Hand-held echocardiography-based heart failure screening in hypertensive or diabetic patients in community: a pilot study

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Background: There is lack of solid data on screening methods for preclinical heart failure (HF) in primary care settings. Standard echocardiography is not regarded as a routine test due to high cost and need of operation by specialists. Hand-held echocardiography (HHE) has been used in various clinical settings with easier access and lower price but has never been integrated into HF screening programme.

Purpose: This study aimed to explore the feasibility and cost-effectiveness of hand HHE-based HF screening strategies in patients with risk factors in community.

Methods: The registered patients with hypertension or diabetes at two Chinese community health service centres (CHSCs) who had not been diagnosed previously as HF were recruited. Every patient received symptom assessment (dyspnea and/or lower limb edema), blood test for N-terminal-probrain natriuretic peptide (NT-proBNP ≥ 125 pg/ml regarded as positive), and HHE for any indexed abnormality in the dedicated protocol with focused and semiquantitative scanning [i.e. left ventricular (LV) dilation, left atrial (LA) dilation, interventricular septum (IVS) thickening, LV systolic dysfunction by calipers, as well as region wall motion abnormality, valvular stenosis, ≥ moderate valvular regurgitation, significant pericardial effusion by eyeballing]. By using the results of all the three modalities for screening compared to the concurrent guidelines, the patients were categorized into HF stages A, B, or C as the "gold standard". Three screening strategies were proposed (Figure 1), of which Strategy I was designed as a single test, Strategy II as a combined test, and Strategy III as a stratified stepwise test. Diagnostic accuracy and cost-effectiveness of each strategy was calculated in comparison with the "gold standard".

Results: A total of 423 patients (70 ± 9 years; 46.6% males) were enrolled. There were 166 (39.2%) symptomatic patients, while 106 (25.1%) patients had elevated NT-proBNP. HHE abnormalities were found in 286 (67.0%) patients, of which IVS thickening was the most common finding (47.0%), followed by LA enlargement (30.0%). LV systolic dysfunction was identified in 18 (4.3%) patients. 232 (54.8%) and 59 (13.9%) patients were reclassified as HF stage B and C, respectively. As shown in Figure 2, the stepwise Strategy III of using symptoms for the first stratification, followed by choosing HHE or NT-proBNP test led to a 100% accuracy and a 35.6% reduction in cost.

Conclusions: HHE-based focused screening detects HF earlier in high-risk populations. The screening strategy combined with symptoms, NT-proBNP, and HHE is feasible for identifying underdiagnosed HF stage B or C that may be considered in primary care.
Figure 1. The scheme of HF stage screening strategies. HHE, hand-held echocardiography; NT-proBNP, N-terminal-probrain natriuretic peptide; SAHF, stage A heart failure; SBHF, stage B heart failure; SCHF, stage C heart failure.

Scheme of HF stage screening strategies

Enrolment
- 423 patients at two CHSCs
  - With hypertension or diabetes
  - Without known HF

HF screening test
- Gold standard for HF stages
- Symptom
- NT-proBNP
- HHE

Proposed screening strategy
- Strategy I: single
  - I-1: Symptom
  - I-2: NT-proBNP
  - I-3: HHE
- Strategy II: combined
  - II-1: Symptom+NT-proBNP
  - II-2: Symptom+HHE
- Strategy III: stepwise
  - Symptom
  - NT-proBNP
  - HHE

The accuracy and cost-effectiveness of HHE based strategy

<table>
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<th>Strategy</th>
<th>I-1</th>
<th>I-2</th>
<th>I-3</th>
<th>II-4</th>
<th>II-5</th>
<th>III</th>
<th>Gold standard</th>
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<tr>
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Figure 2. The HHE-based HF screening strategies and cost-benefit analysis. CHSCs, community health service centres; HF, heart failure; HHE, hand-held echocardiography; NPV, negative predictive value; NT-proBNP, N-terminal-probrain natriuretic peptide; PPV, positive predictive value; SAHF, stage A heart failure; SBHF, stage B heart failure; SCHF, stage C heart failure.

HF Screening and cost-effectiveness