Heart failure after myocardial infarction: a neglected problem?

MARTIN R COWIE, LARRY LACEY, MAGGIE TABBERER

Abstract

Improvements in the management of acute myocardial infarction together with population ageing have contributed to a growing burden of heart failure. Around half of new cases of heart failure in patients aged less than 75 years are due to coronary artery disease; many of these patients develop heart failure in the context of acute myocardial infarction. Left ventricular systolic dysfunction is the single most common cause of heart failure after myocardial infarction. Of the estimated 65,000 new cases of heart failure in the UK each year, it is likely that around 15,000 occur in the context of acute myocardial infarction. Ventricular remodelling generally occurs in the early period after myocardial infarction, and early identification offers the potential to modify this process and reduce the risk of heart failure. Clear guidelines should be built into the myocardial infarction care pathway to ensure an integrated approach from hospital and community services.

Key words: heart failure, acute myocardial infarction, prognosis, epidemiology, left ventricular systolic dysfunction.

Br J Cardiol 2005;**12**:205–08

Introduction

Heart failure is a clinical syndrome that may result from any structural or functional cardiac disorder that impairs the pumping ability of the heart. It not only reduces life expectancy but is associated with symptoms of breathlessness, fluid retention and fatigue that markedly impair quality of life. From the health care perspective, patients with heart failure often require hospitalisation to re-establish control of the syndrome; heart failure admissions accounting for around 5% of emergency medical admissions in the UK. Chronic disease management continues to be a major challenge, as recognised in the recent National Institute for Clinical Excellence (NICE) guidelines.[1] Paradoxically, major advances in the treatment of acute myocardial infarction (AMI) have led to an increasing burden of heart failure, due to patients surviving the acute cardiac insult but then living with a significantly damaged heart.

Traditionally, heart failure has been something of a Cinderella service. Better access to cardiac imaging and new biochemical assays have made the diagnosis more straightforward, while improved understanding of the underlying pathophysiology and large randomised controlled trials have led to major advances in treatment. Modern treatment now offers the potential to improve symptoms and quality of life, reduce hospital admission rates, slow the rate of disease progression, and improve survival.

In recommending appropriate investigations for patients with suspected heart failure, the National Service Framework (NSF) for Coronary Heart Disease (CHD) has provided a great fillip to NHS heart failure services, both in primary and secondary care.[2] The main focus of services, however, is on the management of chronic heart failure, with little attention generally paid to one of the major precursors of heart failure in the population, that of left ventricular systolic dysfunction (LVSD) following AMI.

This article is based on a systematic review of the literature regarding the epidemiology of heart failure, with a focus on LVSD and heart failure after myocardial infarction (MI) in the UK. Searches were carried out using Medline, PubMed, the Cochrane library, the NHS National E-Library for Health, eBMJ and British Heart Foundation statistics web site (www.heartstats.org), supplemented by searching manually from the reference lists of key papers identified from the searches.

Pathophysiology

AMI has both immediate and delayed effects on the ventricle: a healthy ventricle may become severely dysfunctional almost instantaneously due to massive myocardial ischaemia and subsequent necrosis, usually manifest as cardiogenic shock. In a few patients, the 'surgical' complications of acute ventricular septal defect or papillary muscle dysfunction or rupture may lead to heart failure. Pump dysfunction in the peri-infarct period may alternatively be short-lived due to myocardial stunning or arrhythmia. The underlying cause for most patients developing heart failure after MI is a moderate amount of myocardial necrosis with consequent ventricular remodelling.[3]

Ventricular remodelling consists of left ventricular wall thin-

Department of Clinical Cardiology, National Heart & Lung Institute, Imperial College, Dovehouse Street, London, SW3 6LY.
Martin R Cowie, Professor of Cardiology

LaceySolutions Ltd, The Beaches, South Strand, Skerries, County Dublin, Ireland.
Larry Lacey, Scientist and Health Economist

Pfizer Limited, Walton Oaks, Dorking Road, Tadworth, Surrey, KT20 7NS.
Maggie Tabberer, Outcomes Research

Correspondence to: Professor MR Cowie
(email: m.cowie@imperial.ac.uk)

ning in the infarct area, ventricular chamber dilatation, and compensatory hypertrophy via lengthening of the non-infarcted portion of the myocardium. Remodelling initially maintains stroke volume and pump function of the left ventricle but over time these changes become maladaptive, leading to increased wall stress and oxygen demand, interstitial fibrosis, decreased contractility and a vicious downward spiral to heart failure. Such remodelling is associated with, and is probably causally related to, neurohormonal stimulation.[4] The process of remodelling occurs rapidly in the immediate post-infarction period and then more slowly thereafter.

Epidemiology

Studies based on echocardiographic diagnosis of heart failure suggest a prevalence rate of 2–3% of the population aged 45 years and older.[5,6] The incidence rate is conservatively estimated to be one to two per 1,000 per year.[7] Population-based studies suggest that the one-year mortality rate is of the order of 30–40%.[8] The EuroHeart Failure study found that 9% of patients in the UK died during an admission, while almost a third of survivors were re-admitted within 12 weeks of discharge.[9] The prevalence, incidence and rate of hospital admission for patients with heart failure rise dramatically with age: the average age of a patient with new heart failure in the UK is 75 years of age.

How important is AMI in producing the burden of heart failure and LVSD in the UK population? Clinical trials recruiting patients with heart failure report a history of prior MI in around 60% of patients,[10] but this is likely to over-estimate the situation in the general population.

In a prospective population study conducted in Glasgow, the prevalence of LVSD (defined as left ventricular ejection fraction on echocardiography ≤ 30%) was found to be approximately 30 per 1,000 of the population aged 25 years and older (40 per 1,000 for men and 20 per 1,000 for women), with approximately 50% of those with LVSD being symptomatic.[6] Among those with symptomatic LVSD, 50% had a previous history of MI and 95% had some history of ischaemic heart disease. In the community-based Heart of England study, a smaller proportion (53%) of patients had a history of ischaemic heart disease[5] but the single most powerful predictor for LVSD was previous MI.[11] Of the estimated 650,000 people with heart failure in the UK currently,[12] these studies would suggest that between 25 and 50% have a history of a previous MI.

In a population-based study in South London, more than half of new cases of heart failure in patients aged less than 75 years were due to coronary artery disease, and half of these developed heart failure for the first time in the context of AMI.[13] This would suggest that of the estimated 65,000 new cases[7,12] of heart failure in the UK each year, at least 15,000 occur in the context of AMI.

Other data sources suggest the size of the problem may be much greater. In the US National Registry of Myocardial Infarction (NRMI) database, approximately 20% of those with AMI had heart failure at the time of hospital admission and approximately 9% developed heart failure thereafter.[14] In a French study, 38% of patients exhibited heart failure during the first five days after MI.[15] Extrapolating these data to the UK, where there are approximately 110,000 admissions each year due to AMI,[16] would suggest that at least 30,000 patients develop heart failure following MI. Of course, such signs of heart failure may be temporary and it is not known what proportion of these will continue to 'chronic' heart failure.

Who is at risk of post-MI heart failure?

Most studies suggest that the risk of heart failure post-MI is higher in older patients, women, and those with a history of cardiac disease or diabetes mellitus.[17] US studies suggest a bimodal occurrence, with an early peak at the time of hospital admission, and a later peak beginning after the fourth day of admission.[18] Predictors of early heart failure were older age, diabetes mellitus, or previous cardiac symptoms, whereas the predictors of heart failure after the fourth day also included a history of hypertension, male gender, tachycardia, and a higher peak creatine phosphokinase level. Heart failure is more common after anterior MI than after infarction at other sites.

Identification and management of post-MI heart failure

The NSF for CHD states that patients suspected of suffering an AMI or other acute coronary syndrome should be rapidly assessed and treated. Patients should be given angiotensin-converting enzyme (ACE) inhibitors unless contraindicated, and this should be reviewed after four to six weeks, at which point they should be continued in patients who have symptomatic heart failure, extensive Q-wave infarcts or echocardiographic evidence of left ventricular dysfunction.[2] In some centres, particularly where imaging of the ventricle can routinely be performed during that early period, ACE inhibitors are only prescribed for patients in these categories.

Ideally, all patients after MI should undergo imaging of left ventricular function during their initial in-patient stay. As much of the ventricular remodelling occurs in the very early period after MI, the value of delaying 'routine' imaging to the out-patient phase may be reduced – although no trial comparing a delayed strategy with an in-patient strategy has been published. If imaging facilities are unable to provide an assessment of left ventricular systolic function in all patients during the admission with MI, then resources should be targeted towards those most at risk, notably those patients with signs or symptoms of heart failure or who are at high risk of such, the elderly, diabetic patients, those who have a previous cardiac history, an anterior MI or new bundle branch block. In this way, acute 'surgical' causes of heart failure (such as ventricular septal defect or papillary muscle rupture) can be distinguished from the majority of cases with underlying impairment of LVSD as the primary cause of heart failure, and drug therapy can be tailored to the patient.

Very rapid reperfusion therapy, whether by means of fibrinolysis or by percutaneous coronary intervention, helps to limit myocardial damage. Data from randomised controlled trials strongly support the use of ACE inhibitors in the treatment of

LVSD and heart failure post-MI,[19] while a recent study suggests that the angiotensin II receptor blocker valsartan is not inferior to ACE inhibition using captopril.[20] The NSF for CHD includes as a key audit criterion the number and percentage of patients discharged from hospital with a diagnosis of AMI who have been prescribed an ACE inhibitor, with documentation of left ventricular function being recommended "when it becomes possible" to collect this level of data.

Data from at least one randomised controlled trial also support the use of beta blockade in addition to ACE inhibition in the treatment of LVSD and heart failure post-MI.[21] A more recent trial suggests clinically significant benefit from treatment with the mineralocorticoid receptor antagonist eplerenone.[22] In the longer term, the risk of heart failure in patients with coronary artery disease is likely to be reduced by use of secondary preventive therapies such as aspirin, statins,[23] and ACE inhibitors.[24,25]

Interface issues

There should be consistency and continuity between care delivered to patients post-MI. Research has identified a number of barriers to accurate diagnosis and effective management of heart failure in the community setting, including uncertainty about diagnosis, concerns about treatment with ACE inhibitors and beta blockers, lack of awareness of relevant research evidence, and availability and use of echocardiography services.[26] This implies that secondary care has an important responsibility in initiating and communicating the management plan.

The assessment of underlying cardiac damage is an integral part of risk stratification for all patients after MI. If imaging has not been done during the patient's hospital stay, this should be carried out early in the post-discharge period. Many patients will require up-titration of ACE inhibitors, with monitoring of renal function and blood pressure. Responsibility for the supervision of this process should be agreed locally.

Standard 12 of the NSF for CHD requires that patients be invited to participate in a multidisciplinary programme of secondary prevention and rehabilitation in order to reduce their risk of subsequent cardiac problems and to promote their return to a full and normal life. Many patients decline involvement in cardiac rehabilitation programmes, for a variety of reasons, and it is particularly important to ensure that all secondary preventive measures are put in place for these patients by their general practitioners.

Conclusions

Heart failure is a major health care issue. Much needed attention has been focused on care for the 'chronic' phase of the syndrome, yet a substantial proportion of new cases are driven by ventricular damage occurring at the time of MI. Increasing efforts to reduce the extent of cardiac damage at the time of infarction through rapid thrombolysis or primary coronary intervention should help reduce the subsequent burden of heart failure. Early identification and treatment of cardiac damage after infarction can be, and should be, improved. This will require an integrated approach from hospital and community services. Clear guidelines on identification and management of ventricular dysfunction and heart failure after post-MI should be built into the care pathway.

Key messages

- Improved treatment of acute myocardial infarction (AMI) and the ageing of the population have led to an increasing burden of heart failure
- Around half of new cases of heart failure in patients aged less than 75 years are due to coronary artery disease. Half of these develop heart failure for the first time in the context of AMI
- Left ventricular systolic dysfunction (LVSD) is the single most common cause of heart failure after MI
- Older patients, women, and those with a history of cardiac disease or diabetes mellitus are most at risk of heart failure following MI
- Of the estimated 65,000 new cases of heart failure in the UK each year, at least 15,000 occur in the context of AMI
- Ventricular remodelling generally occurs in the early period after MI. Early identification offers the potential to modify the process and reduce the risk of heart failure
- Clear guidelines should be built into the care pathway to ensure an integrated approach from hospital and community services

Conflict of interest

MC is in receipt of research funding from Pfizer, Takeda and Medtronic. At the time of writing MT was employed by Pfizer Ltd. LL is a health outcomes consultant who has provided consultancy services to several pharmaceutical companies, including Pfizer Ltd.

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