Cardiology

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Heart failure: diagnosis and healthcare burden

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Epidemiology

Almost 900,000 people in the UK live with heart failure.[1] This syndrome can affect people at any age but the average age at diagnosis is 76 years.[2] The prevalence is steadily increasing due to ageing of the population and improved survival from acute cardiac disease such as myocardial infarction (MI). The annual incidence of heart failure is estimated to be 1–4 cases per 1,000 population. Despite improvements in management, mortality in the first year after diagnosis remains high (40%), although thereafter it falls to 10% per annum (Fig 1).[3]

Heart failure reduces self-reported quality of life more than most other chronic medical conditions. Consequently there is an increasing number of long-term survivors but with limiting symptoms. Such patients visit the primary care health team more than eleven times each year and are at high risk of admission to hospital with decompensated heart failure, particularly if chronic disease management is poor.[1] Estimates suggest that 5% of all emergency admissions relate to heart failure, often with a long hospital stay. Approximately 2% of the NHS budget (around £700 million) is spent on the care of people with heart failure, hospitalisation accounting for more than 60% of this figure.[4] Hospital admissions for heart failure are predicted to rise by 50% over the next 25 years.

Aetiology

Heart failure can arise from any condition that damages the heart (Table 1). An individual suffering heart failure commonly has a combination of potential causes, for example hypertension, diabetes mellitus and a history of previous MI. Hypertension and valvular disease have declined in importance ver the past century; ischaemic heart disease is now the single most common aetiology, accounting for approximately 65% of new cases in the UK.[5]

Diagnosis

Diagnosing heart failure poses a significant challenge to practising physicians. It is a condition for which there is no diagnostic 'gold standard'. The initial assessment of a patient with suspected heart failure is based on a careful and detailed history and physical examination, but must be followed by further investigations to confirm or refute the clinical diagnosis. The reliability of a clinical diagnosis without the benefit of the results of investigations (such as echocardiography) is poor.[2,6]

The National Institute for Clinical Excellence (NICE) has recently published a guideline for the management of chronic heart failure in adults, with recommendations for diagnosis summarised in an algorithm (Fig 2).[7]

Symptoms

Breathlessness on exertion, fatigue and ankle swelling are common symptoms of heart failure, although they are non-specific. Orthopnoea and paroxysmal dyspnoea are more specific, but may not be present except in severe cases. Other symptoms that may be due to heart failure include anorexia, abdominal pain and bloating, weight loss, constipation, dizziness, memory impairment and

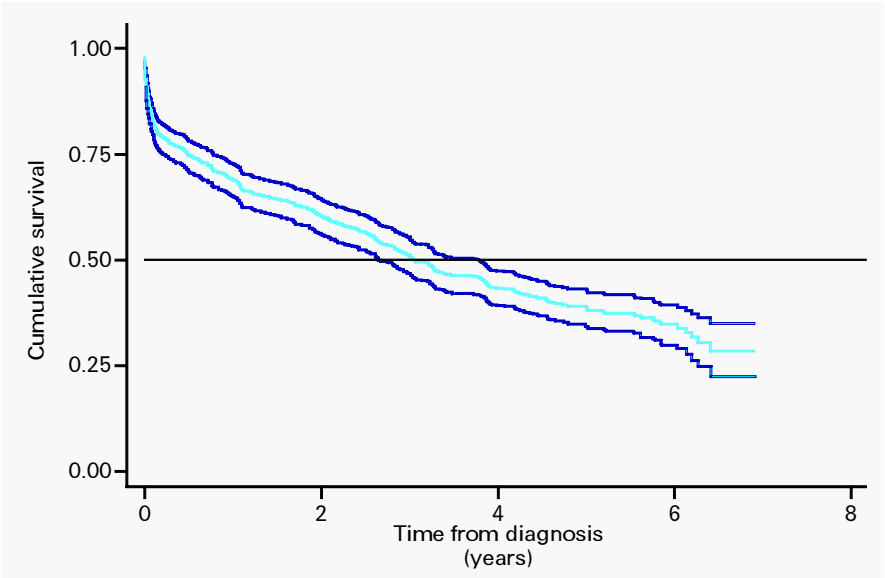


Fig 1. Cumulative survival of 552 incident (new) cases of heart failure identified in the London Heart Failure Studies 1995–1998. Kaplan-Meier estimates with 95% pointwise confidence bands (author's own data).

confusion. Symptoms alone cannot be used to diagnose heart failure, although a combination of such symptoms in a patient with a past history of cardiac disease is highly suggestive of the diagnosis.

Signs

Clinical signs that may be present in a patient with heart failure include tachycardia, pulmonary crackles and peripheral oedema. A raised jugular venous pressure, displaced apex beat or third heart sound are more specific (but less sensitive) for heart failure. A murmur may suggest valvular heart disease, although many patients with a dilated left ventricle may have a murmur of 'functional' mitral regurgitation due to stretching of the mitral valve annulus. The probability of heart failure increases with the number of clinical signs present. The reliability of eliciting clinical signs (particularly in routine practice) may be low. Furthermore, both clinical signs and symptoms are likely to be modified by treatment.

Table 1. Major recognised causes of heart failure (simplified).

- Coronary heart disease
- Hypertension
- Valvular heart disease
- Familial/genetic
  - Duchenne muscular dystrophy
  - Mitochondrial myopathies
  - Hypertrophic cardiomyopathy
- Infectious disease
  - Viral
  - Chagas disease
- Autoimmune disease
  - Systemic lupus erythematosus
  - Rheumatoid arthritis
  - Scleroderma
- Toxins
  - Alcohol
  - Radiation
  - Chemotherapeutic agents (particularly anthracyclines)
  - Iron overload (eg haemochromatosis, frequent blood transfusion without chelation)
- Metabolic disease
  - Diabetes
  - Familial storage diseases
  - Amyloidosis
- Obesity
- General system disease
  - Sarcoidosis
- Pregnancy
- Endocardial disease
- Pericardial disease
- 'Tachycardia induced'
  - Atrial fibrillation
  - Atrial flutter

Initial investigations

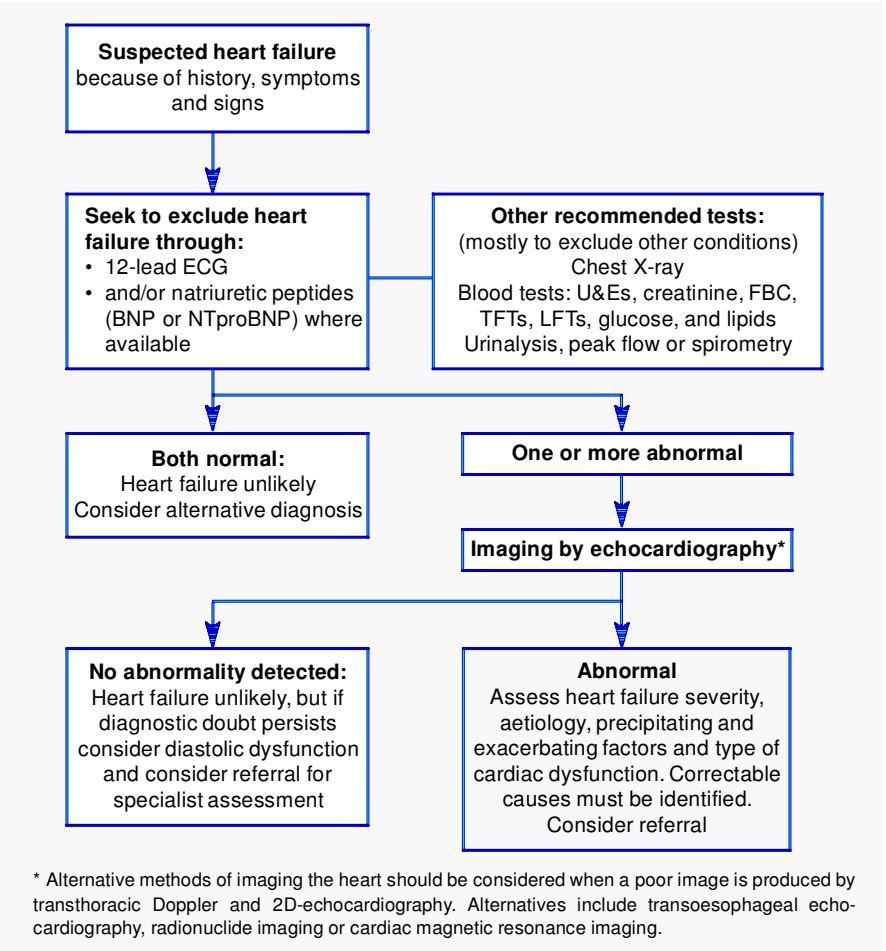
Investigations must be performed to:

- confirm or refute the diagnosis
- exclude alternative diagnoses (Table 2)
- define the underlying cause
- identify precipitating and aggravating factors
- guide management
- provide a baseline against which to monitor the effects of treatment, including assessment of the functional severity of the syndrome (Table 3)
- provide prognostic information.

The NICE guideline recommends that both a 12-lead resting ECG and the plasma concentration of B-type natriuretic peptide (BNP) or N-terminal pro BNP (NTproBNP) can be used to help rule out a diagnosis of heart failure in a patient with new symptoms.

12-lead resting ECG

Heart failure is unlikely in the context of a completely normal resting ECG with a negative predictive value exceeding 90%.[8]



* Alternative methods of imaging the heart should be considered when a poor image is produced by transthoracic Doppler and 2D-echocardiography. Alternatives include transoesophageal echocardiography, radionuclide imaging or cardiac magnetic resonance imaging.

Fig 2. Algorithm summarising the National Institute for Clinical Excellence recommendations for the diagnosis of heart failure (BNP = B-type natriuretic peptide; FBC = full blood count; LFT = liver function test; NTproBNP = N-terminal pro B-type natriuretic peptide; TFT = thyroid function test; U&E = urea and electrolytes).

However, an abnormal ECG is not specific for heart failure and requires investigation. The ECG may also provide additional information, indicating the presence of an arrhythmia (eg atrial fibrillation) or evidence of a previous MI (eg pathological Q waves).

Plasma BNP/NTproBNP concentration

BNP, a hormone produced in response to cardiac stretch or strain, and the co-secreted inactive peptide NTproBNP are useful in helping to exclude heart failure in patients presenting with new symptoms either in the emergency room or clinic.[9,10] A low plasma concentration of either peptide makes the diagnosis unlikely. High plasma concentrations are found in heart failure, irrespective of the underlying cardiac abnormality, and correlate with the severity of symptoms and cardiac dysfunction. Renal dysfunction also raises the concentration of circulating BNP and must be excluded. Rapid assay methods (either laboratory-based or point-of-care) are now available;[11] they are likely to be cost-effective, particularly where access to echocardiography is limited.[12]

If both the ECG and BNP level are normal, heart failure is unlikely and a more thorough search for alternative diagnoses is recommended (Table 2). If either test is abnormal, echocardiography is the recommended next step.

Table 2. Conditions which may present with symptoms and/or signs similar to those of heart failure.

- Obesity
- Chest disease:
  - chest wall
  - diaphragm
  - intrinsic lung disease
- Venous insufficiency in lower limbs
- Drug-induced:
  - ankle swelling (eg calcium-channel blockers)
  - fluid retention (eg non-steroidal anti-inflammatory drugs)
- Hypoalbuminaemia
- Intrinsic renal or hepatic disease
- Pulmonary emboli
- Depression/anxiety
- Severe anaemia
- Severe thyroid disease
- Bilateral renal artery stenosis
- Cardiac deconditioning ('unfitness')

Key Points

Heart failure is a major public health problem in the UK, affecting almost 900,000 people and comprising 5% of emergency hospital admissions

Heart failure has a major impact on life expectancy and quality of life

Diagnosis is not straightforward; clinical suspicion needs to be supported by further investigation

Full evaluation of a patient with suspected heart failure also requires consideration of the underlying abnormality of the heart, the severity of the syndrome, the aetiology, precipitating and exacerbating factors, identification of concomitant disease relevant to the management, and an estimation of prognosis

The 12-lead ECG and/or plasma B-type natriuretic peptide concentration can be useful in ruling out heart failure as a cause of new symptoms

Echocardiography is central to the confirmation of the clinical diagnosis

The National Institute for Clinical Excellence has recently published guidance on the management of heart failure

KEY WORDS: diagnosis, epidemiology, healthcare, heart failure

Other investigations

Other investigations are also recommended by the NICE guideline, mainly to exclude alternative diagnoses (Fig 2). Although historically the chest radiograph has been relied upon to diagnose heart failure, it is neither sensitive nor specific for this purpose. In severe cases it may show pulmonary interstitial or alveolar oedema, and is useful for diagnosing other possible causes of breathlessness such as pleural effusion, chronic obstructive pulmonary disease or pulmonary malignancy.

Echocardiography

In most centres transthoracic echocardiography is now the key investigation for patients with suspected heart failure (Figs 3(a) and (b)). This imaging technique can provide important information on the structure and function of the heart, including the valves and both left

Table 3. The New York Heart Association (NYHA) classification of the functional severity of heart failure.

NYHA class	Classification
I	No limitations Ordinary physical activity does not cause fatigue or breathlessness
II	Slight limitation of physical activity Patients are comfortable at rest Ordinary physical activity results in fatigue or breathlessness
III	Marked limitation of physical activity Patients are comfortable at rest, but less than ordinary physical activity will lead to symptoms
IV	Inability to carry on any physical activity without discomfort Symptoms of congestive cardiac failure are present even at rest Increased discomfort is experienced with any physical activity

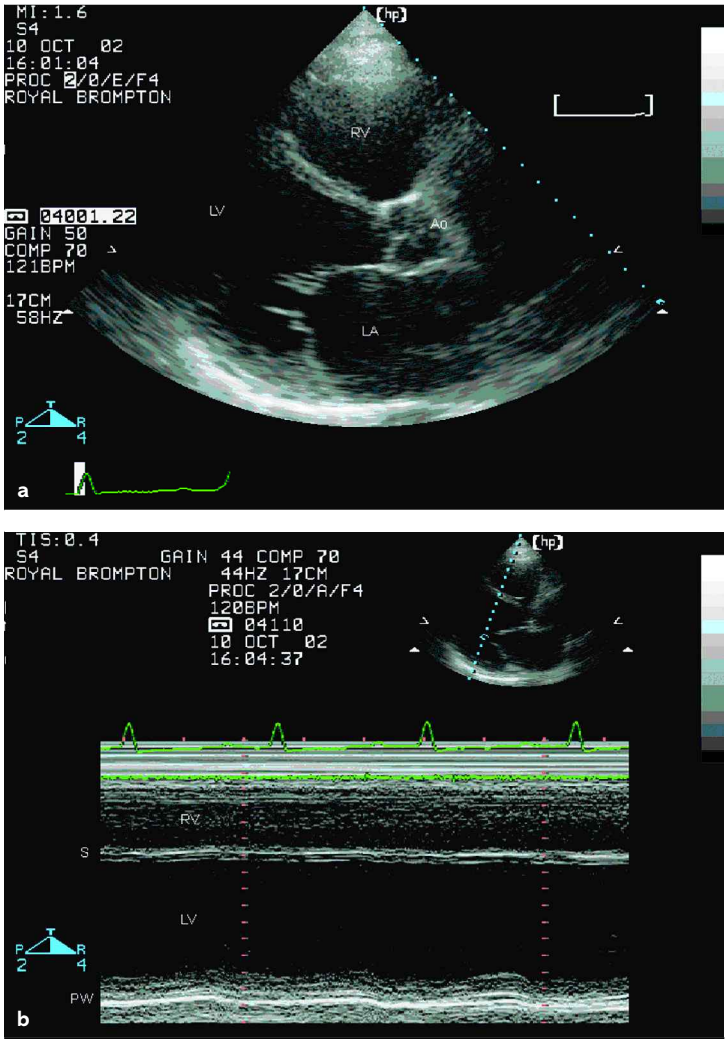


Fig 3. (a) Parasternal long-axis 2D-echocardiogram demonstrating a dilated left ventricle in diastole in a patient with heart failure; **(b)** M-Mode echocardiogram of the same ventricle demonstrating extremely poor basal left ventricular contraction (red bars = cm markers).

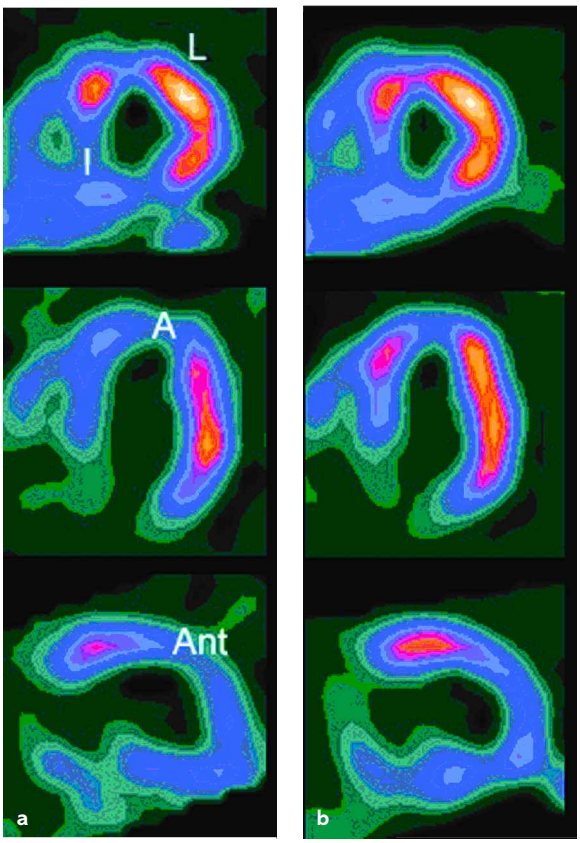


Fig 4. Myocardial perfusion images from a patient with heart failure: (a) Stress image. This picture taken during stress demonstrates severe tracer uptake reduction in the inferior wall and inferoseptum, with moderate reduction in the apex and anterior wall. Only the lateral wall has normal tracer uptake; **(b)** Rest image. At rest, there is partial but significant improvement in tracer uptake throughout the inferior wall, inferoseptum, apex and anterior wall. Combining the images with ECG-gating allows assessment of left ventricular function. The ejection fraction was estimated at 32%. With more detailed image analysis, hibernation could be estimated (3/9 myocardial segments were considered to be hibernating).

and right ventricles; it may also help detect intra-cardiac shunts due to, for example, an atrial or ventricular septal defect. The function of the left ventricle during diastole can also be assessed, although there is still considerable controversy about the best method to do this and the reliability of the results. Echocardiography is now also being used to assess the degree of contractile incoordination, which may help identify patients most likely to benefit from cardiac resynchronisation therapy using an atriobiventricular pacemaker. For patients in whom the echocardiographic 'window' is poor (typically those with chronic obstructive airways disease or extreme obesity), other imaging methods can be used, including transoesophageal echocardiography, ECG-gated myocardial perfusion imaging (Fig 4) or cardiac magnetic resonance imaging (Fig 5).

Echocardiography is underused in patients with heart failure in the UK compared with other European countries. In the pan-European Euroheart Heart Failure Survey, only 56% of patients hospitalised with heart failure in the UK had an echocardiogram compared with almost 95% in France and the Netherlands.[13]

Further investigations

Exercise testing

Objective evidence of functional limitation is provided by exercise testing. A gentle incremental protocol using a cycle or treadmill, with increments graded such that the test lasts 8–12 minutes is ideal. Measurement of gas exchange during the test may also provide important prognostic information, with peak oxygen uptake the most frequently used measure. Shuttle walk tests and six-minute walk tests which do not require specialist equipment may also provide

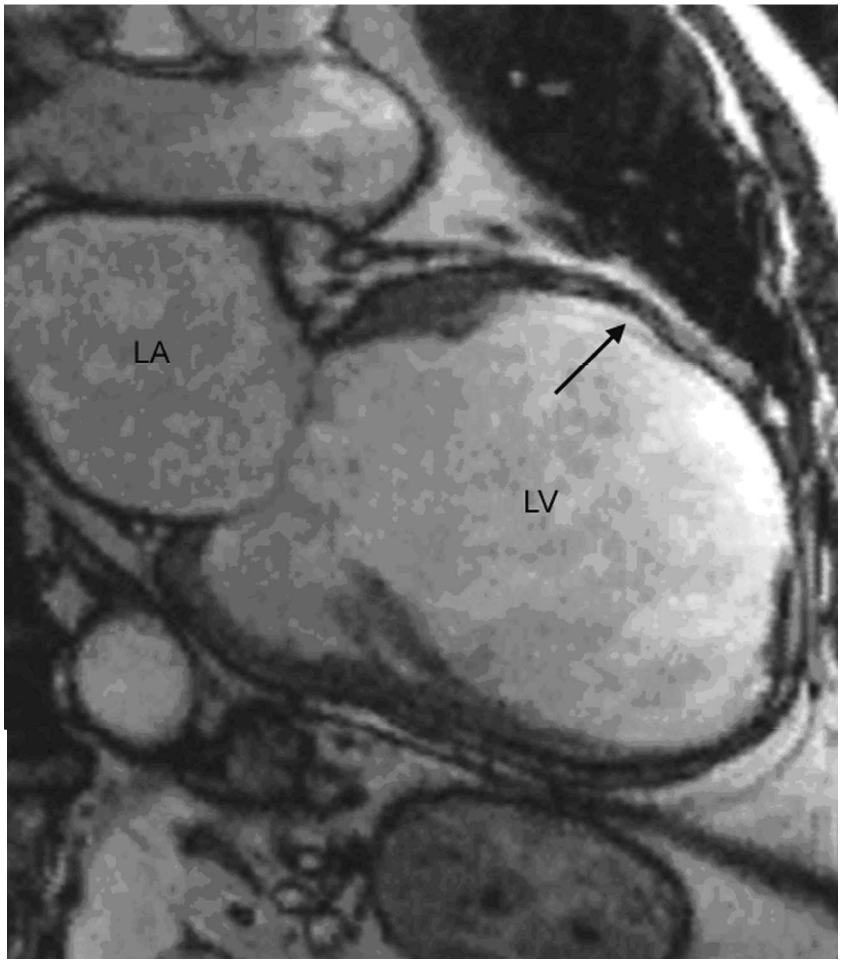


Fig 5. Cardiac magnetic resonance image with gadolinium enhancement demonstrating a dilated poorly contractile left ventricle (LV) with extensive scarring (arrowed) due to previous myocardial infarction.

useful information about submaximal exercise tolerance.

ECG monitoring

ECG monitoring (eg with a Holter system) may be used to detect important cardiac arrhythmias such as (paroxysmal) atrial fibrillation or ventricular tachycardia.

Coronary arteriography

The NICE guideline does not support routine coronary arteriography for the investigation of patients with heart failure. Some patients with heart failure due to coronary artery disease have a significant amount of myocardium that may recover its function on revascularisation ('hibernating myocardium'). Several randomised controlled trials are examining the value of routine coronary angiography and subsequent revascularisation for patients with heart failure.[14] At present, angiography is usually recommended if a patient with heart failure has angina or other evidence of clinically significant myocardial ischaemia. Nuclear perfusion imaging may also be useful in determining the site and extent of reversible ischaemia.

Conclusions

Heart failure is common in the UK and imposes a considerable burden on the NHS. Diagnosis is not straightforward, and clinical suspicion needs to be supported by further investigation. Recent guidance from NICE has provided clear and specific advice about how to diagnose the syndrome. If a 12-lead ECG and/or plasma BNP concentration confirm the possibility of heart failure, people with new symptoms should undergo further investigation, echocardiography being central to this. Full evaluation of a patient with suspected heart failure also requires consideration of:

- the underlying abnormality of the heart
- the severity of the syndrome
- the aetiology
- precipitating and exacerbating factors
- identification of concomitant disease relevant to the management, and
- an estimation of prognosis.

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The treatment of chronic heart failure due to left ventricular systolic dysfunction

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It is of paramount importance to realise that the best way to treat chronic heart failure (CHF) is to prevent it happening in the first place by modifying known risk factors for ischaemic heart disease (IHD) and better treatment of myocardial infarction (MI). An aetiology should always be sought for CHF as its reversal may subsequently improve cardiac function. Once established, CHF has a poor prognosis – worse than many forms of cancer. Treatment aims are to reduce mortality and relieve symptoms. It is encouraging that recent improvements in disease-modifying therapy have markedly improved both morbidity and mortality.

Disease-modifying therapy

Angiotensin-converting enzyme inhibitors

Angiotensin-converting enzyme inhibitors (ACEIs) are the first-line drugs which should be given to all patients with left ventricular systolic dysfunction (LVSD) whether symptomatic[1,2] or not,[3] combined with a diuretic if there is evidence of cardiac decompensation (eg peripheral or pulmonary oedema) (Fig 1). These drugs reduced both morbidity and mortality in clinical trials involving more than 7,000 patients (on average, a 20–25% relative risk (RR) reduction). Unless there is a contraindication, such as significant renal disease, angioedema or ACEI-induced cough, their use is mandatory.

Beta-blockers

There is also now unequivocal evidence that the beta-blockers bisoprolol,[4] carvedilol[5-9] and metoprolol[10] reduce mortality and long-term symptoms in patients with all grades of CHF and in post-MI LVSD. Their use is imperative in patients who are free of cardiac decompensation and should be uptitrated slowly – 'start low, go slow'. Neither chronic obstructive airways disease without airways reversibility nor mild to moderate peripheral vascular disease should be seen as a contraindication to beta-blocker therapy.

Aldosterone antagonists

Spironolactone reduces mortality and morbidity in patients with moderate to severe CHF (New York Heart Association (NYHA) classes III and IV) when used in

TRIAL ACRONYMS

CARE-HF	Cardiac Resynchronisation in Heart Failure (European study)
CHARM	Candesartan in Heart Failure: Assessment of Reduction in Mortality and Morbidity
COMPANION	Comparison of Medical Therapy, Pacing, and Defibrillation in Chronic Heart Failure
DIG	Digitalis Investigation Group
WASH	Warfarin-Aspirin Study in Heart Failure
WATCH	Warfarin Antiplatelet Therapy in Chronic Heart Failure