Clinical Profile and Prognosis of Left Ventricular Apical Aneurysm in Hypertrophic Cardiomyopathy

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ABSTRACT

Background: Hypertrophic cardiomyopathy with left ventricular apical aneurysm is a unique entity with diverse manifestations and varied prognoses among races. This study evaluated the prevalence, clinical characteristics and outcomes of apical aneurysm in Chinese patients with hypertrophic cardiomyopathy.

Methods: Consecutive patients with apical aneurysm were recruited from 1,844 patients with HCM treated at our hospital from 2002-2013. Basic clinical data and follow-up data were collected and analyzed.

Results: Apical aneurysm was identified in 24 patients (1.3%) (mean age: 52 ± 14 years). We identified an hourglass-shaped (71%) or distally hypertrophic (29%) left ventricle and found mural thrombi and nonsustained and sustained ventricular tachycardia in 11 (46%), 4 (17%) and 9 (38%) patients, respectively. During follow-up (5.0 ± 3.4 years [range: 1–14 years]), following were the clinical adverse events experienced by 14 patients (58%) (annual rate: 11.7%): sudden cardiac death ($n = 4$), appropriate discharge of an implantable cardioverter-defibrillator ($n = 4$), progressive heart failure ($n = 4$) or heart failure–related death ($n = 1$) and stroke ($n = 4$). The 4 patients who underwent aneurysmectomy had no adverse events. Patients with SCD had a lower ejection fraction ($P = 0.004$) and a larger left ventricular end-diastolic diameter ($P < 0.001$) than nonoperated survivors.

Conclusions: Apical aneurysm is not rare in patients with HCM and it confers an extremely poor prognosis. Early aggressive therapies should be considered for this entity and prophylactic aneurysmectomy may be an option.

Key Indexing Terms: Hypertrophic cardiomyopathy; Apical aneurysm; Ventricular tachycardia; Thrombus; Aneurysmectomy.
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INTRODUCTION

Hypertrophic cardiomyopathy (HCM) is characterized by a broad spectrum of morphologic features, clinical manifestations, natural histories and prognoses.[1,2] A unique subgroup of patients with HCM develops left ventricular (LV) apical aneurysm unrelated to coronary artery disease. This entity has gained attention because of its high risk of complications, including LV thrombosis and embolization, malignant dysrhythmias, heart failure and sudden cardiac death (SCD). The prevalence of LV apical aneurysm has been reported to be from 2%–8.5% in the HCM population,[3-5] with diverse phenotypes and varying prognoses in different races. For example, LV apical aneurysm has a worse prognosis with fewer apical hypertrophy in a Caucasian cohort than in a Japanese cohort.[3,5] However, the clinical characteristics and prognosis of this disease in Chinese patients are not fully understood. Medical treatment to control disease progression has thus far been unsuccessful, and surgery as a therapy for apical aneurysm in patients with HCM has been described only in case reports.[6-8] Also, methods of early recognition of patients at high risk of SCD from this entity have not yet been identified. Accordingly, in this study, we evaluated the incidence, clinical course and prognosis of Chinese patients with HCM and apical aneurysm. In addition, we examined the therapeutic effect of prophylactic aneurysmectomy and the possible indicators of poor prognosis.

MATERIALS AND METHODS

Patients

Of 1,844 patients with HCM treated at Fuwai Hospital from April 2002 to November 2013, those with LV apical aneurysm were consecutively enrolled and analyzed. In the present study, we used the following definitions: *HCM*: documented hypertrophied and nondilated left ventricle in the absence of other cardiac or systemic disease capable of producing hypertrophy of a similar magnitude[9,10]; LV outflow tract obstruction: peak instantaneous outflow gradient ≥30 mm Hg by continuous Doppler echocardiography under resting conditions[11]; midventricular obstruction: simultaneous estimated midventricular gradient ≥30 mm Hg and midventricular hourglass-shaped obliteration caused by systolic midventricular muscular apposition of the hypertrophic septum against the LV free wall[12]; and LV apical

aneurysm, a discrete thin-walled dyskinetic or akinetic segment of the most distal portion of the chamber with a relatively wide communication with the LV cavity.[3,4]

Selective coronary angiography and LV angiography were performed at initial evaluation of each patient with HCM and LV apical aneurysm. Patients who demonstrated significant coronary artery narrowing (≥50% stenosis) in the left anterior descending artery on coronary angiography were excluded.

All included patients' medical records were retrospectively reviewed. Clinical data, including medical history and findings from electrocardiography, echocardiography and histopathology, were collected. This study was performed according to the principles of the Declaration of Helsinki. All patients provided written informed consent to participate in the study, which was approved by the ethics committee of Fuwai Hospital.

Follow-Up Evaluation

Follow-up data were obtained during serial clinic visits or by telephone interviews until the final evaluation or death. A major adverse event was the occurrence of systemic embolism, progressive heart failure, death or heart transplantation. Death included SCD, heart failure–related death, stroke-related death and unclassified death. SCD[13] was defined as an unexpected sudden collapse occurring within 1 hour of the onset of symptoms in patients with a previously stable or uneventful clinical course. Heart failure–related death[13] was defined as that occurring in the context of progressive cardiac decompensation ≥1 year before death and preceded by signs and symptoms of heart failure or cardiogenic shock. Stroke-related death[13] was defined as the result of probable or proven embolic stroke. Aborted cardiac arrest or appropriate discharge of an implantable cardioverter-defibrillator for ventricular fibrillation was regarded as surrogate SCD.

Statistical Analysis

Continuous data are expressed as mean ± standard deviation and categorical data as frequency. Variables were compared between groups using the unpaired Student's *t* test, Chi-square test or Fisher's exact test, as appropriate. Statistical analysis was performed using SPSS for Windows, Version 18.0 (SPSS Inc, Chicago, IL). A 2-sided $P < 0.05$ was considered statistically significant.

RESULTS

Baseline Characteristics

Prevalence and Demography

LV apical aneurysms were identified in 24 of the 1,844 study patients (1.3%). The demographic and clinical characteristics at baseline are shown in Table 1 and summarized in Table 2. Mean age at first evaluation was 52 ± 14 years (range: 19–75 years); 11 patients (46%) were aged <50 years and 5 patients (21%) were aged ≤40 years. In all, 19 presented with symptoms, including 4 with severe New York Heart Association class III or IV at initial evaluation. HCM in the remaining 5 patients (21%) was detected during routine physical examination. LV ejection fraction was 52% ± 13% for all patients and <50% in 9 patients (38%).

Echocardiography

All aneurysms were identified on echocardiography and confirmed on left ventriculography. Selective coronary angiography suggested no atherosclerotic coronary artery narrowing ≥50% in these patients, except for a myocardial bridge in left anterior descending branch in 3 patients and a left main coronary artery origin anomaly in 1 patient. Aneurysms were divided into the following 3 echocardiographic types: large (>4 cm; $n = 7$ [29%]), medium (2-4 cm; $n = 9$ [38%]) and small (<2 cm; $n=8$ [33%]). Following were the 2 distinct LV morphological forms identified: an hourglass shape with maximal wall thickness at the mid ventricle ($n = 17$ [71%]) rather than at the distal or proximal portions, and prominent hypertrophy in the distal portions of the LV wall ($n = 7$ [29%]). Twelve patients with hourglass morphology had intraventricular pressure gradients (61 ± 46 mm Hg; range: 16-180 mm Hg), including 9 (38%) from midventricular obstruction (Figure 1) and 2 (8%) by LV outflow-tract obstruction (Figure 2). A 6 of 7 large (≥40 mm) aneurysms in 7 patients had an hourglass shape. A 7 of 11 mural thrombi were present in the distal portions of the hourglass, including 1 identified by histopathology.

Electrocardiography

At the initial diagnosis of apical aneurysm, electrocardiography showed ST-segment elevation (≥1 mm in 2 or more contiguous leads) in leads V1-V4 in 17 patients (71%). The shapes of the QRS complexes and T waves varied. An rS (including rSr′ pattern) without T-wave inversion was observed in 7 patients (Figure 3A), normal R-wave amplitude with T-wave inversion in 4 patients (Figure 3B), a high R-wave amplitude with T-wave inversion in 2 patients (Figure 3C) and a normal or reduced R-wave amplitude without T-wave inversion in leads V2-V4 in 4 patients (Figure 3D). The remaining 7 patients had tall R waves and inverted T waves with downsloping ST-T segments in leads V3-V5 (Figure 3E).

At initial evaluation, atrial fibrillation was present in 4 patients, atrial flutter in 1 patient and nonsustained ventricular tachycardia (VT) in 4 patients. Sustained VT, documented in 9 patients (38%), was in each case refractory to amiodarone and required synchronized cardioversion. Of these, 4 patients had an ICD inserted for primary prevention and another 4 underwent simultaneous prophylactic aneurysmectomy and myomectomy