Original article

Metabolic syndrome in patients with atrial fibrillation in the absence of structural heart disease from a tertiary hospital in China

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Keywords: *metabolic syndrome; atrial fibrillation; catheter ablation*

Background Metabolic syndrome (MetS) and atrial fibrillation (AF) are causally related. This study aimed to determine the prevalence of MetS in patients with AF in the absence of structural heart disease from a tertiary hospital in China.

Methods In a single center, 741 inpatients with AF in the absence of structural heart disease prior to catheter ablation were retrospectively reviewed. Among them, 588 (79.4%) patients had paroxysmal AF. Subgroup analyses were performed in paroxysmal AF and persistent/permanent AF.

Results MetS was found in 343 (46.3%) patients (200 males, 143 females); 0, 1, 2, 3, 4, 5 components of the MetS were found in 59 (8.0%), 140 (18.9%), 199 (26.9%), 203 (27.4%), 103 (13.9%) and 37 (5.0%) patients, respectively. The prevalences of overweight/obesity, high blood pressure, high glucose level, high triglyceride level and low high density lipoproteins cholesterol level were 53.8%, 47.6%, 23.2%, 40.6% and 72.1%, respectively. The prevalence of MetS was not significantly different between the paroxysmal AF group and the persistent/permanent AF group (44.6% vs 52.9%, P=0.064). The five components of MetS except overweight/obesity (69.3% vs 49.8%, P <0.001) were not significantly different between the aforementioned two groups. The left atrium diameter increased with the sum of the MetS components. The left atrium diameter in the MetS group was significantly higher than that in the non-MetS group both in patients with paroxysmal AF and in patients with persistent/permanent AF.

Conclusions The prevalence of MetS in patients with AF prior to catheter ablation is high. Further study and prevention are needed.

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Atrial fibrillation (AF) is the most common arrhythmia in clinical practice. From 1980 to 2000, the annual incidence of AF in the US increased from 3.03 to 3.68 per 1000 persons.[1] It is important to determine the risk factors for the development of AF. Metabolic syndrome (MetS) is characterized by a cluster of atherosclerosis risk factors including obesity, insulin resistance, hypertension, dyslipidemia and high levels of inflammatory factors, many of which are risk factors of new-onset AF. It has been shown that the trend of prevalence of MetS and AF is similar.[2] Recent studies have indicated that MetS and AF are closely related,[3,4] and MetS was an independent predictor of recurrence after catheter ablation of AF.[5,6] There have been many studies about the distribution of MetS in patients with coronary heart disease,[7] however, there are few studies about MetS in patients with AF. In this study, we investigated the prevalence of MetS in patients with AF in the absence of structural heart disease prior to catheter ablation from a tertiary hospital in China.

METHODS

Subjects

From January 2005 to November 2007, 857 inpatients with AF referring to Beijing Anzhen Hospital prior to catheter ablation of AF were retrospectively recruited. Patients with structural heart disease (including valvular heart disease, dilated, hypertrophic or ischemic cardiomyopathy, heart failure) were excluded, the remaining 741 patients were enrolled. Among the enrolled patients, 588 (79.4%) had paroxysmal AF and 153 (20.6%) had persistent/permanent AF. Paroxysmal AF was defined when the arrhythmia terminated spontaneously and the duration was less than 7 days. When it sustained beyond 7 days and terminated with pharmacological therapy or direct-current cardioversion, AF was considered persistent. Permanent AF was designated if there was no indication of cardioversion or failed cardioversion.[8]

Definition of MetS

MetS was defined according to the guidelines issued by the Society of Diabetology of the Chinese Medical

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Association and the National Cholesterol Education Program Third Adult Treatment Panel (NCEP-ATP III).[9-11] According to the baseline characteristics, MetS was diagnosed when at least 3 of the following criteria were met: (1) body mass index equal to or greater than 25.0 kg/m^2, which was calculated by dividing weight in kilograms by the square of the height in meters; (2) elevated blood pressure (systolic blood pressure ≥130 mmHg, diastolic blood pressure ≥85 mmHg, and/or a history of treated hypertension); (3) elevated blood glucose (≥5.6 mmol/L) and/or a history of diabetes mellitus; (4) elevated triglycerides (≥1.69 mmol/L); and (5) low high-density lipoprotein cholesterol (<1.03 mmol/L in men, <1.29 mmol/L in women).

Statistical analysis

Continuous variables were presented as mean ± standard deviation (SD). Student′s *t* test was employed for continuous data between the two groups. The chi-square test was employed for categorical variables. The prevalence of MetS in this study was compared with the data derived from the literatures by the chi-square test.[7,12] The value of *P* <0.05 was considered statistically significant. Statistical analyses were performed with SPSS 13.0.

RESULTS

Patient characteristics

The age of the patients with AF was (55.8±11.6) (17–79) years. Of the 741 patients, 426 (57.5%) were male; 399 (53.8%) were overweight or obese, and 588 (79.4%) had paroxysmal AF. The duration of AF was (6.6±6.2) years. Other characteristics are listed in Table. The patients with MetS had a higher proportion of diabetes mellitus, hypertension, as well as larger left atrial diameter, larger left ventricular end diastolic diameter, larger left ventricular end systolic diameter, higher body mass index, higher blood glucose level, higher triglycerides and lower high-density lipoprotein cholesterol than those without MetS. The gender proportion and AF duration were not different significantly between paroxymal AF and persistent/permanent AF. The patients with paroxymal AF were older than those with persistent/permanent AF ((56.3±11.6) vs (54.1±11.6) years, *P*=0.040).

Distribution of MetS and its components

Among the 741 patients, 343 (46.3%) had MetS (200 male, 143 female). The prevalence of MetS in AF patients was significantly higher than that in Chinese adults[12] (46.3% vs 16.5%, *P* <0.001). There was no significant difference in MetS prevalence between the patients with AF and those with coronary artery disease in our hospital[7] (46.3% vs 49.3%, *P*=0.130). According to the definition of MetS, there was a significant difference in the prevalences of hypertension, overweight/obesity, hyperglycemia, hypertriglyceridemia and low high-density lipoprotein cholesterol between the MetS group and the non-MetS group. Zero, 1, 2, 3, 4, 5 components of MetS were found in 59 (8.0%), 140 (18.9%), 199 (26.9%), 203 (27.4%), 103 (13.9%) and 37 (5.0%) patients, respectively. The prevalences of overweight/obesity, high blood pressure, high glucose level, high triglyceride level and low high density lipoproteins cholesterol level were 53.8%, 47.6%, 23.2%, 40.6% and 72.1%, respectively.

Table. Characteristics of the patients

Variables	Overall (*n*=741)	MetS (*n*=343)	Non-MetS (*n*=398)	*P* values
Age (years)	55.8±11.6	55.9±10.8	55.8±12.4	0.857
Male (*n* (%))	426 (57.5)	200 (58.3)	226 (56.8)	0.675
AF duration (years)	6.6±6.2	6.4±6.6	6.6±5.9	0.682
Paroxysmal AF (*n* (%))	588 (79.4)	262 (76.4)	326 (81.9)	0.064
Diabetes (*n* (%))	88 (11.9)	73 (21.3)	15 (3.8)	<0.001
Hypertension (*n* (%))	338 (45.6)	239 (69.7)	99 (24.9)	<0.001
Body mass index (kg/m^2)	25.6±3.3	27.1±3.0	24.2±2.9	<0.001
Overweight/obesity (*n* (%))	399 (53.8)	276 (80.5)	123(30.9)	<0.001
Glucose (mmol/L)	5.14±1.09	5.47±1.29	4.85±0.77	<0.001
Triglycerides (mmol/L)	1.75±1.22	2.23±1.55	1.34±0.59	<0.001
HDL cholesterol (mmol/L)	1.00±0.23	0.90±0.16	1.08±0.25	<0.001
Left atrial diameter (mm)	37.9±6.0	39.5±5.8	36.5±5.7	<0.001
LVEDD (mm)	48.3±6.2	48.9±6.8	47.8±5.5	0.027
LVESD (mm)	31.8±5.2	32.5±5.2	31.2±5.1	0.001
LVEF (%)	62.9±7.7	62.5±7.6	63.2±7.8	0.251

AF: atrial fibrillation. HDL: high density lipoproteins. LVEDD: left ventricular end diastolic diameter. LVESD: left ventricular end systolic diameter. MetS: metabolic syndrome.

AF and MetS

The prevalence of MetS was not significantly different between the paroxysmal AF group and the persistent/permanent AF group (44.6% vs 52.9%, *P*=0.064). The proportions of paroxysmal AF were 9.4%, 19.4%, 26.7%, 26.7%, 12.6%, 5.3% from zero to five MetS components, respectively (Figure 1). While the proportions of persistent/permanent AF were 2.6%, 17.0%, 27.5%, 30.1%, 19.0%, 3.9% from zero to five MetS components respectively. The prevalence of different MetS components in different AF type is shown in Figure 2. The prevalence of overweight/obesity was significantly higher in persistent/permanent AF patients than in paroxysmal AF patients (69.3% vs 49.8%, *P* <0.001). The prevalence of the other four MetS components was not significantly different between the paroxysmal AF group and the persistent/permanent AF group. Left atrial enlargement is an important characteristic of atrial remodeling in AF patients. The diameter of the left atrium in the MetS group was significantly larger than that in the non-MetS group ((39.5±5.8) mm vs (36.5±5.7) mm, *P* <0.001) (Table). Subgroup analysis indicated that the diameter of the left atrium in the MetS group was also significantly greater than that in the non-MetS group both in patients with paroxysmal AF ((38.6±5.7) mm vs (35.7±5.3) mm, *P* <0.001) and in patients with persistent/permanent AF ((42.5±5.2) mm vs (40.4±6.2) mm, *P*=0.029). The diameters of the left atrium in patients with 0, 1, 2, 3, 4, 5 components of MetS were (34.1±5.1) mm, (36.2±6.1) mm, (37.4±5.4) mm, (38.7±5.4) mm, (41.0±6.7) mm, (39.7±4.5) mm, respectively (*P* <0.001).

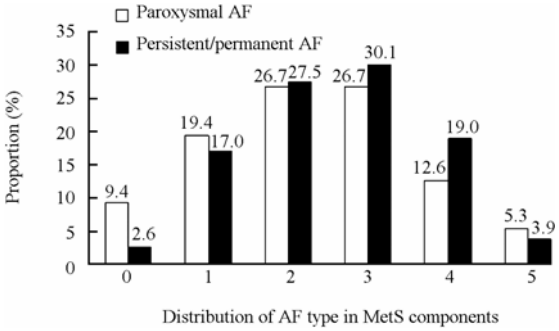

Figure 1. Distribution of paroxysmal and persistent/permanent AF among zero to five MetS components.

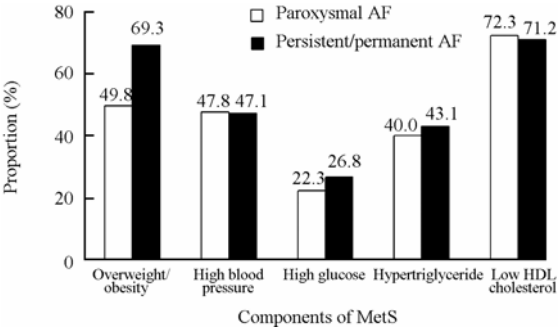

Figure 2. Distribution of the MetS components in paroxysmal and persistent/permanent AF.

DISCUSSION

The association between AF and MetS has been proposed in recent years. A follow-up of 592 patients without obvious organic heart disease[3] showed that the prevalence of new-onset AF/atrial flutter in MetS subjects was 9%, which was significantly higher than that in non-MetS subjects (4%). The effect of MetS on AF/AFL was independent of age and the diameter of the left atrium. A prospective study[4] showed that MetS was an independent predictor after a 4.5-year follow-up of 28 449 patients. Among the five components of MetS, overweight, abnormal glucose metabolism, hypertension and hypertriglyceridemia markedly increased the risk for AF. Different from the aforementioned studies, this study sought to survey the prevalence of MetS in patients with AF in absence of structural heart disease in a tertiary hospital. The prevalence of MetS (46.3%) in AF patients was significantly higher than that in general people.

MetS is a syndrome which includes obesity, insulin resistance, hypertension, dyslipidemia and high level of inflammatory factors. Its multiple components are remarkably related to AF. A research[13] demonstrated that the incidence of AF in 43 673 patients with diabetes was 14.9%, which was significantly higher than that in 57 077 patients without diabetes (10.3%, P <0.0001). Diabetes was an independent correlated risk factor of AF. The Framingham heart study,[14] including a 38-year follow-up of 4731 subjects, showed that hypertension was significantly associated with risk for AF in both genders (odds ratio, 1.5 for men and 1.4 for women). A prospective Framingham cohort study demonstrated that AF developed in 265 subjects.[15] Compared with individuals with normal body mass index, overweight/obesity was related to the risk of new-onset AF. According to the result of another research,[16] which included a total of 8051 consecutive patients who had undergone cardiac surgery, obesity was an independent predictor of new-onset AF after the surgery. The potential mechanism of AF associated with obesity was not understood. Some related factors may be the pathophysiological basis such as elevated plasma volume, ventricular diastolic dysfunction, enhanced neuro-hormonal activation, structural and electrophysiological abnormality of the myocardium resulted from fat itself.[15,16] This study demonstrated that the percentage of overweight/obesity in AF subjects was 53.8%. And the prevalence of overweight/obesity in patients with persistent/permanent AF was significantly higher than that in patients with paroxysmal AF. It is indicated that metabolic disorder may be more important in the pathogenesis of persistent/permanent AF, which may be one of the reasons why the success rate of catheter ablation is low in patients with persistent/permanent AF.[5]

MetS is related to atrial remodeling. Umetani et al[3] demonstrated that the diameter of the left atrium in patients with MetS was greater than that in patients without MetS. The number of components fulfilled for MetS was correlated with cardiac structural abnormity including the diameter of the left atrium as revealed by Azevedo et al.[17] The diameter of the left atrium notably increased with the number of MetS components, which was in agreement with the reports in the literature. We also found that the diameter of the left atrium in the MetS group was significantly greater than that in the non-MetS group both in patients with paroxysmal AF and in those with persistent/permanent AF.

This study was based on the data from inpatients with AF prior to catheter ablation in a single center. The economic conditions and awareness of AF among the patients prior to catheter ablation might be different from those of other patients with AF. This study could not represent the prevalence of MetS in the general AF population because of sample selection bias. However, it provided important clinical data for the prevalence of MetS in patients with AF prior to catheter ablation. MetS accounts for a large proportion in the AF population. In clinical practice, we should pay more attention to the patients with AF and MetS. The effect of MetS on the ventricular rate control, the rhythm control as well as the anticoagulation of AF patients remains to be further investigated.

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