function tests. The mathematical procedures constitute a powerful technique for identifying the relative "weight" to be assigned to each individual measurement towards an ultimate discriminant equation for correlating radiographic measurements with lung function parameters and clinical emphysema. Such techniques are well worth reporting and should be applicable in many other situations where measurements are to be tested for diagnostic value.

However, it is illogical to propose using this or the other methods for recognition of clinical emphysema because of the patients who have the symptom complex but do not have emphysema, most of whom will appear as false negative cases. For example, Table 4 of Rothpearl et al suggests that, at best, there were 13 percent false-negative results from the discriminant function among the cases with clinical emphysema. Furthermore, their Table 4 shows that there were 11 percent false positive results among the control cases. These data represent a sensitivity of 87 percent and specificity of 89 percent, which are rather low values for diagnostic purposes.

It seems far more logical to recognize that chest films should reflect structure, rather than function or symptomatology, and to use films for recognition of emphysema as defined in structural terms. Several reports have shown that this can be accomplished with virtually no false positive interpretations even in nonsymptomatic cases, or false negative interpretations in cases with emphysema present at autopsy, who have had COPD during life. The result is that when a patient with the symptoms or functional criteria of COPD (or clinical emphysema) has negative findings on chest films, one can reliably conclude that the lungs would not show emphysema at autopsy and that the impairment results from small airways disease. This situation probably accounts for most of the false negative cases reported by Rothpearl and associates.

It is necessary here to mention a procedural error in the preparation of their Table 4. This involves the evaluation of the diagnostic reliability of the derived discriminant function, using the same population of cases and controls that provided the data to create the function. This certainly must have produced the best possible sensitivity and specificity values and it must be assumed that, if the formula were to be used with a different population, the diagnostic accuracy would undoubtedly be lower than 88 percent.

Another aspect of the evaluation of diagnostic tests is the predictive value of positive or negative interpretations. When sensitivity and specificity values are below 95 percent, predictive values, although they also are affected by disease prevalence, are usually disappointingly low. In the reports noted above where x-ray film interpretation was matched against findings in autopsy lungs, the predictive values of both negative and positive interpretations would be 98 percent if the technique were applied in a population where emphysema prevalence was 5 percent.

If reliable early recognition of emphysema and exclusion of emphysema in symptomatic patients are clinically desirable, as the papers listed above would imply, the interpretation of chest films using validated criteria appears to be the best available technique. A detailed review of relevant literature can be found in reference 10.

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**The Evolving Role of Echocardiography in Management of Bacterial Endocarditis**

Since the early 1970s echocardiography has had an increasing impact on the management of bacterial endocarditis. Although its utility in the diagnosis,
prognosis and follow-up of this disease has been examined in multiple studies, considerable uncertainty persists regarding its specific roles in disease management. The rapid development of ultrasound technology has created a profusion of new techniques, thereby creating new questions concerning the position of echocardiography in clinical decision-making. Specifically, the advent of two-dimensional echocardiography, Doppler ultrasound and most recently, transesophageal echocardiography have had and will continue to have significant impact upon the utilization of echocardiography in the treatment of endocarditis.

Diagnosis

Prior to the development of echocardiography the diagnosis of endocarditis was based on subjective and often presumptive criteria. The ability of echocardiography to visualize vegetations in the setting of bacteremia has provided a powerful diagnostic standard enjoying a degree of specificity approaching 100 percent in skilled hands. In addition, echocardiography is the only noninvasive, objective tool the clinician has available for the documentation of culture-negative endocarditis.

The sensitivity of the medium has, however, been called into question. While a greater than 80 percent sensitivity has been claimed for the technique's ability to detect vegetations, this number is based upon clinical and not anatomic diagnostic standards and is, therefore, open to debate. Nevertheless, it is clear that significant improvements in two-dimensional imaging technology have led to heightened diagnostic sensitivity since the time of the early efficacy studies in the early 1980s. The recent clinical introduction of high-frequency transesophageal echocardiography should increase this sensitivity even further by limiting ultrasonic noise and increasing image resolution. The diagnostic capacities of Doppler echocardiography in endocarditis detection are as yet untested.

Prognosis

Technologic advances have also made significant contributions to echocardiography's prognostic capabilities. The original study of Wann et al of the M-mode technique demonstrated that over 90 percent of patients presenting with echocardiographically-documented vegetations either eventually required cardiac surgery or died. Possibly because of its ability to visualize smaller vegetations, vegetations on right heart structures and earlier disease in general, the two-dimensional detection of vegetations appears to be a less ominous sign. While some investigators have suggested that visualization of any vegetation is predictive of either subsequent embolization, congestive heart failure or surgical intervention, others have disputed this contention. In addition, vegetation size over 1 cm in length has been implicated as a risk factor for clinical sequelae. The relationship of vegetation mobility to subsequent embolization remains a question but deserves future investigation.

Follow-up

The value of echocardiographic follow-up studies in the management of endocarditis is also becoming apparent. While major utility of the M-mode in this regard has been its capacity to portray progressive left-sided valvular destruction manifesting as leaflet flail or premature mitral closure due to severe aortic insufficiency, two-dimensional echocardiography provides a wider spectrum of follow-up capabilities due to its superior spatial resolution. For example, identification of ring abscesses, pseudoaneurysms and pericardial effusions prior to their clinical manifestations may lead to earlier life-saving surgical intervention.

The utility of Doppler echocardiography in the prognosis and follow-up of endocarditis patients has only recently been investigated. Doppler flow mapping can depict the physiologic integrity of affected valves and roughly quantitate severity of valvular insufficiency. Preliminary results from a multicenter investigation suggest that the development of valvular regurgitation is an ominous sign and may predict future surgical intervention.

The article by Chow and colleagues (Chest 1988; 94:462-65 [September]) supports the contention that echocardiographic follow-up of certain endocarditis patients may be useful. The authors have confirmed an earlier report documenting the ability of Doppler echocardiography to diagnose rupture of a sinus of Valsalva aneurysm. They describe an even more impressive capability of the color Doppler technique: its detailed portrayal of aortic perforation sites caused by abscess formation. The combination of high-resolution two-dimensional echocardiography with color Doppler imaging, as utilized in this report, provides the surgeon with detailed preoperative maps of the anatomic and pathophysiologic landscape previously unobtainable with either invasive or noninvasive imaging modalities, and superior at times to angiography. The potential surgical benefits to be gained from these powerful tools are obvious.

It appears, then, that the precise role of echocardiography in management of bacterial endocarditis is still evolving. While initially providing only a diagnostic capability, its value in prognosis and therapeutic assessment are now coming to light as well.

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