A new predictor of atrial fibrillation after coronary artery bypass graft surgery: HATCH score

Mithat Selvi,[1] Hasan Gungor,[2] Cemil Zencir,[2] Sevil Gulasti,[2] Ufuk Eryilmaz,[2] Cagdas Akgullu,[2] Selim Durmaz[3]

[1]Department of Cardiology, Cine State Hospital, Aydin, Turkey
[2]Department of Cardiology, Adnan Menderes University Faculty of Medicine, Aydin, Turkey
[3]Department of Cardiovascular Surgery, Adnan Menderes University Faculty of Medicine, Aydin, Turkey

Correspondence to
Dr Mithat Selvi, Department of Cardiology, Cine State Hospital, Aydin 09500, Turkey;
drmithatselvi@gmail.com

Accepted 12 October 2017
Published Online First 14 November 2017

ABSTRACT

The aim of this study was to investigate the association between HATCH score and atrial fibrillation (AF) after coronary artery bypass graft (CABG) surgery. 369 patients (103 patients with AF and 266 patients without AF) undergoing isolated CABG surgery were analyzed. Complete medical records were retrospectively collected to investigate HATCH score. The median age of patients with AF was significantly higher than the median age of non-AF group (60.8±10.0 years vs 67.8±9.5 years, P<0.001). HATCH score was significantly higher in patients who developed AF after CABG surgery than the non-AF group (P=0.017). Multivariate logistic regression analysis showed that HATCH score (OR 1.334; 95% CI 1.022 to 1.741, P=0.034) was an independent predictor of AF after CABG surgery. Receiver operating characteristic curve analysis showed that the cut-off point of HATCH score related to predict AF was >1 (two or more), with a sensitivity of 42% and specificity of 70%. Patients with elevated preoperative HATCH score may have higher risk for AF after CABG surgery.

Significance of this study

What is already known about this subject?

- The most widespread arrhythmia after cardiac surgery is postoperative atrial fibrillation (POAF).
- HATCH scoring system was composed as calculating individual points based on the presence of hypertension, age >75 years, transient ischemic attack (TIA) or stroke, chronic obstructive pulmonary disease and heart failure.
- In recent studies, higher HATCH score was found to be correlated with the progression of atrial fibrillation (AF).

What are the new findings?

- HATCH score was significantly higher in patients who developed AF after coronary artery bypass graft (CABG) surgery than the non-AF group (P=0.017).
- Multivariate logistic analysis showed that HATCH score (OR 1.334; 95% CI 1.022 to 1.741, P=0.034) was an independent predictor of AF after CABG surgery.
- Our receiver operating characteristic analysis showed that the cut-off point of HATCH score related to predict AF was >1 (2 or more), with a sensitivity of 42% and specificity of 70%.

How might these results change the focus of research or clinical practice?

- Patients with elevated preoperative HATCH score may have higher risk for AF after CABG surgery.
- Prospective and multicenter studies with long-term follow-up are needed to support our findings.

INTRODUCTION

Atrial fibrillation (AF) is the most widespread arrhythmia after cardiac surgery. Recent studies have shown that the incidence of AF after coronary artery bypass graft (CABG) is about 25%–40% among postoperative patients.[1–3] Postoperative atrial fibrillation (POAF) is associated with an increased incidence of heart failure, cerebrovascular diseases, mortality, prolonged hospitalization, renal insufficiency and raised social costs.[1–4]

Prophylactic therapy with antiarrhythmic drugs can be preferred to decrease the incidence of POAF.[5 6] This option is not cost-effective because of the side effects of the drugs, and also prophylactic therapy for all patients who undergo CABG is not considerable. Therefore, an acceptable risk assessment tool for POAF is needed.

Progression of AF is associated with the underlying structural heart diseases and electroanatomical remodeling of the left atrium.[7] In recent studies, higher hypertension, age ≥75 years, transient ischemic attack or stroke, chronic obstructive pulmonary disease, and heart failure (HATCH) score was found to be correlated with the progression of AF.[8 9] Each component has a value of one point apart from stroke and heart failure, which have values of two points each. The aim of our work was to assess the association between HATCH score and POAF.

MATERIALS AND METHODS

Study designs

The present study was retrospective and single center.

Check for updates

To cite: Selvi M, Gungor H, Zencir C, *et al*. *J Investig Med* 2018;**66**:648–652.

Table 1 Baseline characteristics and preoperative medications

	Patients without AF (n=266)	Patients with AF (n=103)	P value
Age (years)	60.8±10.0	67.8±9.5	<0.001
Male	200 (75%)	80 (77%)	0.617
BMI (kg/m^2)	28.4 (16.7–53.6)	28.4 (16.7–53.6)	0.520
Gensini score	59.8 (6–172)	63.7 (16–142)	0.264
Hypertension	160 (60%)	67 (65%)	0.386
Hyperlipidemia	61 (22%)	24 (23%)	0.940
Diabetes mellitus	121 (45%)	41 (40%)	0.324
Smokers	137 (51%)	52 (50%)	0.861
PAD	15 (6%)	4 (4%)	0.489
PCI	43 (16%)	20 (19%)	0.456
COPD	28 (%10)	17 (%16)	0.115
HATCH score	1.20 (0–6)	1.50 (0–6)	0.017
Previous medications			
Beta-blocker	219 (82%)	84 (81%)	0.861
ACEi	88 (33%)	39 (38%)	0.386
ARB	45 (17%)	15 (15%)	0.582
CCB	33 (12%)	20 (19%)	0.078
Statin	137 (52%)	59 (57%)	0.335
Furosemide	15 (6%)	12 (12%)	0.047
Spironolactone	11 (4%)	5 (5%)	0.761

Data are presented as n (%) or mean±SD.
ACEi, ACE inhibitor; AF, atrial fibrillation; ARB, angiotensin receptor blocker; BMI, body mass index; CCB, calcium channel blocker; COPD, chronic obstructive pulmonary disease; PAD, peripheral arterial disease; PCI, percutaneous coronary intervention.

Patients and eligibility criteria

In our work, patients who had isolated CABG surgery as elective at the department of cardiovascular surgery in Adnan Menderes University Hospital between January 2011 and December 2015 were analyzed retrospectively. Patients with infections, autoimmune and proinflammatory diseases, malignancy, arthritis, the use of digitalis, steroids, amiodarone and propylthiouracil before CABG surgery, preoperative AF or any other arrhythmia, previous diagnosis of paroxysmal AF, hyperthyroidism, the presence of a permanent pacemaker or an implantable cardioverter defibrillator, the diagnosis of decompensated congestive heart failure, a hemodynamically unstable condition before CABG surgery, myocardial infarction for less than 7 days, the need for urgent surgery, the presence of chronic renal failure (creatinine >2 mg/dL), and patients undergoing a second bypass surgery and concomitant valvular surgery were excluded. In all, 369 consecutive patients who had been providing inclusion criteria were admitted to the study. HATCH score of the patients who had enrolled in the study were estimated and patients were separated into groups according to these scorings. Furthermore, details of preoperative treatment, baseline clinical characteristics, angiographic results, echocardiographic features, and intraoperative and postoperative detections were recorded.

HATCH score

The HATCH scoring system depends on a point system in that one point is given for hypertension, COPD, age (75 years or more) and two points each are given for heart failure (ejection fraction<40%) and stroke or TIA. All eligible patients were classified according to preoperative HATCH scores.

POAF definition

After cardiac surgery, all the patients were admitted to intensive care unit. A heart rhythm monitor recorded the changes of the ECG. A 12-lead ECG was used for documentation of the arrhythmic events on the patients. POAF was defined as documentation during ECG at least 30 s of AF.

Echocardiography

An echocardiogram (Vivid 5 s, GE Vingmed Ultrasound A/S, Horten, Norway) with a 3.5-MHz transducer was carried out in all patients, and the subsequent data were enrolled: left ventricular end-systolic diameter, left ventricular end-diastolic diameter, left ventricular ejection fraction (LVEF), degree of valvular dysfunction and left atrial diameter. The Simpson method was used to estimate LVEF.

Statistical analysis

Whole statistical analyses were performed using SPSS V.15.0 for Windows software. Continuous variables were examined for normal dispersion by the Kolmogorov-Smirnov test. We described continuous variable data as mean and SD or median and min–max. We compared continuous variables using the Student's t-test or Mann-Whitney U test between groups. Categorical variables were briefed as percentages and cross-checked with the χ^2 test. The predictive values of HATCH score were evaluated using receiver operating characteristics (ROC) curve analysis. The threshold of value for HATCH score was estimated about predicting POAF. Statistical significance was considered according to a P value <0.05 for whole analyses.

Table 2 Laboratory and echocardiographic parameters of patients

	Patients without AF (n=266)	Patients with AF (n=103)	P value
Creatinine (mg/dL)	1.01 (0.55–6.70)	1.15 (0.5–9.4)	0.710
Potassium (mg/dL)	4.3 (3.1–6.2)	4.3 (3.4–5.8)	0.751
Hemoglobin (g/dL)	13.3 (6.5–46.6)	12.9 (8.1–16.5)	0.230
Triglyceride (mg/dL)	199.4 (55.0–1537.0)	155 (55.0 - 471.0)	0.054
LDL (mg/dL)	121.9±47.0	114.6±35.4	0.263
HDL (mg/dL)	37.6 (16.0–69.0)	38.2 (21.0–77.0)	0.790
Total cholesterol (mg/dL)	197.5±54.2	183.9±40.9	0.066
LVEF (%)	51.8 (30.0–70.0)	51.1 (20.0–70.0)	0.716
Left atrium diameter (cm)	3.6 (2.8–4.6)	3.7 (2.7–4.5)	0.082

Data are presented as n (%) or mean±SD.
AF, atrial fibrillation; HDL, high-density lipoprotein; LDL, low-density lipoprotein; LVEF, left ventricular ejection fraction.

Table 3 Multivariate logistic regression analysis

Variables	Adjusted OR	95% CI	P value
HATCH score	1.334	1.022 to 1.741	0.034
Triglycerides	0.996	0.992 to 1.000	0.030
Furosemide usage	1.632	0.560 to 4.757	0.370
Distal anastamosis	1.415	0.942 to 2.126	0.094

HATCH, hypertension, age ≥75 years, transient ischemic attack or stroke, chronic obstructive pulmonary disease, and heart failure; OR, odds ratio; CI, confidence interval.

RESULTS

Of the 369 study patients, 103 (28%) developed POAF. Median time for POAF existence was 2.6 days (range 1–9) and mean termination time for POAF was 20.2 hours (range 1–123).

The preoperative drugs, baseline characteristics, echocardiographic and laboratory findings with POAF (AF group) and without POAF (non-AF group) are shown in tables 1 and 2. The median age of AF group was significantly higher than the median age of non-AF group (60.8±10.0 years vs 67.8±9.5 years, P<0.001). Only advanced age obtained the statistical significance in cardiovascular comorbidities between two groups.

In patients who developed POAF, the median of HATCH score was detected as 1.5 (0–6). However, the median of HATCH score for non-AF group was detected as 1.2 (0–6). HATCH score was significantly higher in patients who developed AF after CABG surgery than the non-AF group (P=0.017). Multivariate logistic analysis showed that HATCH score (OR 1.334; 95% CI 1.022 to 1.741, P=0.034) was an independent predictor of AF after CABG surgery (table 3). ROC curve analysis showed that the cut-off point of HATCH score related to predict AF was >1 (two or more), with a sensitivity of 42% and specificity of 70% (figure 1). In addition, the distribution of AF among the HATCH scores was shown as the bar chart (figure 2).

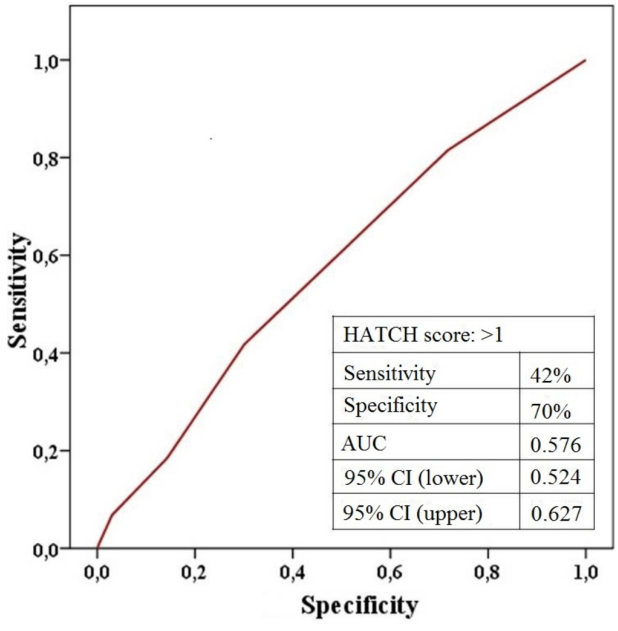

Figure 1 Receiver operating characteristics curve of HATCH score for predicting atrial fibrillation after coronary artery bypass graft surgery. AUC, area under the curve; HATCH, hypertension, age ≥75 years, transient ischemic attack or stroke, chronic obstructive pulmonary disease, and heart failure.

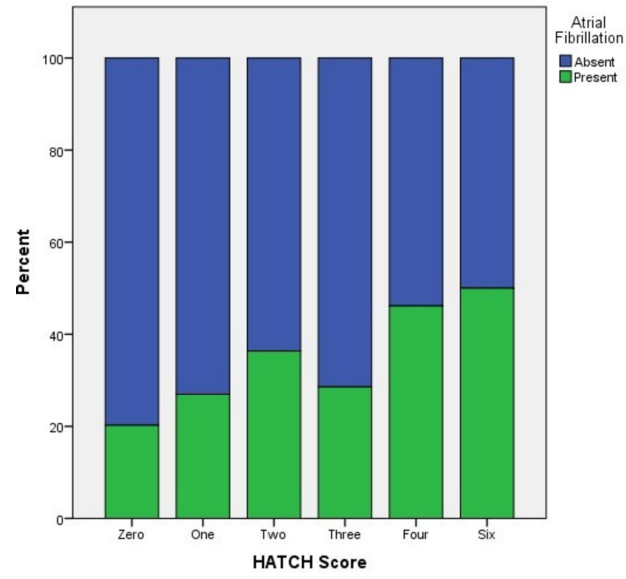

Figure 2 The distribution of atrial fibrillation among the hypertension, age ≥75 years, transient ischemic attack or stroke, chronic obstructive pulmonary disease, and heart failure (HATCH) scores.

The risk factors for AF are as follows: age >75 years, female gender, having heart failure, LVEF<40%, CHA2DS2-VASC score2 or more, having hypertension, peripheral artery disease, diabetes, COPD, and LA diameter >4 cm. CHA2DS2-VASC scoring system which contains congestive heart failure, hypertension, age>75, stroke, female gender and vascular diseases is the current scala for predicting thromboembolic events in AF patients. Three hundred and twenty patients had at least one of these risk factors, and 49 did not have any risk factor. Among those who have at least one risk factor, 96 (30%) of them had AF, whereas only 7 (14%) of those who do not have any risk factor had AF (P=0.02).

DISCUSSION

AF is the most widespread arrhythmia after cardiac surgery. Recent studies have shown that the incidence of AF after CABG is about 25%–40% among postoperative patients.[1–3] The mortality raises because of thromboembolic complications in patients with POAF. In addition, hospital costs increases due to prolonged hospitalization. In several studies, POAF has been associated with twofold to fourfold raised risk of cerebrovascular disease, a 4-day to 5-day raise in hospital length of stay, and a rise in the expense of care of about US$10 000 per patient.[10–15] Hence, predicting POAF is crucial to decrease healthcare complications and hospital costs.

Several risk factors were defined to predict POAF in previous studies. Age, gender, previous AF history, hypertension, COPD, heart failure, prior myocardial infarction, heart rate, smoking, body mass index, left atrial diameter, valvular heart disease, postoperative bleeding, postoperative

hypokalemia and chronic kidney disease were reported as risk factors for POAF.[1–3] In recent literature, PR-interval and QRS duration were found as useful for predicting POAF.[16] According to the ALDO-POAF study, preoperative plasma aldosterone and galectin-3 levels could be helpful for prevention of POAF.[17] Also, Gungor *et al* demonstrated that progression of AF after CABG surgery can be predicted by preoperative poor coronary circulation and POAF may be encountered more frequent in patients with increased postoperative resistin level.[18 19] However, there has been no consensus about predicting POAF for preoperative state.

Hypertension, age, TIA, COPD and heart failure are used to assess the development of persistent AF. These independent predictors were originated by Cees B de Vos and it was named as the HATCH score.[8] According to this study, higher HATCH score causes progression of AF and rhythm or rate control strategy might be determined. Furthermore, the HATCH score was evaluated in patients with typical atrial flutter for predicting the repetition of AF by Chen *et al*.[20] They have demonstrated that left atrial diameter and the HATCH score are significant predictors for new onset AF. Correlation between left atrial diameter and the HATCH score might be an outcome of atrial remodeling which has been caused by underlying structural heart diseases. Thus, the HATCH scoring system is related with altered electroanatomical characteristics of left atrium which have comprised some cellular pathological mechanisms of atrium as fibrosis and cellular hypertrophy. Several studies documented that with higher HATCH scores, AF recurrences after catheter ablation more frequent.[9 21 22] Tischer *et al* showed that prevalence of AF increases with higher HATCH scores.[23]

In our work, we intended to research the association between HATCH score and POAF. In literature, there have been very limited data about this subject. As a first paper, Emren and co-authors analyzed HATCH score in 284 consecutive patients who underwent CABG surgery. They have documented that the HATCH score can be used for predicting POAF.[24] According to their ROC analysis, if the HATCH score was 2 or more as a threshold, there were 72% sensitivity and 75% specificity for POAF. Furthermore, advanced age, COPD, left atrial enlargement (>35 mm), lower ejection fraction (<40%) were statistically significant about development of POAF in their study. Our study design was similar to their study but there have been some differences between two works. Firstly, our study population was larger than their study. Secondly, our ROC analysis showed that the cut-off point of HATCH score related to predict AF was >1 (two or more), with a sensitivity of 42% and specificity of 70%. In addition, only advanced age obtained the statistical significance about development of POAF in our study. In this topic, we have the second paper and we found that the HATCH score can predict AF after CABG. The HATCH score is a simple, inexpensive and non-invasive tool for utilization. Antiarrhythmic treatment can be easily initiated according to this scoring system at preoperative state.

LIMITATIONS

The POAF after discharge of intensive coronary unit was diagnosed according to the symptoms of patients or daily ECG records. In this period, some of short or asymptomatic AF episodes have been missed and they have been included in the other group due to lack of continuous ECG monitoring. The other significant limitation of the present study was retrospective study design. In addition, our study reports a single-center experience. Prospective and multicenter studies with long-term follow-up are needed to support our findings.

CONCLUSION

Patients with elevated preoperative HATCH score may have higher risk for AF after CABG surgery. Antiarrhythmic therapy can be considered according to this scoring system at preoperative state.

Contributors MS was responsible for the data collection, writing and is the corresponding author. HG was responsible for the data collection and writing of the article. CZ was involved in the reviewing and forming the tables. SG did the statistical analysis. UE and CA reviewed the article. SD gave additional opinion to the original idea.

Competing interests None declared.

Provenance and peer review Not commissioned; externally peer reviewed.

REFERENCES

1 Patel D, Gillinov MA, Natale A. Atrial fibrillation after cardiac surgery: where are we now? *Indian Pacing Electrophysiol J* 2008;8:281–91.
2 Mathew JP, Fontes ML, Tudor IC, *et al*. A multicenter risk index for atrial fibrillation after cardiac surgery. *JAMA* 2004;291:1720–9.
3 Maisel WH, Rawn JD, Stevenson WG. Atrial fibrillation after cardiac surgery. *Ann Intern Med* 2001;135:1061–73.
4 Magee MJ, Herbert MA, Dewey TM, *et al*. Atrial fibrillation after coronary artery bypass grafting surgery: development of a predictive risk algorithm. *Ann Thorac Surg* 2007;83:1707–12.
5 Burgess DC, Kilborn MJ, Keech AC. Interventions for prevention of post-operative atrial fibrillation and its complications after cardiac surgery: a meta-analysis. *Eur Heart J* 2006;27:2846–57.
6 Sezai A, Nakai T, Hata M, *et al*. Feasibility of landiolol and bisoprolol for prevention of atrial fibrillation after coronary artery bypass grafting: a pilot study. *J Thorac Cardiovasc Surg* 2012;144:1241–8.
7 Park JH, Joung B, Son NH, *et al*. The electroanatomical remodelling of the left atrium is related to CHADS2/CHA2DS2VASc score and events of stroke in patients with atrial fibrillation. *Europace* 2011;13:1541–9.
8 de Vos CB, Pisters R, Nieuwlaat R, *et al*. Progression from paroxysmal to persistent atrial fibrillation clinical correlates and prognosis. *J Am Coll Cardiol* 2010;55:725–31.
9 Miao DD, Zang XB, Zhang SL, *et al*. [Predictive value of HATCH score on atrial fibrillation recurrence post radiofrequency catheter ablation]. *Zhonghua Xin Xue Guan Bing Za Zhi* 2012;40:821–4.
10 Taylor GJ, Malik SA, Colliver JA, *et al*. Usefulness of atrial fibrillation as a predictor of stroke after isolated coronary artery bypass grafting. *Am J Cardiol* 1987;60:905–7.
11 Aranki SF, Shaw DP, Adams DH, *et al*. Predictors of atrial fibrillation after coronary artery surgery. Current trends and impact on hospital resources. *Circulation* 1996;94:390–7.
12 Tamis JE, Steinberg JS. Atrial fibrillation independently prolongs hospital stay after coronary artery bypass surgery. *Clin Cardiol* 2000;23:155–9.
13 Creswell LL, Schuessler RB, Rosenbloom M, *et al*. Hazards of postoperative atrial arrhythmias. *Ann Thorac Surg* 1993;56:539–49.
14 Reed GL, Singer DE, Picard EH, *et al*. Stroke following coronary-artery bypass surgery. A case-control estimate of the risk from carotid bruits. *N Engl J Med* 1988;319:1246–50.
15 Hogue CW, Murphy SF, Schechtman KB, *et al*. Risk factors for early or delayed stroke after cardiac surgery. *Circulation* 1999;100:642–7.
16 Gu J, Andreasen JJ, Melgaard J, *et al*. Preoperative electrocardiogram score for predicting new-onset postoperative atrial fibrillation in patients undergoing cardiac surgery. *J Cardiothorac Vasc Anesth* 2017;31:69–76.
17 Chequel M, Ollitrault P, Saloux E, *et al*. Preoperative plasma aldosterone levels and postoperative atrial fibrillation occurrence following cardiac surgery: a review of literature and design of the ALDO-POAF study (ALDOsterone

for Prediction of Post-Operative Atrial Fibrillation). *Curr Clin Pharmacol* 2016;11:150–8.
18 Gungor H, Eryilmaz U, Akgullu C, *et al*. Preoperative poor coronary collateral circulation can predict the development of atrial fibrillation after coronary artery bypass graft surgery. *Coron Artery Dis* 2013;24:572–6.
19 Gungor H, Ayik MF, Kirilmaz B, *et al*. Serum resistin level: as a predictor of atrial fibrillation after coronary artery bypass graft surgery. *Coron Artery Dis* 2011;22:484–90.
20 Chen K, Bai R, Deng W, *et al*. HATCH score in the prediction of new-onset atrial fibrillation after catheter ablation of typical atrial flutter. *Heart Rhythm* 2015;12:1483–9.
21 Schmidt EU, Schneider R, Lauschke J, *et al*. The HATCH and CHA2DS 2-VASc scores. Prognostic value in pulmonary vein isolation. *Herz* 2014;39:343–8.
22 Pokushalov E, Romanov A, De Melis M, *et al*. Progression of atrial fibrillation after a failed initial ablation procedure in patients with paroxysmal atrial fibrillation: a randomized comparison of drug therapy versus reablation. *Circ Arrhythm Electrophysiol* 2013;6:754–60.
23 Tischer TS, Schneider R, Lauschke J, *et al*. Prevalence of atrial fibrillation and the HATCH score: Intensified monitoring of patients with high HATCH score. *Herz* 2015;40:803–8.
24 Emren V, Aldemir M, Duygu H, *et al*. Usefulness of HATCH score as a predictor of atrial fibrillation after coronary artery bypass graft. *Kardiol Pol* 2016;74:749–53.