The Role of Transesophageal Echocardiography in Identifying Anomalous Coronary Arteries

Francis Fernandes, MD; Mohsin Alam, MD, FACC; Stephen Smith, MD, FACC; Fareed Khaja, MD, FACC

Background. The study objective was to evaluate the role of transesophageal echocardiography in identifying the origin of anomalous coronary arteries and confirming their course in relation to the great vessels. The diagnosis of coronary anomalies is made by angiography. The anomalous left main artery with a course between the pulmonary artery and the aorta has been associated with myocardial infarction and sudden death. The course of these anomalous coronary arteries is difficult to demonstrate by angiography alone.

Methods and Results. Nine patients with angiographically confirmed anomalous coronary arteries were studied by transesophageal echocardiography with color flow Doppler. The abnormal origin of the anomalous coronary arteries was confirmed by transesophageal echocardiography in all nine patients. In four patients, the left main coronary artery originated from the right sinus of Valsalva. In all of these patients, transesophageal echocardiography demonstrated the course of the anomalous left main coronary artery between the aorta and pulmonary artery better than angiography. Other anomalies that were visualized included two patients with origin of the right coronary arteries from the left aortic sinus, one patient with origin of the left anterior descending from the right sinus, one patient with origin of circumflex from the right sinus, and one patient with origin of the left main coronary artery from the pulmonary artery.

Conclusions. Transesophageal echocardiography is a useful noninvasive test for diagnosing anomalous origin of the coronary arteries. Furthermore, it is a valuable adjunct to angiography in demonstrating the abnormal course of the left main coronary artery interposed between the aorta and the pulmonary artery, a potentially life-threatening entity. (Circulation. 1993;88:2532-2540.)

KEY WORDS • echocardiography • artery • echocardiography, Doppler

Anomalous coronary arteries have been associated with myocardial infarction and sudden death. In 1974, Cheitlin et al reported 9 sudden deaths in 33 patients who had an anomalous left main coronary artery arising from the right sinus of Valsalva. Since then, there have been several reports describing the significance of the anomalous left or right coronary artery with its proximal segments interposed between the pulmonary artery and the aorta. Previous methods to demonstrate the course included catheter placement in the pulmonary artery or angiographic views of a heart model with solder wire in anomalous positions for comparison. Transthoracic echocardiography with color Doppler has been useful in the pediatric age group, especially for diagnosing the anomalous left coronary artery arising from the pulmonary artery. In this study, we evaluate the role of transesophageal echocardiography in identifying the origin of the aberrant coronary arteries and confirming their course in relation to the great vessels.

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Methods
Nine patients with angiographically confirmed anomalous coronary arteries were studied by transesophageal echocardiography. A Hewlett-Packard ultrasound system (Sonos 1000) with a 5-MHz monoplane or biplane transesophageal transducer was used for the study. At 25 to 30 cm from the incisor teeth, the transducer tip was anteflexed to obtain a short-axis view of the aortic root. The left main coronary artery is usually identified between 2 and 3 o'clock. After clockwise rotation of the transducer tip, the right coronary artery is usually seen between 6 and 7 o'clock. Once the anomalous coronary ostia were visualized, the proximal segments were tracked using transducer tip manipulations, and color Doppler was used to confirm the course. Routine transthoracic echocardiography was also performed in all nine patients. The results were reviewed by two independent echocardiographers.

Results
The history and stress test and coronary angiogram results are summarized in the Table.
In four patients, transesophageal echocardiography identified the anomalous left main coronary artery arising from the right sinus of Valsalva with a course between the aorta and the pulmonary trunk (Figs 1 and
FIG 1. Transesophageal echocardiogram (A) in the basal short-axis view and coronary angiogram (B) of patient 1. The anomalous origin of the left main (LM) from the right aortic sinus is demonstrated with a course between the pulmonary artery (PA) and the aorta (Ao). RCA indicates right coronary artery; LAD, left anterior descending coronary artery; Cx, circumflex artery; and LA, left atrium.
Fig 2. Above and facing page. Transesophageal echocardiogram (TEE) (A) and coronary angiogram (B) of patient 2 demonstrating the left main (LM) arising from the right aortic sinus (R) and coursing between the pulmonary artery (PA) and the aorta (Ao). Note coronary angiogram with a Swan-Ganz (SG) catheter in the pulmonary artery. TEE with color Doppler (C) confirming flow in the anomalous left main. L indicates left aortic sinus; and RCA, right coronary artery.
Fig 3. This and bottom of preceding page. Transesophageal echocardiogram (TEE) (A) and coronary angiogram (B) of patient 5 showing the origin of the left coronary artery (L) from the pulmonary trunk (PT). Selective right coronary angiogram demonstrates the left coronary artery filling by collaterals from a markedly dilated right coronary artery (RCA). TEE with color Doppler (C) confirms flow in the left coronary artery. Ao indicates aorta.
Fig 4. Transesophageal echocardiogram (A) and coronary angiogram (B) of patient 6 demonstrating the origin of the right coronary artery (RCA) from the left aortic sinus (L) and its passage between the pulmonary artery (PA) and the aorta (Ao). LM indicates left main.
FIG 5. Transesophageal echocardiogram (A) and coronary angiogram (B) of patient 8 demonstrating the origin of the left anterior descending artery (LAD) from the right aortic sinus (R) and coursing between the pulmonary artery (PA) and the aorta (Ao). RCA indicates right coronary artery; and LA, left atrium.
Clinical and Angiographic Characteristics

<table>
<thead>
<tr>
<th>Patient</th>
<th>Age, y</th>
<th>Sex</th>
<th>Chest Pain</th>
<th>Stress Test</th>
<th>TTE Identification</th>
<th>Anomaly Diagnosed by Cardiac Catheterization</th>
<th>ASHD</th>
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<tr>
<td>1</td>
<td>49</td>
<td>M</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>LM from right sinus</td>
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<tr>
<td>2</td>
<td>45</td>
<td>M</td>
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<td>3</td>
<td>77</td>
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<tr>
<td>4</td>
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<td>6</td>
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<td>+</td>
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<tr>
<td>9</td>
<td>50</td>
<td>M</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>LC from right sinus</td>
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</tr>
</tbody>
</table>

TTE indicates transthoracic echocardiography; ASHD, atherosclerotic heart disease; MI, myocardial infarction; LM, left main; RCA, right coronary artery; LAD, left anterior descending coronary artery; and LC, left circumflex artery.

2). There was no coronary artery originating from the left aortic sinus.

In one patient, coronary angiography had shown an aneurysmally dilated right coronary artery that continued distally to form the left coronary system with late visualization of the pulmonary artery. Intraoperative transesophageal echocardiography confirmed the anomalous origin of the left coronary artery from the pulmonary trunk (Fig 3).

In two patients, transesophageal echocardiography visualized the anomalous right coronary artery and its course between the aorta and the pulmonary artery (Fig 4).

The origin of the anomalous left anterior descending artery from the right sinus of Valsalva and its course between the aorta and the pulmonary trunk were confirmed by transesophageal echocardiography in one patient (Fig 5).

The origin of the circumflex from the right aortic sinus was identified by transthoracic and transesophageal echocardiography in one patient. The course of the circumflex posterior to the aortic root was visualized only by transesophageal echocardiography.

Discussion

Coronary artery anomalies are rare, with an incidence of about 1%. However, patients with anomalous origin of either the left main coronary artery or the right coronary artery, with a subsequent course between the aorta and the pulmonary trunk, are at risk for myocardial infarction and sudden death. Theories to explain this risk include the slit-like ostia with acute take-off angles of the aberrant coronary arteries and possible compression between the pulmonary trunk and the aorta.

Transesophageal echocardiography has been shown to be of value in identifying the anomalous origin of the circumflex coronary artery from the right sinus, the right coronary from the left sinus, and the right coronary artery from the pulmonary trunk. These reports, however, involved fewer patients and did not include the clinically important anomalous left main coronary artery with a course between the pulmonary artery and the aorta.

This series of coronary anomalies includes five patients with an anomalous left main coronary artery. The abnormal course of either the left or the right coronary artery between the aorta and the pulmonary trunk was present in seven patients. This course was equivocally suggested by angiography. Transesophageal echocardiography confirmed the abnormal course of these aberrant coronary arteries and their relationships to the great vessels. Transesophageal echocardiography was also able to visualize the origin of the coronary anomalies in all nine patients. Slit-like ostia were not identified on monoplane or biplane imaging. Transthoracic echocardiography was able to identify the coronary anomaly in only one patient (anomalous circumflex artery).

Transesophageal echocardiography has limitations, including an inability to visualize the entire course of the coronary arteries. Small segments of the coronaries were visualized at one given time, and time-consuming transducer manipulations were required to track the course of the vessel.

The nine adult patients were first studied by coronary angiography to identify atherosclerotic coronary disease. The coronary anomalies were then diagnosed, and their course was demonstrated later by transesophageal echocardiography.

At the present time, coronary angiography is the procedure of choice to diagnose coronary anomalies and exclude atherosclerotic coronary disease. Transesophageal echocardiography, however, may be a good semi-invasive screening test to evaluate for coronary anomalies in a younger population. In patients with angiographically confirmed coronary anomalies, transesophageal echocardiography was very helpful in identifying and confirming the course of the coronary artery anomalies.

References


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