Diagnostic accuracy of tissue Doppler echocardiography for patients with acute heart failure

C-H Huang, M-S Tsai, C-C Hsieh, T-D Wang, W-T Chang, W-J Chen

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See end of article for authors' affiliations

Correspondence to:
W-J Chen, Department of
Emergency Medicine,
National Taiwan University
Hospital, No 7 Chung-
Shan S Road, Taipei,
Taiwan; jone@ha.mc.ntu.
edu.tw

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Background: Acute heart failure leads to high mortality and morbidity rates. The symptom of acute dyspnoea is non-specific and the diagnostic tools of acute heart failure are still not satisfactory. Tissue Doppler echocardiography is accurate in evaluating cardiac function; however, its efficacy in diagnosing patients with acute dyspnoea in emergency departments remains unclear.

Methods: Patients with acute dyspnoea were included prospectively while visiting the emergency department. Tissue Doppler echocardiography was carried out and the ratios of peak early diastolic transmitral blood flow velocity (E) to the peak early diastolic tissue velocity over mitral annulus (Ea) were recorded. The sensitivity, specificity and accuracy of tissue Doppler parameters and the receiver-operating characteristic curves for diagnosing acute heart failure were also evaluated.

Results: A total of 92 patients were enrolled. The ratio E:Ea was found to be a good diagnostic test to estimate the diagnostic performances of tissue Doppler echocardiography using receiver-operating characteristic curves in cases of acute heart failure in patients with preserved left ventricular systolic function (mean (SD) area under the curve=0.875 (0.049); $p<0.001$; cut-off value=11) and with left ventricular systolic dysfunction (mean (SD) area under the curve=0.903 (0.061); $p=0.003$; cut-off value=16). E:Ea was an independent predictor of acute heart failure in multiple logistic regressions. For patients with a B-type natriuretic peptide level between 100 and 500 pg/ml, E:Ea provided an accuracy of 90.9% ($p=0.015$) for diagnosing acute heart failure.

Conclusions: Tissue Doppler echocardiography is accurate in diagnosing patients with acute heart failure in emergency departments. It can be a useful supplementary diagnostic tool for patients with inconclusive blood B-type natriuretic peptide level.

Heart failure is one of the most important health issues in the world.¹⁻³ Acute heart failure has become the leading cause of hospitalisation in people >65 years old in the US.^{4,5} The 5-year death rate has been as high as 50%.⁶ Correct diagnosis is important to decrease the complications and mortality, and to provide cost-effective treatment for patients with acute heart failure. However, the correct and timely diagnosis of acute heart failure can be difficult for patients presenting with symptoms of acute dyspnoea to the emergency department, which has a highly stressful and fast-paced environment. These patients usually have different kinds of comorbidities, which also interfere with the correct and rapid differential diagnosis.

B-type natriuretic peptide (BNP) is efficient in the rapid diagnosis of heart failure. However, its diagnostic accuracy is not satisfactory, especially for patients with an intermediate BNP level.⁶⁻⁸ Evidence of non-specificity can also be found from the increase in plasma BNP level in conditions of sepsis, ischaemic heart disease, lean body mass and anaemia without the coexistence of heart failure.⁹⁻¹³ Furthermore, the use of BNP cannot substitute for echocardiography in the definitive management be a risk stratification of patients with acute heart failure.^{14,15}

Echocardiography has been the gold standard for the evaluation of patients with heart failure. However, assessment of left ventricular ejection fraction, left ventricular size and transmitral blood flow by conventional echocardiography has limitations and hence it is not satisfactory for accurate estimation of the real haemodynamic and fluid status, which is the key issue in diagnosing and managing patients with acute dyspnoea.¹⁶⁻¹⁸ By using the recently developed tissue

Doppler echocardiography, the ratio of peak early diastolic transmitral blood flow velocity (E) to the peak early diastolic tissue velocity over mitral annulus (Ea) provides a better estimation of the left ventricular end-diastolic pressure (LVEDP) compared with the blood BNP level.¹⁸⁻²⁰ Although tissue Doppler echocardiography has become more popular for evaluating various heart diseases, its application in the differential diagnosis of patients with acute dyspnoea in the emergency department and in the diagnosis of acute heart failure is rarely studied. Here, we conduct a prospective study to evaluate the diagnostic accuracy of tissue Doppler echocardiography in patients with acute heart failure who visit the emergency departments mainly with complaints of dyspnoea.

PATIENTS AND METHODS

Study design and populations

The study is prospectively designed and its protocol was approved by the institutional review boards. The patients were included from a tertiary medical centre during January 2005 to August 2005. Their main complaint was dyspnoea, including acute-onset dyspnoea or worsening of chronic dyspnoea in the emergency department. The exclusion criteria were as follows: age <18 years, acute myocardial infarction, and presence of trauma and dyspnoea clearly caused by a condition other than heart failure, such as pneumothorax. The plasma BNP levels were assayed if indicated for the clinical evaluation, especially for patients

Abbreviations: BNP, B-type natriuretic peptide; LVEDP, left ventricular end-diastolic pressure; LVEF, left ventricular ejection fraction; ROC, receiver-operating characteristic

with comorbidities or complicated clinical conditions, and decided by the primary emergency doctors. The BNP was assayed on an AxSYM analyser (Abbott Laboratories, Abbott Park, Illinois, USA).²¹

Echocardiography and tissue Doppler imaging

Echocardiography was carried out by a cardiologist in the emergency ultrasonography laboratory in the emergency department.²² Echocardiography examinations, including tissue Doppler imaging, were carried out using the same echocardiographic machine (System V, GE-Ving Med Sound AB, Horten, Norway) with a 3.5-MHz multiphase array probe. All the data were digitalised and stored. Pulsed Doppler imaging was used to record transmitral and aortic flow in the apical four-chamber view. Tissue Doppler velocities were acquired at the septal and lateral mitral annular sites of the left ventricle from the apical four-chamber view with a spectral pulse-wave pattern. Studies were analysed by an echocardiologist blinded to all clinical, haemodynamic and BNP data. Mitral inflow measurements included peak early diastolic (E) and peak late diastolic (A) velocities, E:A ratio and deceleration time of early diastolic flow. The tissue Doppler peak early diastolic (Ea) velocities at the septal and lateral mitral annular sites were measured and the E:Ea ratios were calculated from the average of the septal and lateral Ea, owing to the optimal accuracy of this approach in patients with regional wall motion abnormalities.²³

Data collection and processing

The baseline demographic characteristics, medical history and clinical signs were evaluated and prospectively collected after enrolling the patients. Reports of blood tests, electrocardiograms and chest radiographs carried out in the emergency department were collected for each patient. Whether heart failure was acute or not was determined by two independent cardiologists blinded to the patient's tissue Doppler echocardiography data and BNP level after patient discharge. All the available medical history and history of drugs were reviewed. In addition, details of clinical findings, laboratory test results (except for BNP), medical treatments and responses to treatment, electrocardiograms from admission and results of echocardiography (except for tissue Doppler echocardiography), radionuclide ventriculography and cardiac catheterisation investigations (when carried out) during hospitalisation were also available. The Framingham and National Health and Nutrition Examination Survey criteria for congestive heart failure were provided to the experts. The experts made their diagnosis on the basis of these two criteria, with corroborative information according to the clinical data, related examinations and response to treatment during hospitalisation. In case of disagreement between two experts, the third cardiologist was invited to discuss and make the final diagnosis for the patients. All patients with dyspnoea were categorised into two groups, acute heart failure or non-heart failure, on the basis of the cause of their acute symptoms. The basis of categorisation as acute heart failure or non-heart failure were listed.

Statistical analysis

Continuous variables were presented as mean (standard deviation (SD)) and unpaired t tests were used to check the difference between groups. χ^2 tests were used for the categorical variables. Receiver-operating characteristic (ROC) curves were constructed to determine the optimal sensitivity and specificity of E:Ea for diagnosing acute heart failure. Multivariate logistic regression analyses were carried out on variables of echocardiographic parameters and BNP for predicting acute heart failure. A value of $p < 0.05$ was considered significant. Analyses were carried out using SPSS V.11.0 software.

RESULTS

We prospectively identified 104 patients with dyspnoea and enrolled 92 of them. In all, 12 (11.5%) patients were excluded owing to poor echocardiographic windows. The final diagnoses of acute heart failure and non-heart failure were made for 51 and 41 patients, respectively. The reasons for dyspnoea in the non-heart failure group were chronic obstructive pulmonary disease ($n = 19$, 46.3%), pneumonia ($n = 9$, 21.9%), pulmonary embolism ($n = 3$, 7.3%) and other disorders ($n = 10$, 24.4%). There were more patients with diabetes mellitus, hypertension and coronary artery disease in the acute heart failure group (table 1). The blood urea nitrogen was higher in the acute heart failure group than in the non-heart failure group. We found more pulmonary oedema (50.9% *v* 14.6%; $p < 0.001$) and cardiomegaly (76.5% *v* 51.2%; $p = 0.011$) in the chest radiographic findings for the acute heart failure group (table 2).

The body surface area-adjusted left ventricular end-diastolic and end-systolic diameters were higher in the acute heart failure group (mean (SD) 41.3 (5.9) and 30.2 (7.0) mm/m², respectively) than in the non-heart failure group (34.5 (5.5) and 21.9 (5.2) mm/m²; $p < 0.001$ for both). The left ventricular systolic function was better in the non-heart failure group, with a higher ejection fraction compared with the acute heart failure group (64.9 (12.1) *v* 50.4 (16.4); $p < 0.001$; table 3). In the tissue Doppler echocardiographic studies, the average of peak early diastolic velocities (Ea) of medial and lateral mitral annulus was higher in the non-heart failure group than in the acute heart failure group (8.6 (3.3) *v* 6.4 (2.4) cm/s; $p < 0.001$). The interobserver correlation of the echocardiographic measurement evaluated by the inter-rater correlation coefficient reliability test was 0.889 ($p < 0.001$), and intraobserver correlation was 0.947 ($p < 0.001$).

For evaluating the correlation of E:Ea with the diagnosis of acute heart failure, we plotted ROC curves for the patients with preserved systolic function (left ventricular ejection fraction (LVEF) $\geq 50\%$) and impaired left ventricular systolic function (LVEF $< 50\%$). The ROC curves showed good area under the curve values of 0.875 (0.049; $p < 0.001$) for the patients with preserved left ventricular systolic function and 0.903 (0.061; $p = 0.003$) for the patients with left ventricular systolic dysfunction (fig 1). According to the ROC curves, the best cut-off value of E:Ea for diagnosing acute heart failure was 11, the sensitivity was 88.9%, specificity was 82.9% and

Table 1 Demographic characteristics and underlying diseases in patients with acute heart failure and in those without heart failure

	Non-HF (n = 41)	Acute HF (n = 51)	p Value
Age (years)	71.7 (16.7)	72.7 (12.9)	0.753
Sex (male)	21 (51%)	25 (49%)	0.834
Body weight (kg)	70.6 (28.8)	71.2 (30.3)	0.929
Body height (cm)	154.7 (29.1)	150.2 (33.4)	0.525
Underlying diseases			
Diabetes mellitus	11 (26.8%)	23 (45.1%)	0.071
Hypertension	17 (41.5%)	32 (62.7%)	0.042
Coronary artery disease	5 (12.2%)	22 (43.1%)	0.001
Prior HF	6 (14.6%)	21 (41.2%)	0.005
Arrhythmia	6 (14.6%)	6 (11.8%)	0.685
COPD	14 (34.1%)	5 (9.8%)	0.002
Cerebral vascular disease	4 (9.8%)	8 (15.7%)	0.401
ESRD	1 (2.4%)	5 (9.8%)	0.155
Malignancy	2 (4.9%)	5 (9.8%)	0.376

COPD, chronic obstructive pulmonary disease; ESRD, end-stage renal disease; HF, heart failure.
Values are mean (SD) unless specified otherwise.

Table 2 Physiological parameters, clinical symptoms, signs and laboratory blood tests in patients with dyspnoea in the emergency department

	Non-HF (n = 41)	Acute HF (n = 51)	p Value
Physiological parameters			
Heart rate (beat/min)	91.6 (22.2)	88.5 (20.3)	0.19
Respiratory rate (per min)	18.9 (3.9)	19.6 (5.1)	0.472
Systolic blood pressure (mm Hg)	128.1 (34.2)	135.9 (26.6)	0.409
Diastolic blood pressure (mm Hg)	69.0 (20.9)	73.3 (15.1)	0.248
Peripheral oxygen saturation %	93.9 (15.7)	96.8 (3.3)	0.475
Symptoms and signs			
Rales in auscultation	14 (34.1%)	22 (43.1%)	0.38
Leg oedema	10 (24.4%)	9 (17.6%)	0.427
Jugular vein engorgement	3 (7.3%)	9 (17.6%)	0.144
Episodes of chest pain	7 (17.1%)	7 (13.7%)	0.657
Laboratory tests			
Blood urea nitrogen (mg/dl)	28.8 (22.1)	46.6 (30.2)	0.002
Serum creatinine (mg/dl)	1.6 (1.7)	3.3 (5.8)	0.076
Creatinine kinase (U/l)	199.8 (412.2)	308.8 (732)	0.429
CK-MB (U/l)	18.4 (27.0)	24.2 (35.6)	0.422
Troponin I (ng/ml)	0.73 (3.2)	0.26 (0.8)	0.336
Chest x ray			
Cardiomegaly	21 (51.2%)	39 (76.5%)	0.011
Pulmonary oedema	6 (14.6%)	26 (50.9%)	<0.001

HF, heart failure; CK-MB, creatinine kinase-MB form.

accuracy was 85.4% for patients with preserved systolic function. The best cut-off value of E:Ea for diagnosing acute heart failure was 16, the sensitivity was 70.8%, specificity was 100% and accuracy was 76.7% for patients with left ventricular systolic dysfunction. For evaluating the overall accuracy of the E:Ea index in diagnosing acute heart failure in patients with dyspnoea, we used the above cut-off values for patients with preserved and impaired left ventricular systolic function, and checked the prediction accuracy of E:Ea for all patients with dyspnoea accordingly. The combined sensitivity was 80.4%, specificity was 85.4% and the accuracy was 82.6%.

We used multiple logistic regression analysis with the factors blood urea nitrogen level, cardiomegaly and pulmonary oedema in chest radiography, LVEF, left ventricular end-diastolic diameter corrected by the body surface area and E:Ea to determine the independent predictors for the correct diagnosis. The significant indicators for the prediction of acute heart failure were the E:Ea ratio (odds ratio (OR) 31.92, 95% confidence interval (CI) 6.28 to 162.35), LVEF (OR 0.91, 95% CI 0.87 to 0.96) and the left ventricular end-diastolic diameter corrected by the body surface area (OR 1.10, 95% CI 1.02 to 1.18).

Only 43 patients had their blood sampled for BNP (table 4). Among these patients, the blood BNP level was markedly higher in the acute heart failure group (1329 (1682.3) pg/ml; n = 24) than in the non-heart failure group (232.2 (299.2) pg/ml; n = 19; p = 0.005). Setting the BNP to 100 as the cut-off value for differentiating acute heart failure from non-heart failure, the sensitivity, specificity and accuracy were 83.3%, 52.6% and 69.8%, respectively. If we include BNP with cut-off values of <100, 100–500 and >500 pg/ml as one factor in the multiple regression analysis, the E:Ea ratio, the left ventricular end-diastolic diameter corrected by the body surface area and LVEF fare as significant predictors of acute heart failure.

The BNP level was not an independent indicator in the multiple logistic regression analysis model. BNP levels from

Table 3 Echocardiographic and tissue Doppler echocardiographic parameters of patients with dyspnoea in the emergency department

	Non-HF (n = 41)	Acute HF (n = 51)	p Value
Echocardiographic parameters			
Left atrium*	27.6 (6.4)	32.8 (7.6)	0.001
Interventricular septum*	8.1 (1.6)	8.1 (1.4)	0.951
LV posterior wall*	8.0 (1.6)	8.3 (1.3)	0.456
LV end-diastolic dimension*	34.5 (5.5)	41.3 (5.9)	<0.001
LV end-systolic dimension*	21.9 (5.2)	30.2 (7.0)	<0.001
LV ejection fraction (%)	64.9 (12.1)	50.4 (16.4)	<0.001
Mitral E flow (cm/s)	74.9 (24.3)	109.9 (39.7)	<0.001
Mitral A flow (cm/s)	88.4 (48.9)	80.7 (42.5)	0.811
E:A ratio	0.88 (0.45)	1.29 (0.78)	0.007
Tissue Doppler parameters			
Mean Sa (cm/s)	8.3 (2.1)	6.3 (2.1)	<0.001
Sa medial (cm/s)	7.8 (2.0)	5.8 (1.9)	<0.001
Sa lateral (cm/s)	8.8 (2.7)	6.9 (2.5)	0.001
Mean Ea (cm/s)	8.6 (3.3)	6.4 (2.4)	<0.001
Ea medial (cm/s)	7.9 (3.5)	5.9 (2.0)	<0.001
Ea lateral (cm/s)	9.4 (3.8)	7.3 (3.0)	0.003
Mean Aa (cm/s)	9.5 (3.6)	6.3 (3.4)	0.001
Aa medial (cm/s)	8.6 (4.1)	5.5 (3.7)	0.001
Aa lateral (cm/s)	10.4 (3.9)	6.8 (3.9)	<0.001
E:Ea for overall	9.3 (3.3)	18.7 (7.9)	<0.001
LVEF ≥ 0.5	9.1 (3.4)	17.6 (8.1)	<0.001
LVEF < 0.5	10.7 (2.6)	20.1 (7.7)	<0.001

*The diameters were corrected by the body surface area (m²).

A, peak late diastolic blood flow velocity; Aa, peak late diastolic velocity over mitral annulus in tissue Doppler imaging; E, peak early diastolic blood flow velocity; Ea, peak early diastolic velocity over mitral annulus in tissue Doppler imaging; LV, left ventricle; LVEF, left ventricular ejection fraction; Sa: the peak systolic velocity over mitral annulus in tissue Doppler imaging.

100 to 500 pg/ml had less predictive power and were inconclusive for the correct diagnosis for acute heart failure. Using the E:Ea ratio to evaluate the patients with inconclusive BNP level (100–500 pg/ml), the correct diagnoses could be made with 90.9% (10/11) accuracy (p = 0.015 by Fisher's exact test).

DISCUSSION

Tissue Doppler echocardiography is a novel technique to directly measure myocardial velocity. We found that by using tissue Doppler echocardiography, the E:Ea ratio was especially feasible as the preferred diagnostic tool for patients with acute dyspnoea in the emergency department. Tissue Doppler echocardiography can provide more important information than the conventional two-dimensional and Doppler echocardiography. Compared with BNP, which is a popular and well-accepted indicator for diagnosing acute heart failure, tissue Doppler echocardiography showed similar accuracy and proved to be an independent predictor for acute heart failure, especially for patients with an inconclusive BNP level.

Patients with dyspnoea are comprised of different patient groups. The volume status is a key issue in the evaluation and management of patients with acute dyspnoea. The left ventricular filling pressure increases in patients with acute heart failure and decreases in those without heart failure.^{6–24} With the increasing popularity of echocardiography as a diagnostic tool among first-line doctors, it has recently been recommended as the most powerful tool to diagnose patients with cardiac dysfunction and heart failure, in the current heart failure management guidelines.^{14–25–26} Tissue Doppler echocardiography has shown a good correlation with the pulmonary capillary wedge pressure and has been considered to be a good non-invasive indicator to monitor the left ventricular filling pressure. E:Ea has been reported to have different cut-off values when correlating LVEDP in different

Figure 1 The receiver-operating characteristic (ROC) curves of the ratio of the peak early diastolic transmitral blood flow velocity (E) to the peak early diastolic tissue velocity over mitral annulus (Ea) in diagnosing acute heart failure for patients with left ventricular (LV) ejection fraction $\geq 50\%$ (A) and $< 50\%$ (B). AUC, area under the curve; SE, standard error.

left ventricular systolic function statuses. The correlations are good between LVEDP > 15 mm Hg and E:Ea > 11 for patients with LVEF $\geq 50\%$, and E:Ea > 15 for those with LVEF $< 50\%$.^{18, 19} The accuracies of BNP, mitral E:Ea and comprehensive echocardiography, which includes more complex parameters, have been compared in the referred echocardiography laboratory in the in-hospital setting. However, the preferred cut-off value of E:Ea was 15 for both the patients with reduced and preserved systolic function, and the predictive power of E:Ea was comparable to the BNP level in the selected patient group.¹⁹ In our study, we examined the feasibility and efficacy of tissue Doppler echocardiography for the first time in patients presenting with acute dyspnoea to the emergency department. An E:Ea value of 11 had the maximal diagnostic accuracy for patients with LVEF $\geq 50\%$ by the ROC curve evaluation. The maximal diagnostic accuracy of E:Ea for the patients with LVEF $< 50\%$ was about 16. The results are comparable to those of previous studies using invasive pulmonary artery catheters, which provided similar cut-off values for the raised LVEDP for different levels of left ventricular systolic function.¹⁸ The E:Ea ratio, which is an indication for the LVEDP, showed a powerful correlation with the diagnosis of acute heart failure.

More interestingly, the application of E:Ea can be an important supplementary examination when the biomarkers show inconclusive results. The diagnostic power of BNP is known to be unsatisfactory and the “grey-zone” ranges from 100 to 500 pg/ml, as in our study.^{8, 15, 21} Using tissue Doppler imaging with E:Ea, the diagnosis became clearer and 10/11 (90.9%) patients obtained the correct diagnosis on acute heart failure in our study. Although the number of patients is small in our study, the pattern is obvious.

Our study has some limitations. Firstly, the number of cases was limited. However, it reaches statistical significance

for the key issues in the study. Secondly, it was difficult to obtain an adequate echocardiographic window in 11.5% of our patients, which is comparable to other echocardiograph-based studies, although the echocardiographic instrument we used was more modern.²⁷ The acute dyspnoeic status of the patients might be the cause for this difficulty in obtaining good images. The improvement in echocardiographic technology might provide a way to minimise the uncertainty in patients with poor echo windows. Thirdly, the plasma BNP assay was not performed for everyone. The primary physicians decided to carry out the assays according to their clinical judgement, especially for patients with ambiguous diagnoses. Although the first-line doctors were blinded to the echocardiography results at that time, it might influence the overall diagnostic sensitivity, specificity and accuracy of BNP in the study. The diagnostic accuracy of BNP for acute heart failure in our study was low compared with previous studies.^{28, 29} Finally, the underlying diseases of the patients with dyspnoea in our study were different, which might have some influence on the validity of the study. However, the “real-world” designs of the study showed the feasibility of tissue Doppler imaging application in daily practice, which would help doctors to make diagnoses with more confidence and accuracy. A large-scale study with more complete biomarker assay will be helpful in clarifying and generalising the clinical application of tissue Doppler echocardiography for diagnosing patients with acute dyspnoea.

In conclusion, tissue Doppler echocardiography can help to differentiate the aetiology of acute heart failure from that of non-heart failure for patients with acute dyspnoea. E:Ea > 16 for patients with left ventricular systolic dysfunction and E:Ea > 11 for those with preserved left ventricular systolic function, which may implicate increased LVEDP, suggested acute heart failure for patients with dyspnoea in the emergency department. Tissue Doppler imaging may be a good diagnostic tool for patients with acute dyspnoea and can be helpful especially for those patients with inconclusive plasma BNP results.

Authors' affiliations

C-H Huang, M-S Tsai, C-C Hsieh, W-T Chang, Department of Emergency Medicine, National Taiwan University Medical College and National Taiwan University Hospital, Taipei, Taiwan

T-D Wang, W-J Chen, Department of Internal Medicine (Cardiology), National Taiwan University Medical College and National Taiwan University Hospital

Competing interests: None.

Table 4 Differentiation of the causes of dyspnoea in patients with blood B-type natriuretic peptide levels

	Non-HF (n = 19)	Acute HF (n = 24)	p Value
BNP (pg/ml) (continuous variable)	232.3 (299.2)	1329 (1682.3)	0.005
BNP (pg/ml) (categorical variable)			0.001
<100	10 (71.4%)	4 (28.9%)	
100–500	6 (54.4%)	5 (45.5%)	
>500	3 (16.7%)	15 (83.3%)	

BNP, B-type natriuretic peptide; HF, heart failure.

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"FAST HEART"

There is one problem all editors of scientific journals encounter—how to get important material published quickly. We have overcome this to some extent by introducing "Online First" (<http://heart.bmjjournals.com/onlinefirst.dtl>) which has now been running successfully on the journal's website since March 2005. Although this allows a paper to be citable within two weeks of being accepted by the journal, it does not speed up the review process. The review process is hampered by the general inertia of the system, in particular the time it takes to get reviews back from reviewers. This is because everybody is busy and there are not enough good reviewers to go around.

To counter this *Heart* has introduced a new feature: "Rapid Communications". The full details of these Rapid Communications can be found in the instructions to authors (<http://heart.bmjjournals.com/ifa/>). They will be a little shorter than the average full paper, and are intended for scientific results that are of particular importance and merit rapid publication. By accelerating and personalising the review process we hope to be able to accept a Rapid Communication for publication within four weeks, and guarantee that it will be published on the web within the following week; it will appear in the next print version of the journal to be produced after the acceptance date. This very rapid process will depend on immediate responses from reviewers, and also a rapid turnaround from the authors once they have received their paper for revision.

We anticipate that we may be overwhelmed with requests for this type of publication unless we only process those papers that are recognisable as having great merit at first sight. Clearly if everybody asks for this service nobody will get it! The main safeguard is that if the paper is clearly unsuitable as a Rapid Communication because it does not satisfy the one criterion of being outstandingly important, then the paper will be returned to the authors unprocessed and will need to be resubmitted; we cannot simply divert it into the normal review process.

Rapid Communications is now open for business and we hope that we will see a healthy number of important papers coming through this route.

Roger Hall
Editor, *Heart*