The electrocardiogram in heart failure

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Introduction

Heart failure is predominantly a disease of older people, affecting almost 1 in 10 of those over the age of 80 [1] and accounting for 5% of hospital admissions in this age group [2]. Although an overall 5-year survival figure of 50% has been quoted [3], prognosis is considerably worse in older patients, with a corresponding figure of less than 20% in those aged 80 or over [4].

Angiotensin-converting enzyme inhibitors [5] and β-blockers [6, 7] reduce morbidity, mortality, and hospitalization rates in patients with systolic heart failure with benefits in older (>60) as well as younger subgroups [5, 8], although very elderly patients have generally been under-represented in these trials. More recently, spironolactone has been shown to reduce morbidity and mortality in patients with advanced systolic heart failure when added to standard treatment, an effect seen in the older as well as the younger subgroups within the trial [9].

Diagnosis of heart failure in older people

Given these important prognostic and therapeutic implications, correct diagnosis of heart failure is essential. However, diagnosis may be difficult, particularly in older patients, for a number of reasons.

First, older people are more likely to present with atypical symptoms (such as cough, weakness, or confusion) and the specificity of more classical symptoms is reduced by inactivity and co-morbidity [10].

Secondly, there may be over-reliance on isolated physical signs, such as ankle oedema and pulmonary crepitations, which lack sensitivity and specificity and may be misleading, although they may be more useful in combination [10, 11]. In one study of 207 patients with an average age of 77, pulmonary crepitations were found to be an insensitive and non-specific sign, with no cause found for their presence in 42% of patients [12]. In another study of patients presenting to hospital with acute dyspnoea, isolated crepitations were found to be a poor predictor of left ventricular systolic impairment [13]. Anecdotally, it is common to find diuretics initiated in elderly patients on the basis of basal crepitations alone, even in the absence of a radiological correlate of pulmonary oedema.

Thirdly, although all patients with suspected heart failure should ideally undergo transthoracic echocardiography [14, 15], many do not do so as demand for this resource continues to exceed supply. In one audit in primary care, only 31% of patients with a clinical diagnosis of heart failure had undergone echocardiography—even though 75% had been seen at hospital at some stage [14]. In another study of 307 patients with heart failure (mean age 82) admitted to 12 different geriatric units, 40% of whom were newly diagnosed, echocardiography was performed in only 39% (either during the index admission or previously [15]).

Fourthly, difficulties arise as there is no agreed standard for the diagnosis of heart failure. One useful diagnostic paradigm, however, is that of the Working Group on Heart Failure of the European Society of Cardiology. This states that a positive diagnosis of heart failure requires appropriate symptoms, evidence of fluid retention (pulmonary or peripheral oedema) and evidence of a structurally abnormal heart on echocardiography. In doubtful cases, a symptomatic response to a trial of diuretic is regarded as confirmatory evidence [16].

Heart failure in older people is therefore both under- and over-diagnosed [17]. Studies examining the validity of a primary care diagnosis of heart failure in patients at a range of ages have shown that specialist cardiological evaluation (including transthoracic echocardiography) results in rejection of the diagnosis in half to three-quarters of cases [18–20]. Therefore many patients are treated inappropriately on the basis of non-specific signs and symptoms [21]. However, these studies may overestimate the prevalence of false positives, as the diagnosis of heart failure was accepted only if evidence of systolic dysfunction was
demonstrated on transthoracic echocardiography, thereby excluding patients with possible diastolic heart failure. Although an uncommon cause of heart failure in younger patients, diastolic dysfunction may account for up to 30–40% of cases of heart failure in older people [22]. While still associated with substantial morbidity and mortality, it appears to have a more favourable prognosis than systolic heart failure—but optimal treatment remains uncertain [22]. On the other hand, many patients with heart failure remain untreated. In one study of patients with systolic heart failure living at home, 30% of those identified were receiving no treatment [23].

Utility of the electrocardiogram (ECG) in suspected heart failure

When assessing a patient with possible heart failure, the utility of the ECG has perhaps been under-appreciated. Although performed in most patients assessed in hospital (but probably only a minority in primary care [14]), the ECG may receive scant attention and may not be taken into consideration when deciding whether or not a patient’s symptoms are caused by heart failure in the absence of echocardiographic guidance. The clinician does well to examine the ECG carefully in this context, as studies have demonstrated that the diagnosis of systolic heart failure is unlikely if the ECG is normal.

One of the best known is a study of 96 patients (aged 17–94) with echocardiographically-proven left ventricular systolic dysfunction referred from primary care to an open access echocardiography service. Major ECG abnormalities (atrial fibrillation, previous myocardial infarction, left ventricular hypertrophy, bundle branch block or left axis deviation) were identified in 90. No patient had a normal ECG [24].

In another study of 71 emergency admissions presenting with acute dyspnoea (mean age 73), the 37 with proven systolic heart failure all had abnormal ECGs [13]. In a series of 252 acute admissions with heart failure (mean age 73), the ECG was abnormal in every case (although the proportion that had a transthoracic echocardiography was not stated) [25]. Similarly, of a series of 100 patients (mean age 74) presenting with acute pulmonary oedema, only one had a normal ECG. This series included 20 patients with normal systolic function, half of whom had valvular disease (including the one patient with a normal ECG, who had mitral stenosis) as the dominant substrate for the episode [26]. In a series of 165 patients with ejection fractions of <40% attending a heart failure clinic (mean age not stated), 89% had an abnormal ECG [27]. Finally, a cross-sectional study of 1640 patients aged 25–74 was performed to define the prevalence of left ventricular systolic dysfunction. It demonstrated an abnormal ECG (defined as Q waves, left bundle branch block, ST depression, abnormal T waves, left ventricular hypertrophy, atrial fibrillation or flutter) in 77% of those with symptomatic left ventricular systolic impairment [23].

The ECG is therefore highly sensitive for the diagnosis of clinical systolic heart failure, particularly in patients presenting acutely. In the three series which examined this subgroup [13, 25, 26], the ECG was abnormal in every case (presumably reflecting more advanced ventricular disease in these patients). Although specificity is only low to moderate (an abnormal ECG is associated with about a one in three chance of left ventricular systolic impairment [24]), the presence of Q waves, left ventricular hypertrophy or an arrhythmia may suggest an underlying cause. Other ECG signs may occasionally be useful. For example, the triad of high precordial QRS voltage, poor precordial R wave progression and low limb lead voltage is said to have high specificity for the diagnosis of heart failure [28]. The combination of right axis deviation and left bundle branch block is highly suggestive of idiopathic dilated cardiomyopathy [29], and the combination of right axis deviation and atrial fibrillation is suggestive of mitral stenosis, although it may be seen in other situations [30].

This impressive sensitivity is particularly useful given the known high false-positive rates in the diagnosis of heart failure [18–20], as a normal ECG in the context of suspected heart failure suggests either that the diagnosis is incorrect and other possibilities should be pursued [16, 24, 31, 32] or, if clinical suspicion remains strong, that valvular disease [24] or an uncommon condition such as pericardial disease may be the cause [31].

In the acute situation or at first presentation, assimilation of information from the ECG with clinical findings increases the specificity of diagnosis of heart failure [13]. Greater attention to the ECG in combination with historical, clinical and radiological factors could potentially reduce the number of false-positive diagnoses, particularly when transthoracic echocardiography may not be immediately available. This would reduce the number of patients receiving inappropriate treatment with diuretics, the commonest cause of adverse drug reactions in the older population [33].

In addition, the clinician should always examine the ECG in patients with apparent established heart failure where the diagnosis has been made and treatment initiated without echocardiographic guidance by a non-specialist. Again, a normal ECG in this context should lead to a re-evaluation of the diagnosis and request for transthoracic echocardiography. Where left ventricular function is found to be normal, withdrawal of heart failure treatment should be considered. However, some of these patients may have diastolic dysfunction. It may therefore be prudent to review the clinical context in which the diagnosis of heart failure was made before discontinuing diuretics. If doubt remains, the physician
should request a further echocardiographic examination, and consider specialist referral, looking specifically for diastolic dysfunction [34].

Conclusion

The ECG has high sensitivity for the diagnosis of systolic heart failure and is undervalued in this regard. Its sensitivity in diastolic heart failure has not been studied. In patients assessed for the first time, a normal ECG suggests that alternative diagnoses should be pursued—unless a murmur is present or clinical suspicion is otherwise strong. In patients already established on heart failure treatment without prior echocardiographic guidance, a normal ECG should lead to a reassessment of the diagnosis and a request for echocardiography. Although a normal ECG in this context will only identify a few inappropriately treated patients (clearly, some patients with a false-positive diagnosis of heart failure will have abnormal ECGs), it will, nevertheless, identify a subgroup of patients in whom echocardiography is likely to lead to an important change in treatment.

With the continuing imbalance between supply and demand for echocardiography services in many districts, a greater awareness of the importance of the ECG in patients with suspected heart failure could reduce the proportion treated inappropriately. A normal ECG in this context is arguably one of the most underused signs in clinical medicine.

Key points

- Systolic heart failure is unlikely in the presence of a normal ECG.
- The ECG is a useful, and probably undervalued, diagnostic aid when access to echocardiography is limited.
- Where heart failure has been confirmed, the ECG may suggest an aetiology.

References


