Limited reliability of the "negative" two-dimensional echocardiogram in the evaluation of infectious vegetative endocarditis: Diagnostic and surgical implications

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SUMMARY.—Three patients with vegetative endocarditis involving a native valve, a mechanical prosthesis and a bioprosthetic valve respectively are presented. Each underwent emergency surgical exploration and prosthetic valve replacement based on clinical evidence of vegetative endocarditis after an initial delay following a report of a negative two-dimensional echocardiographic study. These cases emphasize the fact that within the clinical setting in which vegetative endocarditis is strongly suspected a negative two-dimensional echocardiographic study must be interpreted with caution. This is particularly true in patients with fungal, embolic or prosthetic valvular endocarditis. A decision to delay surgical consultation and therapy based upon a negative two-dimensional echocardiographic study in these patients is ill advised and may result in serious thromboembolic complications or even death.

KEY WORDS.—Two-dimensional echocardiography - Endocarditis - Vegetative valvulitis - Embolic endocarditis - Prosthetic endocarditis.

INTRODUCTION

Two-dimensional echocardiography (TDE) has greatly enhanced noninvasive study of the heart. It has proven particularly useful in the evaluation of congenital heart defects, wall motion abnormalities, myopathies, pericardial disease, intracardiac masses, endocardial surfaces and the size, function and physical characteristics of the cardiac valves. Unfortunately, the reliability of TDE in the evaluation of infectious endocarditis has not paralleled its efficacy in other areas of cardiac investigation. Occasionally, valvular vegetations in the presence of infectious endocarditis go undetected by TDE. This is particularly important in the situation wherein the results of TDE directly influence the decision as to whether urgent surgical intervention is indicated, as in cases of fungal, embolic or prosthetic valvular endocarditis. When TDE is negative in this clinical setting and relied upon as the only piece of information upon which a decision for surgical therapy is based, the delay in operative intervention may result in serious complications or death.

We report three cases of embolic endocarditis that required surgery. The large valvular vegetations noted at surgery and located on a native, a mechanical and a bioprosthetic valve respectively were not detected preoperatively by TDE. This experience emphasizes the fact that a negative two-dimensional echocardiographic study in these patients must be interpreted with caution. A decision for operation should be based on clinical indications and not on the basis of echocardiographic findings.
Case 1. A 74-year-old Oriental gentleman with a previous history of bronchopulmonary Aspergillosis was admitted to Stanford University Hospital in April, 1980 with a ten day history of malaise, myalgias, fever (38.8°C) and a sudden loss of vision in the right eye. Examination revealed an endophthalmitis and a hypopyon. Aspergillus fumigatus was isolated from the vitreous aspirate. In addition, a new systolic murmur was detected along the left sternal border. Although vegetative valvular lesions could not be demonstrated by cardiac catheterization or by repeated two-dimensional echocardiographic studies, Aspergillus endocarditis was suspected.

Surgical exploration performed on May 10, 1980 revealed a markedly edematous heart with an inflamed and friable mitral annulus. A 1×1 centimeter vegetation was also present on the anterior mitral leaflet. The valve was replaced with a #31 porcine bioprosthesis.* Although the operative procedure was uneventful, the immediate postoperative course was complicated by a Type I posterior transmural tear of the mitral annulus resulting in sudden tamponade and hemodynamic collapse in the intensive care unit. Resuscitation efforts including internal cardiac massage were unsuccessful. Cultures from the valve removed at surgery were positive for Aspergillus.

Case 2. A 70-year-old white male with a previous history of Streptococcus bovis endocarditis developed progressive heart failure and underwent mitral valve replacement (MVR) on March 16, 1981 with #31 porcine bioprosthesis. The postoperative course was complicated by a hemorrhagic pericarditis and effusion, a steroid induced bleeding duodenal ulcer, and prolonged pulmonary insufficiency. Polymicrobial bacteremias also complicated the hospital course. The patient was discharged from the hospital in June, 1981. Three months later, on September 14, 1981, the patient was readmitted to Stanford University Hospital, extremely ill with a fever of 103°F, a grade II/VI systolic ejection murmur and Roth spots in the ocular fundi. Blood cultures were positive for Candida albicans. Although a two-dimensional echocardiographic study failed to reveal evidence of valvular vegetations (Fig. 1), a sudden embolic occlusion of the left femoral artery occurred on the second hospital day. Gram stain of the material removed at the time of femoral embolectomy revealed budding yeast. The patient underwent emergency exploration and replacement of the previous mitral bioprosthesis. The prosthesis was extensively involved with several vegetations measuring 0.5 to 1.5 cm in diameter which surrounded the sewing ring on the ventricular side causing near total obstruction of the mitral orifice (Fig. 2). Following surgery, progressive cardiac deterioration developed and the patient expired twenty-four hours later from low cardiac output. Cultures of the valvular vegetations grew Candida albicans and histologic sections demonstrated branching hyphae.

Case 3. A 52-year-old white male with a Björk-Shiley * mechanical prosthesis placed in 1972 for rheumatic valvular disease began experiencing tran-

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NEGATIVE TWO-DIMENSIONAL ECHO IN VEGETATIVE ENDOCARDITIS

Two-dimensional echocardiography (TDE) has become very popular in the noninvasive investigation of vegetative endocarditis. Its superiority to M-mode studies in the evaluation of this condition has been well documented. Echocardiographic evidence of valvular abnormalities has been reported in as many as 80-84% of patients presenting with the clinical picture of endocarditis. However, a number of factors have made it difficult to precisely determine the true specificity and sensitivity of this method. First, a study of good technical quality is required. Even under the best of circumstances, approximately 10% of echocardiographic studies are technically inadequate and therefore uninterpretable. In addition, some reports provide excellent clinical follow-up, while others lack specific anatomical confirmation with respect to the presence, size and location of vegetative lesions. Others have attempted to draw conclusions on the efficacy of echocardiography while lumping together the results of two-dimensional and M-mode studies. These inconsistencies have often made interpretation of the data difficult.

Fig. 2.—Infected bioprosthetic porcine valve secondary to Candida endocarditis excised from the mitral position. A large vegetation (arrow), which was not detected by preoperative two-dimensional echocardiography, is noted on both the ventricular (Panel A) and atrial surfaces (Panel B).

occurred on two occasions after the empirical administration of nafcillin. During this period TDE did not demonstrate prosthetic valvular vegetations. On January 6, 1982, an acute left brachial artery embolus required emergency admission and embolectomy. Histologic sections of the embolic material demonstrated gram positive bacteria. TDE was repeated but again failed to demonstrate valvular vegetations. Because of the overwhelming clinical evidence in favor of vegetative prosthetic valvular endocarditis, the patient was taken to the operating room. The previous prosthetic valve was removed along with a large subvalvular vegetation. A 3.0 x 3.0 cm periprosthetic aortic annular abscess was also encountered which extended into the interventricular septum. The aortic valve was replaced with a #21 Ionescu-Shiley pericardial bioprosthesis and the abscess cavity was obliterated by plication at the time of repair. Attempts at weaning the patient from cardiopulmonary bypass including the use of the intraaortic balloon were unsuccessful. Postmortem examination revealed multiple old and recent myocardial embolic infarctions diffusely throughout the heart. Renal and splenic infarcts as well as multiple emboli to the peroneal and tibial arteries were also discovered. Material cultured from the prosthetic valve grew Propionibacterium acnes.

Discussion

Transient fevers and recurrent episodes of painful erythematous areas over his ankles and feet in April 1981. There was no evidence of congestive heart failure or cardiac murmurs. Blood cultures and soft tissue aspirations of the involved areas were negative. Although extensive evaluations failed to explain the cause of these problems, clinical improvement
Two-dimensional studies which are interpreted as positive in the presence of endocarditis usually correlate well with the anatomical presence of valvular vegetations.\textsuperscript{10,11} However, approximately two-thirds of the echocardiographic abnormalities remain unchanged throughout therapy despite good medical management. A large number of these patients will require operative intervention.\textsuperscript{7,10} Among the 12 patients with aortic vegetations noted on TDE reported by Berger \textit{et al.},\textsuperscript{2} five (42\%) ultimately required valve replacement, while 12 (26\%) of 47 patients in the series reported by Stewart \textit{et al.},\textsuperscript{7} required surgery. In the Stanford series reported by Martin and associates,\textsuperscript{1} 21 (62\%) of 34 patients with positive TDE required valve replacement and all were found to have vegetative lesions at the time of the operation.

Our observations as well as those reported by others indicate that a negative two-dimensional echocardiogram does not rule out the presence of valvular endocarditis.\textsuperscript{6,10} The infective process may be interstitial and destructive rather than vegetative and therefore not detectable by echocardiographic methods. Technical limitations may also contribute to the inability of TDE to detect valvular or endocardial vegetations in certain situations.\textsuperscript{4} For example, valvular lesions less than 2-3 mm in diameter have generally been considered below the limits of resolution.\textsuperscript{2} In some circumstances such as fungal and bacterial prosthetic valve endocarditis, larger masses may also go undetected. Valvular obstruction and embolic complications are common in these conditions and failure to detect vegetations by TDE could be serious. The vegetative valvular lesions in our three cases were not detected despite the fact that each was larger than 1 cm in diameter, an observation which has been substantiated by others.\textsuperscript{7,8} In addition, the physical characteristics of a particular lesion as determined by the composition, size, shape, density and type of infecting organism may also directly influence its echoability.\textsuperscript{11} It appears from accumulated data that between 5-15\% of patients with endocarditis and negative echocardiographic studies will ultimately require surgery.\textsuperscript{5,7,8}

When the infective process invades perivalvular tissue abscesses and "mycotic" aneurysms of the aortic annulus and interventricular septum may result. Unfortunately, TDE has not been as effective as had been hoped in the detection of these serious complications.\textsuperscript{17} In the series reported by Strom \textit{et al.},\textsuperscript{3} five patients had abscesses in association with their endocarditis but preoperative echocardiography suggested its presence in only one. In addition, of 40 patients with negative TDE in the series reported by Stewart \textit{et al.},\textsuperscript{7} two required surgery for persistent bacteremia and both were found to have annular abscesses, which were not suspected preoperatively. Becher \textit{et al.},\textsuperscript{9} reported an annular abscess and a mycotic aneurysm of the aorta discovered at the time of surgery in two patients which went undetected by preoperative TDE. In their review, they also reported that the number of patients with negative TDE who required surgery for vegetative valvular lesions alone was 7.7\%; when annular or myocardial abscesses were considered as an indication for surgery in addition to valvular lesions, the number requiring surgery increased to 15.4\%. In one of our patients, an annular abscess which was associated with an infected mechanical prosthesis and which extended into the interventricular septum was undetected by preoperative TDE. While we agree with the many authors who advocate the efficacy of TDE in the evaluation of prosthetic valvular endocarditis, and in particular endocarditis on bioprosthetic valves,\textsuperscript{1,10,12} we feel that it is important to emphasize the fact that echoreflective properties inherent in both the components and design of bioprosthetic and mechanical valves may on occasion limit the utility of TDE in the evaluation of these patients.\textsuperscript{10} Our experience with two patients described above supports this contention. A mechanical valve with a large subvalvular vegetation and annular abscess as well as a bioprosthetic tissue valve with large fungal vegetations went undetected in these two cases. Similarly Nunez \textit{et al.},\textsuperscript{13} reported two cases of porcine valve endocarditis in whom valve ring abscesses and valve dehiscence were not detected by TDE. In a recent report by Cavarocci and Kolff,\textsuperscript{14} TDE failed to identify an annular abscess associated with an infected Björk-Shiley\footnote{Shiley Incorporated, Cardiovascular Division, Irvine, CA.} prosthesis.

Medical management is certainly the initial

"NEGATIVE" TWO-DIMENSIONAL ECHO IN VEGETATIVE ENDOCARDITIS

therapeutic course to be taken in all patients presenting with endocarditis. Provided the patient responds satisfactorily and hemodynamic or thromboembolic problems are not encountered, medical therapy may be all that is required. Conversely, continued sepsis, hemodynamic deterioration and embolic complications are indications for a more aggressive approach. The majority of these patients will require urgent valvular replacement. It is advisable to alert the surgeon early in the therapeutic course so that he may become familiar with the patient and better prepared to proceed with surgery should it become necessary. It is clear from the patients and data described above that a decision for surgical intervention should not be based on results of TDE alone. The clinical indications to proceed with valvular replacement in patients with endocarditis are well established:

1. Continued sepsis despite what is considered appropriate and adequate antibiotic therapy.
2. Hemodynamic deterioration despite pharmacologic support resulting from valvular incompetence or obstruction or from the toxic effects of sepsis on the myocardium.
3. Valvular thrombosis.
4. Peripheral arterial embolization.
5. Suspected or confirmed annular or intramyocardial abscess.
6. Prosthetic valvular infection.

We recommend, as do others, that these patients be managed surgically, regardless of what is found by TDE. The decision for proceeding with surgery under these circumstances should be based on the clinical indications and not upon the result of a two-dimensional echocardiographic study, since this could delay surgical therapy and result in serious sequelae or even death.

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REFERENCES


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