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Spontaneous Dissection of the Ascending Aorta Diagnosed by Two-dimensional Echocardiography*

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In two patients with acute dissection of the ascending aorta, the diagnosis was made with two-dimensional echocardiography and confirmed by aortography. The echocardiograms localized the intimal flap and false channel in both cases. Although clinical evaluation and indicated radiologic studies remain the primary modalities of diagnosis in acute aortic dissection, two-dimensional echocardiography may be a useful additional diagnostic technique.

M-mode echocardiography has been used to identify aortic aneurysms and to facilitate the diagnosis of aortic dissection.[1-4] The recent application of two-dimensional echocardiography, with its improved spatial orientation and wide field of view, should provide better visualization of aortic aneurysms and may establish the diagnosis of aortic dissection.[5] Cardiac ultrasound has also been applied as a noninvasive diagnostic tool in some cases of cardiac trauma causing pericarditis (with or without hemopericardium),[6] sinus of Valsalva aneurysm,[7] intracardiac fistula formation with left-to-right shunt,[8,9] and other lesions. In cases of severe, nonpenetrating chest trauma, aortic injuries are not rare, and traumatic tears are usually confirmed with angiography. Patient 1 described in this report is an example of aortic dissection possibly related to trauma identified by two-dimensional echocardiography preceding angiography. In patient 2, two-dimensional echocardiography diagnosed a spontaneous aortic dissection two months after an aortogram had been interpreted as negative.

Case Reports

Case 1

A 23-year-old, previously healthy man without prior cardiovascular history was admitted to the hospital after experiencing abrupt onset of pressing substernal pain radiating to the left arm and neck. The first episode of two to three hours of pain was associated with diaphoresis and light-headedness. The pain recurred several hours later, and the patient came to the Emergency Department. He had been physically assaulted two weeks before admission. Contusions of the right ribs were noted then, but a chest x-ray film was not obtained immediately. On admission to the hospital, the patient was in mild stress due to chest pain. His blood pressure was 110/60 mm Hg in the right arm and 120/60 mm Hg in the left arm, with symmetrical pulses in the upper and lower extremities. There was no external evidence of head, neck, or other chest trauma. Body habitus was normal, and there were no features suggesting Marfan's syndrome. The lungs were clear to percussion and auscultation. No cardiac rub, murmur, or gallop was audible. The ECG revealed sinus rhythm and incomplete right bundle branch block pattern. The cardiac contour and size were normal by chest roentgenogram. Pulmonary vascularity was normal. The mediastinal silhouette was widened, with enlargement of the ascending aorta and aortic knob.

During the initial 24 hours in the hospital, the chest pain subsided with analgesic therapy alone, and the patient's condition was otherwise clinically unchanged. An echocardiogram was done to assess the chest pain and the abnormal roentgenographic findings. The patients' echocardiogram (Fig 1) showed massive dilation of the aortic root. A linear echo within the lumen of the aortic root just cephalad to the right sinus of Valsalva suggested an intimal flap consistent with anterior dissection of the ascending aorta. Mild mitral valve prolapse with slight thickening of the mitral valve leaflets was present, but pericardial effusion was not identified. The remainder of the echocardiographic study was unremarkable. After the echocardiographic examination it was observed both that the left carotid pulse was no longer present and that a new grade 1/6 aortic regurgitation murmur had appeared.

Thoracic aortography (Fig 2) confirmed a Type A dissection,[10] with the false lumen arising just above the origin of the right coronary ostium and extending beyond the aortic arch and descending aorta to the level of the celiac

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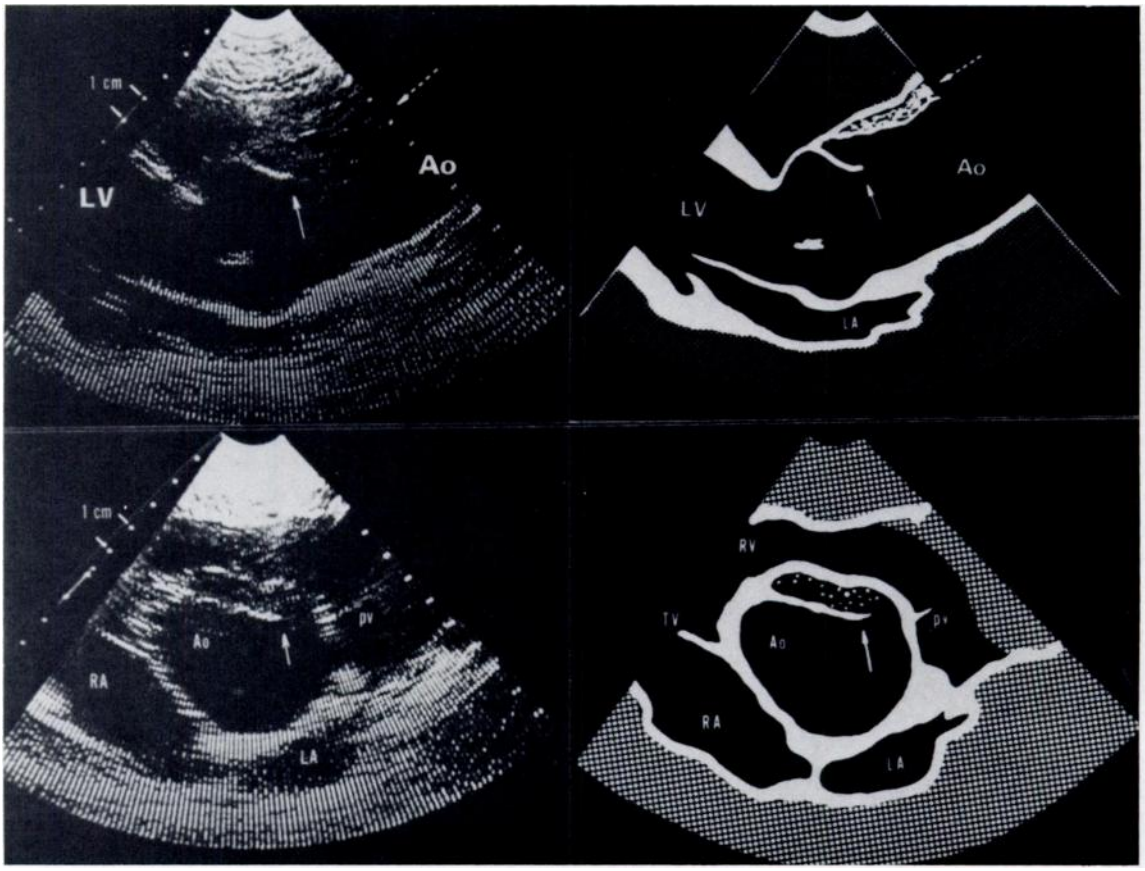

FIGURE 1. Two-dimensional cross-sectional echocardiogram of patient 1. *Top panels:* long axis view during diastole. Diagram at right illustrates findings. Note intimal flap (*solid arrow*) and thickened anterior aortic wall (*broken arrow*) due to dissecting hematoma. *Bottom panels:* short axis view, in which intimal flap is again identified (*solid arrow*). Abbreviations: Ao=aorta, LV=left ventricle, LA=left atrium, RA=right atrium, TV=tricuspid valve, RV=right ventricle, pv=pulmonary valve.

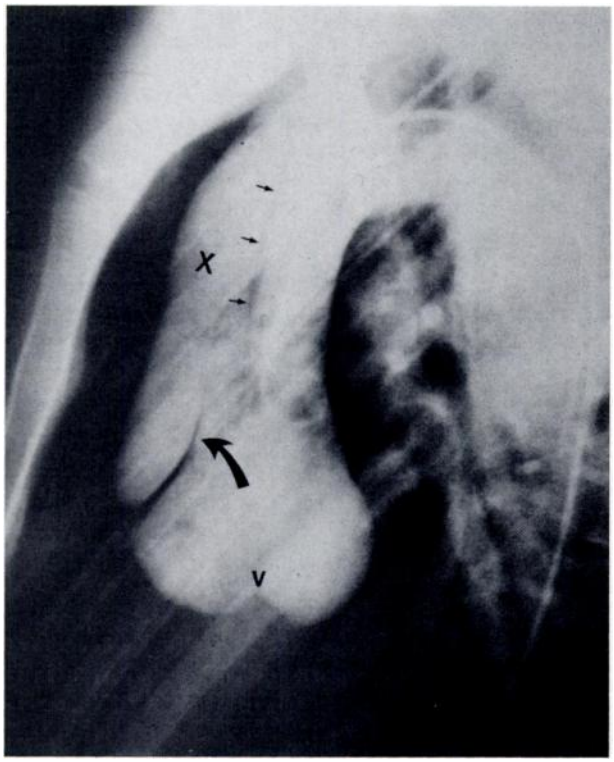

FIGURE 2. Thoracic aortogram (lateral projection) of patient 1. Intimal flap (*large arrow*) of an anterior aortic root type A dissection, whose false lumen (*X*) is outlined (*small arrows*). "V" shows location of aortic valve.

artery. The left common carotid artery was occluded at its origin. All other major aortic tributaries were patent. The echocardiographic and angiographic findings were confirmed at the emergent operation, where aortic valve replacement and interposition of an ascending aortic graft were performed. The excised aortic valve and proximal aorta showed no histologic abnormalities, but annuloaortic ectasia was grossly evident. The patient had an uneventful postoperative recovery with return of the left carotid pulse. Seven months later, acute spontaneous dissection of the descending thoracic aorta occurred, necessitating interposition of a second graft. Histologic examination of aortic sections this time revealed extensive myxoid medial degeneration with multifocal interruption of elastic fibers.

CASE 2

A 66-year-old man with a six-month history of asymptomatic, untreated hypertension was admitted to a coronary care unit after the acute onset of anterior chest pain while jogging. The pain was associated with nausea and slight diaphoresis on admission to the hospital. Physical examination was normal. Serial ECGs and serum enzyme studies did not suggest myocardial infarction, but on the third

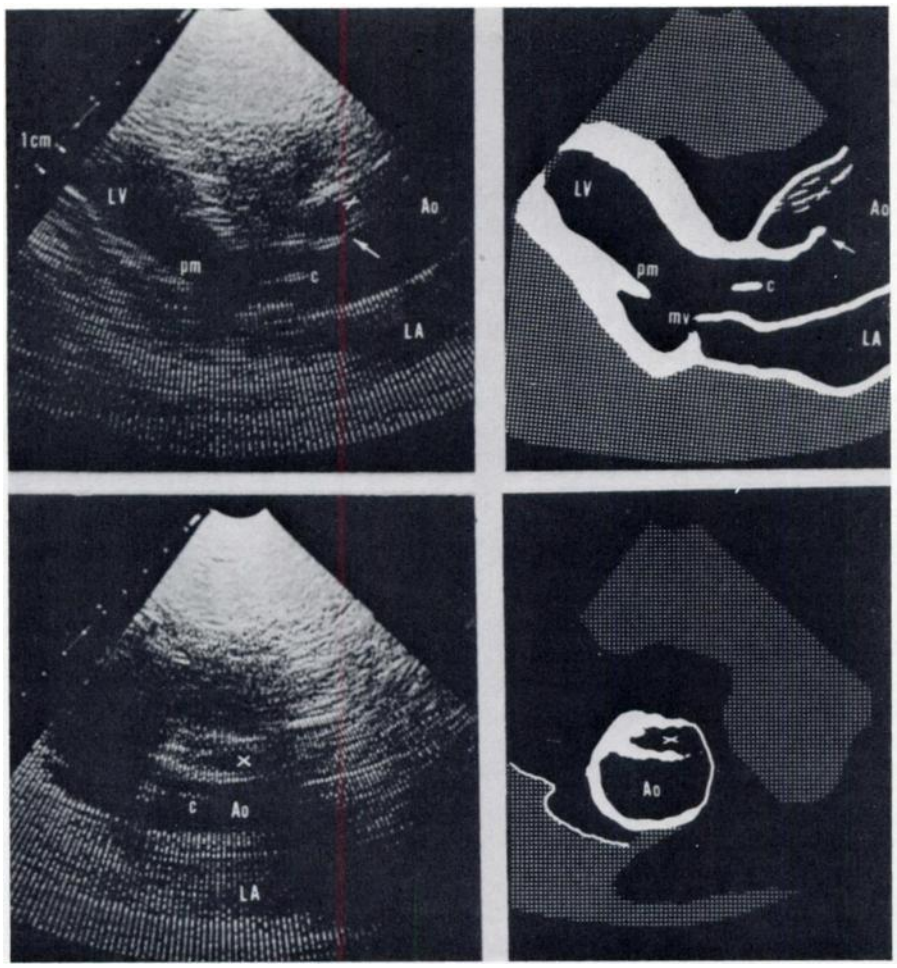

FIGURE 3. Two-dimensional cross-sectional echocardiogram of patient 2. *Top panels:* long axis view (illustrative diagrams on right). Intimal flap on the anterior aortic wall indicated by the *(solid arrow)* and the false lumen by the "X". In this view (diastole) closed aortic valve cusps are in middle of aortic root (c). *Bottom panels:* short axis view, with false lumen (x) anterior to true aortic lumen (Ao). Abbreviations: LA=left atrium, pm=papillary muscle, mv=mitral valve, LV=left ventricle.

hospital day the patient had severe epigastric pain, emesis, and abdominal distention. Coronary and aortic angiography were obtained to rule out aortic dissection or coronary artery disease. Insignificant areas of narrowing in the left coronary system were seen, and although the thoracic aorta was mildly dilated, no dissection was identified. The patient's symptoms resolved spontaneously, and he was discharged.

Two months later the patient experienced acute onset of hip and buttock pain. At the time of transfer to our institution he was in no distress, and physical examination revealed moderate hypertension, equal in both upper extremities. Pulses were normal in the arms and mildly decreased in the legs. A grade 2/6 systolic ejection murmur and a grade 2/6 diastolic decrescendo murmur consistent with aortic regurgitation were appreciated. The ECG and chest x-ray film were normal. The diagnosis of aortic dissection was entertained, and a two-dimensional echocardiogram was done on the night of admission. The echocardiogram showed dilation of the aortic root (Fig 3). In both long and short axis views, a linear echo arising just above the right sinus of Valsalva and running parallel to the anterior aortic wall appeared to divide the lumen into anterior and posterior channels. No pericardial effusion was identified; the remainder of the echocardiogram was unremarkable. Thoracic aortography subsequently confirmed the presence of a type A dissection arising above the aortic valve and

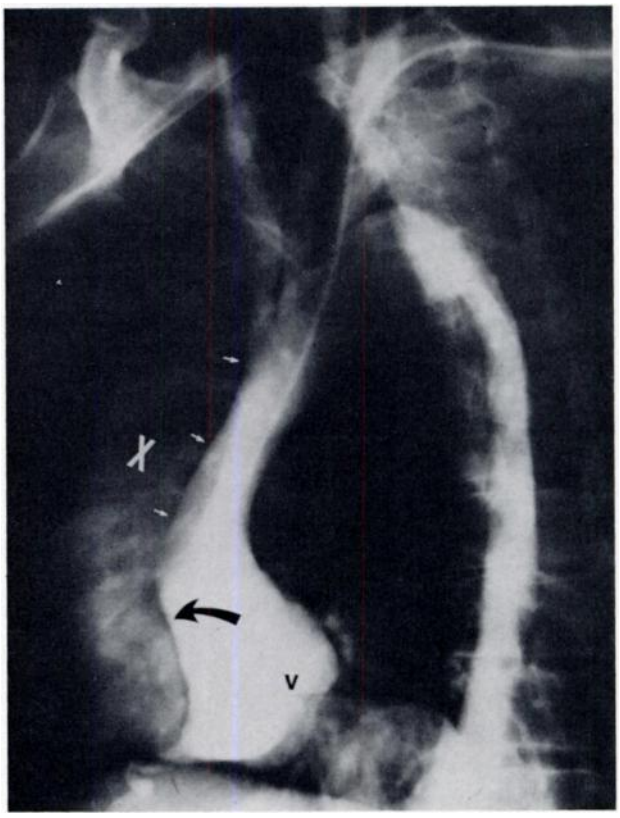

FIGURE 4. Thoracic aortogram of patient 2. Intimal border of true ascending aorta indicated *(large arrow)*. (Aortic valve is located at V.) "X" indicates false channel of type A dissection outlined *(small arrows)*.

extending to the level of the visceral vessels (Fig 4). The patient had an uneventful recovery after interposition of a Dacron ascending aortic graft and aortic valve replacement.

Discussion

Previous reports have identified M-mode echocardiographic features of aortic dissection: an increase in the aortic root dimension; increase in the thickness of the component echoes of the anterior and posterior aortic walls; and synergistic movement of the aortic wall components during the cardiac cycle.[1-4] Krueger et al[11] illustrated that technical artifacts or anatomic thickening of the aortic wall may mimic aortic root dissection. In a study by Brown et al,[2] the criteria for dissection were seen in normal patients as well as in those with aortic dissections. The M-mode echocardiographic findings are most helpful when some supporting clinical indication of dissection is present. Subsequently, the presence of an oscillating flap within the false lumen has been noted in patients with aortic dissection, and, when present, this sign may permit a more specific diagnosis to be based on the M-mode tracing.[12,13]

Two-dimensional echocardiography may be a more definitive diagnostic technique in cases of aortic dissection because of its ability to image the heart in multiple projections and specifically to seek evidence for a false lumen, tear, or both of the aortic intima. Both of these features were seen in our patients. DeMaria et al[5] have described two-dimensional and M-mode echocardiographic findings in three cases of aortic dissection among 12 patients with ascending aortic aneurysms. Ascending aortic dissection was correctly identified by two-dimensional echocardiographic studies in each case, whereas the M-mode studies were negative or equivocal in two of the three patients. Our cases illustrate two instances of anatomic delineation afforded by the two-dimensional images and emphasize the potential close agreement between two-dimensional echocardiographic studies and thoracic angiography.

There are several potential pitfalls in the two-dimensional echocardiographic diagnosis of ascending aortic dissection. False-positive diagnoses may result from ultrasound artifacts, including reverberations from strong anterior aortic wall echoes or extraneous echoes emanating from the sides of the aortic lumen, detected due to beam width. These artifacts are distinguishable from true aortic structures, which demonstrate the following: (1) parallel motion with the anterior aortic wall; (2) lack of "cascading" secondary to echoes posterior to the structure; (3) persistence of the structure's image with adjustment of total gain or reject settings or both; and (4) persistence of the image in multiple views from various angles and transducer positions.

Various features of traumatic aortic tears have been identified through study of patients involved in vehicular accidents.[14] The majority of patients have signs and symptoms of multiple-organ trauma at the time they first receive medical attention. This may direct the examining physician away from the possibility of aortic injury unless overwhelming signs are present. In some instances, aortic rupture may occur with few initial signs or symptoms. In these cases aortic rupture is not suspected until later in the patient's course, when symptoms are evident or when changes are noted on subsequent chest x-ray films. Patient 1 discussed in our report is notable for having experienced blunt chest trauma without significant thoracic symptoms in the immediate post-injury period. After a two-week asymptomatic interval, this patient had chest pain more suggestive of myocardial ischemia than dissection. The patient's physicians did not immediately associate the prior chest trauma with the possibility of significant aortic injury (and indeed there may well have been no connection in light of the second dissection seven months later). As in similar cases, the chest x-ray film directed attention to the aorta. The echocardiogram and changing physical findings strongly suggested the diagnosis of dissection, and angiography was performed as the definitive study. This case illustrates the potential utility of echocardiography in an unusual case of unsuspected aortic dissection. In cases of nonpenetrating chest trauma, the possibility of significant cardiovascular injury must be considered, and echocardiography may have a role in evaluation along with indicated chest x-ray films and appropriately timed angiographic procedures.

The clinical presentation of our second case is more typical of spontaneous aortic dissection in elderly patients with hypertensive vascular disease. A previous aortogram interpreted as negative compounded the difficulty of making the correct diagnosis. Simultaneous opacification of the true and false lumina during angiography in patients with aortic dissection has been suggested as a cause of false-negative angiographic interpretation,[15] but the dissection should be delineated in virtually every case by experienced radiologists using appropriate projections. Although a two-dimensional echocardiographic study subsequently confirmed the diagnosis in our patient, we cannot be certain that the echocardiogram would have identified a dissection at the time the patient initially became sympto-

matic. This case emphasizes that it may be helpful to perform a two-dimensional echocardiographic study in cases of suspected aortic dissection that are unconfirmed by other diagnostic techniques. The reliability of two-dimensional echocardiography in discovering ascending aortic dissection remains unproved, and angiography is still the "gold standard" by which the diagnosis is made.

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