Isolated Noncompaction of the Left Ventricular Myocardium in an Elderly Patient

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Noncompaction of the ventricular myocardium (NVM) is a rare disorder of endomyocardial morphogenesis characterized by numerous, prominent trabeculations and deep intertrabecular recesses. It is commonly associated with congenital heart disease, but the isolated form (INVM) is not associated with other structural heart diseases. Clinical reports of INVM have been limited to a few case reports and small series of pediatric patients. INVM is considered to be a form of congenital abnormal endomyocardial morphogenesis caused by abnormal cessation of the embryonic development of the ventricular myocardium; most reported cases have been pediatric patients, and autopsy cases of elderly patients have been quite rare. In the present case, an elderly female had INVM associated with severely disturbed left ventricular (LV) function and an enlarged left ventricle similar to dilated cardiomyopathy. The echocardiogram showed prominent trabeculations and deep intertrabecular recesses of the LV walls, especially in the posterior and apical areas. LV contrast echocardiography revealed markedly protruberant trabeculations, which were also observed with computed tomography. Five years later, the patient died of refractory heart failure and ventricular fibrillation. The autopsy revealed numerous excessively prominent trabeculations in the LV myocardium, with deep intertrabecular recesses containing thrombi. (Circ J 2004; 68: 964–967)

Key Words: Echocardiography; Isolated noncompaction; Myocardial trabeculation

The etiology of isolated noncompaction of the ventricular myocardium (INVM) is thought to be abnormal arrest of endomyocardial morphogenesis. The gross anatomical appearance is characterized by numerous excessively prominent trabeculations and deep intr trabecular recesses of the left ventricular (LV) wall. In the recently published report of the World Health Organization International Society on the definition and classification of cardiomyopathies, INVM is categorized as an unclassified cardiomyopathy. However, reports of INVM are still rare, especially in the elderly, and the clinical features and course are not known completely. We present a case of INVM in an elderly woman, which was confirmed by autopsy.

Case Report

A 65-year-old woman was admitted to hospital complaining of palpitations and shortness of breath on exertion. Her blood pressure was 122/76 mmHg and her pulse rate was 86 beats/min. Moist rales were audible in all lung fields. A chest X-ray showed marked cardiomegaly and mild pulmonary congestion, and the electrocardiogram revealed complete left bundle branch block. Transthoracic 2-dimensional (D) echocardiography showed prominent trabeculations, with a maximum wall thickness of 39 mm, and deep intertrabecular recesses in the posterior wall and apex of the left ventricle.

Contrast-enhanced computed tomography (CT) revealed blood flowing into the deep intertrabecular recesses (Fig 2). The left ventricle was markedly dilated (the end-diastolic diameter of the inner cavity was 75 mm and 69 mm at end-systole) and its function was severely impaired with an ejection fraction of 17%. To quantify the extent of the trabecular meshwork, the thickness of the LV wall and the X-to-Y ratios were measured at the level of the mitral valve, papillary muscles, and at the apex, according to the methods reported by Chin et al. X represents the distance between the epicardial surface and the trough of a trabecular recess and Y represents the distance between the epicardial surface and the peak of the trabeculation. The trabeculations were least prominent and less numerous near the level of the mitral valve where the X-to-Y ratio was 0.92±0.07 (mean ± SEM). The X-to-Y ratio decreased to 0.59±0.05 at the level of the papillary muscles and decreased further to 0.20±0.04 at the apex where both the depth of the intertrabecular recesses and the increased wall thickness were most prominent. The control echocardiograms did not show a progressive decrease in the X-to-Y ratio (>0.8) from the level of the mitral valve to the apex. In the present case, the maximum wall thickness was observed to be 39 mm at the apex and the maximum extent of the trabecular meshwork (ie, the minimum X-to-Y ratio) was 0.36 at the apex also. The minimum X-to-Y ratio at the apex (ie, 0.20±0.11) was comparable with that observed in the previous study by Chin et al. Pulsed Doppler echocardiography revealed restrictive patterns in the mitral inflow velocity (E velocity: 140 cm/s; A velocity: 40 cm/s; DcT: 140 ms). Other structural heart diseases were not apparent. Transesophageal echocardiography also showed trabeculations of the posterior wall of the left ventricle (Fig 1D), and contrast echocardiography using intravenous Levovist® demonstrated blood flowing into the deep intertrabecular recesses (Fig 2).

Contrast-enhanced computed tomography (CT) revealed
marked thickening of the LV wall and trabeculations of the free wall (Fig 3). Exercise stress thallium-201 myocardial imaging showed spotted defects in the anterior and posterior walls and the apex. Moreover, on the delayed images there was an accumulation of isotope on the prominent trabeculations. Coronary angiography did not show any occlusive or stenotic lesions. Left ventriculography demonstrated a severely hypokinetic left ventricle. In the hemodynamic study, the LV pressure was 128/15 mmHg, pulmonary arterial pressure was 22/9 mmHg, and the mean pulmonary capillary wedge pressure was 5 mmHg. On the left ventriculogram, the LV end-diastolic and end-systolic volumes (indexes) were 474 ml (309 ml/m²) and 282 ml (184 ml/m²), respectively. The diagnosis was INVM and the patient began a treatment regimen of 81 mg aspirin, 5 mg enarapril, 20 mg furosemide and 40 mg isosorbide dinitrate. After discharge, her status was New York Heart Association II heart failure, which later lead to dysfunction of the liver and kidney. After a 5-year course, the patient died of refractory heart failure and ventricular fibrillation.

At autopsy, the heart weighed 660 g and the left ventricle was dilated. The myocardial wall consisted of 2 layers, a thin epicardial layer and a thick endocardial layer that, on gross examination, had numerous excessively prominent trabeculations and deep intertrabecular recesses in the ante-

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Fig 1. Two-dimensional echocardiograms showing the trabeculations (arrow) of the left ventricular posterior wall. (A) Long-axis view, (B) short-axis view, (C) apical long-axis view and (D) transesophageal echocardiogram in the 4-chamber view. LV, left ventricle; Ao, aorta; LA, left atrium; RA, right atrium; RV, right ventricle. Prominent thick trabeculations and deep intertrabecular recesses in the left ventricular posterior wall and apex.

Fig 2. Contrast echocardiography with Levovist® shows the blood flow to the deep intertrabecular recesses.

Fig 3. Computed tomography shows the trabeculations of the left ventricular free wall.
rior, lateral and posterior walls and apex of the left ventricle, but were absent from the interventricular septum and right ventricle (Fig 4B). There were organized thrombi in the intertrabecular recesses. These findings were consistent with INVM (Fig 4A) and no other cardiac abnormality was found. There was minimal atherosclerosis of the left anterior descending coronary artery (LAD), right coronary artery (RCA), which had a luminar stenosis less than 50%, and of the aorta.

The histological examination showed that the deep intertrabecular recesses were covered by endothelium that was continuous with the LV cavity, indicating that the recesses were not sinusoids (Fig 4C). The myocytes did not have an intricate arrangement, but there was hypertrophy and interstitial fibrotic changes. There was interstitial fibrotic change with proliferation of fibroelastosis in the subendocardial area of the free wall of the left ventricle, particularly the posterior wall, and there were numerous prominent trabeculations. The interventricular septum did not show any fibrotic changes.

Discussion

The pathogenesis of INVM is yet to be elucidated, but it has been speculated that this rare congenital disorder results from the arrest of compaction of the myocardium. In the previously reported cases,2-22 the age of the patients ranged from 4 months to 71 years, and in an echocardiographic study the frequency was 0.045%.3 The 3 major complications of this disease are ventricular dysfunction, ventricular arrhythmia and systemic embolism, which previous reports reveal as 73%, 40% and 33%, respectively.2-6 The mechanism of the progressive ventricular failure in cases of INVM is still unknown, but the prognosis for the present patient after the onset of congestive heart failure was comparable with that for dilated cardiomyopathy (DCM). She had severe global hypokinesis and a low LV ejection fraction on initial admission. We speculate that the LV dysfunction was induced by myocardial ischemia caused by the mismatch in blood supply and demand for the numerous prominent trabeculae; an hypothesis that is supported by the common pathologic finding of trabecular7,8 or endocardial7,9 fibrotic changes in INVM. Moreover, Jenni et al proved that coronary microcirculatory dysfunction is associated with INVM, demonstrating a decreased coronary flow reserve.10 Autopsy of the present case revealed similar fibrotic changes in the LV myocardium and trabeculae.

To quantify clinically the extent of the trabecular meshwork, we used X-to-Y ratios according to the methods reported by Chin et al.2 The trabecular meshwork was predominantly in the inferoapical region on 2-D echocardiogram3 and in this case, the X-to-Y ratio decreased from the level of the mitral valve to the apex of the left ventricle, and the minimum X-to-Y ratio at the apex was comparable with that reported by Chin et al.2 Contrast echocardiography11 CT5 and magnetic resonance imaging12,13 may all be useful in determining the diagnosis. In the present study, contrast echocardiography using Levovist® showed the LV cavity and blood inflow to the deep intertrabecular recesses so clearly that the extent of the trabecular meshwork was obvious (Fig 2)14,15.

The autopsy of the present case confirmed that the location and size of the prominent trabeculations and deep intertrabecular recesses of the posterior and lateral walls corresponded to the echocardiographic findings. However, it was difficult to detect the trabeculations in the anterior
wall by echocardiography, because of the poor resolution of the near field. Contrast-enhanced CT was useful for evaluating the morphology of the entire ventricular walls, but as it could not evaluate cardiac function, it should be regarded as a supplementary diagnostic technique.

The high prevalence of thromboembolic events is independent of the size or function of the left ventricle. The deep recesses are an additional factor and may aggravate the risk of thrombus formation. The contrast echocardiograms, especially the apical views, depicted the deep intertrabecular recesses and thrombi more clearly than any other imaging modality. We treated the patient with an oral antiplatelet agent, but there are no specific therapeutic strategies for INVM at present and the prognosis is poor.

During a 14-year follow-up of 34 adults patients with INVM, 12 (35%) died, and 4 (12%) underwent heart transplantation. The manifestation of INVM can be sporadic or familial; the latter being more common in pediatric cases than in adults. A large family series of 6 cases of INVM with 2 sets of siblings, has been reported. The present patient had 3 siblings who died in childhood, although they had no malformations including prominent forehead, strabismus, low-set ears, high-arched palate, micrognathia or other dysmorphic features. The familial form of NVM is accompanied by facial or other dysmorphisms caused by mutations of the G4.5 gene in the Xq28 chromosomal region. A few sporadic and familial cases of INVM have been reported; the inheritance pattern of INVM is thought to be heterogeneous. We consider that the form of INVM that appears in adults, including the present patient, does not have a no link with genetic factors and is therefore sporadic.

References