



# Handheld Ultrasound Versus Physical Examination in Patients Referred for Transthoracic Echocardiography for a Suspected Cardiac Condition

Manish Mehta, MD,\* Timothy Jacobson, MD,\* Dawn Peters, PhD,† Elizabeth Le, MD,‡ Scott Chadderdon, MD,\* Allison J. Allen, MD,§ Aaron B. Caughey, MD,§ Sanjiv Kaul, MD\*

## ABSTRACT

**OBJECTIVES** The purpose of this study was to test the hypothesis that handheld ultrasound (HHU) provides a more accurate diagnosis than physical examination in patients with suspected cardiovascular abnormalities and that its use thus reduces additional testing and overall costs.

**BACKGROUND** Despite the limitations of physical examination and the demonstrated superiority of HHU for detecting cardiac abnormalities, it is not routinely used for the bedside diagnosis of cardiac conditions.

**METHODS** Patients referred for a standard echocardiogram for common indications (cardiac function, murmur, stroke, arrhythmias, and miscellaneous) underwent physical examination and HHU by different cardiologists, who filled out a form that also included suggestions for additional testing, if necessary, based on their findings.

**RESULTS** Of 250 patients, 142 had an abnormal finding on standard echocardiogram. Of these, HHU correctly identified 117 patients (82%), and physical examination correctly identified 67 (47%,  $p < 0.0001$ ). HHU was superior to physical examination ( $p < 0.0001$ ) for both normal and abnormal cardiac function. It was also superior to physical examination in correctly identifying the presence of substantial valve disease (71% vs. 31%,  $p = 0.0003$ ) and in identifying miscellaneous findings (47% vs. 3%,  $p < 0.0001$ ). Of 108 patients without any abnormalities on standard echocardiography, further testing was suggested for 89 (82%) undergoing physical examination versus only 60 (56%) undergoing HHU ( $p < 0.0001$ ). Cost modeling showed that HHU had an average cost of \$644.43 versus an average cost of \$707.44 for physical examination. This yielded a savings of \$63.01 per patient when HHU was used versus physical examination.

**CONCLUSIONS** When used by cardiologists, HHU provides a more accurate diagnosis than physical examination for the majority of common cardiovascular abnormalities. The finding of no significant abnormality on HHU is also likely to result in less downstream testing and thus potentially reduce the overall cost for patients being evaluated for a cardiovascular diagnosis. (J Am Coll Cardiol Img 2014;7:983-90) © 2014 by the American College of Cardiology Foundation.

Physical examination has been the mainstay for the point-of-care diagnosis of cardiovascular disease for centuries. Despite reports on the limitations of physical examination using the stethoscope (1,2) and the surge of imaging devices that can visualize the heart in real-time and augment

From the \*Knight Cardiovascular Institute, Oregon Health & Science University, Portland, Oregon; †Division of Biostatistics, Department of Biostatistics, Public Health and Preventive Medicine, Oregon Health & Science University, Portland, Oregon; ‡Portland Veterans Administration Medical Center, Oregon Health & Science University, Portland, Oregon; and the §Department of Obstetrics and Gynecology, Oregon Health & Science University, Portland, Oregon. This research was supported in part by a research grant from GE Medical, Milwaukee, Wisconsin and was presented in part at the 2013 annual scientific sessions of the American College of Cardiology in San Francisco, California, the American Society of Echocardiography in Minneapolis, Minnesota, and the American Heart Association in Dallas, Texas. Dr. Caughey serves as a medical advisor to CellScape, Ariosa Diagnostics, and MindChild Medical. All other authors have reported that they have no relationships relevant to the contents of this paper to disclose.

Manuscript received January 2, 2014; revised manuscript received April 28, 2014, accepted May 6, 2014.

**ABBREVIATIONS  
AND ACRONYMS**

**BMI** = body mass index  
**HHU** = handheld ultrasound  
**LV** = left ventricular  
**RV** = right ventricular

the physical examination (3-6), the stethoscope has not been replaced, in whole or in part, as the principal means of the bedside diagnosis of cardiac conditions.

An adverse consequence of the inaccuracy of physical examination is missing a diagnosis such as critical aortic stenosis or significant mitral regurgitation in a patient with severe left ventricular (LV) dysfunction. Another adverse consequence is the lack of confidence regarding the clinical significance of a physical finding (e.g., a murmur), which frequently leads to ordering a test that is often unnecessary. Finally, there are cardiac abnormalities that cannot be assessed by physical examination, such as moderate LV dysfunction, LV thrombus, and vegetation. For all these reasons, a direct visual assessment of cardiac structures and function at the point of care makes eminent sense.

We hypothesized that use of a handheld ultrasound (HHU) device that could be easily deployed at the point of care would provide a more accurate diagnosis than physical examination in patients suspected of having cardiovascular abnormalities. We also reasoned that finding no abnormality on HHU would reduce the chances of ordering an unnecessary test and thus potentially reduce overall cost in patients being evaluated for a cardiovascular diagnosis.

**METHODS**

**STUDY DESIGN.** This was a prospective study designed to compare HHU with physical examination in patients admitted to the hospital and referred for echocardiography. The reference standard was a routine 2-dimensional Doppler echocardiogram. The indications were broadly grouped under the 5 most common categories seen in an echocardiography laboratory: 1) LV function in patients with chest pain, dyspnea, and the like; 2) valve disease in patients with murmurs or known valve disease; 3) a cardiac source of embolism in patients with stroke; 4) structural heart disease in patients with arrhythmias; 5) and miscellaneous (congenital abnormalities, hypertrophic cardiomyopathy, diseases of ascending aorta, pericardial effusion, etc.). Because some patients were referred for more than 1 indication, each patient was assigned a primary and, if needed, a secondary indication.

The study was approved by the Institutional Human Investigation Committee at the Oregon Health & Science University. All patients gave written informed consent. Pregnant subjects and those <18 years of age were excluded.

A cardiology fellow (M.M. or T.J.) was assigned to the echocardiography laboratory to identify patients referred for 1 or more of the above 5 categories. The number of patients selected for each indication was roughly proportional to the frequency with which they were referred to the echocardiography laboratory. The fellow then identified a cardiology attending physician who examined the patient without access to the echocardiogram results. The patient was also examined the same day by another cardiologist using HHU, who also was blinded to the standard echocardiogram findings. Each attending physician was only told of the indication for which the standard echocardiogram had been ordered and was not allowed to obtain a patient history. They then completed a pre-designed form (Table 1). In addition, they indicated that based on their examination, the patient either needed no further testing or needed to undergo 1 of the tests listed in Table 1 to further clarify the diagnosis.

HHU was performed using a pocket-sized, battery-operated device (Vscan, GE Healthcare, Milwaukee, Wisconsin) weighing 39 g with a length of 13.5 cm, a width of 7.3 cm, and a thickness of 2.8 cm, attached to a broad-bandwidth ultrasound probe (1.7 to 3.8 MHz). It provides B-mode and color Doppler images but no spectral Doppler data. Its retail price is \$7,900.

LV and right ventricular (RV) function and pulmonary artery pressure were classified by both physical examination and HHU as either normal or abnormal. Valve disease was classified as none, mild, moderate, or severe. LV hypertrophy; LV, RV, and aortic dilation; hypertrophic cardiomyopathy; ventricular or atrial septal defect; and pericardial effusion were classified as being present or absent on both physical examination and HHU. For stroke patients, although hand-agitated saline was administered as per protocol for the standard echocardiogram to rule out a patent foramen ovale, it was not performed as a part of the HHU examination. Consequently, for purposes of this study, the cardiac sources of stroke included only LV thrombus or endocarditis.

There were 17 cardiologists who performed the physical examination. They were classified according to level of clinical experience based on the number of years they had practiced as an attending physician (<5, 5 to 10, or >10 years). There were 4 cardiologists who performed HHU examinations. They all had some experience in echocardiography, varying from <2 years to >20 years.

**STATISTICAL ANALYSIS.** The data were analyzed in 2 steps. The first was a comparison of HHU and

Download English Version:

<https://daneshyari.com/en/article/5980184>

Download Persian Version:

<https://daneshyari.com/article/5980184>

[Daneshyari.com](https://daneshyari.com)