CASE REPORTS

Echocardiographic Features of a Mycotic Aneurysm of the Left Ventricular Outflow Tract Caused by Perforation of Mitral-Aortic Intervalvular Fibrosa

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SUMMARY We present the apparently unique M-mode and two-dimensional echocardiographic features of a surgically confirmed pseudoaneurysm of the left ventricular outflow tract, which probably developed as a result of perforation of the mitral-aortic intervalvular fibrosa. Echocardiographic studies revealed an aneurysmal sac situated between the aortic root and the left atrium. The aneurysm expanded in systole and collapsed or emptied in diastole, suggesting direct communication with the left ventricle. Such an aneurysm must be differentiated from various pathologic findings of the aortic root. The location and characteristic motion during the cardiac cycle should alert the clinician to the correct diagnosis of such an aneurysm.

Two types of left ventricular aneurysms are recognized: the true aneurysm and pseudoaneurysm, each generally a complication of transmural myocardial infarction. A true aneurysm communicates with the main ventricular chamber through a wide mouth and its wall is composed of fibrous tissue and some residual elements of myocardial wall. A pseudoaneurysm communicates with the ventricular chamber through a narrow mouth or ostium and its wall is composed of pericardium, organized blood clot and fibrotic tissue without any element of myocardium. Pseudoaneurysms, in contrast to true aneurysms, tend to rupture. Less often, a pseudoaneurysm may arise from distinct fibrous structures of the heart: the fibrous ring below either the mitral (annular subintimal) or aortic (annular subaortic) valves or the mitral-aortic intervalvular fibrosa (interannular subaortic aneurysm). The mitral-aortic intervalvular fibrosa is the junctional tissue between the mitral and aortic valves. Anular subvalvular aneurysms have been reported almost exclusively in black African population, presumably on a congenital or developmental basis. Echocardiographic findings in a case of annular subintimal aneurysm were recently reported. Pathoanatomic and angioanatomic features of pseudoaneurysms of the left ventricular outflow tract due to perforation of mitral-aortic intervalvular fibrosa have been described. In this paper we present the apparently unique M-mode and two-dimensional echocardiographic features of such a pseudoaneurysm detected in a patient with a history of subacute bacterial endocarditis involving the aortic valve. To our knowledge, echocardiographic features of such an aneurysm have not been previously reported.

Case Report

A 20-year-old Caucasian female was first noted to have a heart murmur at age 3 years. At age 16 years and again at 18 years, she was treated for bacterial endocarditis related to i.v. drug abuse. When she was 19 years old, during the third trimester of a pregnancy, she developed congestive heart failure. At age 20 years, because of increasing dyspnea on exertion, fatigue and palpitations, she was referred for the first time to our institution for cardiac catheterization.

Physical Findings

On physical examination, the pulse was 72 beats/min and blood pressure 116/78 mm Hg. The jugular venous pressure was not elevated. The carotid upstroke was delayed and deformed by a shudder. The lungs were clear to percussion and auscultation. A sustained and mildly diffuse left ventricular impulse was detected in the midclavicular line with an associated systolic thrill along the left sternal border. The first heart sound was normal; the second heart sound was narrowly split. An ejection click was followed by a grade IV/VII ejection systolic murmur that was loudest in the aortic area and radiated to the carotid arteries and the apex of the heart. A grade III/VI early diastolic decrescendo murmur was present along the left sternal border. The remainder of the physical examination was unremarkable. The ECG revealed sinus rhythm and was within normal limits. The chest x-ray showed normal heart size.

Echocardiographic Findings

M-mode and two-dimensional echocardiographic findings are shown in figures 1 and 2. The M-mode echocardiogram shows mild, concentric left ventricular hypertrophy but no dilatation. Fine diastolic fluttering of the anterior mitral leaflet is present, indicative of aortic regurgitation (fig. 1B). The aortic valve cusps are thickened and have multiple echoes in diastole, with apparently normal leaflet separation in systole (fig. 1A). An echo-free space lies immediately posterior to the aortic root and is well seen during ventricular
systole but is apparently obliterated during diastole (fig. 1A). Two-dimensional echocardiographic parasternal long- and short-axis views are most informative. This study reveals a bicuspid aortic valve with irregular thickening of the cusps and restricted opening (fig. 2). An echo-free space is seen behind the aortic root and posterosuperior to the anterior mitral leaflet. This space expands in systole and is almost completely obliterated in diastole, indicative of direct communication with the left ventricular chamber (fig. 2).

Cardiac Catheterization and Surgical Findings

Cardiac catheterization demonstrated moderate aortic stenosis and moderate aortic insufficiency, with a peak systolic aortic valve gradient of 42 mm Hg. Left ventriculography revealed an oval aneurysmal sac (3 × 1.6 cm) posterior and inferior to the aortic valve (figs. 3 and 4). The aortic root injection showed moderate poststenotic dilatation and a small mycotic aneurysm of the ascending aorta (fig. 3). Surgical inspection revealed a congenitally bicuspid aortic valve with conjoined left and right coronary cusps along with irregular thickening and stenosis. A 1-cm irregular mycotic aneurysm of the anterior aortic root was noted. After excision of the aortic valve, a 0.8-cm, smooth-walled perforation or opening was noted in the mitral-aortic intravalvular fibrosa just below the commissure separating the left and noncoronary aortic leaflets. This opening communicated with a sac-like structure positioned behind the aortic root. The abnormal chamber had a smooth, glistening lining. The orifice was oversewn and the aortic valve replaced with a #21 Hancock porcine bioprosthesis. The small mycotic aneurysm of the ascending aorta was also resected. The patient had an uncomplicated postoperative period and was discharged 8 days after surgery.

Discussion

Normally, the anterior leaflet of the mitral valve shows anatomic continuity with the left half of the noncoronary aortic cusp and the adjacent third of the left coronary cusp. The junctional zone between the elements of the two valves is formed by fibrous annular tissue and has been termed the "mitral-aortic intervalvular fibrosa." This zone separates the outflow tract of the left ventricle from the "epicardial wedge" and the pericardial cavity. Perforation of this zone may occur as a result of infection or blunt chest trauma and results in pseudoaneurysm formation. The wall of this aneurysm may be composed of organized thrombus, connective and granulation tissue. Eventually, the aneurysm may rupture into the pericardial cavity or left atrium.

The case we have reported had bacterial endocarditis involving a bicuspid aortic valve. The infection may have secondarily involved the mitral-aortic intervalvular fibrosa with subsequent perforation and pseudoaneurysm formation. An alternative possibility is that of a congenital or developmental abnormality of this fibrous intranunnular tissue occurring in association with the bicuspid aortic valve. If the outpouching were in fact a developmental structure, the term diverticulum might be appropriate. However, for consistency with prior reports, we have elected to use the term pseudoaneurysm.

An aneurysm arising from the mitral-aortic intervalvular fibrosa may be recognized echocardiographically by the aneurysm's location immediately behind the aortic root and by the occurrence of systolic expansion and diastolic collapse, indicating communication with the left ventricle. These features are best seen with two-dimensional echocardiography, but in the present case were also suggested by M-mode echocardiography. Echocardiographic findings should be differentiated from those observed in aortic ring abscess,8 aortico–left ventricular tunnel,9 dissecting aortic aneurysm10,11 and aneurysm of the sinus of Valsalva.12,14 In these conditions, marked parallel widening of the anterior or posterior aortic wall is typically seen. However, this widening frequently persists throughout the cardiac cycle. Characteristic M-shaped motion of the intimal flap may be seen in dissecting aneurysm.10,11 Several abnormal echocardiographic findings have been reported in cases of aneurysm of sinus of Valsalva.12-14 Rothbaum et al.17 described systolic emptying and diastolic expansion of a sinus of Valsalva an-
FIGURE 2. Systolic and diastolic frames of the parasternal long- (A and B) and short-axis (C and D) views. Short-axis views show thickening and restricted opening of the bicuspid aortic valve (AV). Systolic frames show an echo-free space (An) behind the posterior aortic root. This space expands in systole and completely empties (not visible in diastolic frame) in diastole. DA = descending thoracic aorta; RA = right atrium; p = posterior or noncoronary cusp; a = anterior cusp (conjoined right and left coronary cusp); A = anterior; P = posterior; I = inferior; S = superior; R = right; L = left; MV = mitral valve; other abbreviations as in figure 1.
Mycotic aneurysm. Shulman et al.\textsuperscript{13} noted parallel widening of the anterior aortic root in a case of aneurysm of right sinus of Valsalva. An aneurysm of the left sinus of Valsalva has been reported in which the M-mode echocardiogram suggested systolic expansion and diastolic collapse.\textsuperscript{14} However, the case lacked two-dimensional echocardiographic or surgical confirmation and communication of the aneurysmal structure with the left ventricle was not excluded. Two-dimensional echocardiography provided valuable information about our patient and showed that the aneurysmal structure in question was located posterior to the aortic root, expanded in systole and collapsed in diastole. These features clearly suggested that the aneurysm communicated with the left ventricle.

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