Diabetes Mellitus-Stroke ($CHADS_2$), Congestive heart failure-Hypertension-Age ≥75 years-Diabetes Mellitus-Stroke-Vascular disease-age 65–74 years- female sex (CHA_2DS_2-Vasc), modified-Congestive heart failure-Hypertension-Age ≥75 years-Diabetes Mellitus-Stroke-Vascular disease-age 65–74 years- male sex (m-CHA_2DS_2-Vasc) and the Anticoagulation and Risk Factors in Atrial Fibrillation (ATRIA) scores are the most common scoring systems used to determine the risk of these patients[9,10]. In a study conducted by Kılıc et al., it was emphasized that the CHA_2DS_2-Vasc score was a predictor of unsuccessful response in STEMI patients receiving thrombolytic therapy[11]. Studies have shown that the ATRIA score is superior to $CHADS_2$ and CHA_2DS_2-Vasc in predicting the risk for thromboembolism[12,13]. Cetinkal et al. showed in their recently published studies that mortality increases in COVID-19 patients with higher m-CHA_2DS_2-Vasc scores[14]. The aim of this study was to compare the ATRIA and m-CHA_2DS_2-Vasc scores in patients with COVID-19 who were followed in intensive care units.

METHODS

This retrospective study consisted of 394 patients who were hospitalized with COVID-19 symptoms and laboratory or radiological findings between 10 June 2020 and 10 September 2020. Additionally, all patients over the age of 18 who had a confirmed diagnosis of HT, DM, and other comorbid conditions and received ongoing treatment were included in the study. Patients with end-stage heart failure, malignity, chronic inflammatory disease, and known coagulopathy were excluded. In the study of Ai et al., published in August, chest CT findings were more sensitive than PCR positivity[15]. Considering that, PCR positivity status was not imposed for the patients included in our study. A detailed medical history was recorded for each patient, and the baseline clinical characteristics at study entry, along with information on follow-up, were carefully collected. Systolic heart failure was defined as left ventricular ejection fraction <40%. Hypertension was defined as systolic and diastolic blood pressures >140/90 mmHg or if the patient was taking any anti-hypertensive medication. Diabetes mellitus (Type 2 DM) was defined as having a previous diagnosis of DM or using an anti-diabetic medication, or fasting blood glucose ≥126 mg/dL or HbA1c >6.5%. Patients with a history of thromboembolic stroke originating from carotid or vertebral arteries were defined as "presence of stroke". m-CHA_2DS_2-Vasc score was calculated by adding 2 points for age ≥75 years; 2 points for prior stroke or transient ischemic attack (TIA); and 1 point for each of the following factors: congestive heart failure or left ventricular ejection fraction ≤40%, hypertension, diabetes mellitus, vascular disease, age 65–74, and male gender, with a maximum score of 9 points[14]. The ATRIA risk score was calculated by adding 1 point for each of the following factors: female gender, diabetes mellitus, congestive heart failure, hypertension, proteinuria, and renal dysfunction (i.e. eGFR <45 mL/min/1.73 m^2 or end-stage renal disease), and by adding 0–9 points depending on the specific score weight of patient's age according to the presence or absence of prior ischemic stroke[16]. We did not have data about proteinuria, so the maximum score of the ATRIA risk score will be 14 points. Patients with ≤5 points were defined as low risk, patients with 6 points were at intermediate risk, while patients with ≥7 points were defined as high risk[17].

eGFR was estimated using the 4-variable Modification of Diet in Renal Disease (MDRD-4) equation[18].

The study was approved by the Clinical Research Ethics Committee of the Ministry of Health of our country and the local Clinical Research Ethics Committee of our hospital (No. 1081, date: September 23, 2020). The study protocol complies with the ethical guidelines of the 1975 Declaration of Helsinki, as reflected in the approval previously obtained by the institution's human research committee.

Statistical analysis

All statistical analyses were performed with SPSS 17 (SPSS, Inc., Chicago, Illinois, USA) and MedCalc for Windows. The minimum number of subjects required in both groups for a significant difference between the two groups was 40 for the ATRIA score and 41 for the m-CHA_2DS_2-Vasc score (type 1 error: 0.01, test power: 0.9). Continuous variables were expressed as mean ± standard deviation (mean ± SD) or median (interquartile range), and categorical variables as numbers and percentages. Comparisons of the continuous variables between groups were performed using the independent samples t-test and Mann-Whitney U test. For appropriate and categorical variables, the χ^2 test or Fisher's exact test was used. We analyzed whether continuous variables had normal distribution using the Kolmogorov-Smirnov test. Univariate and multivariable logistic regression analyses were performed to assess the relationship between the ATRIA and m-CHA_2DS_2-Vasc scores. Variables with a p≤0.05 in univariate analysis were included in the multivariate analysis. The receiver operating characteristic

(ROC) curve analysis was performed to demonstrate the cut-off values, and sensitivity and specificity of the ATRIA and m-CHA_2DS_2-Vasc scores in showing COVID-19 mortality. The results are expressed as relative risk and 95% confidence interval (CI). A p value lower than 0.05 was considered statistically significant.

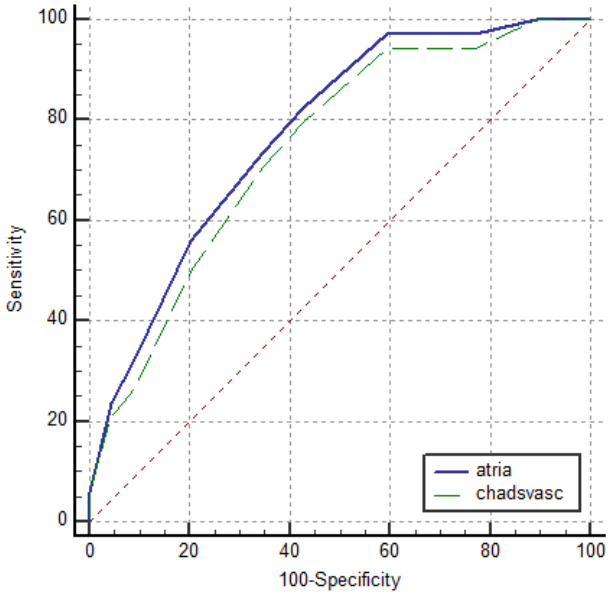
RESULTS

Three-hundred and ninety-four patients with a mean age of 66.2±9.7 years were included in the study (56.1%, n=221, male). Three-hundred and two patients (n=15, mortality group) were in the low-risk category, 49 (n=8, mortality group) were in the intermediate-risk category, and 43 (n=11, mortality group) were in the high-risk category according to the ATRIA score. One-hundred and ninety-six (n=5, mortality group) patients had a m-CHA_2DS_2-Vasc score of <3 and the remaining 198 (n=29, mortality group) had a score of ≥3. The median ATRIA and m-CHA_2DS_2-Vasc scores, with which patient-based cumulative risk was calculated and total comorbidity was evaluated, were different between the groups (Table 1).

A multivariate logistic regression analysis showed the ATRIA and m-CHA_2DS_2-Vasc scores were independent predictors of mortality in COVID-19 patients. Moreover, in the ROC analysis, the ATRIA score performed better than the m-CHA_2DS_2-Vasc score at predicting mortality with an AUC 0.774, 95%CI 0.729–0.814 and SE:0.037, and p<0.001 (Figure 1). The results of univariate and multivariate logistic regression analyses are shown in Table 2.

DISCUSSION

COVID-19 has become a health problem with deaths worldwide. It is known that mortality is higher in the elderly and those with comorbidity and widespread pulmonary involvement[19]. Around



	Area under the curve	Standard error	95%CI
ATRIA	0.774	0.0371	0.729–0.814
m-CHA_2DS_2Vasc	0.744	0.0404	0.698–0.787

Figure 1. Receiver operating characteristic curve analysis of the ATRIA and m-CHA_2DS_2Vasc scores.

Table 1. Baseline characteristics of non-mortality and mortality groups.

	Non-mortality group (n=360)	Mortality group (n=34)	p
Age, years	65.8±9.9	70.3±6.3	0.009*
Gender, male, n(%)	202 (56.1)	19 (55.8)	0.980
HT, n (%)	228 (63.3)	27 (79.4)	0.063
DM, n (%)	129 (35.8)	17 (50)	0.136
CAD, n (%)	117 (32.5)	16 (47)	0.091
HF, n (%)	31 (8.6)	6 (17.6)	0.115
CVD, n (%)	6 (1.6)	2 (5.8)	0.146
ESRD or GFR<45, n (%)	9 (2.5)	0 (0)	1.000
AF, n (%)	16 (4.4)	1 (2.9)	1.000
m-CHA_2DS_2-VASc, median (IQR)	2 (0–6)	5 (1–7)	<0.001
ATRIA, median (IQR)	3 (0–8)	6 (1–10)	<0.001

AF: atrial fibrillation; ATRIA: the anticoagulation and risk factors in atrial fibrillation; CAD: coronary artery disease; CVD: history of cerebrovascular disease; DM: diabetes mellitus; ESRD: end-stage renal disease; GFR: glomerular filtration rate; HF: heart failure; HT: hypertension; m-CHA_2DS_2Vasc: modified-congestive heart failure-hypertension-age ≥75 years-diabetes mellitus-stroke-vascular disease-age 65–74 years-sex category;
*Although p-value was statistically significant, lowest and highest age values were in the same score for both scoring systems.

Table 2. Univariate and multivariate regression analyses of the ATRIA and m-CHA_2DS_2-VASc scores, and other variables.

	Univariate analysis OR (95%CI)	p	Multivariate analysis OR (95%CI)	p
ATRIA score	1.603 (1.339–1.920)	<0.001	1.331 (1.039–1.704)	0.024
m-CHA_2DS_2-VASc score	1.976 (1.529–2.554)	<0.001	1.453 (1.012–2.088)	0.043
Age	1.012 (1.052–1.093)	0.010	–	–

ATRIA: the anticoagulation and risk factors in atrial fibrillation; m-CHA_2DS_2Vasc: modified-congestive heart failure-hypertension-age ≥75 years-diabetes mellitus-stroke-vascular disease-age 65-74 years-sex category.

5–10% of the patients who have the disease become severely ill and need intensive care[20]. While the mortality rate in intensive care hospitalizations reaches 60% when the disease was first detected, it is now around 20%. The course of the disease is more serious and mortality rates are higher in those who are intubated[21].

Increased vasoconstrictor angiotensin II, decreased vasodilator angiotensin, and sepsis-induced release of cytokines can trigger a coagulopathy in COVID-19[22]. It is known that approximately 50% of patients hospitalized due to COVID-19 develop thrombosis and, despite anticoagulation, a high number of patients with ARDS secondary to COVID-19 followed in intensive care unit developed life-threatening thrombotic complications[23].

Determining the thrombosis risk of the patients who are followed in intensive care units due to COVID-19 is important to both improve disease prognosis and guide treatment. Coagulation tests, such as prothrombin time, fibrinogen, activated partial thromboplastin time and fibrin degradation product, and d-dimer, are the laboratory tests that could determine patients' coagulation status[24,25]. Zhang et al. showed that elevated d-dimer levels on admission could predict in-hospital mortality in patients with COVID-19[26]. In another study by Tang et al., longer prothrombin time and higher levels of d-dimer and fibrin degradation product were determined in non-survivors[27]. Similar to these results, we determined higher levels of d-dimer and longer prothrombin time in patients with COVID-19 who did not survive.

The CHA_2DS_2-Vasc score, which is one of the most widely used scoring systems to determine thrombosis risk without the need for laboratory tests, has been evaluated in recent studies in patients with COVID-19. Çetinkal et al. demonstrated that higher CHA_2DS_2-Vasc scores are associated with adverse clinical events in patients with COVID-19, and they also showed that the m-CHA_2DS_2-Vasc score was superior to the CHA_2DS_2-Vasc score in predicting in-hospital mortality. The ATRIA score is another score used for thrombosis risk and some studies have indicated it performs better at determining risk compared to the CHA_2DS_2-Vasc score. In our study, where we compared the ATRIA and m-CHA_2DS_2-Vasc scores, we found that both scores were higher in non-survivors. Also, we believe both scores can be used as independent predictors of thrombosis and mortality in patients hospitalized in intensive care units due to COVID-19. In addition, the predictive value of the ATRIA score was higher than that of the m-CHA_2DS_2-Vasc score. A relationship between COVID mortality and CHA_2DS_2-Vasc has been shown in previous studies[28]. ATRIA may have a better performance than m-CHA_2DS_2-Vasc as it categorizes age more effectively and is calculated using GFR.

Acute pulmonary embolism, deep-vein thrombosis, ischemic stroke, myocardial infarction, and systemic arterial embolism are responsible for the majority of deaths in COVID-19 patients. Although the treatment protocol of these patients includes anticoagulants, there is no definite consensus on dosage. Identifying patients at risk of thromboembolism could offer the possibility of more careful treatment in the form of thromboprophylaxis. The ATRIA score could be a guide in determining whether anticoagulants can be used in prophylactic or therapeutic doses in this group.

We think that the low number of patients in our study is a limitation that can be overcome with a longer study period and prospective studies. The fact that the laboratory parameters affecting the prognosis of COVID-19 infection were not obtained is not a great obstacle to our study, as it will only play a role in proteinuria evaluation in the ATRIA score, which we already mentioned in the protocol and did not add to the study.

Limitations

Our study has more than one limitation. The most significant one is the retrospective and single-centered design of the study. Furthermore, since there were no data for proteinuria, it was evaluated as 0 in all patients included in the study. The laboratory parameters that could have an effect on the primary outcome were not included in the study, and this is another limitation.

CONCLUSIONS

The ATRIA and CHA_2DS_2-Vasc scores are scoring systems that can be used to determine the risk of thromboembolism in

COVID-19 patients and can be evaluated quickly at bedside. Moreover, the ATRIA score may give a better result than the CHA_2DS_2-Vasc score. It can be recommended for the evaluation of high-risk COVID-19 patients.

AUTHORS' CONTRIBUTIONS

OOA: Conceptualization, Data curation, Formal analysis, Supervision, Writing – original draft. **AY:** Data curation, Formal analysis, Supervision.

REFERENCES

1. Harapan H, Itoh N, Yufika A, Winardi W, Keam S, Te H, et al. Coronavirus disease 2019 (COVID-19): a literature review. J Infect Public Health. 2020;13(5):667-73. https://doi.org/10.1016/j.jiph.2020.03.019
2. Guan WJ, Ni ZY, Hu Y, Liang WH, Ou CQ, He JX, et al. Clinical characteristics of Coronavirus Disease 2019 in China. N Engl J Med. 2020;382(18):1708-20. https://doi.org/10.1056/NEJMoa2002032. Epub 2020 Feb 28
3. Kim L, Garg S, O'Halloran A, Whitaker M, Pham H, Anderson EJ. et al. Risk Factors for Intensive Care Unit Admission and In-hospital Mortality Among Hospitalized Adults Identified through the US Coronavirus Disease 2019 (COVID-19)-Associated Hospitalization Surveillance Network (COVID-NET). Clin Infect Dis. 2021;72(9):e206-14. https://doi.org/10.1093/cid/ciaa1012
4. Zaim S, Chong JH, Sankaranarayanan V, Harky A. COVID-19 and Multiorgan Response. Curr Probl Cardiol. 2020;45(8):100618. https://doi.org/10.1016/j.cpcardiol.2020.100618
5. Zhang B, Zhou X, Qiu Y, Song Y, Feng F, Feng J. et al. Clinical characteristics of 82 cases of death from COVID-19. PLoS One. 2020;15(7):e0235458. https://doi.org/10.1371/journal.pone.0235458
6. Bradley BT, Maioli H, Johnston R, Chaudhry I, Fink SL, MD,Xu H. et al. Histopathology and ultrastructural findings of fatal COVID-19 infections in Washington State: a case series. Lancet. 2020;396(10247):320-32. https://doi.org/10.1016/S0140-6736(20)31305-2
7. Ahmed S, Zimba O, Gasparyan AY. Thrombosis in Coronavirus disease 2019 (COVID-19) through the prism of Virchow's triad. Clin Rheumatol. 2020;39(9):2529-2543. https://doi.org/10.1007/s10067-020-05275-1
8. Becker RC. COVID-19 update: Covid-19-associated coagulopathy. J Thromb Thrombolysis. 2020;50(1):54-67. https://doi.org/10.1007/s11239-020-02134-3
9. Al-Turaiki AM, Al-Ammari MA, Al-Harbi SA, Khalidi NS, Alkatheri AM, Aldebasi TM, et al. Assessment and comparison of CHADS2, CHA2DS2-VASc, and HAS-BLED scores in patients with atrial fibrillation in Saudi Arabia. Ann Thorac Med. 2016;11(2):146-50. https://doi.org/10.4103/1817-1737.180026
10. Chao TF, Chen SA. Stroke Risk Predictor Scoring Systems in Atrial Fibrillation. J Atr Fibrillation. 2014;6(5):998. https://doi.org/10.4022/jafib.998
11. Kilic S, Kocabas U, Can LH, Yavuzgil O, Çetin M, Zoghi M. Predictive value of CHA2DS2-VASc and CHA2DS2-VASc-HS scores for failed reperfusion after thrombolytic therapy in patients with ST-segment elevation myocardial infarction. Cardiol J. 2019;26(2):169-75. https://doi.org/10.5603/CJ.a2018.0017
12. van den Ham HA, Klungel OH, Singer DE, Leufkens HG, van Staa TP. Comparative Performance of ATRIA, CHADS2, and CHA2DS2-VASc Risk Scores Predicting Stroke in Patients With Atrial Fibrillation: Results From a National Primary Care Database. J Am Coll Cardiol. 2015;66(17):1851-9. https://doi.org/10.1016/j.jacc.2015.08.033
13. Aspberg S, Chang Y, Atterman A, Bottai M, Go AS, Singer DE. Comparison of the ATRIA, CHADS2, and CHA2DS2-VASc stroke risk scores in predicting ischaemic stroke in a large Swedish cohort of patients with atrial fibrillation. Eur Heart J. 2016;37:3203-10. https://doi.org/10.1093/eurheartj/ehw077
14. Cetinkal G, Kocas BB, Ser OS, Kilci H, Keskin K, Ozcan SN, et.al. Assessment of the modified CHA2DS2VASc risk score in predicting mortality in patients hospitalized with COVID-19. Am J Cardiol. 2020;135:143-49. https://doi.org/1016/j.amjcard.2020.08.040
15. Ai T, Yang Z, Hou H, Zhan C, Chen C, Lv W, et al. Correlation of chest CT and RT-PCR testing for Coronavirus Disease 2019 (COVID-19) in China: a report of 1014 cases. Radiology. 2020;296(2):E32-40. https://doi.org/10.1148/radiol.2020200642
16. Singer DE, Chang Y, Borowsky LH, Fang MC, Pomernacki NK, Udaltsova N, et al. A new risk scheme to predict ischemic stroke and other thromboembolism in atrial fibrillation: The ATRIA study stroke risk score. J Am Heart Assoc. 2013;2(3):e000250. https://doi.org/10.1161/JAHA.113.000250
17. Abumuaileq RR, Abu-Assi E, López-López A, Raposeiras-Roubin S, Rodríguez-Mañero M, Martínez-Sande L, et al. Comparison between CHA2DS2-VASc and the new R2CHADS2 and ATRIA scores at predicting thromboembolic event in non-anticoagulated and anticoagulated patients with non-valvular atrial fibrillation. BMC Cardiovasc Disord. 2015;15:156. https://doi.org/10.1186/s12872-015-0149-3
18. Levey AS, Coresh J, Balk E, Kausz AT, Levin A, Steffes MW, et al. National Kidney Foundation practice guidelines for chronic kidney disease: evaluation, classification, and stratification. Ann Intern Med. 2003;139(2):137-47. https://doi.org/10.7326/0003-4819-139-2-200307150-00013
19. Sanyaolu A, Okorie C, Marinkovic A, Patidar R, Younis K, Desai P, et al. Comorbidity and its Impact on Patients with COVID-19. SN Compr Clin Med. 2020;1-8. https://doi.org/10.1007/s42399-020-00363-4
20. Murthy S, Gomersall CD, Fowler RA. Care for critically ıll patients with COVID-19. JAMA. 2020;323(15):1499-500. https://doi.org/10.1001/jama.2020.3633
21. Karagiannidis C, Mostert C, Hentschker C, Voshaar T, Malzahn J, Schillinger G, et al. Case characteristics, resource use, and outcomes of 10 021 patients with COVID-19 admitted to 920 German hospitals: an observational study. Lancet Respir Med. 2020;8:853-62. https://doi.org/1016/S2213-2600(20)30316-7
22. Miesbach W, Makris M. COVID-19: coagulopathy, risk of thrombosis, and the rationale for anticoagulation. Clin Appl Thromb Hemost. 2020;26:1076029620938149. https://doi.org/10.1177/1076029620938149
23. Helms J, Tacquard C, Severac F, Leonard-Lorant I, Ohana M, Delabranche X, et al. High risk of thrombosis in patients with severe SARS-CoV-2 infection: a multicenter prospective cohort study. Intensive Care Med. 2020;46(6):1089-98. https://doi.org/10.1007/s00134-020-06062-x

24. Hardy M, Lecompte T, Douxfils J, Lessire S, Dogné JM, Chatelain B, et al. Management of the thrombotic risk associated with COVID-19: guidance for the hemostasis laboratory. Thromb J. 2020;18:17. https://doi.org/10.1186/s12959-020-00230-1

25. Luo L, Xu M, Du M, Kou H, Liao D, Cheng Z, et al. Early coagulation tests predict risk stratification and prognosis of COVID-19. Aging (Albany NY). 2020;12(16):15918-37. https://doi.org/10.18632/aging.103581

26. Zhang L, Yan X, Fan Q, Liu H, Liu X, Liu Z, et al. D-dimer levels on admission to predict in-hospital mortality in patients with Covid-19. J Thromb Haemost. 2020;18(6):1324-9. https://doi.org/10.1111/jth.14859

27. Tang N, Li D, Wang X, Sun Z. Abnormal coagulation parameters are associated with poor prognosis in patients with novel coronavirus pneumonia. J Thromb Haemost. 2020;18(4):844-7. https://doi.org/10.1111/jth.14768

28. Quisi A, Alıcı G, Harbalıoğlu H, Genç Ö, Er F, Allahverdiyev S, et al. The CHA2DS2-VASc score and in-hospital mortality in patients with COVID-19: a multicenter retrospective cohort study. Turk Kardiyol Dern Ars. 2020;48(7):656-63. https://doi.org/10.5543/tkda.2020.03488