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Applying the CHA_2DS_2-VASc score to predict the risk of future acute coronary syndrome in patients receiving catheter ablation for atrial fibrillation

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ABSTRACT

Objective: It remains unknown whether catheter ablation for atrial fibrillation (AF) reduces future acute coronary syndrome (ACS) risk or whether the CHA_2DS_2-VASc score has a role in predicting this risk. We aimed to compare very long-term risk of ACS between patients who received catheter ablation to AF or antiarrhythmic medications and controls without AF.

Methods: Propensity scores were calculated for each patient and used to assemble a cohort of 787 patients undergoing AF ablation in 2003–2012. Patients were compared to an equal number of AF patients treated with antiarrhythmic medications and a control group without AF. Patients with previous coronary events were excluded. The primary endpoint was ACS occurrence.

Results: Baseline clinical characteristics were comparable. After a mean 9.1 ± 3.2-year follow-up, the ablation group had lower incidence of new onset ACS than the medication and non-AF control groups (annual incidence: 0.15%. 0.78%, and 0.35%; with 2.67, 4.16, and 10.44 cases/1000 person-years, respectively; $P < 0.001$). After adjusting for multiple confounders, the ablation group had lower future ACS risk than the medication (hazard ratio [HR]: 0.20, 95% confidence interval [CI]: 0.13–0.30) and control groups (HR: 0.30, 95% CI: 0.20–0.45). The CHA_2DS_2-VASc score was a strong predictor of ACS (HR: 1.61, 95% CI: 1.47–1.76; AUC: 85.9%, 95% CI: 78.5–93.2%). A baseline CHA_2DS_2-VASc score ≥ 4 predicted future ACS (positive predictive rate: 14.3%).

Conclusions: This study suggested that catheter ablation for AF may be beneficial to reduce future ACS risk in AF patients, and a high baseline CHA_2DS_2-VASc score can predict future acute coronary events.

1. Introduction

Atrial fibrillation (AF) is the most common form of cardiac arrhythmia and is associated with a higher risk of stroke, congestive heart failure (CHF), and cardiac hospitalization [1,2]. The perpetuation of AF is associated with many cardiovascular diseases and medical conditions, which contribute to substrate formation and maintenance of AF. For example, in coronary artery disease (CAD), several independent risk factors of AF were identified over two decades ago in the original Framingham Heart Study cohort, such as aging, hypertension (HTN), CHF, CAD, valvular heart disease (VHD), and diabetes mellitus (DM) [3]. CAD, which can be treated effectively by revascularization, is a modifiable risk factor present in over 20% of patients with AF [4]. A more recent study by Weijs et al. [5] also showed an increased prevalence of subclinical CAD diagnosed via computed tomography (CT) coronary angiogram in patients with idiopathic paroxysmal AF, with atrial ischemia resulting in AF substrate formation, such as fibrosis and scarring. Adequate revascularization can improve atrial and/or left ventricular perfusion and may further improve the atrial substrate, though the anatomical distribution of coronary artery stenosis

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does not directly contribute to AF in CAD patients [6]. Unsurprisingly, AF may also have an impact on the outcomes of patients with CAD. In patients with acute coronary syndrome (ACS), the presence of AF predicted worse outcomes [7,8]. In recent years, catheter ablation has become a common and effective choice for AF treatment. Although Chong et al. [9] suggested catheter ablation could reduce major cardiac events in AF patients with established CAD that undergo percutaneous coronary intervention (PCI), the impact of AF catheter ablation in patients with CAD has not been well established. Additional evidence is required to clarify the benefits of AF catheter ablation in CAD.

The $CHADS_2$ score is a well-known calculator to evaluate the risk of thromboembolic events and has been used in AF patients since 2001 [10,11]. However, AS et al. [12] reported that the stroke rate in patients with low-risk $CHADS_2$ score was 0.49%, whereas it fell to 0.25% in the subgroup of low-risk patients taking anticoagulant agents. These results implied that some patients classified by $CHADS_2$ as low risk can still gain benefits from anticoagulant therapy. Thus, a more detailed score system, the CHA_2DS_2-VASc score, was developed. The CHA_2DS_2-VASc score can more accurately identify the truly low-risk patients, reduce the proportion of moderate-risk patients, and identify more high-risk patients to avoid inadequate treatment [13,14]. Recently, some studies have attempted to demonstrate the value of the $CHADS_2$ and CHA_2DS_2-VASc scores in patients with CAD. In patients recovering from acute myocardial infarction (AMI), the $CHADS_2$ and CHA_2DS_2-VASc score can predict cardiovascular outcome and the 1-year major adverse cardiovascular event (MACE) rate [15]. In patients with AF, $CHADS_2$ and CHA_2DS_2-VASc scores are independent predictors of future AMI events, with the best cutoff value of $CHADS_2 \geq 2$ or $CHA2DS_2$-VASc ≥ 3 [16]. These results were not surprising because CAD and stroke shared several risk factors such as HTN, DM, and age.

Since there was a paucity of data on the benefit of AF catheter ablation to ischemic heart disease, especially ACS, the purpose of our study was to clarify the impact of AF catheter ablation on the incidence of ACS, and also to demonstrate the predictive value of the CHA_2DS_2-VASc score on ACS in patients with AF.

2. Methods

2.1. Source of data

This retrospective cohort study obtained ethical approval from the institutional review board of the Taipei Veterans General Hospital (IRB number: 201305044W and 2017-09-013BCF) and was conducted in full compliance with national ethical and regulatory guidelines. The institutional review board determined that patient consent was not required because all data were anonymized by the data holder, the Taiwan National Health Insurance (NHI) Administration (NHIA). The Taiwan NHI system was established in 1995 as a single-payer insurance system co-funded by the government, employers, and beneficiaries. All citizens and foreigners living in Taiwan for more than 6 months are required by law to enroll in the NHI. At the end of 2016, approximately 23 million beneficiaries were registered in the NHI, which is equivalent to a coverage rate of 99.5%. Since 1995, the NHI database has recorded comprehensive registration information and claims data, which include patient characteristics, medical diagnoses, prescription details, examinations, surgeries, procedures, and fees incurred. The entire database is linked by a unique national personal identification system, which was anonymized before it was released for research purpose to prevent confidentiality leaks. Anonymized national personal identification remains consistent across the NHI database and between government-held data sets, allowing valid internal and external linkage. The diagnoses and procedures were recorded using the International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9-CM) codes from 2003 through 2015.

2.2. Patient selection and data extraction

We retrospectively included 787 consecutive adult patients with AF receiving catheter ablation from Taipei Veterans General Hospital in Taiwan during the years 2003 to 2012. Propensity scores for AF were calculated for each patient and were used to assemble a cohort, which was then matched to 787 adult patients with AF but did not undergo catheter ablation (ICD-9-CM code: 427.31, including paroxysmal, persistent and long-lasting AF). The accuracy of AF (ICD-9-CM: 427.31) diagnostic accuracy using this definition in NHI system has been validated previously [17]. Further, 770 subjects without AF were also included as a superior control group. We collected clinical data including age, sex, CHA_2DS_2-VASc scores, underlying diseases (HTN, chronic kidney disease [CKD], chronic obstructive pulmonary disease [COPD], DM, and CHF), and medication used (antiarrhythmic agents, insulin, statins, angiotensin receptor blocker and angiotensin-converting-enzyme inhibitor [ARB and ACEi, respectively], anti-platelet agents and anticoagulants) as baseline characteristics. Events of ACS were collected by the ICD-9-CM codes recorded in the NHIA system as primary outcome.

2.3. Study endpoints

The primary endpoints were the time to coronary ischemic events or all-cause mortality during follow-up. Death was confirmed by referencing the Taiwan's National Death Registry. The definition of ACS included: acute myocardial infarction (AMI) and unstable angina (ICD9-CM codes: 410-414). The follow-up period ended when the subjects developed new-onset coronary ischemic events before December 31, 2015, death before December 31, 2015, or lived beyond December 31, 2015.

2.4. Statistical analysis

Normally distributed continuous variables were presented as mean values and standard deviation and were compared using the Student's *t*-test (two groups) or one-way ANOVA (more than two groups). Frequencies were compared using the chi-square test. The incidence rates of cardiovascular events were calculated as the number of cases per 1000 person-years of follow-up. In order to minimize the impact of confounding factors on clinical characteristics among AF patients and superior controls, we employed propensity analysis and a matching technique. We matched the pairs one-to-one with identical propensity scores with a 0.1 caliper width for age, gender, HTN, CKD, DM, CHF, and COPD to two comparison groups of AF cohorts with similar patient numbers. For controls without AF, age, gender, HTN, CKD, and COPD were matched among AF and non-AF groups.

The Kaplan-Meier method was utilized to compare the ACS-free survival rate in each group and to compare outcomes among different CHA_2DS_2-VASc scores. The receiver operating characteristic (ROC) curve was used to identify the optimal threshold of CHA_2DS_2-VASc to predict the occurrence of ACS in all patients with AF. Univariate and multivariate Cox regression analyses were conducted and presented with hazard ratio (HR) with 95% confidence interval (CIs) and P-value. Univariate factors with a P-value < 0.05 were included in the multivariate Cox regression calculation. The level of statistical significance was set at a 2-tailed alpha level < 0.05. The analyses were performed with SAS software (version 9.4, SAS Institute, Cary, NC).

3. Results

A total of 2344 patients were included in this study: 770 subjects without AF were assigned to Group 1 as the superior control group, 787 adult patients with AF but without catheter ablation were assigned to Group 2, and 787 adult patients with AF receiving catheter ablation were assigned to Group 3.

3.1. Patient characteristics

The mean age of patients was 53.1 ± 13.6, 54.9 ± 11.6, and 54.1 ± 11.5 years (P = 0.17) in groups 1, 2, and 3, respectively. Sex composition was 70% male in each group. Demographic data is shown in Table 1, and there were no age or sex differences among the three groups. The underlying diseases including HTN, CKD, and COPD were comparable among the 3 groups, with more patients with DM (P = 0.02) in Group 1. The CHA_2DS_2-VASc scores were similar among the three groups (median, Q1-Q3: 0 [0-1], 0 [0-1], 1 [0-1] in the groups 1–3, respectively; P = 0.15). When Group 3 was compared to Group 2, there were no differences in the distributions of age, gender, HTN, CKD, DM, CHF, and COPD between these 2 groups (P = NS). There were more patients with COPD in Group 3 (P = 0.03). Medications used were also analyzed and are shown. The future AF-related admission rates were 3.5%, 55.4%, and 34.2% in Group 1, Group 2, and Group 3, respectively. In Group 3, a total of 25.2% AF patients in this group had persistent AF.

Further Cox regression analysis revealed that AF type (persistent/paroxysmal AF) did not affect the cardiovascular outcomes in terms of future acute coronary events (adjusted HR: 0.18, 95% CI: 0.02–1.46, P = 0.11) and stroke event (adjusted HR: 1.07, 95% CI: 0.67–1.70, P = 0.78), but patients with persistent AF had significantly higher AF-related admissions (adjusted HR: 1.61, 95% CI: 1.39–1.86, P < 0.001).

3.2. Various incidence rates of subsequent acute coronary syndrome

The mean follow-up period was 9.1 ± 3.2 years (median: 10.3 years), and there were 35, 80, and 14 events in groups 1, 2, and 3, respectively (Table 2). The cumulative incidence rates among the 3 groups were 0.35%, 0.78%, and 0.15% in groups 1, 2, and 3, respectively (P < 0.001), while incidence rates among the 3 groups were 4.16, 10.44, and 2.67 cases/per 1000 person-years, respectively (P < 0.001).

Kaplan-Meier survival analysis in Supplementary Fig. 1 revealed that Group 2 (AF patients without ablation) had significant lower ACS free survival rate when compared to Group 1 (P < 0.001) and Group 3 (P < 0.001), whereas there was no difference in ACS-free survival between groups 1 and 3 (P = 0.15), during the 12-year follow-up.

3.3. Atrial fibrillation ablation and CHA_2DS_2-VASc scores affected the future risk of acute coronary syndrome

Table 3 showed that the presence of AF without ablation (HR: 2.04, 95% CI: 1.61–2.59, P < 0.001), DM (HR: 1.60, 95% CI: 1.14–2.27, P = 0.01), and CHF (HR: 1.85, 95% CI: 1.22–2.80, P = 0.004) were independent risk factors for future ACS in multivariate Cox regression analysis, whereas catheter ablation (HR: 0.37, 95% CI: 0.25–0.55, P < 0.001) reduced the risk.

The uses of anticoagulants and antiplatelets in all study subjects (Groups 1–3) were associated to an increase of future ACS risk (Adjusted HR: 2.06, 95% CI: 1.59–2.67, P < 0.001 for anticoagulants; adjusted HR: 1.95, 95% CI: 1.32–2.88, P = 0.001 for antiplatelets).

Table 1
Baseline characteristics of the study population.

Variables	P-value for all groups	Group 1: Controls without AF (N = 770)	Group 2: AF patients without ablation (N = 787)	Group 3: AF patients with ablation (N = 787)	P-value for AF patients
Male sex (%)	0.99	542 (70.4%)	551 (70%)	552 (70.1%)	0.96
Age (years)	0.17	53.1 ± 13.6	54.9 ± 11.6	54.1 ± 11.5	0.49
CHA_2DS_2-VASc score (median, Q1-Q3)	0.15	0 (0–1)	0 (0–1)	1 (0–1)	0.10
Underlying diseases					
Hypertension (%)	0.98	287 (37.3%)	290 (36.8%)	290 (36.8%)	>0.99
Chronic kidney disease (%)	0.83	3 (0.4%)	4 (0.5%)	10 (1.3%)	0.11
Diabetes mellitus (%)	0.02	82 (10.6%)	53 (6.7%)	63 (8%)	0.34
Congestive heart failure (%)	<0.001	18 (2.3%)	50 (6.4%)	51 (6.5%)	0.92
Chronic obstructive pulmonary disease (%)	0.06	19 (2.5%)	16 (2%)	31 (3.9%)	0.03
Medications used					
Anti-arrhythmic agents (%)	<0.001	65 (8.4%)	459 (58.3%)	759 (96.4%)	<0.001
Insulin (%)	<0.001	101 (13.1%)	114 (14.5%)	13 (1.7%)	<0.001
Statins (%)	<0.001	304 (39.5%)	334 (42.4%)	289 (36.7%)	<0.001
Angiotensin II receptor blockers (%)	<0.001	387 (50.3%)	547 (69.5%)	404 (51.3%)	<0.001
Anti-platelet agents (%)	<0.001	424 (55.5%)	661 (84%)	761 (96.7%)	<0.001
Anti-coagulant agents (%)	<0.001	36 (4.7%)	448 (56.9%)	291 (37%)	<0.001

AF: atrial fibrillation.

Table 2
Various incidence rates of subsequent acute coronary syndrome.

Adjustment after PS matching (N = 2344)	Total number	PY	Total events	Cumulative incidence	Annual incidence	Incidence rate (per 1000 PY)
Group 1: Superior controls without AF	770	8412	35	4.5%	0.35%	4.16
Group 2: AF patients without ablation	787	7666	80	10.2%	0.78%	10.4
Group 3: AF patients with ablation	787	5243	14	1.8%	0.15%	2.67

AF: atrial fibrillation, PY: person-years, PS: propensity-score.

Table 3
Cox regression models for evaluating the risks of future acute coronary syndrome.

Variables	Acute coronary syndrome events			
	Univariate analysis (HR, 95% CI)	P-value	Multivariate analysis (HR, 95% CI)	P-value
Age	1.05 (1.04–1.07)	<0.001	1.05 (1.04–1.06)	<0.001
Male sex	0.98 (0.66–1.43)	0.93	1.18 (0.93–1.48)	0.17
Interventions				
Group 1: Superior controls without AF	Reference		Reference	
Group 2: AF patients without ablation	2.50 (1.68–3.71)	<0.001	2.04 (1.61–2.59)	<0.001
Group 3: AF patients with ablation	0.62 (0.33–1.16)	0.133	0.37 (0.25–0.55)	<0.001
Diabetes mellitus	1.85 (1.13–3.05)	0.015	1.60 (1.14–2.27)	0.01
Hypertension	2.74 (1.92–3.89)	<0.001	0.79 (0.62–1.00)	0.05
Chronic obstructive pulmonary disorder	2.12 (0.93–4.80)	0.073	1.08 (0.60–1.93)	0.80
Chronic kidney disease	2.97 (0.73–12.0)	0.127		
Congestive heart failure	2.12 (1.14–3.94)	0.017	1.85 (1.22–2.80)	0.004
Hyperlipidemia	1.08 (0.59–1.95)	0.808		

A factor with a P-value < 0.1 in univariate analysis was included in the multivariate analysis instead of basic adjustment of age and sex.
AF: atrial fibrillation; CI: confidence interval.

Table 4
Cox regression models for evaluating the effects of catheter ablation on the risk of acute coronary syndrome.

Models	Variables	All groups		AF patients	
		Hazard ratios (95% CI)	P-value	Hazard ratios (95% CI)	P-value
Model 0	Group 1: Superior controls without AF	Reference	<0.001	Not available	Not available
	Group 2: AF patients without ablation	2.50 (1.68–3.71)	<0.001	Reference	<0.001
	Group 3: AF patients with catheter ablation	0.62 (0.33–1.16)	0.13	0.23 (0.13–0.42)	<0.001
Model 1	Group 1: Superior controls without AF	Reference	<0.001	Not available	Not available
	Group 2: AF patients without ablation	1.36 (1.02–1.81)	0.038	Reference	<0.001
	Group 3: AF patients with catheter ablation	0.30 (0.20–0.45)	<0.001	0.20 (0.13–0.30)	<0.001

Model 0: crude effect.
Model 1: adjusted for CHA_2DS_2-VASc scores, chronic kidney disease, chronic obstructive pulmonary disease, and medication uses (antiarrhythmics, insulin, statins, angiotensin receptor blocker and angiotensin-converting-enzyme inhibitor, antiplatelets, and anticoagulants).
AF: atrial fibrillation; CI: confidence interval.

Considering Group 3 only, anticoagulants and antiplatelets did not affect the future coronary outcomes (adjusted HR: 0.94, 95% CI: 0.31–2.80, P = 0.91 for anticoagulants; adjusted HR: 21.6, 95% CI: 0–13.6, P = 0.91 for antiplatelets). The uses of anticoagulants and antiplatelets were adjusted in Model 1 of Cox regressions and did not affect the impact of AF catheter ablation or CHA_2DS_2-VASc scores to future ACS events (Table 4).

As shown in Table 4, after adjusting for multiple confounders for all groups, Group 2 had a higher incidence risk of ACS than Group 1 (HR: 1.36, 95% CI: 1.02–1.81, P = 0.04), whereas Group 3 had lower incidence risk of ACS than Group 1 (HR: 0.30, 95% CI: 0.20–0.45, P < 0.001). Among all the AF patients, multivariate analysis showed that catheter ablation reduced the risk of future ACS (HR: 0.20, 95% CI: 0.13–0.30, P < 0.001; see Table 4).

CHA_2DS_2-VASc score was another independent risk factor for future incidence of ACS in multivariate Cox regression analysis. In Supplementary Table S1, each increment value of the CHA_2DS_2-VASc score implied an increased risk of future ACS in AF patients regardless of whether the patient received ablation or not (adjusted HR: 1.49, 95% CI: 1.26–1.77, P < 0.001). There were no interactions between the effect of CHA_2DS_2-VASc score and the status of ablation in AF patients (HR: 1.31, 95% CI: 1.06–1.60 in Group 2 [P < 0.001], HR: 2.66, 95% CI: 1.89–3.77 in Group 3 [P < 0.001]; interaction P for CHA_2DS_2-VASc score * the status of ablation = 0.78).

3.4. Acute coronary syndrome risk across CHA_2DS_2-VASc scores in AF patients with ablation

In Supplementary Fig. 2, the event-free survival rate was compared for different CHA_2DS_2-VASc scores among patients with AF included in Group 2 and Group 3. The results showed that a CHA_2DS_2-VASc score $\geq$ 4 led to significantly lower event-free survival rates after 3-year follow-up (P < 0.001). After a 6-year follow-up, there were some events in the group with CHA_2DS_2-VASc score = 3, but no significant differences were identified when compared to groups having CHA_2DS_2-VASc score = 1 and 2. Up to the 8-year follow-up, a CHA_2DS_2-VASc score $\geq$ 4 led to a significantly lower event-free survival rate (P < 0.01).

The ROC analysis revealed that the CHA_2DS_2-VASc score had good predictive ability for future ACS risk (85.9%, 95% CI: 78.5%–93.2%; sensitivity: 78.6%; and specificity: 76.7%) in patients with AF included in Group 2 and Group 3 (Supplementary Fig. 3). Fisher linear discriminant analysis revealed that a baseline CHA_2DS_2-VASc score $\geq$ 4 was a suitable cut-off value for predicting future ACS events (positive predictive rate: 14.3%) with an overall accuracy of 97.6%.

4. Discussion

The major findings of this study are as follows: (1) AF patients without catheter ablation have higher risk of future ACS when compared to normal control group; (2) The presence of AF without catheter ablation is an independent risk factor for future acute coronary events; (3) catheter ablation for AF could reduce future risk of ACS events; (4) the cut-off value of baseline CHA_2DS_2-VASc score $\geq$ 4 in AF patients strongly predicted future ACS events.

4.1. Coronary artery disease and atrial fibrillation

CAD and AF are closely related. Recent studies in different patient populations have shown that CAD and AF coexist in a large percentage of patients (18–34%) [18]. Another study also

demonstrated the prevalence of CAD in patients with AF was up to 36–82%, and subclinical atherosclerosis comprised 74% of patients with AF [19]. Conversely, the prevalence of AF among patients with CAD is quite low (0.2–5%) [20–22]. In CAD patients, AF is independently associated with in-hospital post-PCI heart failure, cardiogenic shock, and mortality [23]. CAD can also promote AF by inflammation, fibrosis, hypertrophy, and atrial ischemia [20]. Both diseases share associated risk factors such as HTN, DM, sleep apnea, obesity, and smoking. Moreover, inflammatory processes are also important in both CAD and AF [24–26].

4.2. Acute coronary syndrome and atrial fibrillation

AMI is an established risk factor for AF occurrence such that 6.8–21% of post-MI patients have been reported to develop an AF attack [27]. AF is also a well-established marker of poor short-term and long-term prognosis in patients with AMI. Patients presenting with AMI and a history of AF have a higher mortality rate compared to patients without AF [28]. In addition, there is evidence indicating that AF may contribute to MI by different mechanisms. In patients with AF, impaired artery dilatation predisposes to atherosclerotic complications and may lead to an increased risk of cardiovascular events [29]. Episodes of poorly controlled AF with high ventricular rates may result in type 2 MI [30]. Shibata et al. [31] reported that AF was the most frequent cause of coronary artery embolism inducing non-atherosclerotic AMI. In our present study, patients with unstable angina were also included in the definition of ACS. AF patients without catheter ablation had a higher risk of ACS compared to normal controls, whereas there was a high number of DM cases in the control group, with no significant differences in sex, age, or other underlying diseases (HTN, CKD, COPD). The presence of AF without catheter ablation was an independent risk factor for ACS in both univariate and multivariate analysis.

4.3. Catheter ablation of atrial fibrillation and acute coronary syndrome

Randomized studies showed that rhythm control using antiarrhythmic drugs (AAD) alone could not improve major clinical outcomes, but the sub-study of the AFFIRM trial still suggested improved cardiovascular outcomes in patients maintaining sinus rhythm. Because of the arrhythmogenicity of AAD, benefits of cardiovascular outcomes in patients achieving sinus rhythm maintenance were offset by the side effects [32–34]. However, catheter ablation opened a new era of AF treatment because successful AF ablation could obviate the need for long-term AAD and result in less adverse events of the medication. A recent study also claimed anticoagulants may be unnecessary after successful AF ablation given the concerns of bleeding risk, even in intermediate to high risk (CHA_2DS_2-VASc $\geq$ 1) patients [35]. The impact of AF catheter ablation on patients with CAD was surveyed by Chong et al. [9] in 2016 and suggested that catheter ablation could lead to fewer major adverse cardiac events compared to medical therapy in AF patients with established CAD who underwent PCI. But mention of the effects of AF ablation in ACS, there is still paucity of data. Our study demonstrated that: (1) the baseline characteristics between groups with and without AF catheter ablation were comparable and (2) catheter ablation to AF could reduce future risk of ACS in patients with AF. Nevertheless, we are unable to determine the reasons why AF catheter ablation could protect patients with AF from future ACS. A hypothesis was proposed that maintenance of sinus rhythm might lead to improvement in myocardial perfusion. Autonomic nervous system (ANS) modulation after AF catheter ablation may also play a role in cardioprotection [36]. Further studies investigating the underlying mechanisms involved in cardioprotection are necessary.

4.4. CHA_2DS_2-VASc score and acute coronary syndrome risk in atrial fibrillation patients

Several studies have extended the application of the CHA_2DS_2-VASc score, beyond evaluating the risks of thromboembolic events in AF patients. Chua et al. [37] suggested that the CHA_2DS_2-VASc score could be used to predict subsequent myocardial infarction, stroke, and death in patients with ACS. Li el al. [38] demonstrated that both $CHADS_2$ and CHA_2DS_2-VASc scores could predict MACE risks in patients with AMI, independent of the presence of AF. $CHADS_2$ score $\geq$ 2 in young AF patients, and $CHADS_2$ score $\geq$ 3 in elderly AF patients were predictors of mortality in patients undergoing coronary angiography [39]. A more recent study published by Pang et al. [16] demonstrated that AMI risk in a patient with AF could be predicted by the optimal cut-off values of $CHADS_2 \geq 2$ or CHA_2DS_2-VASc $\geq$ 3. All these studies suggested very high correlations between CHA_2DS_2-VASc scores and ischemic heart disease. Our current study also supported the results that each increment value of CHA2DS2-VASc score suggests an increased risk of future ACS events, which could be predicted by a cut-off value of CHA_2DS_2-VASc $\geq$ 4. The higher cut-off value of the CHA_2DS_2-VASc score in our study when compared to Pang's may be explained by the younger and less illness prone population (HTN, DM, and CHF) in our study cohort. Besides, patients with unstable angina were also included in our study.

5. Study limitations

First, advantages of our study include the large number of AF ablation cases, the very long-term follow-up, and the fact that it was the first study to attempt to demonstrate a relationship between AF ablation and ACS. However, there are limitations to this study. The first is related to its retrospective nature. Data extraction from the NHI database may not be totally accurate and complete. The input of ICD-9-CM codes in the NHI system for unstable angina, non-ST-segment elevation myocardial infarction (NSTEMI), ST-segment elevation myocardial infarction (STEMI), or ACS was not strictly standardized. Second, due to the limitation of NIH system, sub-types (type 1 to 5) of myocardial infarction, types of AF (paroxysmal or persistent), and clinical presentation of AF (symptomatic or asymptomatic) were not available. Predictive values and cut-off values of the CHA_2DS_2-VASc score may differ in different types of AF. Third, follow-up ECG recordings were not available. Thus, we can only provide the nation-wide outcomes of future AF-related hospitalization as surrogate index of AF recurrences. The true recurrence of AF may be underestimated.

6. Conclusion

This very long-term study suggested that AF catheter ablation could be beneficial for reducing risk of future ACS in AF patients. Future ACS event rates can be predicted by a high baseline CHA_2DS_2-VASc score.

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary material

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