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 submitial) 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. Annular 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 submitial aneurysm were recently reported. Pathoanatomic and angiographic 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/VI 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 para-
sternal long- and short-axis views are most informa-
tive. 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 posteroseptal 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 aor-
tic 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 mod-
erate poststenotic dilatation and a small mycotic aneu-
rysms of the ascending aorta (fig. 3). Surgical inspec-
tion 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 not-
ed. 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 com-
missure separating the left and noncoronary aortic leaf-
lets. This opening communicated with a sac-like struc-
ture 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 aneu-
rysms of the ascending aorta was also resected.

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 annu-
lar tissue and has been termed the “mitral-aortic inter-
valvular 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 infection6-8 or blunt chest trauma9
and results in pseudoaneurysm formation. The wall of
this aneurysm may be composed of organized thromb-
bus, connective and granulation tissue. Eventually, the
aneurysm may rupture into the pericardial cavity8, 5 or
left atrium.7

The case we have reported had bacterial endocarditis
involving a bicuspid aortic valve. The infection may
have secondarily involved the mitral-aortic interval-
vular fibrosa with subsequent perforation and pseudoan-
eurysm formation. An alternative possibility is that of
a congenital or developmental abnormality of this fi-
brous intranodal 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 pseudo-
aneurysm.

An aneurysm arising from the mitral-aortic interval-
vular 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 echocardiogra-
phy. Echocardiographic findings should be differenti-
ated from those observed in aortic ring abscess,8
aortico–left ventricular tunnel,9 dissecting aortic aneu-
rysms10, 11 and aneurysm of the sinus of Valsalva.12, 14 In
these conditions, marked parallel widening of the an-
terior or posterior aortic wall is typically seen. How-
ever, 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 Val-
salva.12-14 Rothbaum et al.17 described systolic empty-
ing 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.
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Figure 3. Systolic (A) and diastolic (B) frames of the left ventricular angiogram in the left anterior oblique projection. An oval aneurysmal sac measuring approximately $3 \times 1.6$ cm is seen only in the systolic frame. The exact point of communication of this sac with the left ventricle (LV) is not clear, but it seems to arise below the posterior aortic valve cusp in the region of the mitral-aortic intervalvular fibrosa. The systolic frame also shows a mycotic aneurysm (broken white line) of the anterior ascending aorta (Ao). LCA = left coronary artery; An = aneurysm; RCA = right coronary artery.

Figure 4. The location of the left ventricular outflow tract pseudoaneurysm (An). (A) Systolic frame of the left ventricular long-axis view showing the opening (curved arrow) of the aneurysm between the posterior aortic valve (AV) cusp and the anterior mitral leaflet. Bicuspid aortic valve shows systolic doming. (B) Diastolic frame showing collapse of the aneurysm. (C) Relation of aneurysm to cardiac valves, viewed from above. PV = pulmonic valve; TV = tricuspid valve; other abbreviations as in figures 1 and 2.

eurysm. 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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