GUEST EDITORIAL

Point-of-Care Echocardiography:
Asking the Right Questions

See page 262 for the article by Rugolotto et al. to which this editorial pertains.

This history of cardiology is replete with examples of changes in clinical care that were driven by the development of new technology. The enormous potential clinical value of electrocardiography became apparent with the development of the early string galvanometers, which were expensive and bulky. However, this potential was realized only when electrocardiographic machines became streamlined, smaller, less expensive and portable. Initially performed only in a laboratory setting, the electrocardiogram is currently used by virtually all physicians — cardiologists and non-cardiologists — and by some non-physicians — emergency medical technicians and coronary care unit nurses — in a variety of settings to evaluate patients with known or suspected heart disease.

Echocardiography has replaced electrocardiography as the principal non-invasive cardiac test, and has evolved rapidly over the past few decades. Two-dimensional imaging and colour flow Doppler were technologic innovations that fundamentally changed the way we make cardiac diagnoses. Recent improvements in cardiac ultrasound have been both evolutionary and revolutionary. Examples of evolutionary advances include automatic border detection for assessment of systolic function[1], Doppler tissue imaging for assessment of diastolic function[2], and harmonic imaging for improved endocardial border definition[3]. One revolutionary advance has been the introduction of true three-dimensional echocardiographic imaging based on planar array technology. Although still in its infancy, this technology, by all accounts, represents the future of cardiac ultrasound.

Miniaturization represents the second recent revolutionary advance in echocardiography. Improvements in microcomputer technology have led to the development of ultrasound machines no larger than a laptop computer. These so-called ‘point-of-care’, hand-carried cardiac ultrasound (HCU) devices are capable of generating extremely high quality cardiac images that rival those from standard equipment[4]. The advantages of these small systems are immediately obvious: because they are portable, HCUs can be used with greater flexibility than standard equipment in a variety of hospital settings, including the emergency room and intensive care unit. Physicians can carry them on rounds and use them as an ‘ultrasonic stethoscope’. Beyond the hospital walls, HCUs are currently being considered for use in a variety of field-based emergency medical settings, including by the military. Indeed, portable ultrasound devices were included among the first shipments of emergency supplies sent to the New York City area in the immediate aftermath of the 11 September attack[5]. Their availability, use and capability are very likely to increase over time.

The major question that must be answered in evaluating this new technology is whether, in the best of hands, the image quality and diagnostic accuracy are adequate for general use. In this issue of the Journal, Rugolotto et al. reassures us that the image quality of the OptiGo® portable ultrasound machine is sufficiently high that accurate diagnoses can be made[6]. Similarly, examination with the OptiGo® device was able to identify the vast majority of cardiac abnormalities, with a significantly shorter scanning time than was required with standard equipment.

Yet the results of this particular study may not be immediately generalizable. All portable examinations in this study were performed by an experienced level II echocardiographer, as described in an American College of Cardiology guideline[7]. The results were then compared to those obtained by a trained sonographer and interpreted by an experienced, level III, echocardiographer. Thus, the relatively high diagnostic accuracy of the present study is due, in part, to the skill of the individuals who performed and interpreted the examinations. It is unlikely that all users of HCUs will have such highly developed skills.

Not all recent studies have embraced these new devices so enthusiastically. In a recent study, point-of-care echocardiography by board certified cardiologists with level II echocardiography training, while
significantly improving on physical examination, still failed to detect 21% of major cardiovascular pathology diagnosed by standard imaging\textsuperscript{[8]}. Another recent study revealed that 31% of abnormalities were similarly missed by experienced echocardiographers\textsuperscript{[9]}. This diagnostic gap may relate to the inherent limitations of the HCU or the less comprehensive examination performed. Yet in these studies, like the study by Rugolotto, echocardiograms were performed by well-trained echocardiographers. If examinations are performed by physicians with less or no formal training, it is likely that the diagnostic accuracy will be much lower. The limited examination made possible by the HCU increases the risk of missing relevant information that can be derived from a standard examination.

Concomitant with the decrease in size of HCUs has been a substantial decrease in cost due to the rapidly declining cost of microprocessor technology. The anticipated low cost of these devices is likely to contribute to their popularity. HCUs are substantially less expensive than standard echocardiographic equipment, and are being marketed to a broad range of physicians. Yet portability and low cost do not necessarily translate into increased usability. The authors of the present study cite the complexity of current ultrasound equipment as a rationale for these new devices. While the latter are simpler to use than standard echocardiographic equipment, our own experience suggests that these examinations require no less skill on the part of the operator, who must still choose the imaging plane and acquire the image. That these devices are easier to carry from bed to bed goes only so far in improving the overall usability over standard ultrasound equipment.

One reason that electrocardiograms can be interpreted effectively by non-specialists has been the availability of automated diagnostic algorithms that, while not infallible, identify many clinically relevant abnormalities\textsuperscript{[10]}. In contrast, there are currently no such diagnostic ‘aids’ for portable ultrasonography, although these might be developed in the future. For now, obtaining and interpreting images with these machines requires an appropriate level of skill.

Although the idea of a ‘personal’ HCU is relatively new to cardiology, this issue is well known to the radiology community, particularly in the field of obstetrical radiology. Portable equipment used by practitioners in the office or emergency setting have been subject to little regulation, although the major radiologic societies are currently introducing stringent guidelines that will set standards for quality, require certification for practitioners, and set reimbursement guidelines. Cardiologists will need to develop similar strategies.

Finally, inherent limitations of the current portable ultrasound devices must be recognized. Current devices have limited capacity for storage of images and thus have little or no documentation capability, which is a critical element of quality control. In addition, the current lack of spectral Doppler increases the potential for false negative studies in patients with valvular heart disease.

Technology can empower physicians. The concept of a hand-held ultrasound machine being carried and utilized much like a stethoscope is enormously appealing. Rugolotto et al. make clear that the diagnostic accuracy of point-of-care echocardiographic devices is comparable to that of standard equipment. The broader question, however, is not just how good will these devices be in the hands of the experienced echocardiographer, but how good will they be in the hands of the larger number of physicians that will now have access to this technology? An HCU able to generate high quality images does not make its user an echocardiographer any more than a high quality opthalmoscope makes an ophthalmologist. While standard cardiac ultrasound laboratories and personnel — both physicians and non-physicians — are subject to accreditation processes that ensure adherence to standards of practice, the cardiology community needs to take the lead in ensuring that similar standards of care are applied to this new technology and to provide personalized user-specific training. It is therefore of interest that the American Society of Echocardiography has recently released a policy statement recommending that Level I training (primary performance of 150 echocardiograms — comparable to that received in most modern general cardiology fellowship training programmes) be considered an absolute minimal level of training for performance of hand-held echocardiographic examinations\textsuperscript{[11]}.

The technologic advances inherent in point-of-care echocardiography devices should be applauded. However, future studies will need to define clearly the clinical utility of these devices and indications for standard echocardiographic follow-up. At present, given the risk for misdiagnosis with HCUs, we must be cautious about their use by the cardiology and internal medicine community at large, and vigilant about the standards required of those who choose to use the technology.

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References


