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Predictive Value of HATCH Scoring and Waist-to-Height Ratio in Atrial Fibrillation Following Coronary Artery Bypass Operations Performed with Cardiopulmonary Bypass

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Abstract

Objectives: Postoperative atrial fibrillation (PoAF), an important clinical condition that can occur after coronary artery bypass graft (CABG) operations, may bring about cerebrovascular risks, prolong hospital stay and increase treatment costs. In this prospective study, we aimed to investigate the predictive value of HATCH score and waist/height ratio (WHR) values in revealing the development of PoAF after CABG operations.

Methods: Patients who underwent isolated CABG surgery with cardiopulmonary bypass between May 2019 and November 2019 were prospectively included in the study. Preoperative demographic characteristics, laboratory parameters, and operative parameters of the patients were recorded prospectively.

Results: A total of 255 patients were included in the study. Those who did not develop PoAF were included in Group 1 (N = 196, mean age = 58.9 ± 9.4 years), and those who did were included in Group 2 (n = 59, mean age = 61.1 ± 12 years). There were no statistically significant differences between the two groups in terms of age, gender, presence of hypertension and hyperlipidemia. Rates of chronic obstructive pulmonary disease and previous percutaneous coronary interventions, waist circumference, waist to height ratio and HATCH score values were significantly higher in Group 2 compared to Group 1 (*p* values: 0.019, 0.034, 0.001, <0.001, <0.001, respectively). In multivariate analysis, WHR (Odds ratio: 1.068, Confidence interval: 1.032–1.105, *p* < 0.001) and HATCH score (Odds ratio: 2.590, Confidence interval: 1.850–3.625, *p* < 0.001) were independent predictors of PoAF.

Conclusions: With this current prospective study, we showed that calculating WHR and HATCH score in the preoperative period can help us predict PoAF.

Keywords: Coronary artery bypass, Atrial fibrillation, HATCH score, Obesity, Waist circumference

1. Introduction

Coronary artery disease (CAD), caused by the atherosclerosis of coronary arteries, is an important disease affecting human life expectancy and quality of life. Although there are various

endovascular intervention methods in its treatment, coronary artery bypass graft (CABG) operations still maintain their importance [1]. While these operations are generally performed with cardiopulmonary bypass (CPB) with very low mortality rates, postoperative atrial fibrillation

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(PoAF), renal and pulmonary problems may be encountered [2].

Atrial fibrillation (AF), an important clinical condition that can occur after CABG operations with the incidence ranging from 10 to 65%, may bring about cerebrovascular risks, prolong hospital stay and increase treatment costs. Therefore, it is incredibly important to reveal its risk factors. The HATCH is a valuable scoring system that includes several parameters which are risk factors for atrial fibrillation, such as age, lung disease, and heart failure. It has been shown to predict PoAF in several retrospective studies [3,4].

Obesity is an important health problem of our time and plays a role in the pathogenesis and progression of many diseases, including cardiovascular diseases. Its evaluation parameter generally used in studies is body mass index (BMI). It has been shown that high BMI values can increase PoAF rates [5]. However, some studies revealed that central obesity may be a better predictor for PoAF [6,7]. Accordingly, waist/height ratio (WHR) is an important indicator of central obesity and it can be a better predictor than BMI in terms of the development of cardiovascular disease and impaired glucose tolerance [8,9].

In this study, we aimed to investigate the predictive value of HATCH score and WHR values in revealing the development of PoAF after CABG operations.

2. Methods

Patients who underwent isolated CABG surgery with CPB between May 2019 and November 2019 were prospectively included in the study. Consent form was obtained from all participating patients, and the study was approved by the clinical practices ethics committee our hospital (Approval number: 2011-KAEK-25 2019/04-25). Preoperative (demographic characteristics such as age and gender, concomitant systemic diseases, physical examination findings such as height, weight, and waist circumference), intraoperative (total cardiopulmonary bypass time, cross-clamping time) and postoperative (intensive care length of stay, total hospitalization duration, postoperative complications such as bleeding and arrhythmia) data were noted. Reoperations, emergency operations, patients with moderate or severe mitral valve insufficiency, those with known AF or AF attacks, patients using amiodarone in the preoperative period, those who received renal replacement therapy and who did not consent to this prospective study were

Abbreviations

| | |
|-------|--|
| ACE-I | Angiotensin-converting enzyme inhibitor |
| ARB | Angiotensin receptor blocker |
| AF | Atrial fibrillation |
| AUC | Area under the curve |
| BMI | Body mass index |
| CAD | Coronary artery disease |
| CABG | Coronary artery bypass graft |
| CI | Confidence interval |
| CPB | Cardiopulmonary bypass |
| COPD | Chronic obstructive pulmonary disease |
| ECG | Electrocardiography |
| EF | Ejection fraction |
| HATCH | Hypertension, age, stroke/ transient ischemic attack, chronic obstructive pulmonary disease, heart failure |
| HT | Hypertension |
| OR | Odds ratio |
| PCI | Percutaneous coronary intervention |
| PoAF | Postoperative atrial fibrillation |
| ROC | Receiver operating characteristic |
| WHR | Waist / height ratio |

excluded. After the exclusion criteria were implemented, 255 patients were included in the study. The patients who did not develop PoAF were included in Group 1, and those who did were included in Group 2.

2.1. Surgical technique

Patients were taken to the operating room and vascular access was established with a 16 G angio-cath through their peripheral veins. Afterwards, arterial monitoring was achieved primarily from the left radial artery. Central vascular access was provided from the right internal jugular vein after anesthesia was induced. Vital follow-ups of the patients were carried out by means of an arterial cannula and five electropads placed in the back. The temperature monitoring of the patients was performed with a nasal probe and/or a bladder temperature probe. All patients were approached with median sternotomy and aorta-venous two-stage cannulation. After preparations and obtaining appropriate activated coagulation time values, cardiopulmonary bypass operations were performed with cross-clamping, and ended under favorable conditions. Surgical areas were closed as necessary and the patients were transferred to the intensive care unit with close monitoring. Low molecular weight heparin, beta blocker, acetylsalicylic acid and angiotensin-converting enzyme inhibitor or angiotensin receptor blocker were administered on the first postoperative day for all patients.

2.2. HATCH score calculation

This scoring system includes the preoperative data of the patients. Scoring according to the characteristics of the patients was made as follows [4]:

Presence of hypertension: 1 point

Aged over 75 years: 1 point

Presence of chronic obstructive pulmonary disease (COPD): 1 point

If the ejection fraction (EF) is 40% or less: 2 points

Presence of cerebrovascular event and/or trans-ischemic attack: 2 points

The minimum and maximum scores are 0 and 7, respectively.

2.3. Postoperative rhythm monitoring

All patients were followed up in our intensive care unit for at least two days. During this period, rhythm monitoring was performed with 24-hour electrocardiography (ECG) and arterial monitoring. Due to the prospective planning of the study, patients who were taken to the ward were followed up until the 5th postoperative day, when PoAF was frequently observed, with two-lead ECG monitoring at bedside. In addition, 12-lead ECG was performed daily in all patients. All patients with complaints such as palpitations, respiratory problems, weakness etc. during their follow-up in the ward or mobilization received 12-lead ECG scans immediately.

The absence of a P wave before the QRS complex and the presence of an irregular ventricular rhythm, which lasted for more than 5 min, was defined as PoAF. These patients were given intravenous beta blocker treatment primarily for rate control. Intravenous amiodarone was started in patients who did not respond. Cardioversion was performed in patients with PoAF refractory to medical treatments and with unstable hemodynamic conditions. If the PoAF persisted for more than 48 h and hemodynamic instability developed, electrical cardioversion was performed after excluding left atrial thrombus with transesophageal echocardiography.

3. Statistical analysis

SPSS 21.0 (IBM Statistical Package for the Social Sciences Statistic Inc. version 21.0, Chicago, IL, USA) was used for data analysis. Means and standard deviations were calculated using descriptive methods for continuous and ordinal data. Kolmogorov-Smirnov and Shapiro-Wilk tests were used for checking normality. To compare normally and non-normally distributed variables, Student's *t*-test and Mann-Whitney *U* test were used, respectively.

Frequency and percentage analysis were performed for nominal data, which were compared with the Chi Square test. Multivariate logistic regression analysis was used to analyze the predictors of postoperative atrial fibrillation. A P value below 0.05 was considered statistically significant. In predicting postoperative AF, receiver operating characteristic (ROC) analysis was performed for HATCH score and WHR, and the areas under the curve were calculated.

4. Results

A total of 255 patients were included in the study. Those who did not develop PoAF were included in Group 1 (N = 196, mean age = 58.9 ± 9.4 years), and those who did were included in Group 2 (n = 59, mean age = 61.1 ± 12 years). While the female gender ratio was 18.3% (N = 36) in Group 1, it was 18.6% (N = 11) in Group 2.

There were no statistically significant differences between the two groups in terms of age, gender, presence of hypertension (HT), hyperlipidemia, cerebrovascular event/trans-ischemic attack history, BMI, diabetes mellitus, smoking, ejection fraction and left atrium diameters. And, preoperative beta blocker/ACE-I/ARB use rates were similar between two groups (p = 0.704, p = 0.511, respectively). Rates of COPD and previous percutaneous coronary interventions (PCI), waist circumference, waist to height ratio and HATCH score values were significantly higher in Group 2 compared to Group 1 (p values: 0.019, 0.034, 0.001, <0.001, <0.001, respectively). Demographic characteristics and preoperative data of all patients are presented in [Table 1](#).

Preoperative blood values of the patients are shown in [Table 2](#). The two groups were similar in terms of white blood cell, neutrophil, and lymphocyte counts, kidney, and thyroid function values. There was no statistically significant difference between the two groups in terms of cross-clamp times, cardiopulmonary bypass times and drainage amounts. The number of distal anastomoses, intensive care stay and total hospital stay were statistically significantly higher in Group 2 (p values: 0.004, <0.001, <0.001, respectively) ([Table 3](#)).

Multivariate logistic regression analysis was performed to evaluate the predictive value of certain parameters in terms of postoperative atrial fibrillation. Waist-to-height ratio (Odds ratio: 1.068, Confidence interval: 1.032–1.105, p < 0.001) and HATCH score (Odds ratio: 2.590, Confidence interval: 1.850–3.625, p < 0.001) were independent predictors of postoperative atrial fibrillation ([Table 4](#)).

Table 1. Demographic datas and preoperative features of the patients.

| Parameters | Group 1 (n = 196) | Group 2 (n = 59) | P value |
|---------------------------|----------------------|---------------------|------------------|
| Age (years) | 58.9 ± 9.4 | 61.1 ± 12 | 0.139 |
| Female gender, n (%) | 36 (18.3) | 11 (18.6) | 0.962 |
| COPD, n (%) | 25 (12.7) | 15 (25.4) | 0.019 |
| Hypertension, n (%) | 103 (52.5) | 35 (59.3) | 0.354 |
| Hyperlipidemia, n (%) | 79 (40.3) | 21 (35.5) | 0.396 |
| Previous PCI, n (%) | 27 (13.7) | 15 (25.4) | 0.034 |
| History of CVA, n (%) | 13 (6.6) | 7 (11.8) | 0.190 |
| BMI (kg/m ²) | 28.8 ± 3.9 | 29.8 ± 5.3 | 0.164 |
| WC | 107.7 ± 9.8 | 112.8 ± 11.2 | 0.001 |
| WHR | 0.55 ± 0.14 | 0.64 ± 0.16 | <0.001 |
| Diabetes mellitus, n (%) | 41 (20.9) | 14 (23.7) | 0.507 |
| Smoking, n (%) | 45 (22.9) | 15 (25.4) | 0.624 |
| Beta blocker use, n (%) | 41 (20.9) | 11 (18.6) | 0.704 |
| ACEI/ARB use, n (%) | 55 (28) | 14 (23.7) | 0.511 |
| EF (%) | 52.5 ± 8.7 | 50.1 ± 9.9 | 0.161 |
| Left atrial diameter (cm) | 3.7 ± 0.4 | 3.8 ± 0.5 | 0.108 |
| HATCH Score | 0.92 ± 0.96 | 1.9 ± 0.95 | <0.001 |

COPD: Chronic obstructive pulmonary disease, PCI: Percutaneous coronary intervention, CVA: Cerebrovascular accident, BMI: Body mass index, WC: Waist circumference, WHR: Waist to height ratio, ACEI: Angiotensin-converting enzyme inhibitor, ARB: Angiotensin receptor blocker, EF: Ejection fraction. The bold values are express the statistical significance.

ROC analysis was performed to evaluate HATCH score and WHR in predicting atrial fibrillation after coronary bypass operations performed with cardiopulmonary bypass. The cut-off value of HATCH score was 2 (Area under the curve: 0.775, Confidence interval: 0.709–0.839, $p < 0.001$, with 76.1% sensitivity and 81.1% specificity), and that of waist/height ratio was 0.61 (Area under the curve: 0.624, Confidence interval: 0.541–0.708, $p = 0.004$, with 66.1% sensitivity, 51.5% specificity) (see Fig. 1).

5. Discussion

Coronary artery bypass surgery is one of the most valuable treatment methods in coronary artery disease and can be successfully performed currently in

Table 2. Preoperative laboratory values of the patients.

| Characteristics | Group 1 (n = 196) | Group 2 (n = 59) | P value |
|---|----------------------|---------------------|---------|
| Hemoglobin (g/dL) | 13.7 ± 1.5 | 13.3 ± 1.8 | 0.194 |
| White blood cell ($10^3/\mu\text{L}$) | 7.7 ± 2.7 | 7.9 ± 2.5 | 0.237 |
| Neutrophil ($10^3/\mu\text{L}$) | 4.8 ± 2.1 | 4.6 ± 2.9 | 0.412 |
| Lymphocyte ($10^3/\mu\text{L}$) | 2 ± 0.4 | 1.9 ± 0.3 | 0.119 |
| Creatinine (mg/dL) | 1.1 ± 0.6 | 1.2 ± 0.5 | 0.330 |
| C Reactive protein (mg/dL) | 7.1 ± 10.3 | 7.6 ± 9.8 | 0.098 |
| Albumin (g/L) | 40 ± 5.3 | 42 ± 5.2 | 0.640 |
| Free T3 (pg/mL) | 2.6 ± 1.4 | 2.7 ± 1.3 | 0.109 |
| Free T4 (ng/dL) | 0.6 ± 0.3 | 0.7 ± 0.5 | 0.716 |
| TSH ($\mu\text{IU/L}$) | 1.5 ± 1.1 | 1.4 ± 1.3 | 0.528 |

T3: Triiodothyronine, T4: Thyroxine, TSH: Thyroid-Stimulating Hormone.

Table 3. Peroperative and postoperative variables of the patients.

| Parameters | Group 1 (n = 196) | Group 2 (n = 59) | P value |
|--|----------------------|---------------------|------------------|
| Cross-clamp time, (mean ± sd) | 39.7 ± 10.9 | 42.1 ± 13.2 | 0.471 |
| Total perfusion time, (mean ± sd) | 85.2 ± 22 | 87.8 ± 24.1 | 0.382 |
| Number of distal anastomoses | 3 ± 0.9 | 3.4 ± 1.08 | 0.004 |
| Inotropic support, n (%) | 12 (6.1) | 4 (6.7) | 0.874 |
| Total drainage (ml) (mean ± sd) | 628.3 ± 233.7 | 635.1 ± 239.4 | 0.694 |
| ICU stay (days) (mean ± sd) | 2.2 ± 0.9 | 2.9 ± 1.2 | <0.001 |
| Total hospital stay (days) (mean ± sd) | 6.9 ± 1.2 | 8.1 ± 1.3 | <0.001 |

ICU: Intensive care unit.

The bold values are express the statistical significance.

line with increasing technological developments. The most common rhythm problem after these operations is PoAF. It is mostly observed within the first five days after the operation [10]. Postoperative atrial fibrillation (PoAF) is extremely important because it causes poor general condition in patients, increases treatment costs by prolonging hospitalization periods and causes morbid consequences such as cerebrovascular events. In the literature, various scoring systems have been investigated to predict PoAF [11]. With this current prospectively designed study, we found that HATCH score and WHR are independent predictors of PoAF after CABG operations with CPB (WHR: Odds ratio: 1.068, Confidence interval: 1.032–1.105, $p < 0.001$, HATCH score: Odds ratio: 2.590, Confidence interval: 1.850–3.625, $p < 0.001$).

The HATCH scoring system consists of parameters such as age, COPD, HT, cerebrovascular accident, and heart failure, all of which may pose a risk for AF. Age is a risk factor for coronary bypass operations, as in all kinds of surgical procedures. With increasing age, the risk of PoAF increases because of

Table 4. Multivariate logistic regression analysis to identify factors affecting onset postoperative atrial fibrillation.

| Parameters | Exp(B) Odds Ratio | 95% C.I. | P value |
|---------------------------|----------------------|-------------|------------------|
| Previous PCI | 0.463 | 0.199–1.077 | 0.074 |
| Distal anastomoses number | 0.794 | 0.326–1.156 | 0.108 |
| WHR | 1.068 | 1.032–1.105 | <0.001 |
| HATCH score | 2.590 | 1.850–3.625 | <0.001 |

PCI: Percutaneous coronary intervention, WHR: Waist to height ratio.

The bold values are express the statistical significance.

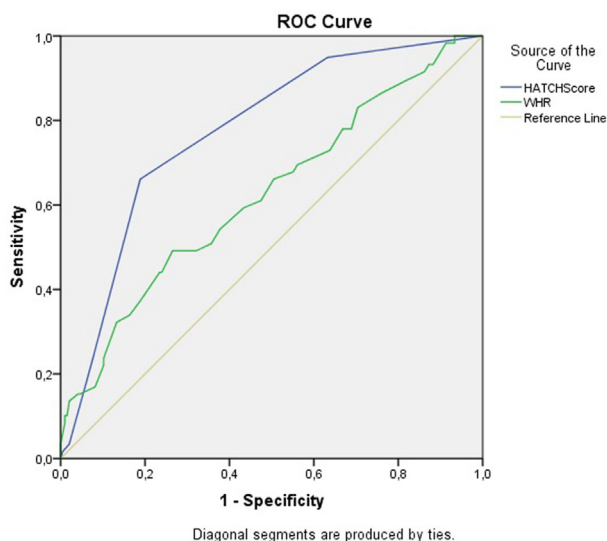


Fig. 1. ROC (Receiver operation characteristics) curve and AUC (Area under the curve) for HATCH score and waist to height ratio (WHR) for predicting PoAF. (HATCH score: cut off:2 (AUC: 0.775, $p < 0.001$, 76.1% sensitivity and 81.1% specificity)(WHR: cut-off: 0.61, AUC: 0.624, $p < 0.001$, 66.1% sensitivity and 51.5% specificity).

problems in the conduction pathways which occur due to fibrosis and collagen deposits developing in the histological components of the heart [10]. Age also brings about mobilization problems in the postoperative period and inadequate breathing exercises, all of which may lead to AF [12]. A study revealed that the frequency of PoAF increased above the age of 55 years and developed five times more frequently over the age of 72 years [13]. Increased vascular stress and inflammation in hypertensive patients may also pose a risk for AF [14].

COPD, which is another parameter of HATCH scoring, is based on chronic inflammation and poses a risk for AF by causing diastolic dysfunction in the heart. Airways obstruction in COPD, which suggests stiffening develops in early lung disease in parallel with asymptomatic changes in pulmonary arterial pressure and right ventricular function [15]. Studies have shown that COPD is a risk factor for AF both in the general population and in the postoperative period [3,16]. Cerebrovascular events may pose a risk for AF as they may include heart failure, chronic inflammation due to atherosclerosis and possible atrial fibrillation attacks [17]. Also, dilatation of the left atrium which is an important contributor to atrial fibrillation. As the last parameter, low EF is one of the most important causes of AF due to the disorders caused by heart failure in the heart cavities and it is worth 2 points in HATCH scoring [18].

Considering all these reasons, we can state that the HATCH scoring system is a valuable parameter

in predicting AF. Accordingly, in a study conducted on more than half a million adult individuals, who were followed for 9.0 ± 2.2 years, the annual incidence of AF was 0.8 per thousand in individuals with a HATCH score of 0, and 57.3 per thousand in individuals with a HATCH score of 7 [19]. In another study, the effect of HATCH score on the success of return to sinus rhythm was investigated in patients with AF who received cardioversion, and it was proven effective on early success [20].

Similar to our study, we identified three studies in the literature investigating the predictivity of HATCH score on the development of AF after CABG operations with CPB. In the study published by Selvi et al., in 2018, 369 patients who underwent CABG were included retrospectively, the patients were divided into two groups as those with and without PoAF, and the risk factors of AF were investigated. AF developed in 27.9% of the patients and the HATCH score was an independent predictor for PoAF. In the ROC curve analysis, HATCH score >1 was predictive for POAF with 42% sensitivity and 70% specificity [21]. Another study was conducted by Emren et al. including 284 CABG patients. In this retrospectively study, the rate of AF was 25%, and high HATCH score was strongly correlated with PoAF. According to the results of the ROC curve analysis, HATCH scores of 2 and above were determined as predictors of PoAF with 72% sensitivity and 75% specificity [22]. A total of 352 patients were included in the study conducted by Engin et al., in 2020, in which the relationship between HATCH score and PoAF was investigated, and PoAF was found to develop in 26.7% of the patients. In the multivariate analysis, HATCH scores >2 (OR: 1.022, 95% CI: 1.004–1.128, $p = 0.032$) were determined as independent predictors for PoAF [4]. The main limitation of these three studies is their retrospective design. Consequently, continuous ECG monitoring was not performed in the postoperative period, except for those in the intensive care unit. As the authors state in their studies, some episodes of AF may have been overlooked. In addition, AF may be missed because ECG was not performed in asymptomatic patients. Since our study was performed prospectively, ECG monitoring was continued for 5 days postoperatively (when AF is common) during hospitalization in the ward, as well. According to our results, the HATCH score was an independent predictor for PoAF (Odds ratio: 2.590, Confidence interval: 1.850–3.625, $p < 0.001$).

There are numerous studies in the literature on obesity, the effect of which has been investigated in coronary bypass operations. In the atrial fibrillation

rhythm management follow-up study (AFFIRM study), overweight patients had lower cardiovascular and other mortality rates than those with normal weight [23,24]. In another study in Chinese individuals, life expectancy was longer in overweight patients compared to normal (BMI: 18.5–24kg/m²) and low weight (BMI <18.5kg/m²) patients [25]. Unlike these studies, in a prospective AF incidence study, being overweight was found to affect adverse outcomes such as ischemic stroke, thromboembolism, and death [26].

All above-mentioned results are known as the “obesity paradox” in cardiovascular diseases. How obesity is defined in studies is also important. Studies generally considered increased weight and BMI. Due to this paradox, it has come to the fore that waist circumference measurement may be more useful, considering that visceral obesity shows increased inflammation in the body more competently. Studies have shown that central obesity poses a risk for PoAF [6]. In a retrospective study by Girerd et al. waist circumference over 102 cm in males was an independent predictor for PoAF after CABG (Odds ratio: 1.40, $p = 0.04$) [27]. In our study, increased waist circumference rate was significantly higher among patients who developed PoAF ($P = 0.001$).

Waist-to-height ratio is an important indicator of central obesity, and it is calculated independent of gender, unlike waist circumference. A study showed that it may be approximately 3 times more valuable than BMI in showing the severity of CAD [8]. Similarly, in another study, the relationship between impaired glucose tolerance and obesity was evaluated and WHR was found more valuable compared to BMI [9]. In our multivariate analysis, we determined that WHR, which is a gender-independent parameter and an important marker of central obesity, was an independent predictor for PoAF (Odds ratio: 1.068, Confidence interval: 1.032–1.105, $p < 0.001$).

The most important limitation of our study is that not all operations are performed by the same surgeon. In addition, our study was single-centered, and the number of patients was limited. On the other hand, continuous ECG follow-ups were performed at the bedside for 5 days in the postoperative period. However, temporary AF attacks which may not have caused complaints during mobilization may have been slightly overlooked in patients during ward follow-up.

6. Conclusion

Coronary bypass operations are particularly important in the treatment of CAD, and

postoperative AF may prolong hospitalizations and lead to morbidity and mortality. With this current prospective study, we showed that the HATCH score can predict PoAF. This score can be calculated in patients preoperatively for whom CABG is planned, and more attention can be paid to PoAF in risky groups. Measuring waist circumference and calculating waist-height ratio in the preoperative period can help us predict PoAF.

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Author contributions

Muhammed Savran: Conception and design of Study; Literature review; Acquisition of data; Revising and editing the manuscript critically for important intellectual contents; Data preparation and presentation; Funding for the research.

Mesut Engin: Conception and design of Study; Literature review; Research investigation and analysis; Drafting of manuscript; Revising and editing the manuscript critically for important intellectual contents; Data preparation and presentation; Funding for the research.

Orhan Guvenc: Acquisition of data; Research investigation and analysis; Data collection; Drafting of manuscript; Revising and editing the manuscript critically for important intellectual contents; Data preparation and presentation; Funding for the research.

Hasan F. Yüksek: Acquisition of data; Data collection; Drafting of manuscript; Revising and editing the manuscript critically for important intellectual contents; Data preparation and presentation.

Sadik Ahmet Sünbül: Analysis and interpretation of data; Research investigation and analysis; Data collection; Drafting of manuscript; Revising and editing the manuscript critically for important intellectual contents; Data preparation and presentation.

Tamer Turk: Research investigation and analysis; Drafting of manuscript; Revising and editing the manuscript critically for important intellectual contents.

Yusuf Ata: Research investigation and analysis; Drafting of manuscript; Revising and editing the manuscript critically for important intellectual contents; Supervision of the research; Research coordination and management.

Ufuk Aydın: Research investigation and analysis; Drafting of manuscript; Revising and editing the

manuscript critically for important intellectual contents; Supervision of the research; Research coordination and management.

Ahmet F. Ozyazicioglu: Research investigation and analysis; Drafting of manuscript; Revising and editing the manuscript critically for important intellectual contents; Supervision of the research; Research coordination and management.

Conflict of interest

There is no conflict of interest.

References

- [1] Pala A, Taner T, Tatli AB, Ozsin KK, Yavuz S. The effect of preoperative hematocrit level on early outcomes after coronary artery bypass surgery. *Cureus* 2020;12(4):e7811. <https://doi.org/10.7759/cureus.7811>.
- [2] Aksoy F, Uysal D, Ibṙisim E. Predictive values of C-reactive protein/albumin ratio in new-onset atrial fibrillation after coronary artery bypass grafting. *Rev Assoc Med Bras* 2020 Aug; 66(8):1049–56. <https://doi.org/10.1590/1806-9282.66.8.1049>.
- [3] Erdolu B, As AK, Engin M. The relationship between the HATCH score, neutrophil to lymphocyte ratio and post-operative atrial fibrillation after off-pump coronary artery bypass graft surgery. *Heart Surg Forum* 2020;23(1):E88–92. <https://doi.org/10.1532/hfsf.2771>.
- [4] Engin M, Aydin C. Investigation of the effect of HATCH score and coronary artery disease complexity on atrial fibrillation after on-pump coronary artery bypass graft surgery. *Med Princ Pract* 2020 May 18. <https://doi.org/10.1159/000508726>.
- [5] Hernandez AV, Kaw R, Pasupuleti V, Bina P, Ioannidis JP, Bueno H, et al. Association between obesity and post-operative atrial fibrillation in patients undergoing cardiac operations: a systematic review and meta-analysis. *Ann Thorac Surg* 2013 Sep;96(3):1104–16. <https://doi.org/10.1016/j.athoracsur.2013.04.029>.
- [6] Echahidi N, Mohty D, Pibarot P, Despres JP, O'Hara G, Champagne J, et al. Obesity and metabolic syndrome are independent risk factors for atrial fibrillation after coronary artery bypass graft surgery. *Circulation* 2007;116(Suppl. 11): 1213–9. <https://doi.org/10.1161/CIRCULATIONAHA.106.681304>.
- [7] Engin M, Ozsin KK, Savran M, Guvenc O, Yavuz S, Ozyazicioglu AF. Visceral adiposity index and prognostic nutritional index in predicting atrial fibrillation after on-pump coronary artery bypass operations: a prospective study. *Braz J Cardiovasc Surg* 2020. <https://doi.org/10.21470/1678-9741-2020-0044>. - Ahead of print.
- [8] Sabah KMDN, Chowdhury AW, Khan HILR, Hasan H, Haque S, Ali S, et al. Body mass index and waist/height ratio for prediction of severity of coronary artery disease. *BMC Res Notes* 2014;7:246. <https://doi.org/10.1186/1756-0500-7-246>.
- [9] Xu Z, Qi X, Dahl AK, Xu W. Waist-to-height ratio is the best indicator for undiagnosed Type 2 diabetes. *Diabet Med* 2013; 30:e201–7. <https://doi.org/10.1111/dme.12168>.
- [10] Echahidi N, Pibarot P, O'Hara G, Mathieu P. Mechanisms, prevention, and treatment of atrial fibrillation after cardiac surgery. *J Am Coll Cardiol* 2008;51:793–801. <https://doi.org/10.1016/j.jacc.2007.10.043>.
- [11] Uysal D, Aksoy F, Ibṙisim E. The validation of the ATRIA and CHA2DS2-vasc scores in predicting atrial fibrillation after coronary artery bypass surgery. *Braz J Cardiovasc Surg* 2020 Oct 1; 35(5):619–25. <https://doi.org/10.21470/1678-9741-2019-0274>.
- [12] Melby SJ, George JF, Picone DJ, Wallace JP, Davies JE, George DJ, et al. A time-related parametric risk factor analysis for postoperative atrial fibrillation after heart surgery. *J Thorac Cardiovasc Surg* 2015;149:886–92. <https://doi.org/10.1016/j.jtcvs.2014.11.032>.
- [13] Shen J, Lall S, Zheng V, Buckley P, Damiano Jr RJ, Schuessler RB. The persistent problem of new-onset post-operative atrial fibrillation: a single-institution experience over two decades. *J Thorac Cardiovasc Surg* 2011;141:559–70. <https://doi.org/10.1016/j.jtcvs.2010.03.011>.
- [14] Hallström S, Pivodic A, Rosengren A, Ólafsdóttir AF, Svensson AM, Lind M. Risk factors for atrial fibrillation in people with type 1 diabetes: an observational CohortStudy of 36,258 patients from the Swedish national diabetes registry. *Diabetes Care* 2019;42(6):1530–8. <https://doi.org/10.2337/dc18-2457>.
- [15] Lopez-Candales A, Rajagopalan N, Dohi K, Gulyasy B, Edelman K, Bazaz R. Abnormal right ventricular myocardial strain generation in mild pulmonary hypertension. *Echocardiography* 2007;24(6):615–22. <https://doi.org/10.1111/j.1540-8175.2007.00439.x>.
- [16] Konecny T, Park JY, Somers KR, Konecny D, Orban M, Soucek F, et al. Relation of chronic obstructive pulmonary disease to atrial and ventricular arrhythmias. *Am J Cardiol* 2014;114:272–7. <https://doi.org/10.1016/j.amjcard.2014.04.030>.
- [17] Heeringa J, van der Kuip DA, Hofman A, Kors JA, van Rooij FJ, Lip GY, et al. Subclinical atherosclerosis and risk of atrial fibrillation: the rotterdam study. *Arch Intern Med* 2007; 167(4):382–7. <https://doi.org/10.1001/archinte.167.4.382>.
- [18] Lardizabal JA, Deedwania PC. Atrial fibrillation in heart failure. *Med Clin North Am* 2012;96:987–1000. <https://doi.org/10.1016/j.mcna.2012.07.007>.
- [19] Suenari K, Chao TF, Liu CJ, Kihara Y, Chen TJ, Chen SH. Usefulness of HATCH score in the prediction of new-onset atrial fibrillation for Asians. *Medicine* 2017;96(e5597):1. <https://doi.org/10.1097/MD.0000000000005597>.
- [20] Emren SV, Kocabaş U, Duygu H, Levent F, Şimşek EÇ, Emren ZY, et al. The role of HATCH score in predicting the success rate of sinus rhythm following electrical cardioversion of atrial fibrillation. *Kardiol Pol* 2016;74(9):978–84. <https://doi.org/10.5603/KP.a2016.0044>.
- [21] Selvi M, Gungor H, Zencir C, Gulasti S, Eryılmaz U, Akgullu C, et al. A new predictor of atrial fibrillation after coronary artery bypass graft surgery: HATCH score. *J Investig Med* 2017;66(3):648–52. <https://doi.org/10.1136/jim-2017-000525>.
- [22] Emren V, Aldemir M, Duygu H, Kocaba U, Tecer E, Cerit L, et al. Usefulness of HATCH score as a predictor of atrial fibrillation after coronary artery bypass graft. *Kardiol Pol* 2016;74(8):749–53. <https://doi.org/10.5603/KP.a2016.0045>.
- [23] Badheka AO, Rathod A, Kizilbash MA, Garg N, Mohamad T, Afonso L, et al. Influence of obesity on outcomes in atrial fibrillation: yet another obesity paradox. *Am J Med* 2010;123: 646–51. <https://doi.org/10.1016/j.amjmed.2009.11.026>.
- [24] Ardestani A, Hoffman HJ, Cooper HA. Obesity and outcomes among patients with established atrial fibrillation. *Am J Cardiol* 2010;106:369–73. <https://doi.org/10.1016/j.amjcard.2010.03.036>.
- [25] Wang J, Yang YM, Zhu J, Zhang H, Shao XH, Tian L, et al. Overweight is associated with improved survival and outcomes in patients with atrial fibrillation. *Clin Res Cardiol* 2014;103:533–42. <https://doi.org/10.1007/s00392-014-0681-7>.
- [26] Overvad TF, Rasmussen LH, Skjoth F, Overvad K, Lip GY, Larsen TB. Body mass index and adverse events in patients with incident atrial fibrillation. *Am J Med* 2013;126:640. <https://doi.org/10.1016/j.amjmed.2012.11.024>. e9 –640.e17.
- [27] Girerd N, Pibarot P, Fournier D, Daleau P, Voisine P, O'Hara G, et al. Middle-aged men with increased waist circumference and elevated C-reactive protein level are at higher risk for postoperative atrial fibrillation following coronary artery bypass grafting surgery. *Eur Heart J* 2009 May; 30(10):1270–8. <https://doi.org/10.1093/eurheartj/ehp091>.