Coronary-Pulmonary Artery Fistulae Depicted by Multiplanar Reconstruction Using Magnetic Resonance Imaging

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We compared the imaging capability of magnetic resonance angiography (MRA) with that of conventional coronary angiography in a patient with coronary-pulmonary artery fistulae. Using the latter procedure, it is difficult to measure abnormal tortuous blood vessels in one section. However, the course of blood vessels could be evaluated quite well by rearranging serial cross-sectional MRA images using multiplanar reconstruction (MPR). This procedure allowed us to determine the anatomic positional relationship of these vessels to the peripheral cardiac great vascular system. MPR may detect sites of influx and outflow of abnormal blood vessels. (Jpn Circ J 1998; 62: 455-457)

Key Words: Coronary-pulmonary artery fistula; Magnetic resonance angiography; Multiplanar reconstruction

Recent advances in magnetic resonance (MR) devices have facilitated coronary artery imaging during short periods of breath-holding using first cardiac gating acquisition with segmented k-space gradient echo cardiograms! We performed coronary MR angiography (MRA) in a patient with bilateral coronary-pulmonary artery fistulae and constructed images of abnormal blood vessels from multiple directions (multiplanar reconstruction; MPR). The constructed images were in good agreement with those obtained by conventional coronary angiography, suggesting that coronary MRA using MPR may be very useful clinically.

Case Report

A 40-year-old woman was referred to our hospital in January, 1997, for evaluation of a heart murmur. The murmur had been detected on physical examination 10 years previously. However, at that time she was asymptomatic and did not receive any medical or surgical treatment. The patient was 156 cm tall and weighed 48 kg. Her nutritional status appeared normal. On examination her pulse rate was 66 beats/min and regular, and her blood pressure was 116/78 mmHg. Physical examination revealed no pallor, jaundice, or cyanosis. Levine grade III/VI continuous murmur was present in the third intercostal space at the left sternal border. Her respiratory sounds were normal, and there were no rales. Her abdomen was normal, and no peripheral edema of her lower extremities was observed.

The patient's electrocardiogram and a chest radiograph revealed no abnormalities and her cardiothoracic ratio was 43%. On treadmill exercise testing there were no symptoms or significant changes in the ST segments at 12 METs.

Coronary angiography revealed several abnormal tortuous blood vessels starting from the origins of the left and right coronary arteries. A left-to-right shunt to the pulmonary trunk was also noted (Fig 1). However, there was no significant step-up of oxygen content (Table 1) and no significant stenosis in either the left or right coronary artery (Fig 1).

MR was performed with a 1.5-T superconducting magnet (GE-Sigma Advantage, Ver. 5.4). The MR study was performed in accordance with protocols approved by the Committee on Human Rights in Research of the University of Tokushima. A phased-array coil was used as a receiving coil. For the imaging sequence, a fast gradient echocardiogram method gated to the electrocardiographically determined cardiac cycle phase was employed. Imaging conditions were established as follows by selecting the best images under several different conditions in

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<thead>
<tr>
<th>Table 1</th>
<th>Data of Cardiac Catheterization</th>
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<tr>
<td></td>
<td>Pressure (mmHg)</td>
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<tr>
<td>SVC</td>
<td>4</td>
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<tr>
<td>IVC</td>
<td>5</td>
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<td>RA</td>
<td>5</td>
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<td>RV</td>
<td>26/6</td>
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<td>rt PA</td>
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SVC, superior vena cava; IVC, inferior vena cava; RA, right atrium; RV, right ventricle; rt PA, right pulmonary artery; lt PA, left pulmonary artery; m PA, main pulmonary artery.

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Fig 1. Coronary angiography. Several abnormal tortuous blood vessels arising from the origins of the left (a) and right (b) coronary arteries were seen. A left-to-right shunt to the pulmonary trunk was also noted.

Fig 2. Coronary MRA and MPR images. Abnormal blood vessels flowing from the left (a) and right (b) coronary arteries to the pulmonary artery were noted. Furthermore, MPR images showed blood vessels flowing from the origin of the left coronary artery to the pulmonary artery (c, d).

normal volunteers before this study. The view segment showing k-space segmentation was determined as 6; the first echo time (TE) 6.5 msec; the repetition time (TR) 14 msec; matrix number $256 \times 192$ (23 field of view; FOV); slice thickness 4 mm; and gap 0 mm. The subject was asked to hold her breath for 20 sec. In addition, cross-sectional images from the origins of the left and right coronary arteries along the coronary course as well as transverse sectional images were taken for MPR. Multidirectional images were rearranged by a reformat treatment using transverse sectional images.

Coronary MRA revealed abnormal blood vessels flowing from the left and right coronary arteries into the pulmonary artery (Fig 2a and b). Furthermore, MPR images from regions similar to these coronary sections also showed blood vessels flowing from the origin of the left coronary artery into the pulmonary artery and abnormal blood vessels flowing from the left anterior descend-
ing artery into the pulmonary trunk (Fig 2c and d).

Discussion

A coronary-pulmonary fistula is a relatively rare anomaly. There have been few reports on the usefulness of magnetic resonance imaging (MRI) in such cases. Pucillo et al. reported a large coronary-pulmonary fistula that was imaged using a spin-echo (SE) pulse sequence. SE pulse sequence techniques can reveal vascular morphologic information which is different from the blood flow information obtained in this study. No previous studies have confirmed coronary fistulae using MPR methods.

Recent advances in fast MRI have facilitated the clinical use of MRA for imaging blood flow through the coronary arteries. The uses of this procedure are currently being examined, thus a consensus regarding its usefulness in evaluating coronary stenosis has not yet been established. Further improvement of these devices and a larger number of cases are needed for such assessment. Coronary MRA may, however, be used to evaluate vascular abnormalities, as shown in this study. This procedure can image abnormal blood flow much better than SE methods. Furthermore, multiplanar reconstruction of several images taken without gaps can allow visualization of sections along the course of abnormal blood vessels as well as the origins and destinations of these vessels.

Coronary MRA is a non-invasive method, can be completed in a short period, and may sometimes be more useful than conventional coronary angiography for diagnosing an arterial fistula. Diagnosis of such coronary abnormalities and selection of the appropriate surgical technique for repairing them requires careful anatomical definition of the coronary artery with the fistula and its branches. MPR methods using coronary MRA may be very useful for the diagnosis and follow-up of coronary fistulae and for preoperative selection of the mode of surgical repair to be used.

References