Age and Ageing 1998; **27**: 297–301

Use of angiotensin-converting enzyme inhibitors in elderly patients with heart failure

SHAUN O'KEEFFE, GILL HARVEY, MICHAEL LYE

Department of Geriatric Medicine, Royal Liverpool University Hospital, PO Box 147, Prescot Street, Liverpool L69 3BX, UK

Address correspondence to: M. Lye. Fax: (+44) 151 706 4064. E-mail: m.lye@liverpool.ac.uk

Abstract

Objective: to determine the factors associated with prescription of angiotensin-converting enzyme (ACE) inhibitors in elderly heart failure patients discharged from acute geriatric units.
Design: retrospective study of case notes.
Setting: 12 acute geriatric units in the Mersey region.
Subjects: 307 patients (median age 82 years; 204 women) with a discharge diagnosis of heart failure.
Main outcome measures: treatment with ACE inhibitors; use of echocardiography; presence of left ventricular systolic dysfunction on echocardiography.
Results: 176 (57%) patients were discharged from hospital with an ACE inhibitor prescription; a further 19 (6%) patients had been unable to tolerate an ACE inhibitor. One hundred and twenty-one patients (39%) had undergone echocardiography. The proportion of patients in different hospitals who had echocardiography after heart failure ranged from 7 to 67%. Left ventricular systolic dysfunction was reported in 58 patients(48%); 45 of these (78%) were discharged with an ACE inhibitor prescription, seven (12%) had had a previous unsuccessful trial of ACE inhibition and two (3%) had aortic stenosis.
Conclusions: the prescribing of ACE inhibitors is satisfactory in elderly heart failure patients attending acute geriatric units in this region who undergo echocardiography. However, the low use of echocardiography in some hospitals is a cause for concern.

Keywords: *angiotensin-converting enzyme inhibitors, audit, echocardiography, heart failure, old age*

Introduction

Treatment with angiotensin-converting enzyme (ACE) inhibitors improves symptoms and survival of patients with chronic heart failure [1]. The incidence and prevalence of chronic heart failure increase exponentially with increasing age [2]. The results of the large randomized treatment trials indicate that treatment with ACE inhibitors benefits elderly patients with heart failure and asymptomatic left ventricular dysfunction [3–6]. Indeed, the absolute reductions in mortality and hospitalizations for heart failure brought about by ACE inhibitors may be greatest in elderly patients [1].

Studies suggest that ACE inhibitors are under-used in patients with heart failure in the UK [7, 8]. Also, many patients taking ACE inhibitors are prescribed a dosage which is less than that shown to be effective in clinical trials [7, 9]. Elderly patients are less likely to receive ACE inhibitors after heart failure than young patients [7, 10]. One possible explanation is that elderly patients are more likely to have contraindications to, or experience adverse effects from, ACE inhibitors. An alternative explanation is that, while the benefits of ACE inhibitor therapy are best established in heart failure patients with systolic dysfunction on echocardiography or radionuclide testing [1], a high proportion of elderly heart failure patients have normal systolic function [11]. However, studies show that echocardiography is performed in only 30–60% of inpatients with heart failure in the UK and there is some evidence that older patients are least likely to undergo this investigation [7, 8, 12, 13].

The aim of the present study was to assess the use of ACE inhibitors in elderly heart failure patients discharged from all acute geriatric units in Mersey region, with particular reference to the performance of

echocardiography and the presence or absence of left ventricular systolic dysfunction.

Methods

Ten consecutive case notes of patients discharged from hospital in 1995 with a diagnosis of heart failure in the discharge summary were assessed for each of the 31 consultants in geriatric medicine working in 12 acute hospitals in the region. Case notes were retrieved and assessed by a specially trained pharmacy audit assistant; the consultants had no influence on the selection of case notes. Patient characteristics, laboratory and other tests and drug usage were recorded for each patient using a standardized assessment form.

Echocardiography reports were obtained for all patients who had undergone this investigation. For this study, left ventricular systolic dysfunction was defined by an ejection fraction less than 0.45 or, where measurement of ejection fraction was not reported, by the presence of a global impairment of left ventricular contraction. Valvular disease was recorded if the echocardiographer or cardiologist described valvular regurgitation or stenosis as 'significant', 'probably significant' or 'moderate to severe'.

Continuous data were examined with Student's *t*-tests (unpaired) and categorical data by χ^2 tests. Stepwise logistic regression was used to determine the independent predictors of dichotomous outcomes. Age, sex and cardiac diagnoses were included in all analyses. Discharge values for plasma creatinine, urea, sodium and potassium concentrations were also entered into the models examining ACE inhibitor use in different patient groups.

Determinants of the dose of ACE inhibitor were examined by stepwise multiple regression analysis. We followed the procedure of Clark and Coats and standardized the dose of each ACE inhibitor to a proportion of the lowest target dose for that agent which had been shown to improve mortality. These were: captopril 25 mg twice daily, lisinopril 10 mg daily, enalapril 10 mg twice daily and ramipril 5 mg twice daily [13].

Results

Complete data were obtained for 310 patients. The median age of these patients was 82 years (range 68–94) and there were 106 men and 204 women. Despite the diagnosis in the discharge summary, three patients were judged not to have heart failure based on consultant comments in the case notes. Two of these patients probably had gravitational oedema and one had dyspnoea secondary to chronic obstructive airways disease. These patients are excluded from subsequent analyses. Of the remaining 307 patients, 124 were newly diagnosed as having heart failure and 181 had had a diagnosis of heart failure established before the index admission.

Of the 307 patients, 121 (39%) had undergone echocardiography either during their index hospital stay (88) or previously (33); no patient had had radionuclide scanning or left ventriculography performed. In a stepwise logistic regression analysis including all demographic, clinical and laboratory data, only patient age [odds ratio (OR) 0.94, confidence interval (CI) 0.90–0.97] was an independent predictor of performance of echocardiography. However, the proportion of heart failure patients in different hospitals who had echocardiography ranged from 7 to 67% while use of echocardiography by different consultants varied from 5 to 75%. There were no significant differences in patient demographics, clinical or laboratory data to account for these findings.

Abnormalities identified on echocardiography are shown in Table 1. Left ventricular systolic dysfunction was reported in 58 patients(48%); 57 patients (47%) had normal systolic function. Only six (5%) of the 121 echocardiograms were reported as totally uninterpretable. One hundred and seventy-six (57%) patients were discharged from hospital with an ACE inhibitor prescription (98 on captopril, 53 on enalapril, 20 on lisinopril, two each on perindopril and fosinopril and one on ramipril). An ACE inhibitor had been prescribed for a further 19 (6%) patients but had been discontinued due to an adverse reaction. Ninety-one (49%) of the 186 patients who did not have echocardiography and 84 (69%) of the 121 patients who had echocardiography were prescribed ACE inhibitors on discharge from hospital ($\chi^2 = 12.6$, $P < 0.0001$).

Characteristics of patients with and without systolic dysfunction on echocardiography are shown in Table 2. Of the 58 patients with systolic dysfunction, 45 (78%) were discharged with an ACE inhibitor prescription, seven (12%) had had a previous unsuccessful trial of ACE inhibition and two (3%) had aortic stenosis (a contraindication to use of ACE inhibitors). ACE inhibitors were prescribed on discharge to 39 (63%) of the 57 patients with normal systolic function on echocardiography. Four such patients (7%) had had an unsuccessful trial of ACE inhibitors and eight (14%) had aortic stenosis. ACE inhibitors were prescribed on discharge for 16 (70%) of the 23 patients who had heart failure associated with an acute myocardial infarction on the current admission; a further four patients with myocardial infarction (17%) had been unable to tolerate ACE inhibitors.

In the study group as a whole, after excluding patients who had a failed trial of ACE inhibitors and those with aortic stenosis, performance of echocardiography (OR 3.6, CI 1.7–7.5), acute myocardial infarction (OR 2.5, CI 1.2–5.3) and hypertension (OR 2.1, CI 1.1–3.9) predicted ACE inhibitor use, while increased age (OR 0.92, CI 0.89–0.96) and increased serum creatinine concentration (OR 0.93, CI 0.88–0.95) were

Table 1. Abnormalities reported on echocardiography

Finding	No. of patients[a]
Echocardiogram impossible/uninterpretable	6
Left ventricular systolic dysfunction	58
Mitral regurgitation	9
Aortic stenosis	2
Left ventricular hypertrophy	2
Normal left ventricular systolic function	57
Regional wall abnormalities	17
Left ventricular hypertrophy	7
Aortic stenosis	8
Mitral stenosis	2
Mitral regurgitation	2
Tricuspid regurgitation	4
Pulmonary hypertension	5
Left ventricular thrombus	1
Hypertrophic cardiomyopathy	2
No abnormality	15

[a]Some patients had more than one of the identified abnormalities

associated with less ACE inhibitor use. In the subgroup of patients who had echocardiography, left ventricular systolic dysfunction (OR 3.7, CI 1.3-10.6), acute myocardial infarction (OR 2.8, CI 1.2-6.5) and hypertension (OR 1.8, CI 1.1-3.0) were independent predictors of ACE inhibitor usage.

Forty-three percent of patients received the target dose of ACE inhibitor. In a stepwise linear regression model, including all patients discharged with an ACE inhibitor prescription, serum creatinine concentration on discharge ($t = -4.1$, $P < 0.001$) was the only independent predictor of the discharge dose of ACE inhibitor. Thus, patients with a high serum creatinine concentration were less likely to receive the target ACE inhibitor dose.

Discussion

Assessment of left ventricular function by echocardiography (or radionuclide scanning, where available) is recommended for all patients with suspected chronic heart failure [15]. Echocardiography is particularly useful in elderly patients because of the difficulty in interpreting symptoms and signs of heart failure and because the physical signs of aortic stenosis (a contraindication to use of ACE inhibitors) may not be obvious in this group [16].

In our study, 39% of heart failure patients discharged from 12 acute geriatric units underwent echocardiography. The hospital in which a patient was treated was a major determinant of whether echocardiography was

Table 2. Characteristics of patient groups

	Systolic dysfunction		
	Yes ($n = 58$)	No ($n = 57$)	No echocardiogram ($n = 186$)
Age, mean (SD)	81.5 (5.8)	79.7 (5.8)	82.9 (7.1)
Male	30%	33%	35%
Ischaemic heart disease	59%	56%	46%
Acute MI	5%	21%	4%
Hypertension	14%	25%	16%
Atrial fibrillation	30%	48%	28%
Valvular disease	19%	32%	2%
Aortic stenosis	2%	14%	0%
Discharge ACEI	78%	63%	48%
Failed ACEI trial	12%	7%	4%

ACEI, angiotensin-converting enzyme inhibitor; MI, myocardial infarct.

performed. Discussions of these findings with our colleagues suggest that in some hospitals waiting times for echocardiography are long and elderly patients under the care of geriatricians receive a low priority. This is consistent with the results of a survey of geriatricians which revealed that less than half felt they had a good access to echocardiography for investigation of congestive heart failure [17]. Hillis and colleagues, who reported that 37% of inpatients with heart failure attending Aberdeen Royal Infirmary received specialist cardiac investigations, including echocardiography, noted that patients receiving such tests were younger and more likely to be under the care of a cardiologist [7].

Previous studies have reported that ACE inhibitors are under-used in patients with heart failure, but have not fully examined the reasons for not prescribing these drugs. The benefits of ACE inhibition are only clearly proven for those patients with left ventricular systolic dysfunction [1]. Thus, it is difficult to judge whether ACE inhibition was indicated without reference to the findings on investigation of left ventricular function. This point is particularly relevant to studies of elderly people because of the high prevalence of heart failure with normal systolic function in this group [11]. The presence of left ventricular systolic dysfunction was a major independent determinant of use of ACE inhibitors among the elderly patients in our study who had echocardiography.

Of the patients with systolic dysfunction, 93% had either received ACE inhibitors at some time or had a contraindication to ACE inhibition. Thus, at worst, only 7% of heart failure patients in whom ACE inhibitors were probably indicated failed to receive this treatment. Almost half the patients who underwent echocardiography in this study had normal left ventricular systolic function. Atrial fibrillation and hypertension were particularly common in this group of patients. These findings are consistent with many previous studies of elderly patients with heart failure [11, 18–22]. Surprisingly, 70% of patients with normal systolic function were prescribed ACE inhibitors in this study. As yet, there is no clear evidence that ACE inhibitors benefit such patients, although ACE inhibition may be beneficial in patients with hypertension or with clinical signs of heart failure after acute myocardial infarction [4, 11].

Less than half of the patients in this study received the target doses for ACE inhibitors identified in the major survival trials. However, this does not necessarily reflect poor practice, since discharge creatinine level was the major determinant of dose. In any case, the average dose of ACE inhibitor actually achieved in some trials was lower than the target dose [9] and the importance of dose as a determinant of outcome is the subject of ongoing trials.

Even within the relatively restricted age range of our study population, advanced age was independently associated with a decreased likelihood that echocardiography would be performed or ACE inhibitors prescribed. This may reflect a degree of 'ageism' among echocardiography departments or even among some geriatricians. However, there are relatively few data concerning use of ACE inhibitors in very old patients (over 80 years) to guide practice. Nevertheless, the high frequency of potentially important findings in patients who underwent echocardiography in this study emphasizes the value of this investigation even when ACE inhibition is not under consideration.

There are a number of limitations to a retrospective study of this type. We relied upon the discharge diagnosis of heart failure in the patients' notes. We acknowledge that under- and over-diagnosis of heart failure are probably common problems among elderly patients; however, the aim of the study was to examine actual practice in patients with a clinical diagnosis of heart failure. Similarly, we relied upon echocardiographic reports to determine the presence or absence of left ventricular systolic dysfunction. The 12 units involved in this study used 10 different report forms, which is likely to have increased the inaccuracy of any independent assessment of the meaning of these reports. Also, it could be argued that our echocardiographic criteria for left ventricular systolic dysfunction of an ejection fraction <0.45 or reported global impairment of left ventricular contraction were too strict. Finally, comorbid conditions such as cognitive impairment will influence whether or not ACE inhibition is appropriate for an individual patient with heart failure.

In conclusion, our study suggests that the prescribing of ACE inhibitors is very satisfactory among those elderly patients discharged after heart failure from acute geriatric units in Mersey region who had systolic dysfunction. The use of ACE inhibitors among patients without systolic dysfunction was surprisingly high in view of the lack of clear evidence for benefit in such patients. The main problem identified was the low use of echocardiography in some hospitals. The reasons for this require further investigation.

Key points

- In this study of 12 acute geriatric units, over 90% of heart failure patients with identified systolic left ventricular dysfunction who did not have contraindications received a trial of angiotensin-converting enzyme (ACE) inhibitors.
- 70% of heart failure patients without systolic dysfunction received ACE inhibitors.
- The proportion of heart failure patients in different hospitals who had echocardiography ranged from 7 to 67%.

Acknowledgements

We are grateful to the geriatricians participating in MRGAS (Mersey Region Geriatric Audit Study) for access to their patient data and to all local audit assistants for their assistance. M. Culshaw from the Cardiothoracic Centre, Broadgreen, gave helpful advice throughout the study. Funding was by Mersey Regional Audit.

References

1. Garg R, Yusuf S. Overview of randomized trials of angiotensin-converting enzyme inhibitors on mortality and morbidity in patients with heart failure. JAMA 1995; 273: 1450-6.

2. Kannel WB, Belanger AJ. Epidemiology of heart failure. Am Heart J 1991; 12: 951-7.

3. The CONSENSUS Trial Study Group. Effects of enalapril on mortality in severe congestive heart failure. Results of the Cooperative North Scandanavian Enalapril Survival Study (CONSENSUS). N Engl J Med 1987; 316: 1429-35.

4. The Acute Infarction Ramipril Efficacy (AIRE) Study Investigators. Effect of ramipril on mortality and morbidity of survivors of acute myocardial infarction with clinical evidence of heart failure. Lancet 1993; 342: 821-8.

5. Gruppo Italiano per lo Studio della Sopravvivenza nell'infarto Miocardio. GISSI-3: effects of lisinopril and transdermal glyceryl trinitrate singly and together on 6-week mortality and ventricular function after acute myocardial infarction. Lancet 1994; 343: 1115-22.

6. Pfeffer MA, Braunwald E, Moye LA *et al.* for the SAVE Investigators. Effect of captopril on mortality and morbidity in patients with left ventricular dysfunction after myocardial infarction. Results of the Survival and Ventricular Enlargement Trial. N Engl J Med 1992; 327: 669-77.

7. Hillis GS, Trent RJ, Winton P, MacLeod AM, Jennings KP. Angiotensin-converting enzyme inhibitors in the management of cardiac failure: are we ignoring the evidence? Quart J Med 1995; 89: 145-50.

8. Clarke KW, Gray D, Hampton JR. Evidence of inadequate investigation and treatment of patients with heart failure. Br Heart J 1994; 71: 584-7.

9. Cleland JGF, Poole-Wilson PA. ACE inhibitors for heart failure: a question of dose. Br Heart J 1994; 72: 106-10.

10. Roberts SJ, Bateman DN. The use of nitrates, calcium channel blockers and ACE inhibitors in primary care in the Northern Region: a pharmaco-epidemiological study. Br J Clin Pharmacol 1994; 38: 489-97.

11. O'Keeffe ST, Lye MDW. Heart failure in the elderly: the same syndrome as the clinical trials? In: McMurray JJV, Cleland JGF eds. Heart Failure in Clinical Practice. London: Martin Dunitz, 1996; 47-71.

12. Parameshwar J, Poole-Wilson PA, Sutton GC. Heart failure in a district general hospital. J R Coll Phys Lond 1992; 26: 139-42.

13. Mair FS, Crowley TS, Bundred PE. Prevalence, aetiology and management of heart failure in general practice. Br J Gen Pract 1996; 46: 77-9.

14. Clark AL, Coats AJS. Severity of cardiac failure and dosage of angiotensin-converting enzyme inhibitors. Br Med J 1995; 310: 973-4.

15. Task Force on Heart Failure of the European Society of Cardiology. Guidelines for the diagnosis of heart failure. Eur Heart J 1995; 16: 741-51.

16. Lombard JT, Selzer A. Valvular aortic stenosis: a clinical and hemodynamic profile of patients. Ann Intern Med 1987; 106: 292-8.

17. Dunbar D, Choy A-M, Lang CC, Pringle TH, McMurdo M, Struthers AD. Attitudes of physicians in the treatment of heart failure in older adults. J Am Geriatr Soc 1995; 43: 943-4.

18. Wong WF, Gold S, Fukuyama O, Blanchette PL. Diastolic dysfunction in elderly patients with congestive heart failure. Am J Cardiol 1989; 63: 1526-8.

19. Soufer R, Wohlgelernter D, Vita NA *et al.* Intact systolic left ventricular function in clinical congestive heart failure. Am J Cardiol 1985; 55: 1032-6.

20. Echeverria HH, Bilsker MS, Myerburg RJ, Kessler KM. Congestive heart failure: echocardiographic insights. Am J Med 1983; 75: 750-5.

21. Aguirre FV, Pearson AC, Lewen MK, McCluskey M, Labovitz AJ. Usefulness of Doppler echocardiography in the diagnosis of congestive heart failure. Am J Cardiol 1989; 63: 1098-102.

22. Taffet GE, Teasdale TA, Bleyer AJ, Kutka NJ, Luchi RJ. Survival of elderly men with congestive heart failure. Age Ageing 1992; 21: 49-55.

Received 9 April 1997

Florence Myers, age 100, born 1897, Bradford, looking at a photo taken when she was just 18. © Ian Beesley.