Portable Echocardiography: An Innovative Tool in Screening for Cardiac Abnormalities in the Community

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Aims: Heart failure is placing an increasing burden on society. This has led to calls for echocardiographic-based programmes to screen for left ventricular systolic dysfunction and other cardiac abnormalities. Echocardiography using new fully portable echocardiography devices would allow community-based cost-effective screening programmes once validated. This study was undertaken to evaluate this further in both high and low-risk subjects.

Methods and Results: 562 consecutive subjects attending a community-based heart failure screening programme, some at high-risk and some at low-risk of cardiac abnormalities, underwent echocardiography by both portable and traditional echocardiography machines. An ‘eyeball’ estimate of left ventricular ejection fraction was made on the portable device and compared to a quantitative measure of ejection fraction on the traditional machine. Qualitative measures of valvular regurgitation and quantitative measures of left ventricular hypertrophy were also compared. An estimate of ejection fraction was possible in 97% of cases using portable echocardiography. It gave a sensitivity, specificity and negative predictive value in diagnosing left ventricular systolic dysfunction of 96%, 98% and 99.6%, respectively. Inter-observer variability gave a mean difference in ejection fraction of 2%, and 95% limits of agreement of −8% to +12%. All cases of moderate or severe valvular regurgitation and 29 of 31 cases of significant left ventricular hypertrophy were correctly identified as abnormal on the portable device.

Conclusions: Thus, echocardiography performed by experienced sonographers using these new fully portable devices is an accurate and reproducible technique for detecting left ventricular systolic dysfunction, left ventricular hypertrophy and valvular regurgitation in both high-risk and low-risk members of the community. Its very high negative predictive values would allow their use in future community-based screening programmes.

Introduction

Heart failure is one of the commonest chronic diseases of the western world with high associated morbidity, mortality and cost[1–4]. Asymptomatic left ventricular systolic dysfunction often precludes the development of symptomatic heart failure[5,6], and if angiotensin converting enzyme-inhibitor and beta-blocker therapy is initiated during this latent asymptomatic stage, then the development of chronic heart failure and its consequences can be delayed if not prevented[5,6]. Therapy with angiotensin converting enzyme-inhibitors, beta-blockers and spironolactone in subjects with symptomatic left ventricular systolic dysfunction also reduces morbidity and mortality dramatically[7–9]. Symptomatic left ventricular systolic dysfunction, however, is commonly misdiagnosed despite symptomatology, especially in primary care where facilities may be limited, mainly due to the non-specificity of the clinical symptoms and the non-sensitivity of the clinical signs[10,11]. The heavy community burden, difficulties in diagnosis, response to early therapy, and presence of significant asymptomatic disease[12] have led a number of authors to call for programmes to screen for and treat symptomatic and
asymptomatic left ventricular systolic dysfunction\textsuperscript{[13,14]}, although who best to screen — whether the whole population or only high-risk subjects — is yet to be determined. Echocardiography has been proposed to be the screening method of choice\textsuperscript{[13,15,16]}, also detecting left ventricular hypertrophy and valvular heart disease, other potential causes of heart failure, morbidity and mortality. Recent advances in ultrasound technology have led to the development of fully portable or ‘hand-carried’ echocardiography machines (‘portable devices’) and the concept of ‘portable echocardiography’ when performing echocardiography with such devices. The advent of such devices potentially allows this approach to be taken further, once validated, allowing echocardiographic screening to be taken into the community setting for the first time. This would allow easier access to screening, improving response rates, and potential cost savings as compared to hospital-based programmes. Possible problems with using portable devices in this role, however, may include their smaller monitor size, fewer image settings, qualitative interpretation, and in some cases absence of second harmonic imaging, previously shown to dramatically improve image resolution and thus accuracy of assessment in difficult subjects\textsuperscript{[17]}. This study, therefore, was undertaken to assess the accuracy of portable echocardiography in screening for left ventricular systolic dysfunction, left ventricular hypertrophy and valvular regurgitation in both low-risk and high-risk subjects randomly selected from the community, potential validating their use in community-based screening programmes. Comparisons were made with a traditional state-of-the-art echocardiography machine using its best imaging mode.

**Methods**

**Subjects**

Five-hundred and sixty-two consecutive subjects attending a large ongoing community heart failure screening programme, *The Harrow Heart Failure Watch*\textsuperscript{[18]}, between May 2000 and May 2001 underwent echocardiographic evaluation by both a portable device and a state-of-the-art traditional echocardiography machine. All attending subjects had been chosen at random from the computer records of seven geographically and socio-economically representative general practices in Harrow, North London. Some were part of a general population screen (a random selection from the entire general practice patient list) and some from a high-risk screen (a random selection from those subjects on the general practice patient list with one or more of the following conditions: ischaemic heart disease, peripheral vascular disease, cerebrovascular disease, diabetes mellitus and heavy alcohol usage).

**Echocardiography**

Each subject underwent two complete echocardiography studies. The first was performed using a prototype portable echocardiography device (OptiGo\textsuperscript{®}, Agilent technologies, Andover, U.S.A.), the second by use of a traditional echocardiography machine (SONOS 4500, Agilent technologies, Andover, U.S.A.). The portable device consisted of a base unit (27 \times 21 \times 7 cm), 2-5 MHz phased array transducer and battery (Fig. 1) giving digital two-dimensional fundamental imaging on a 5-5 inch liquid crystal display; linear measurements with freeze-frame and scrolling capability, and colour flow Doppler imaging. Its total weight was 3 kg. Second harmonic imaging and spectral Doppler were not supported. The traditional machine used a 1-8/3-6 MHz second harmonic fusion imaging transducer and a 15-inch screen, weighed 214 kg, and had external dimensions 151 × 103 × 63 cm. All analyses on this machine were taken using second-harmonic imaging.

Two-dimensional echocardiography was performed and analysed by one investigator (GG), a cardiology registrar, who had undergone an intensive 6-month training programme under RS (Director of Echocardiography) in performing and analysing over 300 echocardiography studies prior to commencement of the study. Images were obtained firstly on the portable device and then on the traditional echocardiography machine, with all measurements from the portable device taken before using the traditional machine. Parasternal long- and short-axis and apical two-, three- and four-chamber views were obtained on both machines. Images from the traditional machine were stored both on to videotape and as digital loops four cardiac cycles in length on to optical disc. An assessment of colour flow on the traditional machine was performed at the time of the scan. All those free of regurgitation were scored as such. All those with any regurgitation had their severity evaluated from videotape review 4-to-6 weeks later without knowledge of the portable device results. All other measurements on the traditional machine were analysed from the digital loop recordings again later on without knowledge of the portable device results.

Image quality on the portable device was measured by assessing endocardial wall visualization using a 22-segment model of the left ventricle (four parasternal long axis segments, six parasternal short axis segments, six apical four-chamber segments and six apical two-chamber segments) (Fig. 2) and a three-point scale (0, not visualized; 1, barely visible; 2, well visualized), a model previously validated for this assessment\textsuperscript{[19]}. Left ventricular ejection fraction was qualitatively estimated on the portable device using ‘eye-ball’ visual inspection, with all cases felt to possibly have left ventricular systolic dysfunction scored as abnormal. Left ventricular ejection fraction was calculated on the traditional machine quantitatively using Simpson’s apical biplane rule\textsuperscript{[20]} by manually tracing left ventricular endocardial borders in the orthogonal apical four- and two-chamber views at end-systole and end-diastole. Images were only analysed when at least 80% of the endocardium was clearly seen. This technique has been recommended as the most accurate two-dimensional echocardiographic
assessment of left ventricular ejection fraction\textsuperscript{[21]}, and has previously been validated in our laboratory\textsuperscript{[22,23]}. An average of the left ventricular ejection fraction was obtained from three cardiac cycles avoiding any ectopic or post-ectopic cycles. Further measurements taken on both devices included interventricular septal wall thickness, left ventricular posterior wall thickness and colour flow assessment across the mitral and aortic valves. Valvular regurgitation was assessed on a five-point scale (nil or trivial, mild, mild-to-moderate, moderate, severe) by qualitatively assessing the width of the regurgitant jet at its origin by visual inspection. Mild-to-moderate regurgitation or above was taken as significant regurgitation.

Inter-observer variability for estimating left ventricular ejection fraction on the portable device was performed by two echocardiographers (GG, a cardiology registrar, and RS, a consultant cardiologist and director of echocardiography). Each performed echocardiography separately on 28 consecutive patients attending two consecutive general cardiology out-patient clinics, estimating left ventricular ejection fraction, blinded to the other’s findings.

\textbf{Statistical Analysis}

All corresponding measurements between the portable device and traditional machine were assessed by linear regression analysis for correlation coefficient and by Bland–Altman plots for 95\% limits-of-agreement. The sensitivity, specificity, positive and negative predictive value and overall accuracy, including kappa values of agreement (<0·40 poor, 0·40–0·59 moderate, 0·60–0·79 good, and ≥0·80 excellent agreement), for the portable device to assess clinically significant abnormalities including left ventricular systolic dysfunction (left ventricular ejection fraction <50\%), left ventricular hypertrophy (interventricular septal or left ventricular posterior wall thickness ≥12 mm) and significant valvular regurgitation (mild-to-moderate or greater regurgitation) were assessed. Results from continuous data are given as mean ± 1 SD. Comparisons between paired normally distributed continuous data were made using the paired Student’s \textit{t}-test. The Chi-squared test was used to compare categorical groups. Data were analysed.
Results

Demographics

Subject demographics and underlying cardiac risk factors are shown in Table 1. 331 subjects were from the general population screen and 231 subjects from the high-risk screen. Fifty-five percent of subjects had one or more cardiac risk factor. Data is presented for both groups combined followed by both groups individually where important differences were seen.

Image Quality

Overall 12,364 endocardial segments were assessed on the portable device, with 9944 (80%) segments well visualized, 1581 (13%) segments barely visualized and 839 (7%) segments not visualized, giving a mean wall visualization score of 1.74. This allowed an 'eyeball' estimate of left ventricular ejection fraction to be estimable in 545 cases (97%) using the portable device. Simpson's left ventricular ejection fraction was measurable in 537 cases (96%) using the traditional device. Six of these 537 cases (1.1%) were of insufficient quality to accurately estimate left ventricular ejection fraction on the portable device.

The mean wall visualization score for the general population group was 1.75 and for the high-risk group was 1.72. Significantly more walls were well visualized in the general population group than the high-risk group (81% vs 79%, P<0.001) and significantly fewer walls barely visualized (12% vs 14%, P<0.001). There was no significant difference in the proportion of walls not visualized (7% vs 7%, P=0.8).

Screening for Left Ventricular Systolic Dysfunction

Five-hundred and thirty-one subjects had left ventricular ejection fractions calculated on both machines. Mean left ventricular ejection fractions were 60±8% for the traditional machine and 59±8% for portable machine (P<0.0001). Fifty-one subjects (10%) had evidence of left ventricular systolic dysfunction on the traditional machine, 23 (7%) from the general population subjects and 28 (13%) from the high-risk subjects (P<0.05). Differences of clinical significance between the portable and traditional devices in detecting left ventricular systolic dysfunction is shown in Table 2, with portable echocardiography correctly identifying 49 of the 51 cases of left ventricular systolic dysfunction, at the expense of over diagnosing left ventricular systolic dysfunction in 10 subjects (1.9% of those screened). The accuracy of the portable device in screening for left ventricular systolic dysfunction is shown in Table 3. All 19 subjects found to have a left ventricular ejection fraction <40% were scored as abnormal on the portable machine. The negative predictive value in diagnosing left ventricular systolic dysfunction was 99.3% in the general population group, 100% in the high-risk group and 99.6% overall (P=0.5).

Scatter plots and Bland–Altman plots showing the agreement between the qualitative estimate of left ventricular ejection fraction on the portable machine and the quantitative measure on the traditional machine are shown in Fig. 3, finding a correlation coefficient of 0.90 and 95% limits of agreement of −68% to +6%. This was similar in the general population and high-risk groups.

Screening for Left Ventricular Hypertrophy

An assessment of the presence or absence of left ventricular hypertrophy on both machines was possible

Table 1. Subject demographics and underlying risk factors.

| Number seen | 562 subjects |
| Age         | 62 ± 11, range 24–89 |
| Male        | 314 (56%) |
| Hypertension| 220 (39%) |
| Ischaemic heart disease | 125 (22%) |
| Diabetes    | 82 (15%) |
| Cerebrovascular disease | 52 (9%) |
| Peripheral vascular disease | 42 (7%) |
| No risk factors | 255 (45%) |

Table 2. A comparison of portable and traditional echocardiography in predicting left ventricular systolic dysfunction (left ventricular ejection fraction <50%).

<table>
<thead>
<tr>
<th></th>
<th>Traditional machine left ventricular systolic dysfunction</th>
<th>Traditional machine no left ventricular systolic dysfunction</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Portable machine left ventricular systolic dysfunction</td>
<td>49</td>
<td>10</td>
<td>59</td>
</tr>
<tr>
<td>Portable machine no left ventricular systolic dysfunction</td>
<td>2</td>
<td>470</td>
<td>472</td>
</tr>
<tr>
<td>Total</td>
<td>51</td>
<td>480</td>
<td>531</td>
</tr>
</tbody>
</table>
in 540 subjects. The correlation coefficient between the two devices in measuring interventricular septal thickness was 0.77, with no significant mean difference and 95% limits of agreement of ±2.5 mm. The correlation coefficient between the two devices in measuring left ventricular posterior wall thickness was 0.59, with portable echocardiography overestimating posterior wall thickness by a mean of 0.2 mm (P=0.002), with 95% limits of agreement of −2.9 to +2.5 mm.

The accuracy of the portable device in screening for left ventricular hypertrophy is shown in Table 3, with 45 of the 55 cases of left ventricular hypertrophy correctly identified using the portable machine. Left ventricular hypertrophy was over diagnosed in 20 subjects (3.7% of those screened). Twenty-nine of the 31 (94%) cases of ventricular wall thickness ≥13 mm and all 13 cases of ventricular wall thickness ≥14 mm were identified as having left ventricular hypertrophy (wall thickness ≥12 mm) on the portable system.

The negative predictive value in diagnosing left ventricular hypertrophy was 99% in the general population group, 97% in the high-risk group and 98% overall (P=0.2). The overall accuracy in diagnosing left ventricular hypertrophy was 96% in the general population group, 92% in the high-risk group and 94% overall (P<0.05, general population group vs high-risk group).

### Table 3. The ability of portable echocardiography to screen for significant cardiac abnormalities.

<table>
<thead>
<tr>
<th>Abnormality detected</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>PPV</th>
<th>NPV</th>
<th>Accuracy</th>
<th>Kappa value of agreement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left ventricular dysfunction (EF &lt;50%)</td>
<td>96%</td>
<td>98%</td>
<td>83%</td>
<td>99-6%</td>
<td>98%</td>
<td>0.88</td>
</tr>
<tr>
<td>Left ventricular hypertrophy (IVS or PW ≥12 mm)</td>
<td>82%</td>
<td>96%</td>
<td>69%</td>
<td>98%</td>
<td>94%</td>
<td>0.72</td>
</tr>
<tr>
<td>Left ventricular hypertrophy (IVS or PW ≥13 mm)</td>
<td>94%</td>
<td>93%</td>
<td>45%</td>
<td>99-6%</td>
<td>93%</td>
<td>0.57</td>
</tr>
<tr>
<td>Valvular regurgitation (≥mild-to-moderate)</td>
<td>84%</td>
<td>99-6%</td>
<td>80%</td>
<td>99-4%</td>
<td>99-4%</td>
<td>0.82</td>
</tr>
</tbody>
</table>

EF, ejection fraction; IVS, interventricular septum; PW, posterior wall; PPV, positive predictive value; NPV, negative predictive value.

### Figure 3.
(a) Scatter plot and (b) Bland–Altman plot. Comparing portable echocardiography with traditional echocardiography in assessing left ventricular ejection fraction.

Screening for Significant Valvular Regurgitation

An assessment of aortic and/or mitral valvular regurgitation on both machines was possible in 556 subjects, with 19 subjects having mild-to-moderate regurgitation or worse. Sixteen of these 19 cases of significant valvular regurgitation were identified as such on the portable machine, with screening accuracies shown in Table 3. All
nine subjects with moderate or severe valvular regurgitation were assessed as such by the portable machine. The severity of valvular regurgitation was underestimated by the portable machine in 41 cases (4%) and overestimated in 18 cases (2%) \((P=0.002)\). Ninety-five percent of cases were scored identically. Four subjects (0.7% of those screened) were over-diagnosed by the portable machine as having significant valvular regurgitation. There were no significant differences between the general population and high-risk groups.

**Inter-observer Variability**

A left ventricular ejection fraction was estimable by both assessors in all 28 cases, with overall mean left ventricular ejection fraction 50.7 \pm 12.7\% (range 15 to 67\%). The correlation coefficient between the two measurements was 0.92, mean difference 2\% and 95\% limits of agreement \(-12\%\) to \(+8\%\) (Fig. 4). There was a sensitivity of 100\%, specificity of 82\% and accuracy of 89\% \((\kappa=0.78)\) for the second observer to predict the results of the first observer.

**Discussion**

Recent advances in ultrasound technology have led to the development of fully portable ultrasound machines. These machines are small, light-weight and battery-powered in the majority of cases, allowing full portability both within and for the first time outside the hospital setting. In the non-cardiological setting such devices are finding a number of potential new roles including: improving the efficacy of central venous cannulation \(\text{(24)}\), assessing and managing the care of trauma cases admitted to emergency departments \(\text{(25)}\), or even during helicopter transfer to hospital \(\text{(26)}\), and in screening for abdominal aortic aneurysms \(\text{(27)}\). In the field of cardiology, portable echocardiography machines, first conceived and developed in the 1980s \(\text{(28)}\) although only recently available to purchase, are currently finding potential roles in a variety of clinical settings, including the coronary care unit (CCU), on ward rounds, in the outpatient clinic, post operatively and in the intensive care unit (ICU) \(\text{(29–33)}\), where rapid answers to clinical questions may speed up and improve overall patient care. This is the first large-scale comparison between portable and traditional echocardiography devices and the first assessment of the role of portable echocardiography in screening for left ventricular and valvular abnormalities in the community.

This study has found portable echocardiography devices to be useful potential tools in screening for left ventricular systolic dysfunction in the community setting, with a normal scan virtually ruling out underlying abnormalities, even when relying on qualitative eyeball estimates of ejection fraction. Indeed it has shown that such eyeball estimates closely agree with quantitative measures of ejection fraction as previously shown on
traditional echocardiography machines. By comparing portable echocardiography with traditional echocardiography this study has found that portable echocardiography, even in the absence of second harmonic imaging, allows an experienced echocardiographer to accurately discriminate normal from abnormal left ventricular systolic function, correctly diagnosing 96% of cases of mild left ventricular systolic dysfunction and 100% of cases of significant left ventricular systolic dysfunction at the expense of over-diagnosing left ventricular systolic dysfunction in less than 2% of the population screened. It also shows very good interobserver variability, with reproducibility a prerequisite of any screening modality.

This study has further found an acceptable accuracy in screening for significant left-sided valvular regurgitation and left ventricular hypertrophy, correctly diagnosing all cases of moderate or severe valvular regurgitation and 29 of 31 cases of significant left ventricular hypertrophy (inter-ventricular septum or left ventricular posterior wall diameter ≥ 13 mm). This would also be important in any future screening programme. However, milder disease was more likely to be missed, with five of 17 (29%) cases of mild left ventricular hypertrophy (inter-ventricular septum diameter 12 mm) and three of 10 cases of mild-to-moderate valvular regurgitation underestimated by the portable device. Approximately 60% of subjects screened were from a group of subjects randomly chosen from the general population and approximately 40% of subjects screened were from a group of subjects at higher risk of cardiac disease. This study has shown only minimal differences in the screening characteristics of the portable device in either group. The screening characteristics were marginally worse when screening the high-risk population than the general population, with slightly fewer walls clearly seen and slightly worse overall accuracy in screening for left ventricular hypertrophy. However, these differences although reaching statistical significance were of little clinical significance. Furthermore, no differences were seen in screening for left ventricular systolic dysfunction or valvular regurgitation. The overall negative predictive values for screening for left ventricular hypertrophy, left ventricular systolic dysfunction and valvular regurgitation in the high-risk group was still 97%, 100% and 99-7% respectively. This implies that portable echocardiography can be used in both general population screening programmes and more focussed high-risk screening programmes where more abnormalities will be found. Both types of screening programmes are currently being mooted.

Although this is the first study to evaluate the role of portable echocardiography in community-based screening for cardiac abnormalities, preliminary studies have been performed evaluating the role of portable echocardiography in the hospital setting. Sim et al. found that portable echocardiography may be used on the coronary care unit in the assessment of left ventricular systolic dysfunction in 40 subjects with no clinical evidence of heart failure a few days after acute myocardial infarction. In this study, however, no comparison with traditional echocardiography was undertaken. Pandian et al. found that the use of portable echocardiography during a ward round gave fast, accurate and valuable clinical information in 35 subjects with a variety of cardiac disorders. Lee et al. found that portable echocardiography gave a mean visualization score of 2·4 (0: not visualized to 3: well visualized) and correctly diagnosed 14 of 17 valvular lesions (82%) in 12 subjects with heart disease, almost identical to our results.

Two studies have found less encouraging results. Goodkin et al. found portable echocardiography to be less effective than traditional echocardiography in the ICU setting. They compared the results of portable echocardiography to that of traditional echocardiography in 80 consecutive ICU patients. The portable device was configured to answer only 84 of the 99 clinical questions posed by the referring physician (85%), in turn correctly evaluating only 86% of these, ie, correctly answering only 73% of posed questions. The traditional machine on the other hand was configured to answer all 99 questions, successfully answering 98% of the 84 clinical questions for which the portable device was configured. Portable echocardiography assessed left ventricular function accurately in only 32 of the 38 patients (84%) where this was a clinical question, compared with 36/38 (95%) for the traditional machine. Similarly it assessed valvular regurgitation correctly in only 14 of the 18 patients (78%) where this was a clinical question compared with 18/18 (100%) for the traditional machine. Beyond the 99 clinical questions asked, portable echocardiography also failed to diagnose a further 17 clinically significant findings diagnosed by traditional echocardiography. The portable study was performed in the absence of second-harmonic imaging, however, previously shown to dramatically improve image resolution and thus accuracy of assessment in difficult subjects. This may be more important in the ICU setting where optimal patient and probe positioning may be difficult as a result of an uncooperative subject, artificial ventilation, surgical wounds, chest drains and difficult ambient light conditions. Indeed, several portable devices now have second-harmonic imaging, and further studies are required. It may simply be, however, that portable echocardiography is inferior to traditional echocardiography in the ICU setting. Spencer et al. similarly found a worse detection rate of left ventricular systolic dysfunction (76%) than our study in 36 clinic patients, although similar rates of detecting significant valvular regurgitation. One criticism of this study, however, is that the portable studies were performed by doctors who did not routinely perform echocardiography, whilst the traditional studies were performed by an experienced sonographer and these results compared. It is thus likely that the image acquisition of the experienced sonographer was superior, potentially picking up more abnormalities.
Study Limitations

There are a number of limitations to this study. Firstly, portable echocardiography was performed by only one operator using only one device. Similar results are thus required in other studies using alternative portable devices before the results from this study can be generalized. Secondly, inter-observer variability has not been assessed for the evaluation of valvular regurgitation or left ventricular hypertrophy. Thirdly, data has only been collected for a few echocardiographic parameters, with no data collected on ventricular dimensions, valvular stenoses, pericardial or right heart abnormalities. These studies are still awaited. Finally, the amount of training required before being fully capable of using such devices, a currently hotly debated topic, has not been addressed in this study. GG, a cardiology trainee, who performed all the echocardiography in this study, had been intensively trained for a 6-month period prior to commencing the study by an expert echocardiographer (RS). Thus the results of the study are only applicable to similarly trained individuals. This is an important point as the results of poorly trained individuals performing screening echocardiography using portable devices may not be equivalent. Potential limitation of the portable devices themselves include limited ultrasound configurations and limited data archiving capabilities.

Despite these limitations, this is the largest comparative study thus far performed comparing a portable echocardiography device to a traditional echocardiography machine, finding excellent agreement between the two along with excellent inter-observer agreement when rating screening echocardiography using portable devices may not be equivalent. Potential limitation of the portable devices themselves include limited ultrasound configurations and limited data archiving capabilities. The SOLVD Investigators. Effect of enalapril on mortality and the development of heart failure in asymptomatic patients with reduced left ventricular ejection fractions. N Engl J Med 1992; 327: 685–691.

Conclusions

This study shows that portable echocardiography is an accurate, reproducible screening technique for the assessment of cardiac abnormalities in the community if used by experienced sonographers. It thus seems that portable devices may be safely used in newly developing screening programmes to diagnose asymptomatic left ventricular systolic dysfunction, in turn allowing such programmes to be taken into the community setting for the first time, reducing costs and increasing response rates. Indeed it may be argued that they are sufficiently accurate that only borderline scans require physician review and/or a repeat study using a traditional machine, as long as the sonographer is sufficiently trained, although this would need to be confirmed in other studies. Portable echocardiography also provides an accurate assessment of the presence or absence of significant left ventricular hypertrophy and aortic or mitral regurgitation, important common cardiac abnormalities that could also be easily picked up in any screening programme.

References


