Physiological Valvular Regurgitation

Doppler Echocardiography and the Potential for Iatrogenic Heart Disease

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The advent of Doppler echocardiography and subsequently the development of color Doppler flow mapping have provided new tools for evaluating the function of the heart and imaging complex intracardiac flow patterns, but with the availability of a new tool it is incumbent on clinical investigators to develop guidelines for defining the normal range of findings. Many recent studies have suggested that with improving sensitivity of Doppler ultrasound devices, valvular regurgitation may be detected through the tricuspid valves of as many as 95% of the healthy subjects in some series, 92% of pulmonary valves, and a variable and lower percentage of left-sided heart valves.

In the early 1970s with M-mode echocardiography and later with two-dimensional echocardiography, similar confusion existed in framing strict and definitive criteria for the echocardiographic detection of mitral valve prolapse and its delineation from the spectrum of normal valve motion. Based on differing criteria for prolapse, a variety of references reported varying incidences of these findings in healthy subjects. Many of these studies are still open to question, and the true incidence of prolapse is still poorly defined although echocardiographic criteria continue to be modified and clinical criteria continue to be applied. It is clear, however, that a population of iatrogenically created "abnormal subjects" were mislabeled as having mitral prolapse. There is still confusion in dealing with issues concerning the natural history of mitral prolapse and the importance and medical and legal aspects of the need for subacute bacterial endocarditis prophylaxis.

As pointed out in the study in this issue by Yoshida and colleagues from Kobe General Hospital, when over 200 healthy Japanese subjects were examined by color Doppler flow mapping echocardiography subjects who were screened by physicians to verify the absence of murmurs as well as normal electrocardiograms, mitral regurgitation could be detected in up to 45% of individuals, tricuspid regurgitation in up to 70%, and pulmonic regurgitation in up to 88%. Aortic regurgitation was not encountered, however. These results confirm and expand previous studies, only a few of which specifically stressed the color flow mapping methodology.

The frequency with which valvular insufficiency could be detected by Doppler echocardiography, as Yoshida and his coworkers point out, varied with age. The frequency of mitral regurgitation was increased in older subjects, which could potentially be a function of valve degeneration. However, the incidence of detectable valve regurgitation also varied in other surprising ways. Thus, regurgitant flow signals from the pulmonary and tricuspid valves were detectable with decreasing incidence by color flow mapping in the older age group. The authors suggest that this change in "detectability" is probably mainly related to deterioration of the ultrasonic windows in the older patients. Also, it seems likely that the thin, "echogenic" body habitus prevalent in the Japanese population may permit valve regurgitation to be detected in a larger percentage of individuals than might be the case in a population of more heavily built or obese individuals.

Yoshida et al. present color flow map criteria related to the spatial distribution of the regurgitant jet, which specify that the valvular regurgitant signal in healthy subjects be localized to the immediate proximity of the valve coaptation site (much less widely distributed in the heart than in groups of patients studied with pathological valve regurgitation). Yoshida et al. also developed the criterion that a valve insufficiency signal should be labeled as such only if it is of at least 100-msec duration on a color Doppler overlayed M-mode image. However, they did not establish criteria for the velocity of normal regurgitation. Most investigators have separated true valve regurgitation from Doppler "ghosting" or other lower velocity signals with spectral, pulsed-wave, or continuous-wave Doppler by requiring that the velocity approximate that expected for the normal Bernoulli-predicted pressure gradient between the affected chambers. This

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is usually more than 1.2–1.5 m/sec for right-sided valves, even if of short duration. Criteria for left-sided valves are less clear.

Likewise in our own experience, the color flow map images that we have been willing to label as “true regurgitation” have shown retrograde acceleration of flow across the valve, often with aliasing at the regurgitant site, suggesting regurgitation through a restrictive orifice located in a closed valve, rather than simply the closing volume of blood pushed by the coapting valve. The true incidence of “normal” valvular insufficiency, therefore, remains a function not only of the sensitivity of the ultrasound device and the ease of echocardiography in the population being studied but also of the actual criteria being used for valvular regurgitation.

As they relate to the color flow area localization of the regurgitant signals described by Yoshida et al., we agree that the limits they have defined clearly fall within the normal population. The separation of individuals with abnormal valvular regurgitation requires a significantly larger area of regurgitation visualized on a color flow map, and the findings also usually occur in conjunction with either elevation of right heart pressure, dilation of a valve anulus, or some structural abnormality of the valve itself. Age and the effects of afterload (pulmonary disease on the right heart or systemic hypertension on the left heart) can also have an influence. Recent work with the transesophageal echo approach, even in awake patients, suggests that the internal echo window significantly increases the sensitivity of Doppler color flow for intracardiac flow events, particularly in the right and left atria and the left ventricular outflow tract. Thus, the incidence of detectable valve regurgitation in healthy subjects, as well as in patients, would be substantially higher if transesophageal echo was used as the gold standard. Our own experience in studying esophageal echoes in noncardiac patients suggests that the spatial distribution of the valvular regurgitation area may be larger and valvular regurgitation may be even more prevalent than that reported by Yoshida et al.

Dr. Harvey Feigenbaum in the fourth edition of his textbook Echocardiography stated: “It is possible that the Doppler technique is so sensitive that clinically insignificant regurgitation can be detected.” To quote Yoshida and his coworkers, “The principal clinical implication of realizing the possibility of silent Doppler regurgitation is to avoid the iatrogenic heart disease.” The quality and localization of these signals, we believe, can be defined in a way that permits this normal regurgitation to be characterized and avoid misinterpretation by third-party payors, insurance carriers, or other physicians. Care should also be taken in discussing such findings in front of the patient during the echocardiographic examination. In our laboratory, we have chosen to report such findings to the referring physician, lest they be interpreted as new findings if the patient comes back for restudy in our hospital or is studied in another facility. Our report specifically states that “physiological valvular regurgitation of the tricuspid, mitral or pulmonary valve was detected and is a normal finding.” However, as instrumentation continues to evolve, with improvements in the quality of the color Doppler displays, better detectability of lower velocity events, enhanced sensitivity of Doppler color flow mapping, and more widespread dissemination of these techniques into the community, the issue of how to report findings in subjects believed to have normal hearts will be an on-going problem.

The new color Doppler flow mapping technologies have tremendous potential for the qualitative and quantitative noninvasive evaluation of valvular heart disease.1,2 The studies by Yoshida and colleagues represent an important expansion of the spectrum of normal findings. There will, however, always be a gray zone where normal meets abnormal, as well as variations in the prevalence of observed valvular regurgitation in specific populations. As instrumentation improves, investigation and reporting of findings characteristic of well-screened, nondiseased populations such as that studied by Yoshida and coworkers will be of continuing importance.

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