

ORIGINAL RESEARCH

# Impact of Body Mass Index on Postoperative Atrial Fibrillation in Patients With Hypertrophic Cardiomyopathy Undergoing Septal Myectomy

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**BACKGROUND:** Obesity is an established cardiovascular risk factor in patients with hypertrophic cardiomyopathy. Postoperative atrial fibrillation (POAF) is one of the most common complications after surgery in patients with obstructive hypertrophic cardiomyopathy (OHCM). We aimed to determine the impact of body mass index (BMI) on the occurrence of POAF in patients with OHCM who underwent septal myectomy.

**METHODS AND RESULTS:** In all, 712 OHCM patients without previous atrial fibrillation who underwent septal myectomy were identified. Patients were stratified into 3 groups based on BMI. Of these, 224 (31.5%) had normal weight (BMI < 24 kg/m<sup>2</sup>), 339 (47.6%) were overweight (BMI, 24 to < 28 kg/m<sup>2</sup>), and 149 (20.9%) were obese (BMI ≥ 28 kg/m<sup>2</sup>). Overweight and obese patients had increased levels of left atrial diameter ( $P < 0.001$ ) and left ventricular end-diastolic diameter ( $P < 0.001$ ), compared with patients with normal weight. Among 184 patients (25.8%) developing POAF, 32 cases (14.3%) occurred in the normal weight group, 100 cases (29.5%) occurred in the overweight group, and 52 cases (34.9%) occurred in the obese group ( $P < 0.001$ ). Logistic regression analysis indicated that overweight (odds ratio [OR]: 2.161, 95% CI, 1.333–3.503;  $P = 0.002$ ) or obesity (OR, 2.803; 95% CI, 1.589–4.944;  $P < 0.001$ ), age (OR, 1.037; 95% CI, 1.018–1.057;  $P < 0.001$ ), and left atrial diameter (OR, 1.060; 95% CI, 1.027–1.095;  $P < 0.001$ ) were independently associated with the occurrence of POAF in patients with OHCM.

**CONCLUSIONS:** Overweight and obesity are strong predictors of POAF in patients with OHCM. Strategies aimed at lowering BMI may be a potential way to prevent POAF.

**Key Words:** body mass index ■ hypertrophic cardiomyopathy ■ postoperative atrial fibrillation ■ septal myectomy

**H**ypertrophic cardiomyopathy (HCM) is a disease characterized by unexplained left ventricular hypertrophy in the absence of other cardiac or systemic diseases.<sup>1</sup> Approximately two thirds of patients with HCM demonstrate a left ventricular outflow tract obstruction at rest or with provocation.<sup>1</sup> An extended septal myectomy is performed in patients with HCM with medically refractory symptoms and left ventricular outflow tract gradient or mid-ventricular gradient > 50 mm Hg at rest or with physiologic provocation.<sup>2</sup>

Obesity is an important environmental pathogenic factor of cardiovascular diseases, such as hypertension, heart failure, and coronary heart disease.<sup>3</sup> Also, the prevalence rate of obesity is high in patients with HCM.<sup>4</sup> Patients with HCM with a body mass index (BMI) > 25 kg/m<sup>2</sup> were not only more symptomatic, but also manifested higher rates of hypertension, left ventricular outflow tract obstruction, and arrhythmia.<sup>4</sup> Compared with non-obese patients, the likelihood of being referred for septal reduction therapies is significantly higher in obese patients with obstructive HCM

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## CLINICAL PERSPECTIVE

### What Is New?

- Patients in overweight or obese group have a higher risk of postoperative atrial fibrillation in a large Chinese obstructive hypertrophic cardiomyopathy patient cohort.

### What Are the Clinical Implications?

- Increased body mass index level could predict the presence of postoperative atrial fibrillation in patients with obstructive hypertrophic cardiomyopathy undergoing septal myectomy, and strategies for controlling weight may contribute to prevent the occurrence of postoperative atrial fibrillation.

## Nonstandard Abbreviations and Acronyms

<b>HCM</b>	hypertrophic cardiomyopathy
<b>LAD</b>	left atrial diameter
<b>OHCM</b>	obstructive hypertrophic cardiomyopathy
<b>POAF</b>	postoperative atrial fibrillation

(OHCM).<sup>4</sup> Postoperative atrial fibrillation (POAF) is one of the most common complications after cardiac surgery in patients with OHCM.<sup>5</sup> It is well known that POAF is associated with poor long-term prognosis in patients who underwent coronary artery bypass graft surgery or other cardiac surgeries.<sup>6</sup> But the impact of POAF in OHCM is still unknown. In recent years, many studies have focused on the prediction and prevention of atrial fibrillation (AF) after cardiac surgery, but there are no good predictors and treatment strategies to date. Zhou et al showed that BMI was related with the left atrial diameter (LAD) in patients with OHCM.<sup>7</sup> However, there is a paucity of data on the relationship between BMI and POAF. Therefore, the purpose of this study was to determine the impact of BMI on the occurrence of POAF in patients with OHCM.

## METHODS

The authors will not make the data, methods used in the analysis, and materials used to conduct the research available to any researcher for purposes of reproducing the results or replicating the procedure.

### Study Population

This retrospective study enrolled 886 patients with OHCM who were consecutively referred for septal

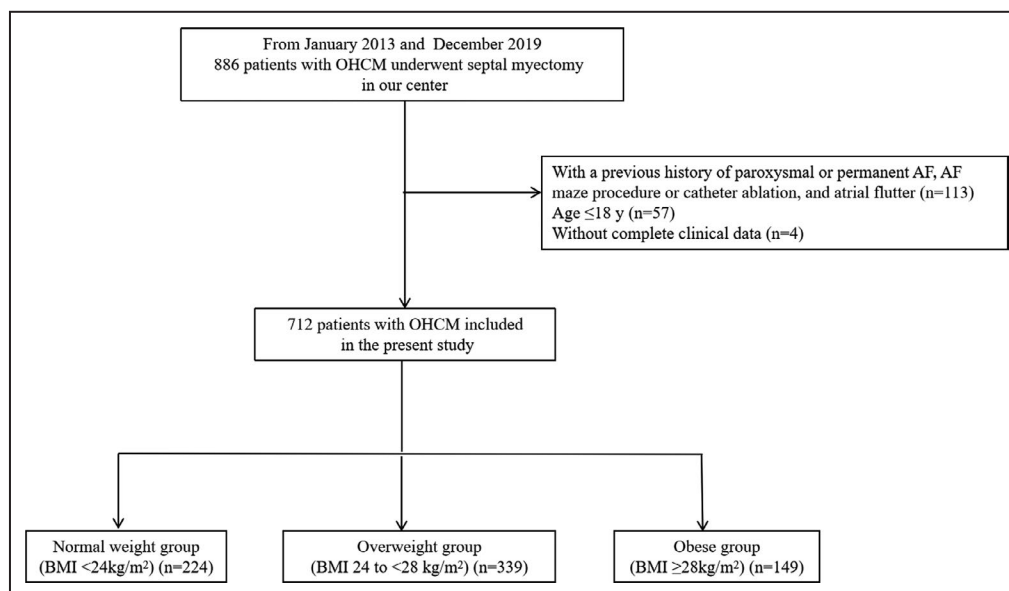
myectomy between January 2013 and December 2019 at Fuwai Hospital in Beijing, China. The diagnosis of HCM was based on the presence of myocardial hypertrophy (maximum wall thickness  $\geq 15$  mm) in the absence of any other cardiac or systemic cause that could lead to cardiac hypertrophy.<sup>1</sup> Septal myectomy was performed in patients with severe symptoms despite optimal medical therapy and left ventricular outflow tract gradient  $\geq 50$  mm Hg at rest or with provocation.<sup>2</sup> We reviewed the medical records of these patients. Exclusion criteria for this study included the following: (1) with a previous history of paroxysmal or permanent AF, AF maze procedure or catheter ablation, and atrial flutter (n=113); (2) age  $\leq 18$  years (n=57); (3) without complete clinical data (n=4). Ultimately, 712 patients were identified in our work (Figure 1). Previous history of AF was excluded in 708 patients by a standardized clinical ambulatory ECG surveillance, and in the remaining 4 patients by medical history and ECG. The study was approved by the institutional review committee of Fuwai Hospital, Chinese Academy of Medical Sciences. All subjects gave informed consent.

### Echocardiography

Preoperative echocardiography was performed on all patients using a GE Vivid 7 or E-9 ultrasound machine (GE Healthcare, Horten, Norway). Echocardiographic examinations were performed by 2 experienced physicians. The measurements of LAD, left ventricular end-diastolic diameter, left ventricular ejection fraction, interventricular septum thickness, and maximum wall thickness were determined following the American Society of Echocardiography recommendations.<sup>8</sup> Left ventricular outflow tract gradients were measured in the apical views by continuous-wave Doppler echocardiography under resting conditions and during provocative maneuvers. Mitral regurgitation was classified as mild, moderate, or severe.

### Cardiac Magnetic Resonance and Polysomnography

Cardiac magnetic resonance was performed on 473 patients with a 1.5-T magnetic resonance scanner (Magnetom Avanto, Siemens Medical Solutions, Erlangen, Germany). Images of late gadolinium enhancement were obtained 10 minutes after a bolus injection of 0.2 mmol/kg gadolinium-diethylenetriamine pentaacetic acid (Gd-DTPA, Magnevist, Schering AG, Berlin, Germany). Overnight polysomnography was performed on 148 patients by using the portable monitoring system Embletta (Medcare Flaga). The diagnosis of obstructive sleep apnea was made in accordance with The Report of an American Academy of Sleep Medicine Task Force.<sup>9</sup>



**Figure 1. Flowchart of patient inclusion.**

AF indicates atrial fibrillation; BMI, body mass index; and OHCM, obstructive hypertrophic cardiomyopathy.

## Cardiac Surgery

An extended septal myectomy was performed as described in our previous study, which evolved from the classic Morrow procedure.<sup>10</sup> All the surgical procedures were performed by our professional team, according to institutional protocols. Concomitant surgery was performed if necessary.

## Definitions

BMI was calculated as weight (kg)/height (m)<sup>2</sup>. The height and weight of all patients were measured at hospital admission, following the standard protocol: (1) wear a hospital gown; (2) measure on an empty stomach; (3) use the prescribed weighing instrument; (4) ensure the sensitivity of the weighing instrument is <0.1 kg; (5) calibrate the instrument before measurement; and (6) record real-time measurement results and then compare them with previous records. According to the BMI classification criteria in China, patients were classified as normal weight (BMI <24 kg/m<sup>2</sup>), overweight (BMI, 24 to <28 kg/m<sup>2</sup>), and obese (BMI ≥28 kg/m<sup>2</sup>).

POAF was defined as the occurrence of any episode of AF after the procedure through the time of discharge that lasted at least 30s, detected by continuous electrocardiographic monitoring, and required drug treatment or cardioversion. Continuous electrocardiographic monitoring after surgery were routinely implemented until patient discharge.

## Statistical Analysis

Continuous variables were presented as mean±SD or median (interquartile range). Categorical variables

were presented as number (percentage). Continuous variables were tested for normal distribution with the Kolmogorov–Smirnov test. Comparison of continuous variables between 2 groups was performed using Student *t*-test (normally distributed) or Mann–Whitney *U* test (non-normally distributed). Comparison of continuous variables between 3 groups was performed using 1-way ANOVA or Kruskal–Wallis H test, as appropriate. Comparison of categorical variables was performed using chi-square or Fisher exact test. Correlation analysis was performed using *Pearson* correlation coefficient. Both univariate and multivariable logistic regression analyses were conducted to determine the predictors of POAF. All variables in the univariate logistic regression analyses were included in the multivariable logistic regression analyses. A *P* value <0.05 (2-sided) was considered statistically significant. Statistical analyses were performed with SPSS version 23.0 (IBM Corp, Armonk, NY) and GraphPad 8.0 (GraphPad Software, La Jolla, CA).

## RESULTS

### Prevalence of Overweight and Obesity in OHCM

A total of 712 consecutive patients with OHCM were included in our study (429 men, 60.3%; mean age, 47.3±12.1 years; average BMI, 25.5±3.4 kg/m<sup>2</sup>). Of these, 224 (31.5%) had normal weight (average, 21.6±1.9 kg/m<sup>2</sup>), nearly half of patients (n=339, 47.6%) were overweight (average, 26.0±1.1 kg/m<sup>2</sup>), and only

20.9% (n=149) were obese (average, 30.2±1.8 kg/m<sup>2</sup>). Patients in the normal weight group were younger and were more often women (Table 1, Figure 2). Patients in overweight and obese group were more likely to have hypertension, diabetes, hyperlipidemia, and obstructive sleep apnea (Table 1). Meanwhile, overweight and obese patients had larger LAD (42.8±6.2 versus 45.1±6.5 mm versus 46.0±6.1 mm, respectively, overall  $P<0.001$ ; normal weight patients  $P<0.001$  versus each other group) (Table 1, Figure 2), larger left ventricular end-diastolic diameter (40.6±4.9 versus 43.6±5.2 versus 44.3±4.3 mm, respectively, overall  $P<0.001$ ; normal weight patients  $P<0.001$  versus each other group), and lower N-terminal pro-brain natriuretic peptide levels (Table 1), compared with normal weight patients. However, there was no difference in the distribution of New York Heart Association class III/IV or late gadolinium enhancement among 3 groups (Table 1).

Surgical data of all patients were obtained. The mean postoperative hospital stay was 8.3±4.1 days. The mean

postoperative left ventricular outflow tract gradient was 8.6±6.4 mm Hg. Detailed results of concomitant surgical procedures, cardiopulmonary bypass time, and cross-clamp time are shown in Table 2.

### Occurrence of POAF in OHCM

POAF developed in 184 of 712 patients (25.8%) who underwent surgical septal myectomy. Among these patients, 32 cases (14.3%) occurred in the normal weight group, 100 cases (29.5%) occurred in the overweight group, and 52 cases (34.9%) occurred in the obese group. POAF were more prevalent in overweight and obese group compared with normal weight group (overall  $P<0.001$ , normal weight patients  $P<0.001$  versus each other group) (Table 2, Figure 2).

### Predictors of POAF

Univariate and multivariable logistic regression analyses were performed to investigate the predictors of

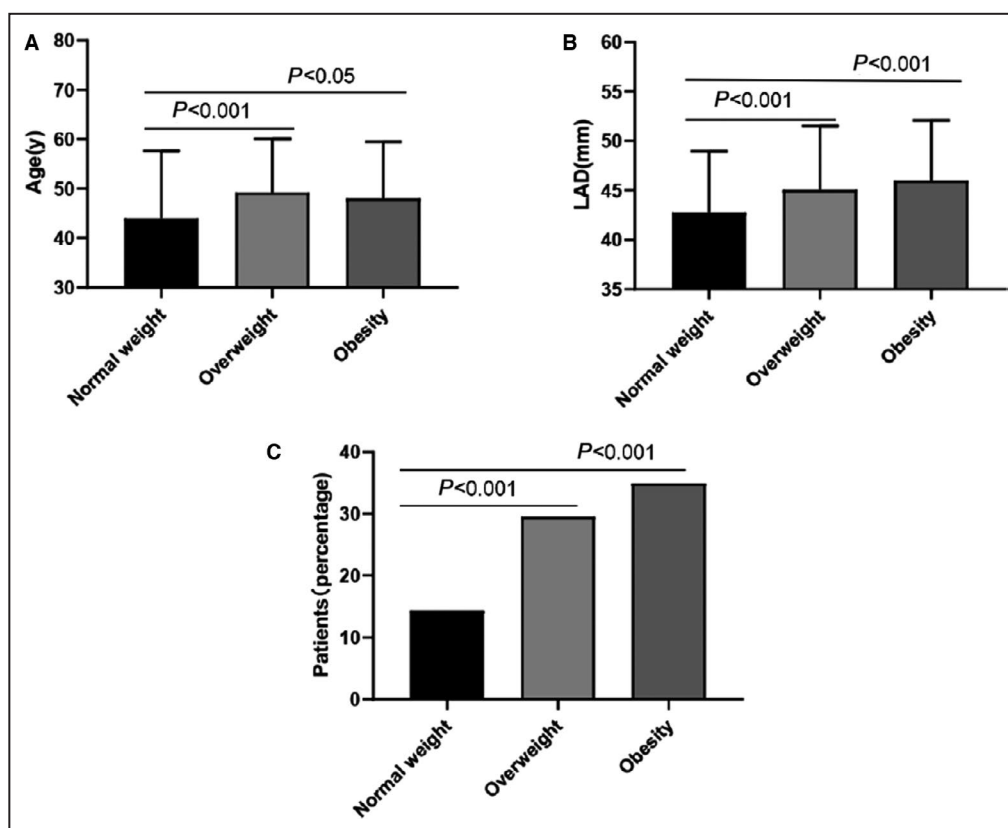
**Table 1. Baseline Characteristics**

Variables	Overall (n=712)	Normal weight (n=224)	Overweight (n=339)	Obese (n=149)	P value
Demographics					
Men*	429 (60.3)	115 (51.3)	222 (65.5)*	92 (61.7)	0.003
Age, y	47.3±12.1	44.0±13.6 <sup>†</sup>	49.2±10.9	48.0±11.5	<0.001
BMI, kg/m <sup>2</sup>	25.5±3.4	21.6±1.9	26.0±1.1*	30.2±1.8 <sup>†</sup>	<0.001
Family history of HCM	91 (12.8)	35 (15.6)	33 (9.7)	23 (15.4)	0.068
Hypertension	197 (27.7)	36 (16.1)	101 (29.8)*	60 (40.3) <sup>†</sup>	<0.001
Diabetes	25 (3.5)	1 (0.4) <sup>†</sup>	18 (5.3)	6 (4.0)	0.003
Hyperlipidemia	229 (32.2)	51 (22.8) <sup>†</sup>	116 (34.2)	62 (41.6)	<0.001
OSA	58 (148) (39.2)	5 (39) (12.8)	27 (71)* (38.0)	26 (38) <sup>†</sup> (68.4)	<0.001
NYHA class III/IV	396 (55.6)	133 (59.4)	190 (56.0)	73 (49.0)	0.138
NT-proBNP, pg/mL	1188.0 (611.0–1993.3)	1397.0 (854.4–2823.5)	1188.0* (585.1–1917.0)	759.5 <sup>†</sup> (308.6–1479.0)	<0.001
Echocardiography/CMR					
LAD, mm	44.5±6.4	42.8±6.2 <sup>†</sup>	45.1±6.5	46.0±6.1	<0.001
LVEDD, mm	42.8±5.2	40.6±4.9 <sup>†</sup>	43.6±5.2	44.3±4.3	<0.001
LVEF, %	70.3±5.8	70.5±6.0	70.2±6.1	70.3±5.2	0.708
IVST, mm	19.0±4.3	19.6±4.4	18.9±4.1	18.8±4.5	0.107
MWT, mm	21.5±4.4	21.9±4.6	21.4±4.2	21.3±4.5	0.371
LVOTG, mm Hg	76.4±32.4	77.1±32.6	78.2±33.0	71.5±30.7	0.212
CMR—LGE positive	411 (473) (86.9)	127 (142) (89.4)	192 (224) (85.7)	92 (107) (86.0)	0.561
Medications					
β-Blocker	695 (97.6)	218 (97.3)	333 (98.2)	144 (96.6)	0.499
CCB	189 (26.5)	43 (19.2) <sup>†</sup>	97 (28.6)	49 (32.9)	0.007

Values expressed as mean±SD or median (interquartile range) or number of patients and percentage. BMI indicates body mass index; CCB, calcium channel blocker; CMR, cardiac magnetic resonance; HCM, hypertrophic cardiomyopathy; IVST, interventricular septal thickness; LAD, left atrial diameter; LGE, late gadolinium enhancement; LVEDD, left ventricular end-diastolic diameter; LVEF, left ventricular ejection fraction; LVOTG, left ventricular outflow tract gradient; MWT, maximum wall thickness; NT-proBNP, N-terminal pro-brain natriuretic peptide; NYHA, New York Heart Association; and OSA, obstructive sleep apnea.

\* $P<0.05$  versus normal.

<sup>†</sup> $P<0.05$  versus each of the other 2 groups.



**Figure 2.** Comparison of variables between normal weight, overweight and obese group patients. **A**, Age (Mann–Whitney *U* test); **B**) left atrial diameter (Mann–Whitney *U* test); **C**) postoperative atrial fibrillation (Chi-square test). LAD indicates left atrial diameter; and POAF, postoperative atrial fibrillation.

POAF. Overweight (odds ratio [OR]: 2.161, 95% CI, 1.333–3.503;  $P=0.002$ ) and obesity (OR, 2.803; 95% CI, 1.589–4.944;  $P<0.001$ ) were independently associated with the occurrence of POAF in patients with OHCM. In addition, age (OR, 1.037; 95% CI,

1.018–1.057;  $P<0.001$ ), and LAD (OR, 1.060; 95% CI, 1.027–1.095;  $P<0.001$ ) were also independent predictors of POAF (Table 3). The association of BMI with LAD is presented in Figure 3 and a clear positive correlation is observed ( $r=0.215$ ,  $P<0.001$ ).

**Table 2.** Operative Characteristics and Postoperative Atrial Fibrillation, Overall and by BMI Categories

Variables	Overall (n=712)	Normal weight (n=224)	Overweight (n=339)	Obese (n=149)	P value
Cardiopulmonary bypass time, min	105.5±41.7	108.9±45.7	103.9±40.9	103.8±37.1	0.299
Cross-clamp time, min	72.1±36.1	74.6±34.0	71.8±41.7	69.1±22.9	0.380
Concomitant surgery					
Myocardial unroofing	64 (9.0)	27 (12.1)	28 (8.3)	9 (6.0)	0.112
CABG for MB	16 (2.2)	6 (2.6)	8 (2.3)	2 (1.3)	0.716
CABG for CAD	37 (5.2)	3 (1.3) <sup>†</sup>	24 (7.1)	10 (6.7)	0.003
AVR	13 (1.8)	1 (0.4)	11 (3.2)*	1 (0.7)	0.032
MV procedure	156 (21.9)	61 (27.2)	63 (18.6)	32 (21.5)	0.052
Postoperative hospital stay, d	8.3±4.1	8.0±3.0	8.4±4.3	8.2±5.1	0.460
Postoperative LVOTG, mm Hg	8.6±6.4	6.8±5.8 <sup>†</sup>	9.0±6.6	10.2±6.3	<0.001
Postoperative AF	184 (25.8)	32 (14.3) <sup>†</sup>	100 (29.5)	52 (34.9)	<0.001

Values expressed as mean±SD or number of patients and percentage. AF indicates atrial fibrillation; AVR, aortic valve replacement; BMI, body mass index; CABG, coronary artery bypass grafting; CAD, coronary artery disease; LVOTG, left ventricular outflow tract gradient; MB, myocardial bridge; and MV, mitral valve.

\* $P<0.05$  versus normal.

<sup>†</sup> $P<0.05$  versus each of the other 2 groups.

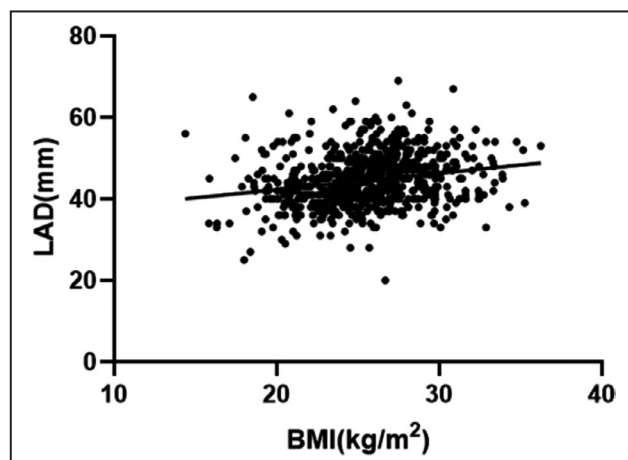
**Table 3. Logistic Regression Analysis for Predictors of Postoperative Atrial Fibrillation**

Characteristics	Univariate Logistic Analysis			Multivariable Logistic Analysis		
	OR	95% CI	P value	OR	95% CI	P value
Age, y	1.044	1.028–1.060	<0.001	1.037	1.018–1.057	<0.001
Women	1.195	0.850–1.680	0.305	1.185	0.778–1.805	0.430
Overweight vs normal weight	2.510	1.615–3.902	<0.001	2.161	1.333–3.503	0.002
Obesity vs normal weight	3.216	1.944–5.322	<0.001	2.803	1.589–4.944	<0.001
Family history of HCM	0.966	0.583–1.602	0.895	1.121	0.644–1.951	0.686
Hypertension	1.479	1.029–2.127	0.034	0.963	0.622–1.491	0.865
Diabetes	2.334	1.040–5.238	0.040	1.631	0.679–3.918	0.274
Hyperlipidemia	1.135	0.796–1.620	0.484	1.228	0.837–1.803	0.294
NYHA class III/IV	1.082	0.772–1.519	0.646	1.080	0.747–1.560	0.684
Ln (NT-proBNP)	1.110	0.949–1.299	0.192	1.142	0.930–1.401	0.204
LAD	1.074	1.045–1.103	<0.001	1.060	1.027–1.095	<0.001
LVEDD	1.052	1.018–1.088	0.003	1.001	0.964–1.040	0.948
LVEF	0.985	0.957–1.014	0.302	0.996	0.965–1.028	0.794
IVST	1.001	0.963–1.041	0.965	1.034	0.965–1.107	0.345
MWT	0.997	0.959–1.036	0.869	0.973	0.904–1.046	0.455
LVOTG	1.000	0.995–1.005	0.979	0.996	0.990–1.002	0.243
Moderate or severe MR	1.114	0.796–1.559	0.527	0.937	0.621–1.412	0.754
Preoperative $\beta$ -blocker use	0.631	0.230–1.732	0.372	0.653	0.209–2.037	0.463
Preoperative CCB use	1.445	1.001–2.087	0.050	1.246	0.823–1.886	0.298

CCB indicates calcium channel blocker; HCM, hypertrophic cardiomyopathy; IVST, interventricular septal thickness; LAD, left atrial diameter; LVEDD, left ventricular end-diastolic diameter; LVEF, left ventricular ejection fraction; LVOTG, left ventricular outflow tract gradient; MR, mitral regurgitation; MWT, maximum wall thickness; NT-proBNP, N-terminal pro-brain natriuretic peptide; NYHA, New York Heart Association; and OR odds ratio.

## DISCUSSION

There are many studies on POAF in cardiac diseases, and the results have showed that the presence of POAF is closely related to the poor prognosis. But it has not been well studied in patients with OHCM. The



**Figure 3. Graph illustrates correlation between body mass index and left atrial diameter.**

(Pearson correlation coefficient:  $r=0.215$ ,  $P<0.001$ ,  $y=0.403x+34.3$ ). BMI indicates body mass index; and LAD, left atrial diameter.

few previous studies have determined that the impact of POAF on the prognosis of the disease is different between patients with OHCM and other cardiac surgical populations, which suggests that POAF in OHCM is unique.<sup>11–13</sup> As a common complication after cardiac surgery, previous studies have shown that the occurrence of POAF in Chinese population is significantly lower than that in other ethnic groups.<sup>14,15</sup> This suggests that the clinical phenotype of cardiovascular disease in Chinese population may be different from that in other populations. The present study is the first study to explore the possibility of the association between BMI and POAF after septal myectomy in Chinese patients with OHCM. The enrolled patients in our study had a lower BMI and more severe New York Heart Association class than other HCM cohorts.<sup>4</sup> The main findings of our study are the following; First, overweight was prevalent in OHCM patients, and obesity accounted for a smaller proportion; second, POAF was a common complication in patients with OHCM; third, overweight and obesity were strong predictors of POAF in patients with OHCM; finally, a clear positive correlation was observed between BMI and LAD. LAD could also predict new-onset AF after surgical septal myectomy. In this study, we defined the occurrence of POAF after septal myectomy in a large Chinese cohort of patients; to our knowledge, found for the first

time that there was a clear and strong positive correlation between weight groups and POAF in patients with OHCM; showed the characteristics of patients with OHCM in the Chinese population; and speculated the possible mechanisms of POAF in OHCM.

### Prevalence of Overweight and Obesity in OHCM

In this single-center study, the prevalence of overweight and obese patients reached 68.5%. Among them, the proportion of obese patients was less than one third, which is lower than previously reported in other ethnic HCM cohorts.<sup>4</sup> We think that this phenomenon is attributable to differences in the genetic gene, dietary structure, and living environment of the Chinese population. Patients with HCM with a higher BMI were more likely to have larger LAD, larger left ventricular end-diastolic diameter, and more clinical comorbidities. These findings were similar with other research reports. But there was no statistical difference in the severity of symptoms (New York Heart Association class III or IV) between obese group and other 2 groups.

### Occurrence of POAF and the Impact of POAF

POAF is an important and common complication in cardiovascular diseases. The occurrence of POAF was reported to be 20% to 30%.<sup>5</sup> In this study, the occurrence of patients with POAF reached 25.8%, which was consistent with the previous studies.

Several studies have shown that POAF contributes to increased length of stay, resource usage, and cardiovascular mortality in patients who underwent coronary artery bypass graft surgery.<sup>16–18</sup> Benedetto and colleagues have determined that POAF is associated with an increased risk of cerebrovascular accident, cardiovascular mortality, and all-cause mortality in patients undergoing coronary artery bypass surgery.<sup>6</sup> The results are also confirmed in the international, multicenter, randomized EXCEL trial.<sup>19</sup> However, the prognostic value of POAF in patients with OHCM remains unclear. To date, the only studies have drawn inconsistent conclusions.<sup>11–13</sup> Although further studies are needed on the impact of POAF on long-term clinical course in OHCM, we speculate that the impact of POAF on the prognosis of patients with OHCM is less severe than that of patients with other cardiovascular conditions.

We think that the possible reasons for the major difference are as follows: First, it is plausible that patients who have developed other cardiovascular conditions (such as patients undergoing coronary artery bypass surgery) are more likely to be sicker, older, or have poor baseline conditions and more comorbidities than those who have developed HCM. Meanwhile, the prognosis of patients with HCM is also different from

that of patients with other cardiovascular diseases. It has been previously suggested that surgical myectomy alters the natural course of patients with HCM with severe symptomatic left ventricular outflow tract obstruction, and most patients have a lifespan similar with an age-matched population.<sup>20</sup> The updated 5-year outcomes from the Nordic-Baltic-British Left Main Revascularisation (NOBLE) trial have described a 9% rate of all-cause mortality in patients who underwent coronary artery bypass surgery.<sup>21</sup> Second, the presence of POAF is attributable to an interaction of acute surgery-related stressors and pre-existing atrial remodeling. Different surgical interventions and surgical types lead to different postoperative inflammatory responses. Left ventricular hypertrophy, left ventricular outflow tract obstruction, diastolic dysfunction, mitral regurgitation, and myocardial fibrosis are typical characteristics of patients with OHCM, which may be the unique mechanisms of POAF in patients with OHCM. Besides, HCM is the most common monogenic cardiovascular disorder. Whether gene mutation is associated with POAF remains unknown. Last but not least, the primary cause of death in patients who underwent coronary artery bypass surgery is cardiac death,<sup>21</sup> while the main cause of death in patients with OHCM who under septal myectomy is non-cardiac death.<sup>20</sup> Notably, it supports that a greater role of POAF on the prognosis of patients who underwent coronary artery bypass surgery than that of patients with OHCM. Further multicenter, larger cohort studies are needed on the impact of POAF on long-term clinical course in patients with OHCM.

### Underlying Mechanisms of the Association Between Higher BMI and POAF

To date, no studies have investigated the relationship between BMI and POAF in patients with OHCM who underwent septal myectomy. The primary finding in this study is that we demonstrated, for the first time, overweight and obesity are strong predictors of POAF in patients with OHCM. According to our results and previous studies, we speculate that the preoperative atrial structural or electrical remodeling and postoperative inflammation are the main causes of POAF in OHCM.

A previous study has demonstrated that increased BMI was independently associated with larger LAD.<sup>7</sup> The longitudinal population study has shown that BMI may be a key risk factor for progressive left atrial enlargement over time.<sup>22</sup> We found that patients with OHCM with overweight or obesity had larger LAD and left ventricular end-diastolic diameter. There was a clear positive correlation between BMI and LAD (Figure 3). Moreover, it has been proven that LAD is an independent risk factor of POAF. Therefore, we

supposed that the association between increased BMI and POAF is likely mediated by left atrial enlargement. Obesity in patients with OHCM is associated with increased prevalence of left ventricular outflow tract obstruction, a higher left ventricular mass index and increased left ventricular cavity, and worse diastolic dysfunction.<sup>4,23–25</sup> These factors may lead to an elevated left ventricular filling pressure, which results in left atrial dilation, remodeling, and following POAF.

Systemic inflammation, measured as C-reactive protein level, is positively associated with BMI.<sup>26</sup> Patients who undergo coronary artery bypass grafting have a greater risk of AF, which is associated with increased inflammatory factor levels, including C-reactive protein and interleukin-6.<sup>27</sup> Those studies indicate that inflammation is one of the main underlying mechanisms of POAF. In the septal myectomy process, surgical injury, myocardial ischemia, and a hyperadrenergic state could trigger the inflammatory cascade. Therefore, it is supposed that inflammatory response may also lead to the presence of POAF in obese patients with OHCM, which may be related to oxidative stress, apoptosis, and fibrosis.<sup>28</sup>

Taken together, atrial remodeling and postoperative inflammation probably confer a predisposition to POAF in patients with higher BMI with OHCM. Lifestyle change and weight loss are considerable methods to prevent POAF.

## Limitations

There are several limitations in this study. The retrospective study was conducted in a single tertiary center. Therefore, this work might have selection bias. Our patients were grouped based on the Chinese population BMI characteristics. The results may not be entirely generalizable. Because the number was too small, we did not separately group for patients with BMI <18.5kg/m<sup>2</sup>. Finally, to investigate the potential mechanisms linking BMI and POAF, it is essential to detect plasma inflammatory cytokines level in our future studies.

## CONCLUSIONS

The present study demonstrates that overweight and obesity are strong predictors of POAF in patients with OHCM. Our findings suggest that we should pay more attention to overweight and obese patients, and strategies aimed at lowering BMI may be a potential way to prevent POAF. Furthermore, the impact of POAF on the prognosis of OHCM is still unknown. Further studies are needed to determine the impact of POAF on long-term clinical course and prognosis of OHCM.

## ARTICLE INFORMATION

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None.

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