Percutaneous transluminal septal myocardial ablation (PTSMA or nonsurgical septal reduction therapy; NSRT) is becoming increasingly common for the treatment of symptomatic patients with hypertrophic obstructive cardiomyopathy (HOCM), although the long-term prognosis has not been well defined. We present a patient with HOCM who suddenly died 19 months after successful PTSMA. Special attention was given to the pathological findings.

**Case Report**

A 56-year-old male with hypertrophic obstructive cardiomyopathy complicated with medically refractory paroxysmal atrial fibrillation and congestive heart failure was treated with percutaneous transluminal septal myocardial ablation. The resting left ventricular outflow tract gradient decreased from 70 mmHg to 0 mmHg after the procedure, and clinical symptoms improved dramatically. However, the patient died suddenly 19 months later and autopsy revealed nontransmural myocardial fibrosis with an irregular border in the interventricular septum. (*Circ J* 2003; 67: 559–561)

**Key Words:** Hypertrophic obstructive cardiomyopathy; Nonsurgical septal reduction therapy; Percutaneous transluminal septal myocardial ablation

A 56-year-old male with hypertrophic obstructive cardiomyopathy complicated with medically refractory paroxysmal atrial fibrillation and congestive heart failure was treated with percutaneous transluminal septal myocardial ablation (PTSMA or nonsurgical septal reduction therapy; NSRT) is becoming increasingly common for the treatment of symptomatic patients with hypertrophic obstructive cardiomyopathy (HOCM), although the long-term prognosis has not been well defined. We present a patient with HOCM who suddenly died 19 months after successful PTSMA. Special attention was given to the pathological findings.

A 50-year-old male experienced palpitation and squeezing chest discomfort for the first time and was taken to the emergency room in Okinawa Chubu Hospital on August 19, 1992. Initial vital signs revealed low blood pressure of 80/62 mmHg and irregular heart beat of 130 beats/min. Auscultation revealed a grade 4/6 systolic murmur at the lower sternal border. An electrocardiogram (ECG) showed atrial fibrillation (AF), high voltage suggestive of left ventricular hypertrophy and a 2-mm depression of the ST segment in leads V4–6, II, III and aVF. An echocardiogram revealed asymmetric septal hypertrophy and systolic anter motion of the anterior mitral leaflet. Based on these findings, HOCM was diagnosed and the patient was successfully managed with electrical defibrillation. After stabilization, while in sinus rhythm, cardiac catheterization revealed a left ventricular outflow tract pressure gradient (LVOTG) only after premature ventricular contraction (Brockenbrough phenomenon) and there was no gradient at rest. Metoprolol (60 mg/day) and procainamide (1.5 g/day) were started.

Over the next 6 years, despite irregular medication, the patient’s condition remained relatively stable. However, in April 1998, he experienced chest squeezing on effort and frequent episodes of paroxysmal AF (pAF) complicated with hypotension and congestive heart failure. An echocardiogram revealed a resting LVOTG of 70 mmHg. Various medications, including metoprolol, atenolol, procainamide, disopyramide, propafenone and pilsicainide, could not control his symptoms and so PTSMA was performed.

Coronary arteriography revealed normal epicardial coronary arteries and a large first septal branch. The resting LVOTG was 70–80 mmHg (Fig 1). After a balloon catheter was inflated in the first septal branch, 4 ml of pure ethanol was gradually injected. Shortly after, the patient developed chest pain and a new right bundle branch block (RBBB) pattern emerged on the 12-lead ECG (Fig 1). The resting pressure gradient disappeared completely (Fig 1). The peak creatine kinase increased up to 1,293 IU/L (normal, <120). Although the patient did not develop atrioventricular (AV) block, the postoperative course was complicated with frequent episodes of accelerated junctional rhythm resulting in hypotension, for which a DDD pacemaker was implanted 16 days after PTSMA. In order to overdrive the junctional rhythm and maintain AV synchrony, the AAI mode was selected and pacing was set at 80 beats/min. The patient was discharged with atenolol and procainamide for prevention and rate control in the event of pAF.

Cardiac catheterization was repeated 3 months after PTSMA and did not show a resting LVOTG during normal sinus rhythm, AAI mode or DDD mode with an AV interval of 140 ms. Because the ECG continued to show RBBB and left axis deviation suggestive of bifascicular block, the pacemaker mode was switched to DDD for possible complete AV block. The patient had experienced only 1 episode of pAF after PTSMA and had been stable. Unfortunately,
the patient was lost to follow-up 14 months after PTSMA and discontinued his medication. He died during sleep, 19 months after the surgery.

A postmortem examination was performed. The heart was hypertrophic and weighed 400 g. Neither obstructive atheroma nor new thrombi were found in the epicardial coronary arteries. The myocardium in the nonfibrotic area showed characteristic disarray consistent with hypertrophic cardiomyopathy (Fig 3A). In the interventricular septum, there was nontransmural myocardial fibrosis with an irregular border (Fig 2). The septal branch was totally obstructed by the marked intimal hyperplasia and fibrosis (Fig 3B). The internal elastic lamina was also damaged. Those changes were considered to be chronic. Microscopically, the border of the fibrotic tissue was irregular and there were islands of surviving myocardium (Fig 3C,D). The small arteries in the fibrotic area were also obstructed whereas the capillaries were slightly dilated. There were no thromboemboli in the pulmonary arteries. The cause of the death could not be identified, even after autopsy.

Discussion

There is increasing evidence that PTSMA is as effective as surgical management to diminish the LVOTG and alleviate symptoms in HOCM.1,2 The mechanism by which PTSMA reduces the LVOTG has been studied using echocardiography. After injection of ethanol into the septal branches, there is thinning and akinesis of the septal base and widening of the LVOT diameter, resulting in reduction of the LVOTG.3,4 Six months after the procedure, there is improvement of the LVOTG and further remodeling of the left ventricle with the increased left ventricular (LV) end-diastolic and end-systolic volumes, decreased LV mass and improved diastolic function.5–8

The pathological findings after PTSMA in the human have never been reported. Inoue et al reported the pathological changes after transcoronary ethanol injection in an experimental canine model for the treatment of ventricular arrhythmias.9 In half of their subjects, the pattern of injury was a discrete transmural focal lesion in the distribution of the ablation vessel, although patchy transmural focal lesions or nontransmural lesions were also seen in some subjects.
Necrosis of the myocardium and the subsequent fibrosis may result in thinning of the septum and improvement of the LVOTG.

In the present case, the pattern of myocardial necrosis was neither discrete nor transmural. The border of the fibrotic areas was irregular and ill-defined, and there were islands of surviving myocardium in the fibrotic tissue. Intra-operative myocardial contrast echocardiography can identify the target vessel and minimize the area at risk for infarction but as shown in the present case, the ethanol injection did not necessarily mean that the area at risk uniformly became necrotic. The mechanism for the non-uniform necrosis can be explained by a possible collateral circulation from the adjacent septal branches.

Anatomical and hemodynamic improvement may improve functional class and reduce the incidence of life threatening ventricular arrhythmias and sudden arrhythmic death associated with HOCM. However, PTSMA has a possible inherent adverse effect that results from inducing artificial myocardial infarction. High-grade AV block requiring permanent pacing develops in up to 10% of cases, and ventricular tachyarrhythmias are another possibility. So far, there has only been one report of life threatening ventricular fibrillation. In the present case, the cause of death was not clear even after the autopsy. Complete AV block would not seem likely because the pacemaker was in DDD mode. Sudden death from ventricular tachyarrhythmia is a possibility, because the nonuniform myocardial fibrosis might be conducive to reentrant ventricular arrhythmias.

In conclusion, the long-term prognosis after successful PTSMA needs to be carefully defined from an accumulation of subjects.

References