Giant Coronary Arterial Aneurysm of the Proximal Left Anterior Descending Artery as the Cause of Wide Splitting of the Second Heart Sound

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Abstract:
Even in modern clinical cardiology, basic auscultation skill is not obsolete and is still important because it can always provide a clue to an underlying pathophysiology. We demonstrate an unusual mechanism of pathological wide splitting of the second heart sound due to external compression of the pulmonary trunk in a patient with a giant coronary arterial aneurysm of the proximal left anterior descending artery. Echocardiography, when combined with a three-dimensional anatomical analysis with cardiac computed tomography, was useful for elucidating the mechanism of the abnormal heart sounds.

Key words: Computed tomography, Coronary arterial aneurysm, Echocardiography, Phonocardiography, Second heart sound

Introduction
A delay in the pulmonary component of the second heart sound during inspiration causes physiological splitting, which disappears during expiration. However, in some cases, the splitting is auscultated even during expiration; this is referred to as pathological wide splitting of the second heart sound (1, 2). We demonstrate an unusual mechanism of pathological wide splitting of the second heart sound, which was clarified by echocardiographic and cardiac computed tomographic analyses.

Case Report
A 43-year-old woman was admitted to our hospital for further examination of an abnormal cardiac silhouette, which happened to be found in her routine health examination. She had no history suggesting the presence of Kawasaki disease. Chest radiography revealed abnormal distension in the middle of the left cardiac border. On admission, systolic ejection murmur followed by wide splitting of the second heart sound was auscultated around the third intercostal space along the left sternal border. Wide splitting of the second heart sound was confirmed by phonocardiography (Fig. 1) and pulsed-wave Doppler echocardiography (Fig. 2). Although she had been asymptomatic, her electrocardiogram demonstrated an abnormal Q-wave in leads V1 through V4. Neither right nor left bundle branch block was observed. Echocardiography confirmed reduced left ventricular wall motion that was consistent with old myocardial infarction in the territory of mid-distal left anterior descending artery. Furthermore, a giant coronary arterial aneurysm was suspected around the proximal left coronary artery. These findings led us to perform cardiac computed tomography in order to further evaluate the entire cardiac pathology. Cardiac computed tomography confirmed a giant coronary arterial aneurysm, as large as 70 mm in diameter, at the proximal left anterior descending artery (Fig. 3). From the aneurysm, a small fistula to the left atrium was also detected. No other...
fistulae, including those between the aneurysm and the pulmonary trunk, were observed. The pulmonary trunk was significantly compressed and deformed between the ascending aorta and giant coronary arterial aneurysm (Fig. 3). At the compressed pulmonary trunk, accelerated flow (1.30 m/s) was observed on continuous-wave Doppler echocardiography, which would have been the main cause of the systolic ejection murmur. She underwent aneurysmectomy combined with reconstruction of the left main trunk with an autologous pericardial patch, coronary artery bypass grafting to the left anterior descending artery, and closure of the fistula. On postoperative day three, the systolic ejection murmur and wide splitting of the second heart sound had disappeared (Fig. 1) along with the restoration of the normal pulmonary trunk (Fig. 3). Continuous-wave Doppler echocardiography confirmed the disappearance of the accelerated flow with the normalization of the flow velocity through the pulmonary trunk (0.84 m/s).

**Discussion**

Even in healthy subjects, the delay of the pulmonary component of the second heart sound during inspiration causes physiological splitting, which disappears during expi-
ration (1, 2). However, in some cases, the splitting is auscultated even during expiration. This is often observed in patients with atrial septal defects, pulmonary hypertension, or right bundle branch block (1, 2). In the present study, we demonstrated an unusual mechanism of pathological wide splitting of the second heart sound due to external compression of the pulmonary trunk, which was observed in a patient with a giant coronary arterial aneurysm of the proximal left anterior descending artery. Stenosis due to compression of the right ventricular outlet, including the infundibulum, pulmonary root, and pulmonary trunk, can increase the right ventricular afterload, which can prolong the right ventricular systole; this is observed as the wide splitting of the second heart sound (2, 3). Three days passed before auscultation could confirm the disappearance of the systolic ejection murmur and the splitting of the second heart sound. Considering the possible interference by the postoperative residual hematoma and edema, this finding would indicate that several days were necessary before the original diameter of the pulmonary trunk was restored.

Although the shunt flow from the coronary aneurysm to the left atrium was continuous, as confirmed by Doppler echocardiography, no continuous cardiac murmur was detected by careful intensive auscultation. We initially considered that the shunt would be associated with current systolic ejection murmur as well as wide splitting of the second heart sound by increasing blood flow through the aortic valve. Contrary to this expectation, however, the shunt was so small that no findings indicating increased flow velocity through the aortic valve were observed by continuous-wave Doppler echocardiography. Furthermore, as shown in Fig. 2, the wide splitting of the second heart sound was not “paradoxical” but simply “pathological”, which supported that the systolic ejection murmur was not created by the increased blood flow through the aortic valve.

Even in modern clinical cardiology, basic auscultation skill is not obsolete and is still important because it can always provide a clue to a patient’s underlying pathophysiology. Furthermore, in addition to phonocardiography and echocardiography, a three-dimensional anatomical analysis with cardiac computed tomographic examination is useful for elucidating the mechanisms of abnormal heart sounds.

In conclusion, we reported a case with pathological wide splitting of the second heart sound. The present report emphasizes the usefulness of echocardiography, combined with a three-dimensional anatomical analysis with cardiac computed tomography, in elucidating unusual mechanisms of abnormal heart sounds.

**Figure 3.** Cardiac computed tomographic findings before and after surgery. The upper and lower panels show multi-planar reconstruction and volume-rendered images, respectively. The pulmonary trunk was compressed and deformed between the giant coronary arterial aneurysm (black stars) and ascending aorta before surgery (A). After surgery, the normal caliber of the pulmonary trunk was restored (B).
The authors state that they have no Conflict of Interest (COI).

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