

Mid-ventricular Obstructive Hypertrophic Cardiomyopathy with an Apical Aneurysm Caused by Vasospastic Angina

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Mid-ventricular obstructive hypertrophic cardiomyopathy (MVOHCM) is a rare form of cardiomyopathy, characterized by the presence of a pressure gradient between the left ventricular basal and apical chambers and is frequently associated with an apical aneurysm. However, the exact cause of this aneurysm remains unknown. We here describe a patient with MVOHCM in whom the apical aneurysm may be caused by vasospastic angina.

Key words: Mid-ventricular obstructive hypertrophic cardiomyopathy; Apical aneurysm; Vasospastic angina; Coronary arteriovenous fistula

INTRODUCTION

Mid-ventricular hypertrophy is a rare form of hypertrophic cardiomyopathy (HCM), which causes mid-ventricular obstruction complicated with apical aneurysm formation in some cases [1–4]. This type of HCM is strongly related to cardiac death associated with cardiac arrhythmias [5, 6]. Furushima *et al.* reported that ventricular tachyarrhythmia was responsible for 38% of hospitalizations in HCM, and ventricular tachycardia occurred particularly in patients with mid-ventricular obstruction and LV apical aneurysm. These authors also reported that electrical storm was more common in HCM patients with ST elevation in precordial leads V4–V6 [6].

Electrocardiographic changes and similar chest symptoms of HCM sometimes obscure the diagnosis of myocardial ischemia. Coexistence of HCM and vasospastic angina has been reported in some cases [7–10]. Although the involvement of myocardial ischemia with HCM has been suggested, the exact cause of apical aneurysm formation in HCM remains to be clarified. We here report a case of HCM with mid-ventricular obstruction and an apical aneurysm, which was difficult to diagnose and which may have been due to myocardial infarction caused by vasospastic angina.

CASE REPORT

A 73-year-old male had been diagnosed with HCM 7 years previously. He was administered β -blocker (atenolol), Ca antagonist (verapamil) and class Ia antiarrhythmic agent (disopyramide) for his chest pain. The duration of his chest pain was variable. His chest pain resolved after a few minutes, or persisted for over few hours. However he did not have a detailed examination because chest pain was bearable. In this hospitalization he was taken to our hospital due to transient ischemic attack with right hemiparesis. He

also complained of chest pain at rest. His risk factors for ischemic heart disease were smoking and hypertension. He did not have a family history of heart disease. Heart sounds were normal with no murmurs. On admission, his blood pressure was 147/80 mmHg, and the pulse rate was 75. His level of consciousness was alert and cyanosis was not observed. Blood tests showed a raised creatinine level (1.48 mg/dl) and positive troponin T test. Chest X-ray showed slight cardiomegaly. ECG revealed normal sinus rhythm and complete right bundle branch block. There was elevation of the ST-segment in leads I, aVL, V3–6 and abnormal Q wave in the I, II, III, aVF and V3–6 leads (Fig. 1). Two-dimensional echocardiography revealed generalized hypertrophy (wall thickness at end-diastolic phase 20mm), mid-ventricular obstruction (mid wall thickness 25 mm), and an apical aneurysm (apical wall thickness 8 mm). Doppler echocardiography revealed an intra-ventricular pressure gradient caused by mid-ventricular obstruction. Urgent coronary angiography was performed to rule out acute myocardial infarction and revealed no stenosis or occlusion. There were two fistulas arising from the left anterior descending artery and right coronary artery extending to the pulmonary artery (Fig. 2). An intra-cardiac blood gas study revealed a pulmonary to systemic flow ratio (Qp/Qs) of 1.1. Hemodynamic investigation revealed low cardiac output (3.69 l/min), normal right atrial pressure (mean 1 mmHg), no evidence of pulmonary hypertension (15/3 mmHg, mean 7 mmHg), but a peak-to-peak intra-ventricular pressure gradient of 20 mmHg during pull-back from the apical chamber. Left ventriculography revealed dyskinesis in the apical wall and a mid-ventricular obstruction (Fig. 3). Stress thallium-201 (201Tl) myocardial imaging showed a permanent defect corresponding to the apical aneurysm (Fig. 4). The acetylcholine (ACh) provocation test was performed for diagnosis of vasospastic angina.

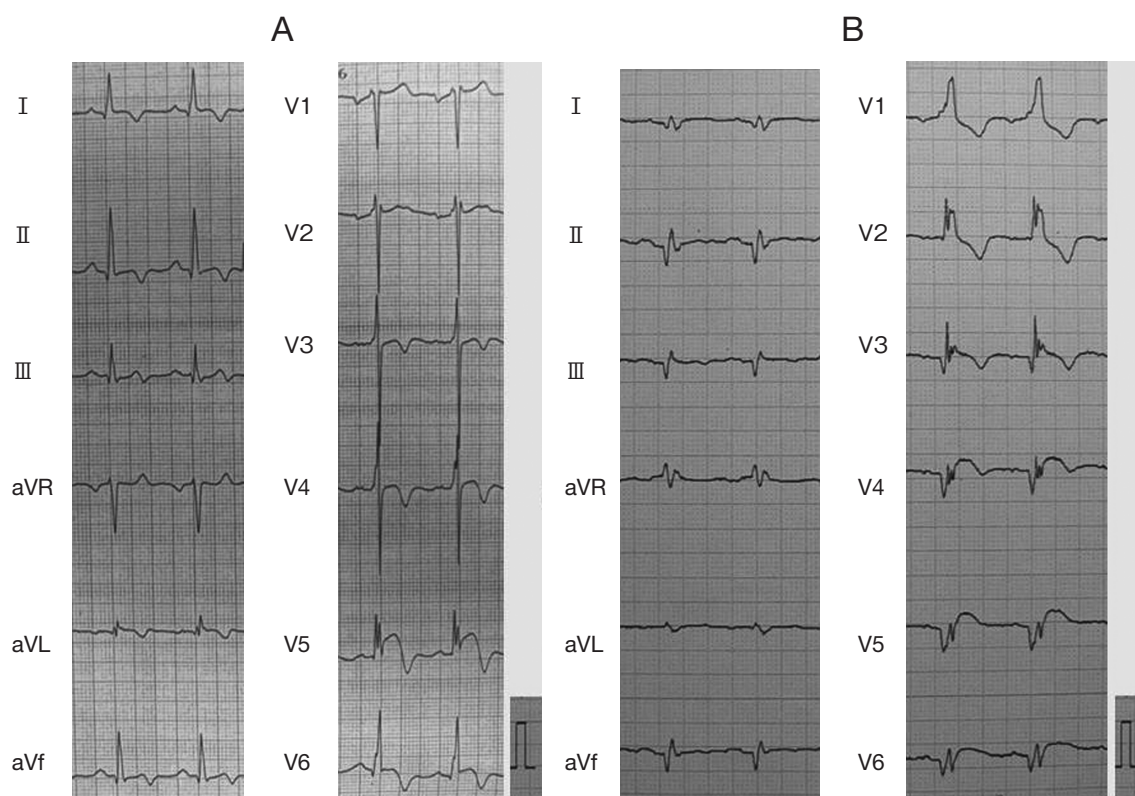


Fig. 1 A: 12-lead Electrocardiogram from 7 years previously. Note inverted T waves in leads I, II, III, aVF, aVL, V3–6 without abnormal Q wave
B: Current 12-lead Electrocardiogram showing normal sinus rhythm and complete right bundle branch block with elevation of ST-segment in leads I, aVL, V3–6 and abnormal Q wave in leads I, II, III, aVF and V3–6

Intracoronary ACh injection induced transient occlusion of the left anterior descending artery with chest pain and ST elevation in leads I, aVL, V3–6 (Fig. 5). Occlusion of the left anterior descending artery was relieved by intracoronary injection of nitroglycerin. The patient was diagnosed as having HCM associated with mid-ventricular obstruction, an apical aneurysm and coronary vasospasm. Diltiazem and isosorbide dinitrate were administered. After he was discharged home, he had no further episode of chest pain. Six months later a repeat echocardiography revealed no recovery of an apical aneurysm or mid-ventricular obstruction.

DISCUSSION

The present case of an elderly male patient with MVOHCM and an apical aneurysm in the left ventricle, also exhibited vasospastic angina. Apical aneurysm formation has been identified in 28.3% of patients with MVOHCM and has strongly predicted HCM-related death and the combined endpoint of sudden death and potentially lethal arrhythmic events [11]. The present MVOHCM is a rare form of hypertrophic cardiomyopathy, which can be associated with an apical aneurysm without significant atherosclerotic coronary artery disease.

The mechanisms responsible for apical aneurysm formation are not well understood. Major causes of aneurysm formation in this case may be myocardial infarction mediated by coronary vasospasm. Stress 201Tl myocardial imaging results were also consistent with myocardial infarction. Myocardial ischemia has

been repeatedly demonstrated in hypertrophic cardiomyopathy as fixed and reversible thallium perfusion defects [12, 13]. O'Gara *et al.* reported that fixed thallium perfusion defects were observed largely in HCM patients with depressed left ventricular function and in segments of the left ventricular wall that were of normal or only mildly increased (15 to 20 mm) thickness [12]. In contrast, totally reversible defects occurred in areas of moderate-to-marked wall thickness (≥ 20 mm) [12]. These authors suggested that chronic hypo-perfusion by whatever mechanism, even in the absence of symptoms, may eventually lead to necrosis and infarction, and result in left ventricular dysfunction. The fixed thallium perfusion defect and normal thickness in the apical aneurysm in the present case are consistent with the O'Gara report. There have also been some reports concerning coexistent hypertrophic cardiomyopathy (HCM) and vasospastic angina in Japan [7–9]. Kodama *et al.* reported that coronary artery spasm was induced in 10 (28%) of 36 patients with HCM and that coronary artery spasm appears to play a significant role in the etiology of myocardial ischemia in Japanese patients with HCM; furthermore, smoking may be a major risk factor for coexistence of HCM and coronary artery spasm [8]. Nosaka *et al.* reported that coronary artery spasm was induced in 7 (9.5%) of 74 patients with HCM [9]. Honda *et al.* also reported that in 31 (44.3%) of 70 HCM patients, coronary spasm was induced by the provocation [10]. In the present case, the ECG from 7 years previously shows that there was no abnormal Q wave in the I, II, III, aVF

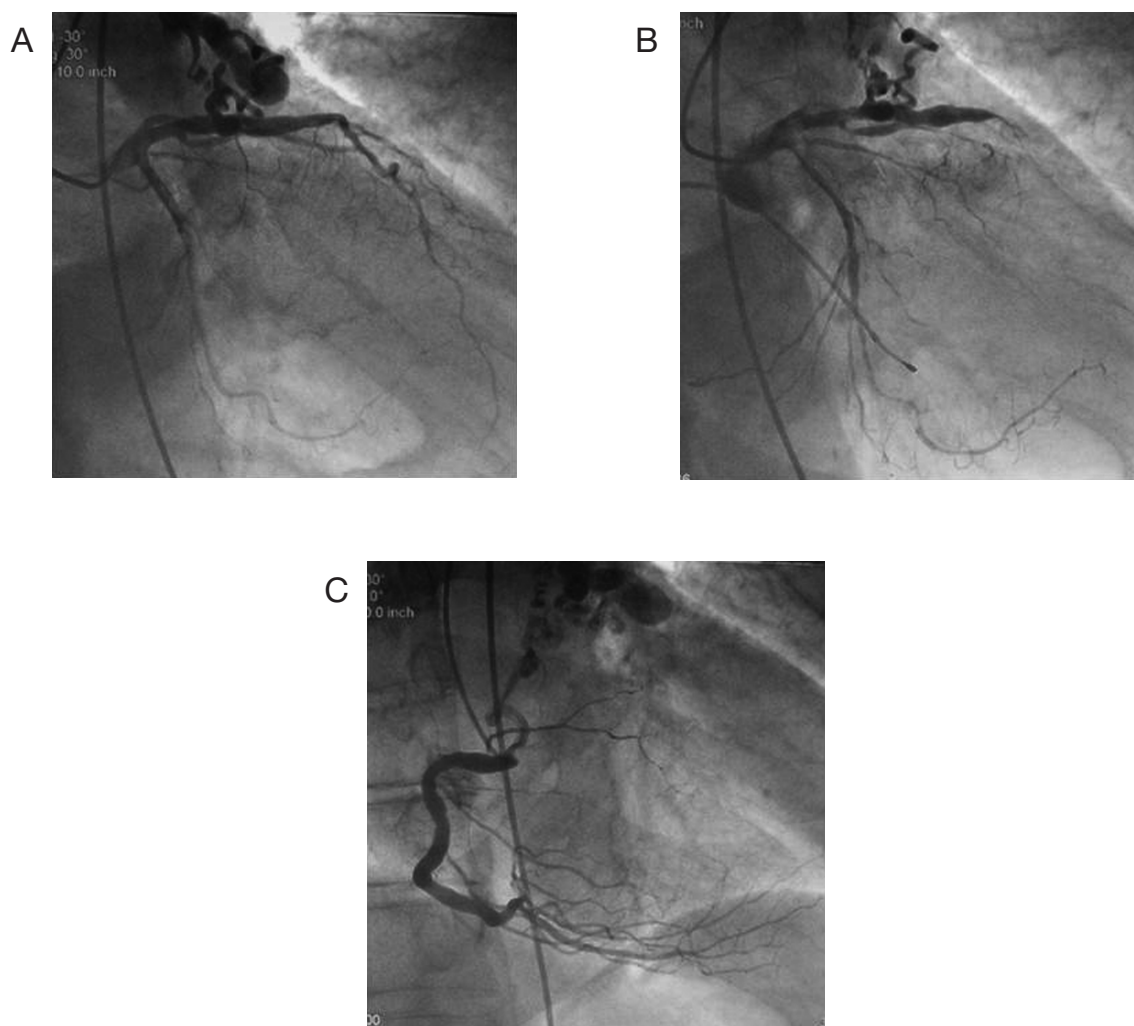


Fig. 2 Panel A shows the left coronary artery under control conditions
 Panel B shows the same artery during coronary spasm induced by intracoronary injection of ACh.
 Intracoronary injection of ACh induced transient occlusion of the left anterior descending artery with chest pain.
 Panel C shows the right coronary artery under control conditions

and V3–6 leads (Fig. 1). Koga *et al.* reported evidence for two mechanisms of abnormal Q waves in HCM using intracoronary ECG [14]. The first of these was loss of electrical forces due to transmural myocardial fibrosis, while the second mechanism involved altered direction of the resultant initial QRS vector, due to increased electrical forces caused by disproportionate hypertrophy of the basal septal and/or ventricular free wall, which were unopposed by apical forces [14]. Because the echocardiography findings 7 years prior to admission showed generalized hypertrophy and mid-ventricular obstruction without an apical aneurysm and there was no abnormal Q wave in the ECG, the abnormal Q waves in the current ECG may have originated from myocardial fibrosis. We consider that myocardial infarction and repetitive ischemia due to coronary artery spasm may have been a major cause of myocardial fibrosis, resulting in aneurysm formation.

Other possible causes that have been proposed are increased afterload and high apical pressure, resulting from mid-ventricular obstruction, which led to compression of the intra-myocardial coronary arteries. This compression may have been the cause

of myocardial ischemia. The pressure overload on the apical wall may have eventually led to myocardial thickness and dysfunction, resulting in dilation of the apical chamber. Myocardial thickness induces greater oxygen demand and decreased oxygen supply, due to decreased capillary myocardial fiber ratio [2, 3].

Coronary artery fistulas are found in 0.1% of patients undergoing coronary angiography [15] and bilateral fistulas are present in 4–5% of such cases [16, 17]. The natural history of coronary artery fistulas is variable and ischemia has been documented in some patients [18]. The treatment of a coronary AV fistula depends on its presentation and the magnitude of the pulmonary-to-systemic flow ratio. Sugihara *et al.* described a patient with coronary artery fistula who underwent surgical treatment. This patient had a large left-to-right shunt flow ratio ($Q_p/Q_s > 2.0$) complicated by myocardial ischemia in the inferior wall [19]. However, the coronary artery fistula in the present case may not have been the cause of myocardial ischemia, because the oxygen saturation study showed that (Q_p/Q_s) was 1.1. As far as we know, only two cases have been reported in which the coronary AV fistula was

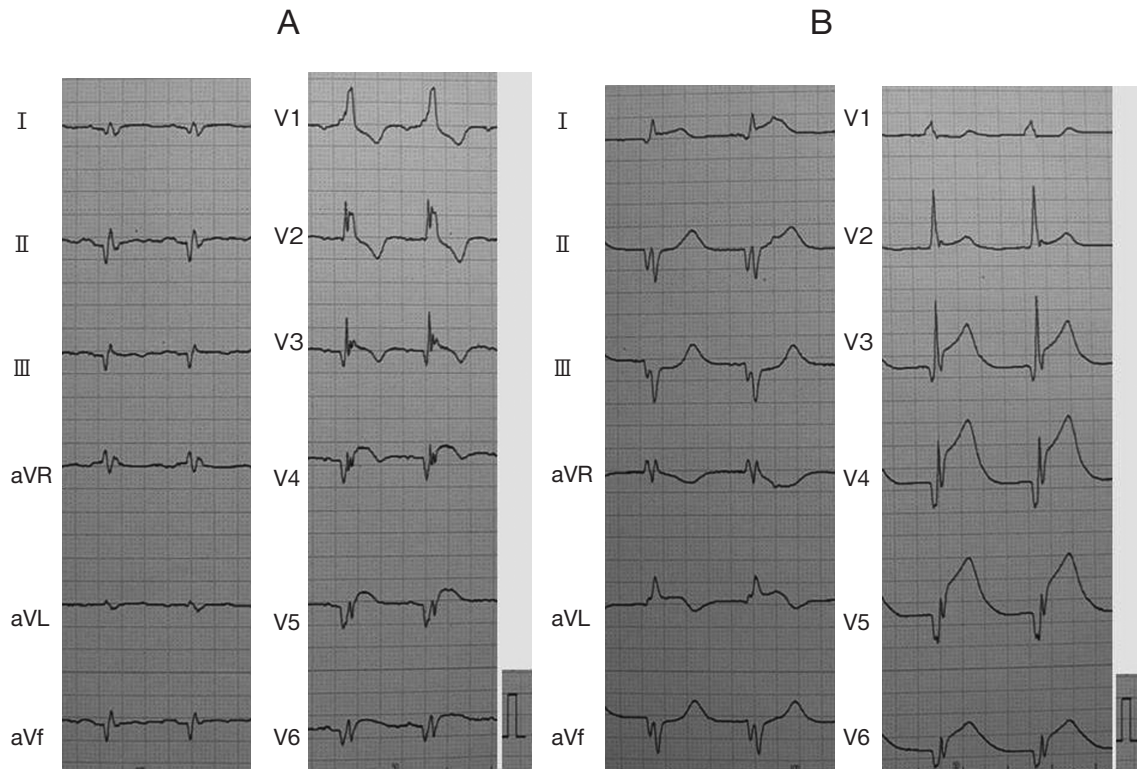


Fig. 3 Panel A: Electrocardiogram shows elevation of the ST-segment in leads I, aVL, V3-6 and abnormal Q wave in the I, II, III, aVF and V3-6 leads under control conditions.
Panel B: The acetylcholine provocation test caused chest oppression and ST elevation in leads in I, aVL, V3-6.

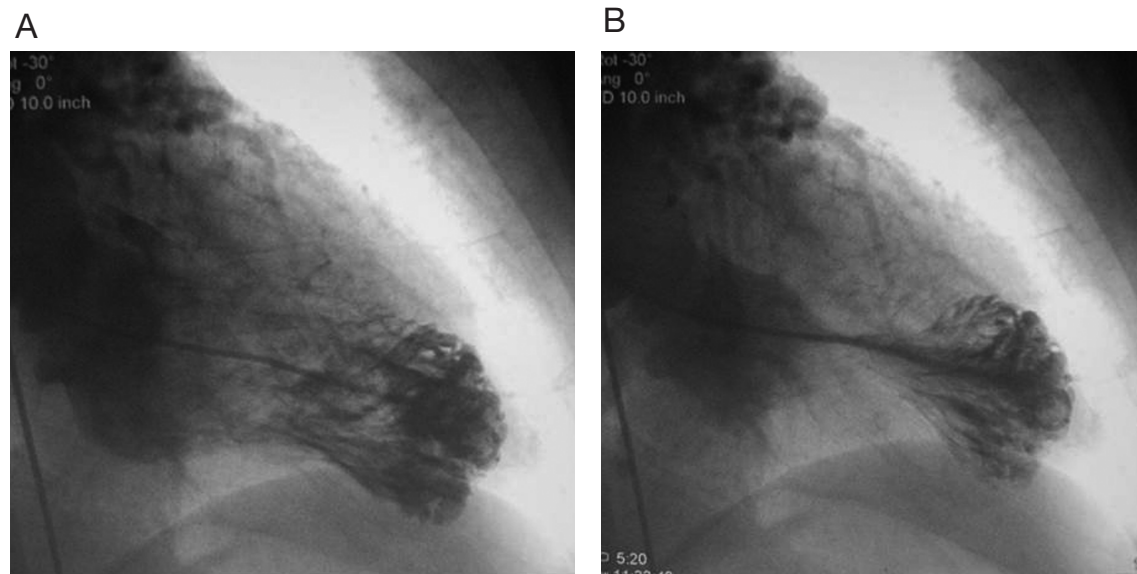


Fig. 4 Left ventriculogram showed dyskinesis in the apical wall and a mid-ventricular obstruction.
Panel A: diastole. Panel B: systole

coexistent with vasospastic angina [20, 21]. Because the degree of spasm in the coronary AV fistula was small after intracoronary ACh injection (Fig 2), the magnitude of the pulmonary-to-systemic flow ratio may have been increased by total occlusion of the mid LAD, resulting in the severe ischemia.

In the present case administration of β -blocker may also have induced repetitive ischemia by coronary artery spasm, because β -blockers can act as vasoconstrictors [22]. We sometime prescribe β -blockers to

patients with HCM due to their potential to minimize myocardial oxygen demand and their antiarrhythmic effect. Because HCM in a patient may be associated with vasospastic angina, we should pay attention to the prescription of β -blockers to such patients [7]. In conclusion, the present case exhibited a rare combination of clinical features and suggests that coronary artery spasm in a patient with MVOHCM may result in an apical aneurysm.

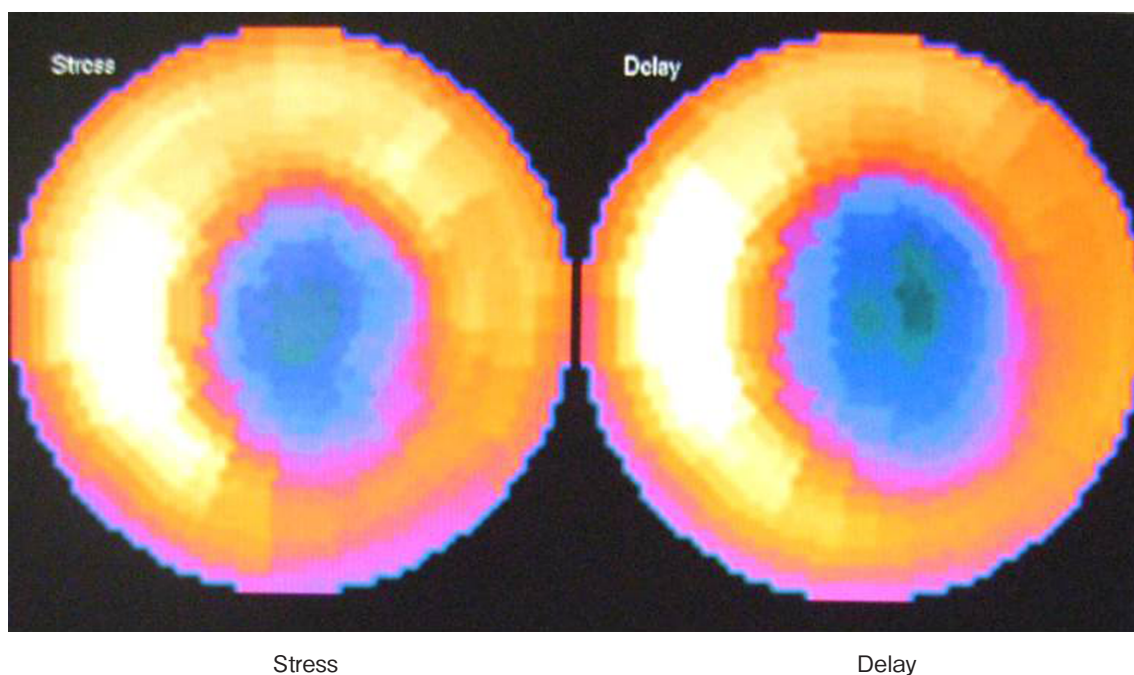


Fig. 5 Stress thallium-201 myocardial imaging. A persistent severe defect was observed in the apex on both initial (left panel) and delayed images (right panel).

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