Hypertrophic Cardiomyopathy With Apical Left Ventricular Aneurysm

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We report a case of hypertrophic cardiomyopathy (HCM) with apical left ventricular aneurysm, which is difficult to review because cases are so rare. A 54-year-old Japanese man was first found to have an electrocardiographic abnormality (T-wave inversion at rest) 19 years ago, and non-obstructive apical HCM without identifiable cause was diagnosed by echocardiography, left ventriculography, and clinical findings. After 19 years, he was admitted because of repeated episodes of palpitation and chest oppression at rest. Widespread left ventricular hypertrophy from the anteroseptal wall to the apex with an apical left ventricular aneurysm was detected by echocardiography, left ventriculography, and cardiac magnetic resonance imaging. Histologic examination of the hypertrophic apical myocardium surrounding the aneurysm showed that the myocardial tissue had been extensively replaced by fibrous tissue containing hypertrophic myocardial fibers, and uptakes of [123I]-metaiodobenzyl guanidine (MIBG) and [123I]-β-methylidophenyl pentadecanoic acid (BMIPP) in single-photon emission photography images were reduced despite high myocardial perfusion. On the other hand, histologic examination of the hypertrophic anterior wall revealed myocardial hypertrophy with disorganization; myocardial perfusion and the uptakes of MIBG and BMIPP were preserved. Abnormalities of myocardial fatty acid metabolism and sympathetic neuron activity with preserved perfusion flow and histologic changes such as fibrosis in the apical wall are indicative of apical myocardial injury or ischemia (infarction) without coronary artery stenosis; apical aneurysm may have occurred in severe apical HCM with cavity obliteration up to the midventricular level. (Jpn Circ J 1998; 62: 127—131)

Key Words: Left ventricular aneurysm; Hypertrophic cardiomyopathy; Single-photon emission tomography; Endomyocardial biopsy

Four patients with hypertrophic cardiomyopathy (HCM) were first described in 1907 by a German investigator, and the gross pathologic features of hypertrophic cardiomyopathy (HCM) were first described systematically in 1958. A distinctive clinical feature was soon recognized in many patients with HCM. However, it is difficult to review previous reports of HCM with apical left ventricular aneurysm because such cases are rare. Furthermore, apical left ventricular aneurysm with HCM is of great interest because the pathogenetic mechanism of apical left ventricular aneurysm with HCM is not clear in the previous reports. We report a case of HCM with apical left ventricular aneurysm.

Case Report

A 54-year-old Japanese man was first found to have an electrocardiographic abnormality (T-wave inversions at rest) 19 years ago. An electrocardiogram (ECG) revealed no giant negative T waves and no left ventricular hypertrophy by voltage criteria. Echocardiography and left ventriculography (LVG) showed hyperkinetic wall motion. Non-obstructive apical HCM without identifiable cause (not the familial form) was diagnosed by echocardiography, LVG, and clinical findings. After 19 years, the patient was admitted to our hospital because of repeated episodes of palpitation and chest oppression at rest. Physical examination revealed heart rate of 68 beats/min in regular rhythm and blood pressure of 118/78 mmHg. Except for a slight systolic murmur at the apex, he had no abnormal physical findings. Fig 1 shows the chest radiograph, ECG, and Holter monitoring. Chest radiograph showed slight cardiac enlargement in the apex with no evidence of ventricular aneurysm [cardiothoracic ratio (CTR) = 50.8%]. ECG revealed T-wave inversion in leads I, II, III, aV1, aV5, and V1-V6. Holter monitoring revealed non-sustained ventricular tachycardia. Echocardiography showed widespread left ventricular hypertrophy from the anteroseptal wall to the apex (anteroseptal wall thickness at end-diastolic phase 18 mm, apical wall thickness 20 mm) with apical aneurysm, but could not find the thrombus in apical aneurysm. Fig 2 shows LVG in the right anterior oblique projection. LVG showed hyperkinetic wall motion (ejection fraction of 89.5%), which was caused by apical hypertrophy. Furthermore, LVG showed a pronounced apical aneurysm with thrombus, as shown at the bottom of Fig 2. Apical left ventricular

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aneurysm, which persisted during the systolic phase without paradoxical systolic pulsation, communicated with the ventricular chamber slightly during diastolic phase. The systolic pressures in the left ventricle did not show a noticeable gradient between the inflow side and the outflow side (124/13 mmHg), but apical aneurysm catheterization showed a high systolic pressure (210/30 mmHg). Coronary arteriography revealed no obstructive lesions. Fig 3 shows cardiac magnetic resonance imaging (MRI) in this patient. Apical aneurysm with thrombus, which was located in the inferior side of the apex, was found by MRI. Endomyocardial biopsy was performed in different areas of the left ventricle (the hypertrophic anterior wall, the hypertrophic apical wall surrounding the aneurysm, and others) because the patient might have had some particular disorder involving solely the apical left ventricle.

Fig 1. Chest radiograph, electrocardiography, and Holter monitoring.

Fig 2. Left ventriculogram (LVG) and selective apical aneurysm cineangiogram in patient with hypertrophic cardiomyopathy with apical aneurysm. (a) End-diastolic phase. (b) End-systolic phase of LVG. (c) Selective apical aneurysm cineangiogram in right anterior oblique projection.

Fig 3. Cardiac magnetic resonance imaging (MRI) in patient with hypertrophic cardiomyopathy with apical aneurysm. (a) T2 image. (b) End-diastolic phase in the cine mode. The arrows show the thrombus into the apical ventricular aneurysm.
ventricle (e.g., endomyocardial fibrosis). Fig 4 shows histologic sections of the anterior and the apical hypertrophic myocardium. Microscopic examination of the anterior wall revealed myocardial hypertrophy with disorganization, but on the apical side the myocardial tissue was replaced by fibrous tissue with hypertrophic myocardial fibers. Cardiac single-photon emission tomography (SPECT) (Prism 2000 XP, Picker Co) with $^{99m}$Tc-Sestamibi (MIBI; 600 MBq) was performed at rest. Fig 5 shows the SPECT images obtained using $^{99m}$Tc-MIBI as a tracer. Hypertrophic myocardium from the anteroseptal wall to the apex was observed as high myocardial perfusion. The inferior side of the hypertrophic apical wall looked as if it was being pressed out from the left ventricle. Cardiac SPECT with $^{123}$I-metaiodobenzyl guanidine (MIBG; 111 MBq) and $^{123}$I-$\beta$-methyliodophenyl pentadecanoic acid (BMIPP; 111 MBq) was performed 1 week after SPECT with MIBI, and early and delayed SPECT images were obtained at rest. Fig 6 shows the early and delayed SPECT images obtained using $^{123}$I-MIBG and $^{123}$I-BMIPP. The early images showed high uptakes of MIBG and BMIPP in the hypertrophic anterior wall, but the hypertrophic apex surrounding the apical aneurysm showed low uptakes of MIBG and BMIPP despite high myocardial perfusion. These results were more noticeable in the delayed images.
An intracardiac electrophysiologic study was performed and ventricular tachycardia was induced by programmed stimulus testing at the apex area. The patient responded to therapy with an antiarrhythmic drug (bepridil hydrochloride).

Discussion

Nuclear cardiac imaging with positron emission tomography (PET) and SPECT is useful for evaluating the severity and the extent of myocardial ischemia in patients with ischemic heart disease. In patients with HCM, previous reports have suggested that the discrepancy in the myocardial distribution of $[^{201}Tl]$- and $[^{123}]$-BMIPP or $[^{123}]$-MBG using SPECT is related to myocardial damage, when the hypertrophic myocardium is revealed by high myocardial perfusion. Histologic examination of the hypertrophic apical myocardium surrounding the aneurysm showed that the myocardial tissue was replaced by fibrous tissue with hypertrophic myocardial fibers, and the uptakes of MBG and BMIPP in SPECT images were reduced despite high myocardial perfusing flow. On the other hand, histologic examination of the hypertrophic anterior wall, showed myocardial hypertrophy with disorganization, and the myocardial perfusing flow and the uptakes of MBG and BMIPP were preserved. Kurata et al. have demonstrated that the decrease in uptake in BMIPP with SPECT is correlated with the severity of cardiac damage. Furthermore, Nakajima et al. and Brush et al. have demonstrated that sympathetic denervation is related to the severity of myocardial hypertrophy.

The pathogenesis of apical left ventricular aneurysm is not clear from previous reports. The co-existence of pathologic factors, such as abnormally high intraventricular pressure or localized abnormalities of cardiac contraction, cause a state of relative ischemia and, finally, myocardial structural abnormalities that affect the continuity of the myocardial fibers may give rise to apical aneurysm in obstructive hypertrophic cardiomyopathy. In non-obstructive hypertrophic cardiomyopathy, there are some mechanisms that could be responsible for myocardial ischemia. Excessive myocardial oxygen demand that exceeds the capacity of the coronary vascular system to deliver oxygen compromises coronary blood flow to the myocardium owing to abnormal intramural coronary arteries, which may result in relative myocardial ischemia.

In our patient, abnormalities of myocardial fatty acid metabolism and sympathetic neuron activity preceded impairment of perfusion in the apical wall. As reported by Dae et al. ischemic areas surrounding the transmural myocardial infarction and areas with non-transmural myocardial infarction that show low uptakes of MBG but normal thallium uptake indicate viable but denervated myocardium. Furthermore, as reported by Tamaki et al. low uptake of BMIPP with high perfusing flow visualized on the reperfused infarct areas indicates a regional wall motion abnormality, suggesting stunned myocardium. They suggested that this discordant BMIPP uptake may reflect decreased $pO_2$ levels and tissue ATP concentrations, which may lead to a switch from fatty acid to glycolytic oxidation despite the restoration of perfusion. Our results may indicate the presence of relative myocardial ischemia in the apical area. Matsuura et al. found myocardial necrosis without coronary artery stenosis in HCM patients with left ventricular aneurysm using $[^{99m}Tc]$-pyrophosphate imaging and $[^{111}In]$-antimyosin antibody imaging with scintigraphy. Patients with HCM studied at necropsy often exhibit fibrous tissue formation in the hypertrophic myocardial walls of the left ventricle. Our results of microscopic examination in the apex surrounding the apical aneurysm were similar to those of the resected apical aneurysm with left ventricular hypertrophy reported by Barbarese et al. These results may reveal injury to the apical myocardium or apical infarction in apical HCM. In this patient, apical HCM without mid-ventricular obstruction 19 years ago worsened to HCM with mid-ventricular obstruction and apical left ventricular aneurysm. As proposed by Wigle et al., the hypertrophic myocardium surrounding the apex in the part of the apical hypertrophy at the mid-ventricular level may have resulted in mid-ventricular obstruction, and apical infarction may occur in severe apical HCM with cavity obliteration up to the mid-ventricular level. Abnormalities of myocardial fatty acid metabolism and sympathetic neuron activity with preserved perfusion flow, and histologic changes such as fibrosis in the apical wall, may reflect apical myocardial injury or ischemia (infarction) without coronary artery stenosis, and apical aneurysm may have occurred in the presence of severe apical HCM with cavity obliteration up to the mid-ventricular level.

In this patient, ECG revealed that the depth of the inverted T waves was reduced, and was the same as 19 years previously. Sakamoto et al., in their previous studies, found a close correlation between the depth of inverted T waves and the apex/mid-ventricular wall thickness ratios in HCM patients. The apex/septal mid-ventricular wall thickness ratio was low (20 mm/18 mm; ratio 1:1) in our patient, which have accounted for the absence of noticeably inverted T waves on ECG, as reported previously.

References


