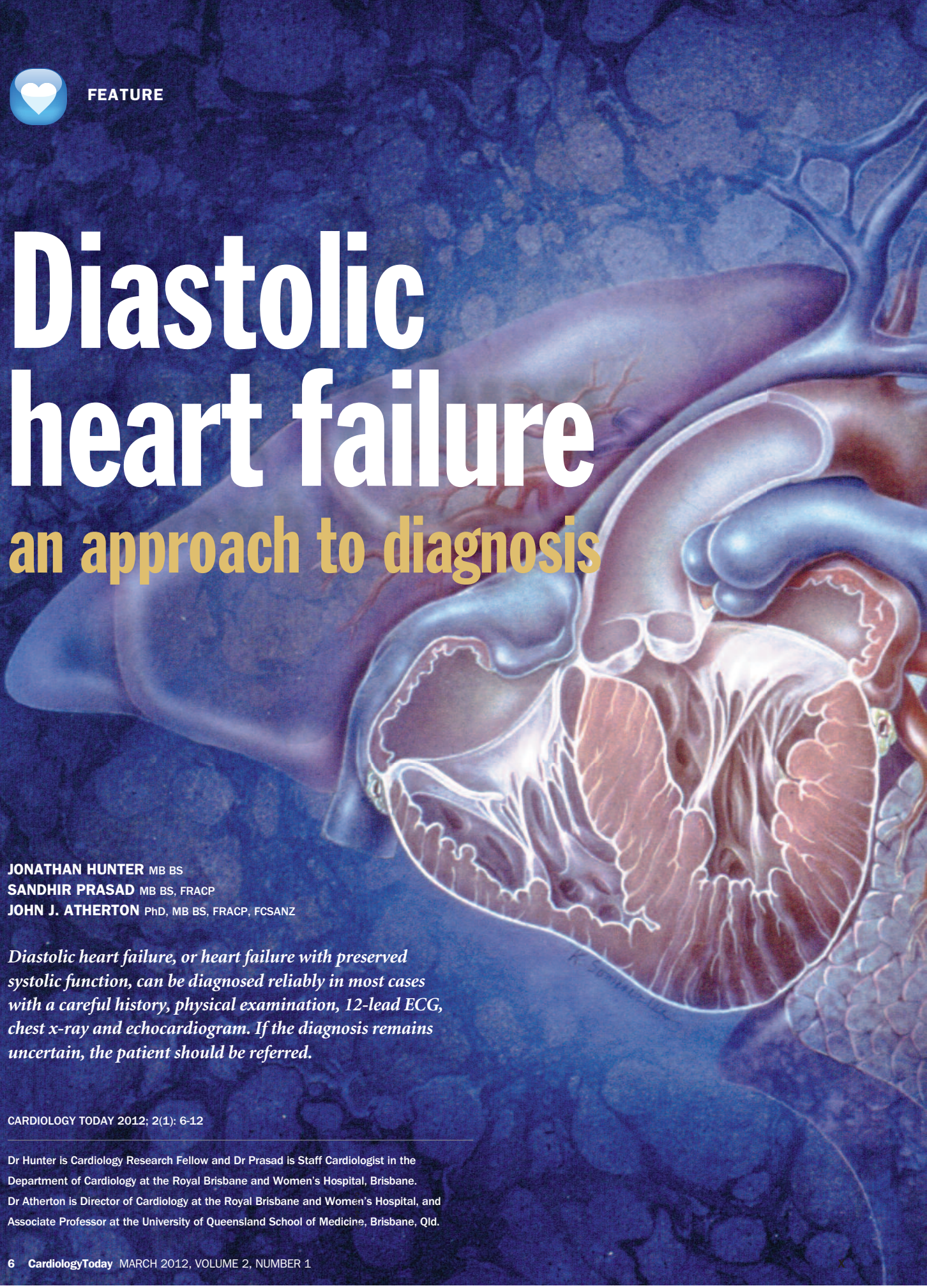
FEATURE

Diastolic heart failure

an approach to diagnosis



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Diastolic heart failure, or heart failure with preserved systolic function, can be diagnosed reliably in most cases with a careful history, physical examination, 12-lead ECG, chest x-ray and echocardiogram. If the diagnosis remains uncertain, the patient should be referred.

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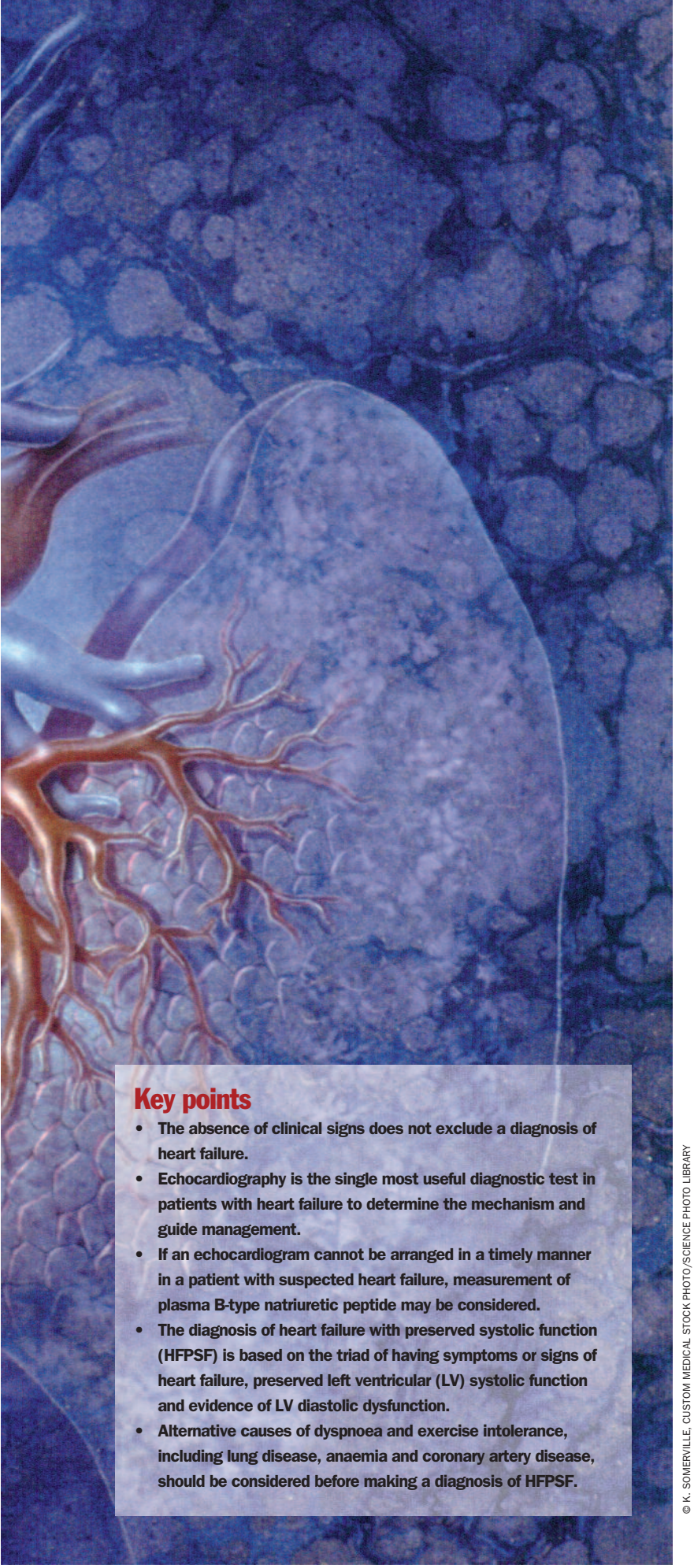

Key points

- The absence of clinical signs does not exclude a diagnosis of heart failure.
- Echocardiography is the single most useful diagnostic test in patients with heart failure to determine the mechanism and guide management.
- If an echocardiogram cannot be arranged in a timely manner in a patient with suspected heart failure, measurement of plasma B-type natriuretic peptide may be considered.
- The diagnosis of heart failure with preserved systolic function (HFPSF) is based on the triad of having symptoms or signs of heart failure, preserved left ventricular (LV) systolic function and evidence of LV diastolic dysfunction.
- Alternative causes of dyspnoea and exercise intolerance, including lung disease, anaemia and coronary artery disease, should be considered before making a diagnosis of HFPSF.

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Diastolic heart failure – or, more accurately, heart failure with preserved systolic function (HFPSF) – accounts for up to half of heart failure cases in western societies.[1,2] The prognosis and rates of hospitalisation for these patients are similar to those for patients with systolic heart failure.[2,3] Furthermore, the prevalence is increasing, related to the ageing population and increasing rates of obesity and diabetes.

The case scenario below sets the scene for a discussion of the diagnosis of HFPSF.

Case scenario

A 77-year-old woman with longstanding hypertension complains of progressive exertional dyspnoea. She is overweight, has mild ankle oedema, the jugular venous pressure is difficult to visualise and the lung fields are clear. Her biochemistry, full blood count, 12-lead ECG, chest x-ray and respiratory investigations are unremarkable. An echocardiogram shows normal left ventricular systolic function with no significant valvular disease. She is anxious about her condition in terms of diagnosis and prognosis.

What is the likely diagnosis and what investigations should be performed?

Mechanism of HFPSF

Mechanistically, HFPSF is thought to be predominantly due to left ventricular (LV) diastolic dysfunction (either abnormal relaxation or increased stiffness), although other factors such as increased arterial stiffness and chronotropic incompetence may contribute. The presence of diastolic dysfunction on an echocardiogram is not synonymous with a diagnosis of HFPSF, because this is commonly present in patients with systolic heart failure and may occur in apparently healthy subjects with no clinical evidence of heart failure.[4] Furthermore, LV diastolic dysfunction may evolve to LV systolic dysfunction in some patients.[4]

Risk factors, clinical features and diagnosis

The recognised risk factors for HFPSF are:

- elderly (female predominance)
- long-term hypertension
- diabetes
- obesity
- moderate to severe chronic kidney disease.

The diagnosis of HFPSF is based on the following triad of conditions being satisfied:[5]

- symptoms or signs of heart failure
- preserved LV systolic function with no significant valvular heart disease
- evidence of LV diastolic dysfunction.

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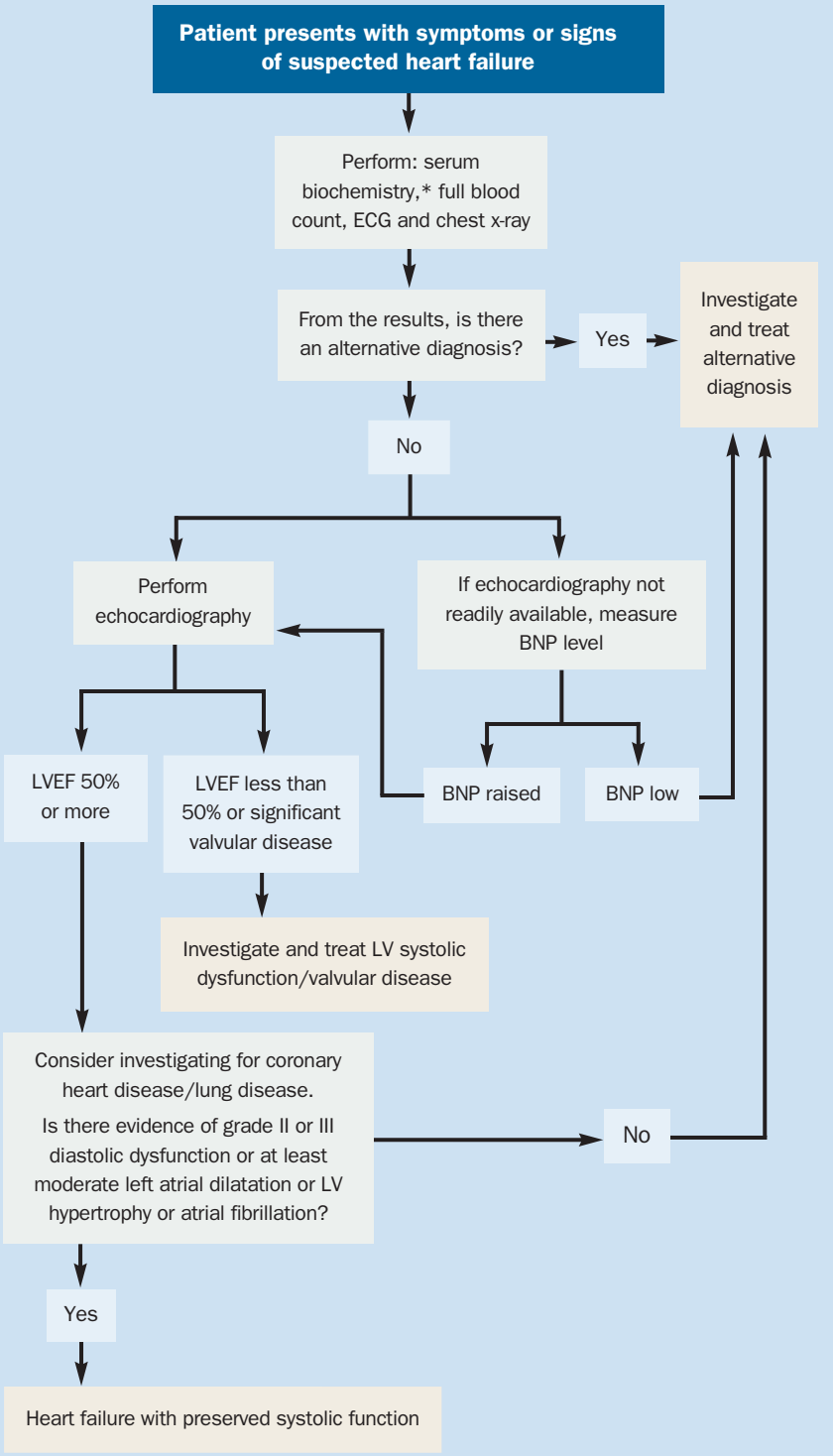
An approach to diagnosing diastolic heart failure



* Serum biochemistry = renal and liver function, and blood glucose level.
ABBREVIATIONS: BNP = B-type natriuretic peptide; ECG = electrocardiogram; LV = left ventricular; LVEF = left ventricular ejection fraction.

Clinical scenarios where this diagnosis may arise include the following:

- acute pulmonary oedema
- exertional dyspnoea or peripheral oedema in a patient with recognised risk factors
- dominant right-sided heart failure without risk factors, where the rarer causes such as restrictive cardiomyopathy and pericardial constriction should be considered.

Atrial fibrillation is common in patients with HFPSF and may lead to acute symptomatic deterioration.

Symptoms and signs of heart failure

Symptoms and signs of HFPSF are indistinguishable from those of systolic heart failure and include exertional dyspnoea, fatigue, paroxysmal nocturnal dyspnoea, orthopnoea, jugular venous distension, lung crepitations, gallop rhythm, hepatomegaly and peripheral oedema. The presence of orthopnoea or clinical evidence of congestion make heart failure more likely; however, their absence does not exclude the diagnosis, so further investigation is necessary if heart failure is suspected.[6]

Given that dyspnoea and fatigue are somewhat subjective, an exercise test may sometimes be helpful to formally document exercise capacity.

Preserved LV systolic function

Preserved LV systolic function has been variably defined and any specific cut-point is arbitrary. There is, however, general consensus that a LV ejection fraction (LVEF) of 50% or more is consistent with normal or preserved LV systolic function and that the left ventricle should be normal in size.[5]

Evidence of LV diastolic dysfunction

Evaluating LV diastolic function is more complex and it has been suggested that HFPSF could be a diagnosis of exclusion in patients with suspected heart failure and a normal LVEF. Although this may be reasonable in patients with unequivocal clinical or radiographical evidence of congestion, it is

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Table. Echocardiographic classification of left ventricular diastolic dysfunction

LV diastolic function	LV diastolic dysfunction grading	E-wave/A-wave ratio	LV filling pressure
Normal	–	1 to 2, with normal E-wave deceleration time (140 to 250 ms) and no other measure indicating raised LV filling pressure*	Normal
Impaired relaxation	Grade I	<1	Normal
Pseudonormalised	Grade II	Normal (1 to 2) with normal E-wave deceleration time (140 to 250 ms) plus other measure indicating raised LV filling pressure*	Elevated
Restrictive	Grade III	>2 or 1 to 2 with E-wave deceleration time <140 ms	Markedly elevated

* Other measures that indicate raised LV filling pressure include raised mitral valve E-wave/E' velocity ratio >15 or left atrial volume index >40 mL/m^2.
ABBREVIATIONS: A-wave = late mitral valve flow velocity (during atrial [A] contraction); E-wave = early [E] mitral valve flow velocity; E' = early mitral annular tissue Doppler lengthening velocity; LV = left ventricular.

likely that such an approach will lead to overdiagnosis of HFPSF. This may be due to the subjective nature of the reported symptoms and the fact that several other conditions lead to exertional dyspnoea and fatigue (including obesity, lung disease, deconditioning, coronary artery disease and anaemia).[7]

Documented evidence of diastolic dysfunction or raised LV filling pressure is, therefore, generally required. This evidence may be obtained either invasively (i.e. cardiac catheterisation) or noninvasively (e.g. echocardiography). Cardiac catheterisation remains the gold standard but, due to its invasive nature, is rarely performed to diagnose HFPSF unless the diagnosis remains elusive following less invasive investigations.

Clinical approach in patients with suspected heart failure

The standard workup of patients with suspected heart failure should include all of the following:[6]

- serum biochemistry (renal function, blood glucose level, liver function)
- full blood count (to exclude anaemia)
- 12-lead ECG (cardiac rhythm, evidence of ischaemic heart disease, LV hypertrophy)
- chest x-ray (cardiothoracic ratio, pulmonary congestion, lung pathology).

Given that none of these investigations exclude heart failure, unless an alternative diagnosis is ruled in, all patients should then have an echocardiogram. If an echocardiogram cannot be arranged in a timely manner in a patient where the diagnosis remains uncertain, measurement of B-type natriuretic peptide (BNP or N-terminal proBNP) should be considered (although this is not currently reimbursed in Australia in the community setting).[6] Further evaluation to exclude ischaemic heart disease and lung disease should be performed in most patients; in selected cases, pulmonary thromboembolism should be considered.

The flowchart on page 8 summarises an approach to diagnosing diastolic heart failure.

Role of B-type natriuretic peptide

Several studies have shown a strong positive correlation between BNP levels and diastolic dysfunction.[8] However, there are some caveats: BNP levels increase with age and they are higher in women and in patients with kidney disease and lower in obese subjects.[9]

Nonetheless, a normal level (e.g. BNP below 100 ng/L) has a high negative predictive accuracy for heart failure in patients where the initial clinical evaluation is equivocal.[10,11] Raised levels require further investigation with either an echocardiogram to determine the mechanism of heart failure or alternative investigations to identify other causes of raised levels (such as pulmonary thromboembolism).[9] Markedly raised levels (e.g. BNP above 400 ng/L) strongly suggest a diagnosis of HFPSF in patients with suspected heart failure and normal LV systolic function.[11]

Role of echocardiography

Echocardiography is the single most useful diagnostic test in patients with heart failure.[6] Assessment of the echocardiogram should include evaluation of the following:

- LV and left atrial size
- LV wall thickness
- LV systolic function (including LVEF)
- LV diastolic function/filling pressure
- valves
- pericardium
- right ventricular systolic pressure.

The echocardiogram allows confirmation of the diagnosis, provides mechanistic insight and guides patient management. A normal sized left ventricle with preserved systolic function and no significant valvular disease in the setting of suspected heart failure suggests a diagnosis of HFPSF. Evidence of LV diastolic

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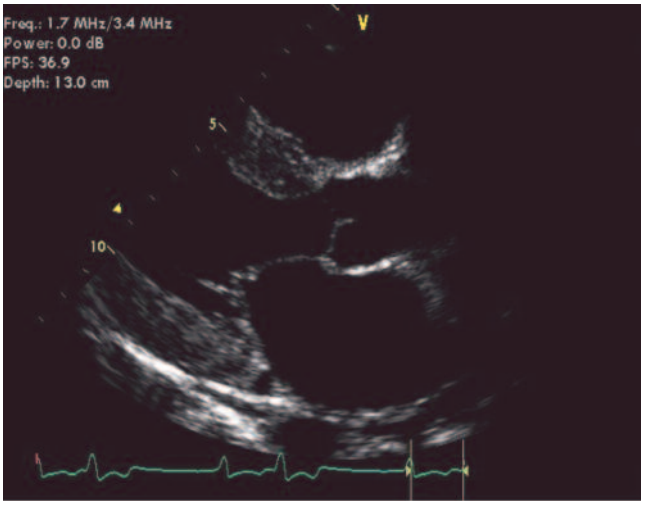

Figure. Mild-to-moderate left ventricular hypertrophy.

dysfunction or raised LV filling pressures is also required for a definitive diagnosis.[5]

A grading system for diastolic dysfunction has been introduced (Table).[12] However, diastolic function parameters vary with age and are variably reported on standard echocardiography. The presence of grade II or III diastolic dysfunction, at least moderate left atrial dilatation (left atrial volume index [i.e. left atrial volume indexed to body surface area] greater than 40 mL/m^2), LV hypertrophy or atrial fibrillation provides strong support for a diagnosis of HFPSF in patients with suspected heart failure and preserved LV systolic function (Figure).[5]

Exercise echocardiography may be helpful in patients with exertional symptoms to provide an objective measure of exercise capacity, rule out myocardial ischaemia and assess diastolic function following exercise.[13]

Conclusion

Diastolic heart failure, or HFPSF, is common and becoming more prevalent in view of the ageing population and increasing rates of obesity and diabetes. The diagnosis is based on the triad of symptoms or signs of heart failure, preserved LV systolic function and evidence of LV diastolic dysfunction. In most cases, the condition can be diagnosed reliably with a careful history, physical examination, 12-lead ECG, chest x-ray and echocardiogram. Alternative causes of dyspnoea and exercise intolerance should be ruled out; these include lung disease, anaemia and coronary artery disease. On echocardiography, the LVEF should be preserved and there should be either direct or indirect evidence of LV diastolic dysfunction or raised filling pressure. If the diagnosis remains uncertain, referral of the patient to a cardiologist for further evaluation and consideration of cardiac catheterisation is reasonable. **CT**

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COMPETING INTERESTS: None.

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