Myocardial Bridging as a Common Phenotype of Hypertrophic Cardiomyopathy Has No Effect on Prognosis

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Abstract: *Background:* The prognostic significance of myocardial bridging in hypertrophic cardiomyopathy (HCM) remains controversial. This investigation sought to evaluate the impact of myocardial bridging on prognosis of patients with HCM. *Methods:* A total of 298 adult patients (73% male, mean age, 53 ± 12 years) with HCM were retrospectively enrolled at Fuwai Hospital from 1999 to 2011. Myocardial bridging was evaluated by coronary angiography. Follow-up data were collected by telephone interviews and mailed questionnaires. *Results:* Thirty-four (11%, 34/298) patients were determined with myocardial bridging and the middle of left anterior descending artery was the most frequently involved segment (77%, 26/34). Patients with myocardial bridging were younger than those without bridging (48 ± 9 versus 54 ± 12 years, $P = 0.001$). During the follow-up of 4.2 ± 2.3 years (range, 0.7–12.2 years), the presence of myocardial bridging was not evidently associated with increased risk for all-cause death ($P = 0.54$), cardiovascular death ($P = 0.60$), sudden cardiac death ($P = 0.53$) and deterioration of heart failure ($P = 0.84$). *Conclusions:* Myocardial bridging was a relatively common morphological component of HCM but not a predictor for adverse clinical outcomes.

Key Indexing Terms: Myocardial bridging; Hypertrophic cardiomyopathy; Prognosis; Coronary angiography. **[Am J Med Sci 2014;347 (6):429–433.]**

Myocardial bridging, an inborn coronary abnormality, is defined as a segment of a major epicardial coronary artery that goes intramurally through the myocardium beneath the muscle bridge. The estimated frequency that has been reported varies from 1% to 4% when assessed by coronary angiography.[1–4] Isolated myocardial bridging has been considered a benign condition in general population.[1,5,6] Two studies (including 118 and 59 adult patients with isolated bridging, respectively) showed neither cardiac death nor acute coronary syndrome occurred during the follow-up of 3 to 4 years.[1,6] However, some reports suggested that it was related to multiple adverse cardiovascular events, including left ventricular (LV) dysfunction, malignant arrhythmia, myocardial infarction and sudden cardiac death (SCD).[7–12]

Hypertrophic cardiomyopathy (HCM) is an inherited cardiovascular disease with a heterogeneous presentation, ranging from an asymptomatic lifelong course to heart failure, stroke and SCD.[13] Classifying the patients under high risks has great clinical significance for improving prognosis of HCM. Currently, several risk factors related to poor prognosis in HCM have been established, including personal history for malignant ventricular arrhythmia, family history for SCD, unexplained syncope, nonsustained ventricular tachycardia, maximal LV wall thickness ≥30 mm, abnormal exercise blood pressure response, atrial fibrillation and LV outflow tract obstruction.[14–16] Even so, these risk factors can only account for a part of adverse cardiovascular events, and risk stratification of HCM remains a great challenge to physicians in clinical practice. To date, studies about myocardial bridging in HCM have been sparse, and the impact of myocardial bridging on the outcomes of HCM remains controversial.[17–19] Therefore, this follow-up study was performed to evaluate the relationship between myocardial bridging and adverse prognosis in an adult cohort with HCM.

METHODS

Patient Population

From 1999 to 2011, 298 unrelated patients (range, 22–82 years) were consecutively diagnosed with HCM at Fuwai Hospital in Beijing. All patients underwent systematic evaluation, including detailed medical history, 12-lead electrocardiogram, echocardiogram and coronary angiography. The diagnosis of HCM was based on an unexplained maximal LV wall thickness of ≥15 mm (or ≥13 mm with a family history of HCM) on echocardiography (or echocardiography and cardiac magnetic resonance imaging), in the absence of other cardiac or systemic diseases that could have been responsible for the hypertrophy (eg, aortic stenosis, uncontrolled hypertension and congenital heart disease).[13,16] Myocardial bridging was defined as maximal systole compression of an epicardial coronary artery of ≥50%. Coexistence of coronary artery disease was defined as luminal stenosis of ≥50% in 1 or more main coronary artery. Unexplained syncope was defined as syncope, which occurred in circumstances not clearly consistent with a neurally mediated event, that is, without apparent explanation at rest or during ordinary daily activities, or during an intense effort.[20]

All included patients were willing to participate in this research project and signed the informed consent documents. This study was complied with the Declaration of Helsinki and approved by the Ethics Committee of Fuwai Hospital.

The End Points

The primary end points included all-cause death and cardiovascular death that involved SCD, heart failure and stroke-related death. SCD was defined as instantaneous

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and unexpected death within 1 hour after a witnessed collapse in patients who were previously in stable clinical condition. Potentially lethal cardiovascular events in which patients were either successfully resuscitated from cardiac arrest or received appropriate defibrillation shocks from an implanted cardioverter-defibrillator were regarded as equivalent to SCD.[21] Heart failure-related death was defined as death occurring in the context of long-standing cardiac decompensation with progression of the disease over the preceding year. Patients with advanced refractory heart failure who received heart transplantations were considered equivalent to heart failure-related deaths.[21] Stroke related-death was defined as death occurring in patients who died of ischemic or hemorrhagic stroke.

The second end point was deterioration of heart failure, which included the development of advanced chronic heart failure (New York Heart Association functional class progression to III/IV) and acute decompensated congestive heart failure. Heart failure was diagnosed on the basis of shortness of breath at rest or during exertion and/or fatigue, signs of fluid retention such as ankle swelling, and objective evidence of an abnormality of the structure or function of the heart at rest.[22] Chronic heart failure was defined as persistent (stable or worsening) heart failure. Acute congestive decompensated heart failure was defined as a rapid onset or change in the signs and symptoms of heart failure, resulting in the need for urgent medical intervention in emergency room.[22] For each end point, the duration of follow-up was calculated from the initial evaluation in our institution. Follow-up data were acquired by telephone and/or mail interview.

Statistical Analysis

Statistical analysis was performed with SPSS (version 18.0) software (SPSS Inc, Chicago, IL). All data were expressed as mean ± standard deviation or frequency. Differences in continuous variables were assessed by using Student *t* test, and Wilcoxon rank-sum test was used when the distributions were unsymmetrical. The χ^2-test was used for comparisons between noncontinuous variables, and if the patient number in any group were less than 5, Fisher's exact test was used. For survival analyses, patients with concomitant coronary artery disease (n = 88) were excluded. Among the remaining patients (n = 210), the Kaplan-Meier method was used to calculate survival free from the end-point events. A log-rank test was used to compare survival curves among different patient groups. Cox proportional hazard regression model was performed to identify variables associated with the end points in these analyses. All statistical tests were 2-sided and P values <0.05 were considered to be statistically significant.

RESULTS

Clinical Characteristics at Registration

Myocardial bridgings were identified in 34 (11%) patients in the cohort (Table 1). Multiple bridging sites and 1 bridging site were observed in 5 (15%) and 29 (85%) patients, respectively. The middle of left anterior descending artery (LAD) was the most frequently involved segment (77%, 26/34). Average degree of arterial compression was 71 ± 17% (Table 1).

Patients with bridging were younger (48 ± 9 versus 54 ± 12 years, $P = 0.001$) and had lower systolic blood pressure than those without bridging (117 ± 19 mm Hg versus 124 ± 18 mm Hg, $P = 0.04$). Hyperlipidemia and coronary artery disease were less observed in the patients with bridging (18% versus 35%, $P = 0.04$% and 6% versus 33%, $P = 0.001$, respectively). There were no significant differences in echocardiographic and electrocardiographic findings between the 2 groups (Table 2).

TABLE 1. Angiographic characteristics of myocardial bridging

No. of vessels detected with MB in per patient, n (%)	
1	29 (85)
2	3 (9)
3	2 (6)
Site of MB, n (%)	
Proximal LAD	2 (6)
Middle LAD	26 (77)
Middle and distal LAD	1 (3)
Distal LAD	1 (3)
1st septal branch	1 (3)
2nd septal branch	2 (6)
1st diagonal branch	2 (6)
2nd diagonal branch	1 (3)
1st obtuse marginal branch	1 (3)
2nd obtuse marginal branch	1 (3)
Posterior descending artery	3 (9)
Degree of luminal compression, %	71 ± 17

MB, myocardial bridging; LAD, left anterior descending coronary artery.

Clinical Outcomes

During the follow-up of 4.2 ± 2.3 years (range, 0.7–12.2 years), 10 patients died. Nine deaths (5%, 9/188) occurred in the patients without myocardial bridging, including 2 SCDs, 4 heart failure-related deaths, 2 stroke-related deaths and 1 due to rectal cancer progression. One death (3%, 1/32) occurred in patients with bridging and the cause was SCD. Neither myocardial infarction nor revascularization occurred in the entire cohort. No patients underwent surgical intervention or stent implantation for bridging during follow-up. Kaplan-Meier analysis revealed that there was no significant difference in all-cause death, cardiovascular death and SCD between patients with and without myocardial bridging (Figure 1; $P = 0.54$, $P = 0.60$ and $P = 0.53$, respectively). Univariate analysis identified neither myocardial bridging, LAD bridging nor compression of LAD ≥70% as a predictor for all-cause death, cardiovascular death and SCD (Table 3).

Deterioration of heart failure was analyzed in 186 patients, after exclusion of the patients with history of acute heart failure and New York Heart Association III/IV at baseline. Deterioration of heart failure was observed in 4 (14%, 4/28) patients with myocardial bridging and 21 (13%, 21/158) without bridging during follow-up. Kaplan-Meier analysis did not identify significant difference in worsening heart failure between the 2 groups (Figure 1; $P = 0.84$). Univariate analysis revealed that myocardial bridging, LAD bridging and compression of LAD ≥70% were unassociated with deterioration of heart failure (Table 3).

DISCUSSION

In this study, myocardial bridging occurred in up to 11% of patients who underwent coronary angiography, and the most commonly affected coronary artery was LAD. The frequency was similar to the result of previous angiographic investigation about adult HCM.[19] Follow-up study revealed that the presence