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Hand Carried Echocardiography Systems – A Beautiful Toy or a Useful Device With Major Impact on Clinical Practice?

Ch. Scholten, H. Baumgartner

Technological progress of recent years has made it possible that ultrasound industry can now offer affordable, portable and battery-operated ultrasound systems with the size of a laptop computer. Some of these hand-held echocardiography systems can now provide all modalities including two-dimensional echo, continuous-wave, pulsed-wave and color Doppler and facilitate rapid bedside diagnosis and patient screening. However, besides skill in performing and interpreting echocardiograms, awareness of the devices' limitations and optimization of conditions and surroundings appear to be crucial for proper application of this new technology. This recent development in echocardiography also raises a number of questions and the actual impact on general clinical practice still remains to be seen. *J Clin Basic Cardiol* 2002; 5: 153–4.

Key words: hand-held echocardiography, ultrasound devices, new technologies

Advances in ultrasound technology have established echocardiography as the central diagnostic tool in cardiology. When performed by skilled and experienced physicians using “high end” instruments, cardiac ultrasound non-invasively provides accurate and comprehensive evaluation of various heart disorders. Thus, echocardiography can identify and grade valve disease, congenital heart defects, systolic and diastolic ventricular dysfunction, pulmonary hypertension, myocardial hypertrophy and myopathy, pericardial disease and, when including stress studies, coronary artery disease. However, a complete conventional study with all possible features is time-consuming and costly. In addition, waiting lists in echocardiography laboratories are long and significant time delay in getting crucial diagnostic information is not uncommon. Thus, the ultrasound industry was challenged to overcome this growing problem. Now, technological research has achieved a first goal towards a promising solution by providing affordable, portable and battery-operated devices with the size of a laptop computer (Fig. 1).

These instruments may not only be very useful for screening as so far described for asymptomatic left-ventricular dysfunction [1] or for hypertrophic cardiomyopathy in athletes [2]. Portable and compact, hand-held echocardiography instruments could indeed substantially improve clinical practice as they enable a cardiologist to have a personal imager that provides comprehensive evaluation of cardiovascular pathology at the point of patient contact [3]. Although proposed by some authors, such bedside ultrasound investigation should certainly not replace deteriorating physical examination skills in our technological era [4]. On the contrary, ultrasound evaluation of cardiovascular pathology should be complementary to expert physical examination.

The advent of this new technology has, however, raised a number of questions:

(1) How accurate are these instruments as some of them, particularly the very small ones, do not include all modalities of modern echo machines? How often will important findings be missed and further evaluation be precluded by a false negative examination? And, on the other hand, how often will they provide confusing findings, particularly when used by poorly trained physicians, leading to unnecessary further testing?

(2) How much training is necessary for proper and helpful use of these instruments? In view of question 1, can these instruments be widely used by internists or even general

practitioners without causing more hassle than help or without being dangerously misleading even?

(3) How much time does the procedure add to each patient encounter and does this additional time expenditure render the use of point of contact echocardiography impractical [5]?

(4) What will be the financial consequences as far as reimbursement of such examinations is concerned? Will these developments reduce reimbursement for echocardiography performed in the regular echolab?

(5) Will these devices adversely affect the profession of cardiac sonography in countries such as the United States?

(6) Will physicians without cardiology training “take up” echocardiography now that the price of equipment has fallen, with the problems raised in question (2)?

It will certainly take some time to answer all these questions while at the same time the situation may continue to change as these instruments will be technically improved.

We were given the opportunity to test one of these very lightweight and compact devices (Fig. 1). Fifty consecutive, unselected patients with various pathologies were studied with the SonoHeart™ System (SonoSite, Inc., Bothell, WA) and the results were compared to those obtained with a conventional scanner (“high end” machine) in a blinded manner.

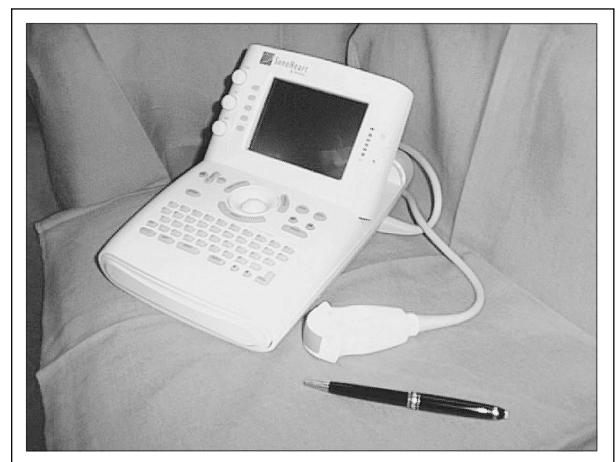


Figure 1. SonoHeart™ System, SonoSite, Inc., Bothell, WA

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With the new system, adequate images could be obtained in all patients. The presence of left ventricular dysfunction, regional wall motion abnormalities, relevant valvular regurgitation (moderate or more) or valve stenosis were correctly diagnosed in all patients. However, there was a tendency towards underestimating the extent of wall motion abnormalities particularly in patients difficult to image. Discrepancies also frequently occurred in patients with trivial or mild regurgitation, where false positive and false negative findings were described. This may be due to the fact that current technique of this particular device does not display regurgitant jets with the usual mosaic pattern. Left heart diameters measured with the hand-held system correlated well with those obtained with conventional scanning [6]. In addition, we have found hand-held echocardiography to be very useful for cardiologists on call to be taken on wards or intensive care units for a first contact examination. We concluded that this device may be able to cover the majority of screening studies and could thereby reduce the number of patients who need a full examination in the echolab. However, it has to be emphasized that all examinations in this study were performed by investigators highly experienced in echocardiography. We are convinced that such results cannot be expected when these instruments are widely used by less trained physicians. Thus, this study cannot answer the majority of questions raised above. Although there are recent data showing that briefly trained non-cardiologist physicians can use hand-held-ultrasound devices [7, 8], it is obvious that echocardiographically not fully-fledged physicians should be cautious utilizing it. First, the very small devices are not yet fully equipped and fully functional (eg spectral Doppler is not provided, color Doppler has low sensitivity), therefore defining clear limitations for the examination. Second, a good imaging quality can only be achieved under favourable conditions. As the system is very small and lightweight, the well resolved images are also extremely small. In order to overcome the handicap of a rather big transducer-footprint, patients should be optimally positioned for better access to imaging windows. The ambience of bedside physician encounter is not that of an echocardiography laboratory, especially with regard to suboptimal environmental lighting, which should be

dimmed for better quality. All these issues restrict the possible application of this small scanner. Conditions not optimally complying to the demand, as for example in a study with critically ill patients [9], have resulted in a high error-rate, thereby producing more harm than benefit for the patient.

In conclusion, hand-held cardiac ultrasound in skilled and experienced hands enables improved patient management by providing fast and comprehensive information on cardiac pathology outside the echolab. Besides skill in performing and interpreting echocardiograms, awareness of the device's limitations and optimization of conditions and surroundings appear to be crucial for proper application of this new technology. The actual impact on general clinical practice remains to be seen.

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