



## Case Report

## Onset of new diastolic murmur as a sign of bioprosthetic valve dysfunction: A case report



Momoko Habu (MD), Tatsuya Kawasaki (MD, PhD, FJCC)\*, Michiyo Yamano (MD, PhD), Tadaaki Kamitani (MD, PhD)

Department of Cardiology, Matsushita Memorial Hospital, Osaka, Japan

## ARTICLE INFO

## Article history:

Received 10 October 2018

Received in revised form 4 December 2018

Accepted 25 December 2018

## Keywords:

Diagnosis

Dysfunction

Murmur

Phonocardiography

Prosthetic valve

## ABSTRACT

The diagnosis of prosthetic valve dysfunction remains challenging because visualization is limited due to artifacts on echocardiography. We herein report a case of bioprosthetic valve dysfunction, in which cardiac auscultation was useful as an initial clue to the diagnosis. An 81-year-old man, who had undergone bioprosthetic aortic valve replacement due to aortic stenosis 10 years earlier, presented to the emergency department with chest discomfort. Cardiac auscultation revealed a newly developed diastolic murmur, although no diastolic murmurs were previously detected on auscultation or phonocardiography. There were no notable changes in electrocardiography, chest radiograph, laboratory tests, or echocardiography except for trivial aortic regurgitation. His hemodynamic status progressively deteriorated due to prosthetic valve dysfunction, which was later confirmed on echocardiography, and aortic valve re-replacement was semi-urgently performed with success. The diastolic murmurs disappeared after surgery.

**<Learning objective:** This case once again highlights the importance of cardiac auscultation for diagnosis even with the use of advanced imaging technology.>

© 2019 Japanese College of Cardiology. Published by Elsevier Ltd. All rights reserved.

## Introduction

Prosthetic valve dysfunction is one of the most catastrophic events because of its high mortality without prompt diagnosis and appropriate intervention. Echocardiography plays an essential role in the management of valvular heart disease, but a diagnosis of prosthetic valve dysfunction remains challenging because visualization is limited due to prosthetic valve artifacts on echocardiography [1,2]. We herein report a case of bioprosthetic valve dysfunction in which cardiac auscultation was useful as an initial clue to the diagnosis.

## Case report

An 81-year-old man presented to the emergency department of our hospital with chest discomfort. The patient had been in a normal state of health until five hours before presentation, when he noticed

anterior chest discomfort. The symptom was not severe and did not radiate to the neck or shoulders, but it had not improved at rest and lasted for hours. The patient reported no antecedent trauma, and exhibited no nausea, vomiting, or headache.

On examination, he was alert and not lethargic. His blood pressure was 92/61 mmHg, heart rate was 71 beats per minute and irregular, body temperature was 36.5°C, respiratory rate was 18 breaths per minute, and oxygen saturation was 99% while breathing ambient air. Systolic ejection murmurs and diastolic regurgitant murmurs (i.e. to-and-fro murmur) were observed on chest auscultation, although no diastolic murmurs were heard in the outpatient clinic approximately one month prior to presentation. The remaining examinations were normal. His medical history included chemotherapy for acute myeloid leukemia 13 years earlier with long-term remission, bioprosthetic aortic valve replacement with 21-mm Carpentier-Edwards Perimount (Edwards Lifesciences, Irvine, CA, USA) due to severe symptomatic aortic stenosis at another hospital 10 years earlier, bypass surgery for middle cerebral artery stenosis at another hospital two years earlier, and diabetes. Medications included aspirin, flunitrazepam, voglibose, glimepiride, sitagliptin, carbocysteine, tocopherol, and goreisan (TSUMURA Chinese herb diuretics, Tokyo, Japan). The

\* Corresponding author at: Department of Cardiology, Matsushita Memorial Hospital, Sotojima 5-55, Moriguchi, Osaka, 570-8540, Japan.

E-mail address: [kawasaki.tatsuya001@jp.panasonic.com](mailto:kawasaki.tatsuya001@jp.panasonic.com) (T. Kawasaki).

patient did not drink, stopped smoking eight years earlier, did not use illicit drugs, and had no known allergies.

Electrocardiography demonstrated a normal sinus rhythm with a heart rate of 70 beats per minute and an axis of  $-34^\circ$ , which were unchanged from those obtained 11 months earlier. A cardiothoracic ratio of 50% was observed on chest radiography with no evidence of pulmonary congestion or pleural effusion. The white cell count was 6600 per cubic millimeter with 49.5% neutrophils, and the C-reactive protein level was 1.16 mg/dL. The levels of creatine kinase, its MB isoenzyme, and troponin T were normal (61 U/L, 12 U/L, and 0.019 ng/mL, respectively). Total bilirubin and creatinine levels were 1.4 mg/dL and 1.17 mg/dL,

respectively. The lactate dehydrogenase level was 251 U/L and creatinine level was 1.11 mg/dL, which were both slightly increased from values assessed approximately one month earlier (i.e. 227 U/L and 1.00 mg/dL, respectively). The brain natriuretic peptide level was 87.6 pg/mL (reference value,  $\leq 18.4$  pg/mL). Bedside echocardiography, which was performed with LOGIQ e (GE Healthcare, Madison, WI, USA), revealed no pericardial effusion or wall motion abnormalities in either ventricle; the chamber sizes were unchanged from those two months earlier. The peak blood flow through the prosthetic aortic valve was unchanged (almost 3.0 m/s), but trivial aortic regurgitation, which had not been detected before, was noted, although clear visualization was difficult due to artifacts

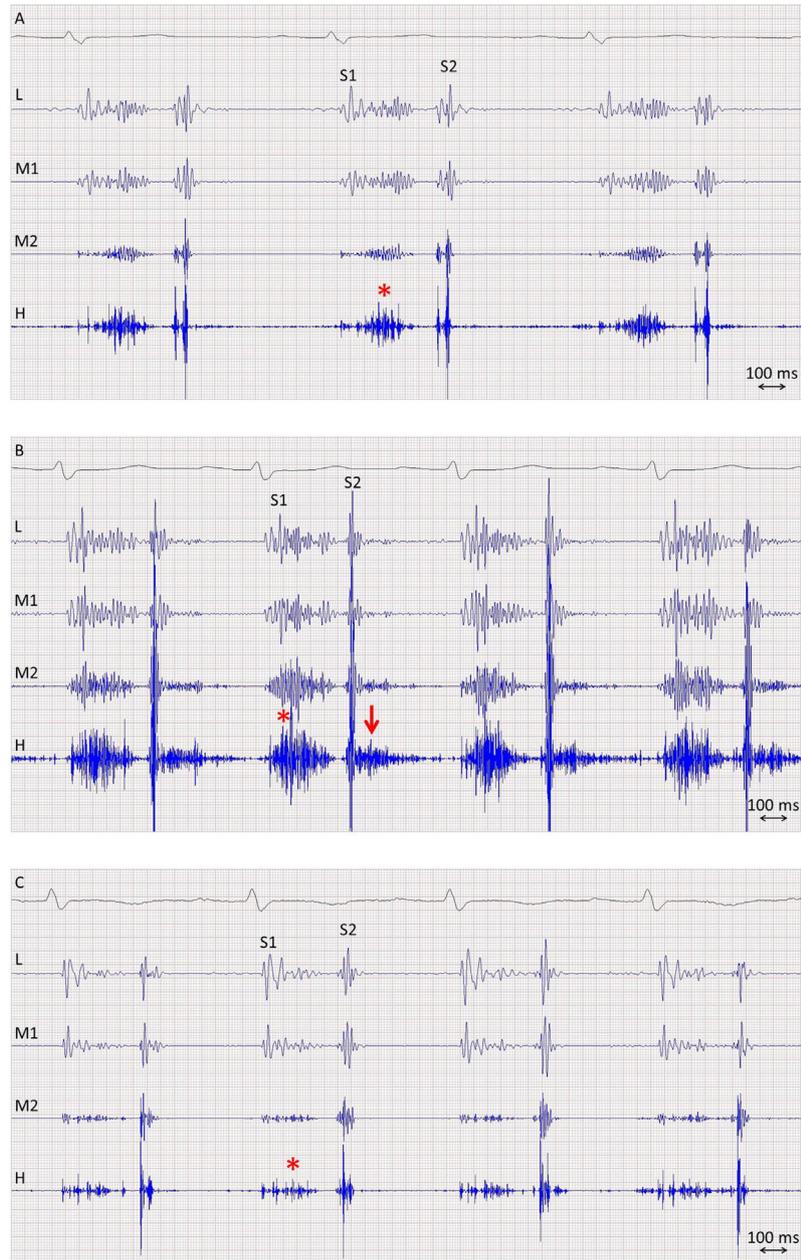
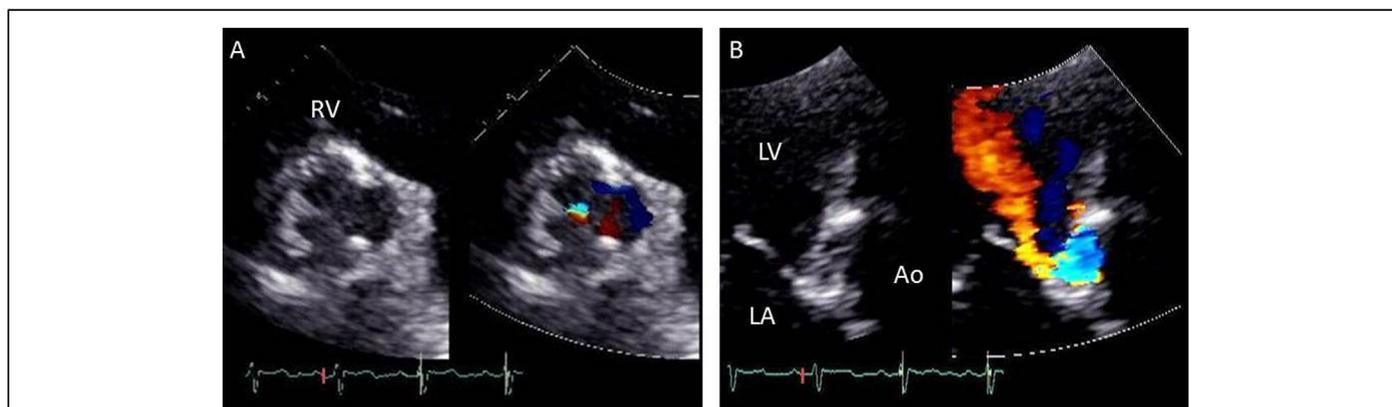


Fig. 1.

Phonocardiography, obtained approximately two years before presentation, showed a high-pitched systolic ejection murmur (A, asterisk) and the increased pulmonary component of the second sound (S2). Two days after presentation, the systolic ejection murmurs increased in amplitude (B, asterisk); note the onset of a new diastolic murmur (B, arrow) that starts immediately after S2 and does not last to the first sound (S1). After surgery, the systolic ejection murmur decreased in amplitude (C, asterisk) and no diastolic murmurs were observed. All phonocardiograms were recorded at the second left sternal border in a supine position with the same methods.

H, high frequency; L, low frequency; M1, low-middle frequency; M2, middle-high frequency.



**Fig. 2.** Echocardiographic short-axis views with and without color Doppler (A) and three-chamber views (B) showing obscure images regarding the bioprosthetic aortic valve and eccentric aortic regurgitant jets probably between the non-coronary and right coronary cusps. Ao, aorta; LA, left atrium; LV, left ventricle; RV, right ventricle.

in the bioprosthetic valve. His symptom disappeared a few hours after presentation, and the patient was asked to visit the outpatient clinic that had been scheduled two days later.

On the follow-up visit, the patient stated that the chest discomfort had recurred the next day after presentation and lasted with no improvement. His vital signs were normal, but the to-and-fro murmur was clearer. Phonocardiography demonstrated the onset of a new diastolic murmur, although only a systolic ejection murmur was detected before this event (Fig. 1A and B). The chest radiograph was not unchanged, but the levels of brain natriuretic peptide and troponin T increased to 451.1 pg/mL and 0.039 ng/mL, respectively. Echocardiography, which was performed with Vivid e9 (GE Healthcare), revealed an increase in aortic regurgitation (Fig. 2), with an effective regurgitant orifice area of 0.59 cm<sup>2</sup> and regurgitant volume of 59 mL/beat, which were consistent with severe aortic regurgitation. The peak velocity through the bioprosthetic aortic valve was 3.4 m/s, which was slightly higher than those two months earlier (almost 3.0 m/s). The patient was admitted for heart failure and his hemodynamics progressively deteriorated despite intensive medical treatment. He was transferred to another hospital and underwent prosthetic aortic valve re-replacement. During the surgery, two of the three cusps were reportedly found to be partially torn. No evidence of infective endocarditis was noted. The postoperative course was uneventful and the diastolic murmurs disappeared (Fig. 1C), as did aortic regurgitation on echocardiography with Vivid e9. The patient has been doing well for more than one year after surgery.

## Discussion

The current patient, who had undergone bioprosthetic aortic valve replacement due to aortic stenosis 10 years earlier, presented to the emergency department with chest discomfort. Cardiac auscultation revealed a newly developed diastolic murmur, although there were no notable changes in electrocardiography, chest radiograph, laboratory tests, or echocardiography. A diagnosis of bioprosthetic valve dysfunction was later confirmed, and aortic valve re-replacement was semi-urgently performed because of hemodynamic instability.

Late prosthetic valve-related complications include thrombosis, thromboembolism, hemorrhage, endocarditis, structural valve deterioration, and nonstructural dysfunction [3,4]. The final diagnosis for the current patient was primary bioprosthetic valve failure due to structural valve deterioration and reoperation was required to stabilize the hemodynamics. Difficulties remain in diagnosing prosthetic valve dysfunction because the usefulness of

imaging modalities, such as echocardiography, is limited [1,2]. Radiographic assessment can provide helpful information regarding valve movements, but this method is not always applied to bioprosthetic valves with the same quality as metallic valves. Cardiac auscultation may be indicative of this condition, as shown in the current patient, but careful consideration is needed because physical examination has inherent inaccuracies. As auscultation skills vary even among experienced clinicians [5], phonocardiography may be an alternative approach, although there seem to be no reports to examine the usefulness of auscultation for the early detection of prosthetic valve dysfunction in the era of advanced imaging techniques.

Of note, diastolic murmurs are rarely heard in healthy subjects, whereas several conditions without cardiovascular disease cause systolic murmurs [6], namely “innocent”, “functional”, or “physiological” murmurs. Causes of diastolic murmurs include aortic regurgitation, pulmonary regurgitation, and mid-diastolic rumbles such as mitral stenosis or tricuspid stenosis [7]. Mid-diastolic murmurs can be also heard in other conditions such as atrial myxoma, aortic regurgitation (Austin-Flint murmur), mitral regurgitation (Carey Coombs murmur), and hypertrophic cardiomyopathy [8–10]. In the current case, the diastolic murmurs were likely the result of acute aortic regurgitation due to bioprosthetic valve dysfunction. As systolic ejection murmurs are commonly heard in patients with a prosthetic aortic valve regardless of whether the valve is mechanical or biological, the onset of the new diastolic murmurs likely caused the to-and-fro murmurs in the current patient.

In general, compared with systolic murmurs, diastolic murmurs are difficult to auscultate. Some techniques are available to avoid missing this distant murmur, e.g. leaning-forward posture, relaxed expiratory apnea, and placing the stethoscope on the diaphragm with firm pressure [6,8]. In our case, however, the diastolic murmurs were detectable without these techniques. Uncertainty remains as to why the diastolic murmurs were clearly heard in the emergency room even though aortic regurgitation was minimal on presentation. According to the rule of heart murmurs that “the greater the gradient, the higher the frequency and pitch” and that “the greater the flow, the more the low” [6], high gradients with little flow volume, as seen in the current patient, can produce high-pitched “blowing” murmurs [6], which can be easily recognized even in non-quiet conditions. Another factor may be that the diastolic murmur was the result of the bioprosthetic valve dysfunction; non-native materials of a prosthetic valve may generate murmurs different from those in native valves.

In conclusion, our case once again highlights the importance of cardiac auscultation even with the use of advanced imaging technology.

#### Conflict of interest

None to declare.

#### Acknowledgments

None to declare.

#### References

- [1] Beigel R, Siegel RJ. Evaluation of prosthetic valve dysfunction with the use of echocardiography. *Rev Cardiovasc Med* 2014;15:332–50.
- [2] Mahjoub H, Pibarot P, Dumesnil JG. Echocardiographic evaluation of prosthetic heart valves. *Curr Cardiol Rep* 2015;17:48.
- [3] Hammermeister K, Sethi GK, Henderson WG, Grover FL, Oprian C, Rahimtoola SH. Outcomes 15 years after valve replacement with a mechanical versus a bioprosthetic valve: final report of the Veterans Affairs randomized trial. *J Am Coll Cardiol* 2000;36:1152–8.
- [4] Chan V, Jamieson WR, Germann E, Chan F, Miyagishima RT, Burr LH, et al. Performance of bioprostheses and mechanical prostheses assessed by composites of valve-related complications to 15 years after aortic valve replacement. *J Thorac Cardiovasc Surg* 2006;131:1267–73.
- [5] March SK, Bedynek Jr JL, Chizner MA. Teaching cardiac auscultation: effectiveness of a patient-centered teaching conference on improving cardiac auscultatory skills. *Mayo Clin Proc* 2005;80:1443–8.
- [6] Constant J. *Bedside cardiology*. 5th ed. Philadelphia: Lippincott Williams & Wilkins; 1999.
- [7] Crawley IS. Diastolic murmurs. In: Walker HK, Hall WD, Hurst JW, editors. *Clinical methods: the history, physical, and laboratory examinations*. 3rd edition, Boston: Butterworths; 1990. Chapter 27.
- [8] Higgins JP. Physical examination of the cardiovascular system. *Int J Clin Cardiol* 2015;1:019.
- [9] Matsumura J, Fujiyama M, Furuta Y, Toshima H, Koga Y. Diastolic murmur in non-obstructive hypertrophic cardiomyopathy. *J Cardiogr* 1982;12:171–80 (in Japanese).
- [10] Sato Y, Kawasaki T, Yamano M, Kamitani T, Nakamura T, Shiraishi H, et al. Diastolic murmur in mid-ventricular obstructive hypertrophic cardiomyopathy: a case report. *J Cardiol Cases* 2017;15:46–9.