

Figure 2. Viability Image

Viability image showing a transmural, inferior myocardial infarction (arrow) in the same patient shown in Figure 1.

enough data about CMR for inflammation evaluation in KD. Our findings were in agreement with previous clinical studies supporting the high incidence of myocarditis during stages II and III (days 12 to 25 and days 25 to 40, respectively) and in older patients. In our patients with myocardial inflammation, both T2-weighted analysis and EGE were highly suggestive of inflammatory process. The lack of LGE in one-half of the patients was not a surprising finding. In contrast to viral myocarditis, which is considered to be the result of injury by virus infiltration and the host's immune response, the myocarditis in KD is characterized by inflammatory infiltration from the coronary arteries to the interstitial myocardium, and therefore the myocardial necrosis is not observed frequently, which may explain the lack of LGE and the rapid clinical improvement of our cases (5).

Another important finding was the presence of ectasia, but not aneurysm, in all KD patients. This is probably because the early administration of immunoglobulin decreased the incidence of coronary aneurysms (1). However, myocardial inflammation was a common finding, with rapid recovery in the subsequent 3 months.

The current study has the following limitations: 1) the small number of patients, older than the usual age for KD; 2) infants with severe myocardial disease were not included; 3) long-term CMR follow-up was not available; and 4) myocardial biopsy was not available because of the benign presentation of the disease, which did not allow an invasive procedure.

In conclusion, coronary ectasia and myocardial inflammation are common findings during the convalescence of KD, but usually have a benign prognosis. Myocardial infarction and coronary aneurysms occasionally can be found, although immunoglobulin was administered during the early phase of the disease. A single comprehensive CMR examination applied in KD during convalescence may provide important diagnostic information on myocardial inflammation and coronary anatomy, and thus may be helpful for therapeutic decision making. However, further studies are needed to confirm these findings in larger samples.

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Prosthetic Heart Valve Ring Thrombosis



Despite being mechanical and prosthetic, heart valve rings (HVR) are known to have a lower risk of thrombosis compared with prosthetic mechanical heart valves, thus anticoagulation therapy is only recommended within 3 months after the surgery according to the current guidelines (1). We present 4 cases in which HVR thrombi were obtained by transesophageal echocardiography (TEE) as a novel finding with HVR.

The first case was a 41-year-old woman who had a mitral HVR operation 3 months before her admission with acute atrial fibrillation and who was a candidate for electrical cardioversion. She was referred for TEE to exclude the presence of left atrial (LA) thrombus when we incidentally observed multiple hyperechogenic, mobile thrombus images on the prosthetic mitral ring (Sorin ring, number: 34, Sorin Group, Milan, Italy) (Fig. 1A, Online Video 1A). Her international normalized ratio (INR) was effective (2.6) on admission. As a result of having a history of embolic stroke 1 year previously, the patient was given a low-dose (25 mg), slow-infusion (6 h) tissue-type plasminogen activator (TPA) without bolus administration 2 times (for a total of 50 mg), and as a result, TEE showed an unsatisfactory regression in the thrombi (Fig. 1B, Online Video 1B). We decided to follow up the patient under effective anticoagulation because she refused both the repeat dose of TPA and choice of surgery.

The second case was a 61-year-old woman who had mitral valve replacement (ATS, number: 27, ATS Medical, Inc., Minneapolis, Min-

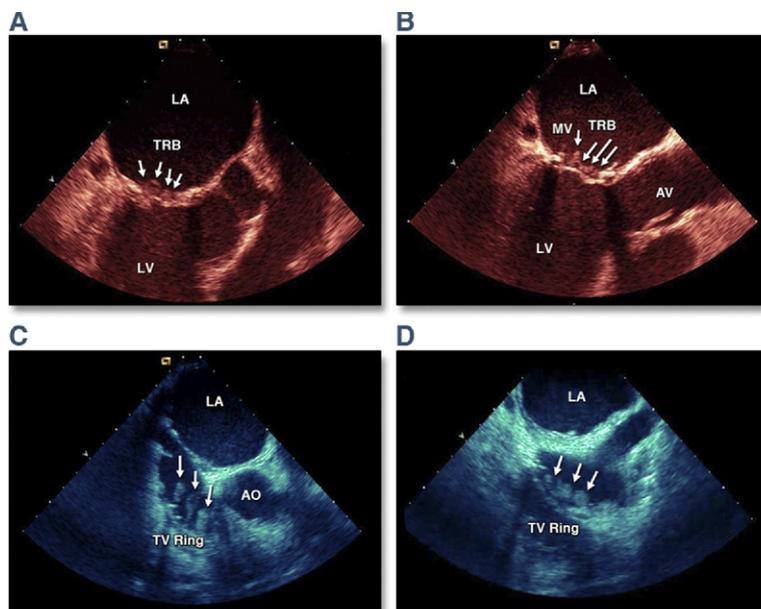


Figure 1. TEE Findings of 2 Patients With HVR

(A) A 41-year-old woman with multiple hyperechogenic, mobile thrombi (arrows) on the prosthetic mitral ring in transesophageal echocardiographic (TEE) imaging. (B) An unsatisfactory regression in the thrombus size (arrows) after thrombolytic therapy is observed. (C) A 61-year-old woman with 3 huge thrombi (arrows) (2.9×1.0 cm, 2.4×1.3 cm, and 1.2×0.8 cm, respectively) over the tricuspid annuloplasty ring, which were relocating from right atrium to right ventricle in every diastole. (D) Control TEE images showing minimal regression in the thrombus sizes (arrows) after administering thrombolytic treatment. See [Online Video 1](#). AO = aorta; AV = aortic valve; HVR = heart valve rings; LA = left atrium; LV = left ventricle; MV = mitral valve; TRB = thrombus; TV Ring = tricuspid valve ring.

nesota) and tricuspid valve annuloplasty (Sorin ring, number: 34, Sorin Group) operation 3 months before her admission with progressive severe dyspnea. TEE revealed 3 big nonobstructive thrombi (2.9×1.0 cm, 2.4×1.3 cm, and 1.2×0.8 cm, respectively) over the prosthetic tricuspid ring, which were relocating from right atrium to right ventricle in every diastole (Fig. 1C, [Online Video 1C](#)). Because she had elevated pulmonary artery pressure (PAP) (60 mm Hg), we also performed thoracic computed tomography for a suspected pulmonary embolism, but the pulmonary arteries were clear of thrombus. It was surprising to obtain thrombus on the tricuspid ring despite having effective INR levels (3.4) and a mechanical prosthetic mitral valve clear of thrombus. Because the thrombi were big and extremely mobile, the patient was considered to be high risk and was offered surgery. Because she refused the operation, again low-dose, slow-infusion TPA was performed 3 times (for a total of 75 mg). Control TEE revealed minimal regression in the thrombus sizes (Fig. 1D, [Online Video 1D](#)). The patient refused further treatment and was discharged with effective-dose anticoagulation.

The third case was a 40-year-old asymptomatic woman who was admitted for routine echocardiographic examination 3 months after having aortic and mitral valve replacement and a tricuspid annuloplasty operation. After obtaining suspected thrombus images on tricuspid ring in transthoracic echocardiography, we observed 2 hyperechogenic, mobile masses (1.5×0.8 cm and 0.78×0.5 cm in size) over the tricuspid annuloplasty ring (Sorin ring, number: 34, Sorin Group) causing a 2.8 mm Hg transtricuspid gradient in TEE examination (Fig. 2A, [Online Video 2A](#)). Despite having an ineffective INR (1.68) this time, similar to the second

case, both the mechanical prosthetic mitral and aortic valves were free of thrombus. Because the thrombi were obstructive, we performed low-dose, slow-infusion TPA 2 times (for a total of 50 mg), and significant regression in both thrombi sizes and transtricuspid gradient (1.2 mm Hg) was provided (Fig. 2B, [Online Video 2B](#)).

The last case was a 68-year-old man who presented with acute pulmonary edema with a history of coronary artery bypass graft surgery and mitral annuloplasty (Sorin ring, number: 32, Sorin Group) 1 year previously. TEE revealed an obstructive 1.16×0.7 cm, hyperechogenic, mobile mass over the prosthetic mitral ring causing an 11.8 mm Hg mean transmitral gradient and elevated PAP (65 mm Hg) (Fig. 2C, [Online Video 2C](#)). He was on anticoagulation therapy due to atrial fibrillation, but his INR (1.5) was ineffective. Because of the obstructive pattern of the thrombus, we administered low-dose, slow-infusion TPA 3 times (for a total of 75 mg) in this case. Thrombus seemed to be smaller, but the transmitral gradient was still high (8.9 mm Hg) (Fig. 2D, [Online Video 2D](#)). Because the patient rejected the surgical option, we decided to follow him up under effective anticoagulation. One year later, he was re-admitted to our hospital with acute pulmonary edema again caused by an obstructive mitral ring thrombus; he urgently underwent cardiac surgery and had a successful clinical outcome.

These cases are interesting because 2 of them were asymptomatic and were incidentally diagnosed, whereas 3 of the patients were diagnosed within 3 months after the annuloplasty operation, such that they were still on anticoagulation. Having thrombus-free prosthetic valves in 2 of the cases accompanying the presence of valve ring thrombosis is also challeng-

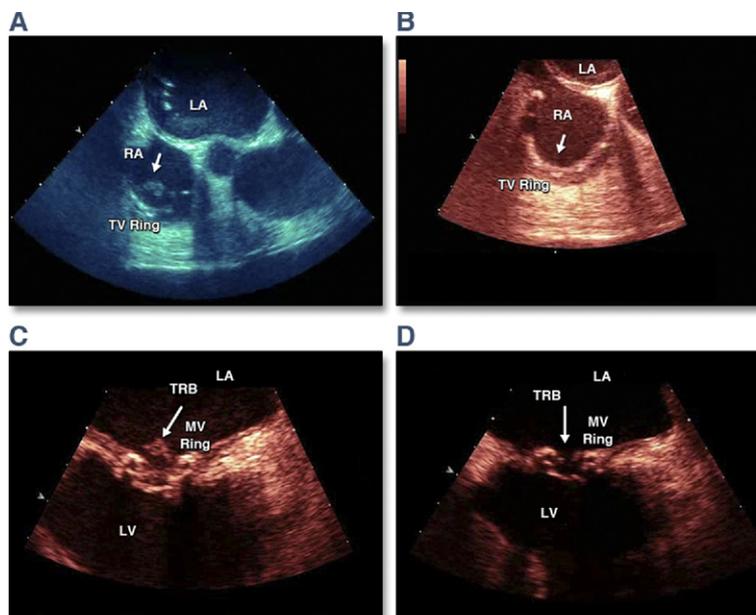


Figure 2. HVR Thrombosis Images by TEE

(A) A 40-year-old asymptomatic woman with hyperechogenic, mobile masses (arrow) (1.5×0.8 cm and 0.78×0.5 cm in size) over the tricuspid annuloplasty ring in TEE examination. (B) A complete resolution was revealed after the thrombolytic therapy with tissue-type plasminogen activator (arrow). (C) TEE images of a 68-year-old man with a 1.16×0.7 cm, hyperechogenic, mobile mass (arrow) over the prosthetic mitral valve ring with a transmitral mean gradient of 11.8 mm Hg. (D) Despite regression of the thrombus size (arrow), the transmitral gradient was found to be still high (8.9 mm Hg) in control TEE examination. See Online Video 2. MV Ring = mitral valve ring; RA = right atrium; other abbreviations as in Figure 1.

ing. We think that more attention should be paid to prosthetic heart valve rings because of their potential for the increased risk of thrombosis.

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APPENDIX

For supplemental videos, please see the online version of this paper.

Does Low Pre-Test Probability of Coronary Artery Disease Reflect Overuse of Stress Testing?

Chen et al. (1) describe few differences in downstream use of cardiovascular procedures between office- and hospital-based cardiovascular stress testing. Despite the similarities between the 2

groups, we are struck by low post-test rates of cardiac catheterization: >7 of 8 patients who underwent myocardial perfusion imaging and >13 of 14 patients who underwent stress echocardiography did not undergo cardiac catheterization (or revascularization) within the next 6 months. We argue that these low rates reflect overuse of stress testing in both groups, due at least in part to inappropriate testing of lower pre-test probability patients, even with a 26% prevalence of coronary artery disease.

We performed estimates of pre-test probabilities with: 1) rates of cardiac catheterization reported by Chen et al. (1) as a ceiling of post-test probability; and 2) likelihood ratios (LRs) based on published sensitivity/specificity estimates of myocardial perfusion imaging (LR = 3.2 to 3.6) (2) and stress echocardiography (LR = 2.7 to 7.1) (3). We estimate that the mean pre-test probability of having ischemic heart disease in this cohort averages only 1.5% to 3.9%.

American College of Cardiology/American Heart Association guidelines recommend exercise stress testing individuals with intermediate pre-test probabilities of ischemic heart disease, as defined by age, sex, and symptoms (4). For comparison of expected cardiac catheterization rates, we estimated post-test probabilities of a hypothetical intermediate risk cohort of 50- to 59-year-old subjects with chest pain with an adjusted Diamond-Forrester model (5) and conservative LR = 3.4. We estimate a post-test probability of coronary artery disease (as cardiac catheterization estimate/ceiling) of 63% to 76% in men and 31% to 75% in women, compared with rates of 5% to 12% in Chen et al. (1).