Definition and Classification of Heart Failure

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Abstract

A review of the definition and classification of heart failure, updated since the recent 2016 European Society of Cardiology guidelines for the diagnosis and treatment of acute and chronic heart failure. Heart failure is defined by the European Society of Cardiology (ESC) as a clinical syndrome characterised by symptoms such as shortness of breath, persistent coughing or wheezing, ankle swelling and fatigue, that may be accompanied by the following signs: jugular venous pressure, pulmonary crackles, increased heart rate and peripheral oedema. However, these signs may not be present in the early stages and in patients treated with diuretics. When apparent, they are due to a structural and/or functional cardiac abnormality, leading to systolic and/or diastolic ventricular dysfunction, resulting in a reduced cardiac output and/or elevated intra-cardiac pressures at rest or during stress. According to the most recent ESC guidelines the initial evaluation of patients with suspected heart failure should include a clinical history and physical examination, laboratory assessment, chest radiography, and electrocardiography. Echocardiography can confirm the diagnosis. Beyond detecting myocardial abnormality, other impairments such as abnormalities of the valves, pericardium, endocardium, heart rhythm, and conduction may be found. The identification of the underlying aetiology is pivotal for the diagnosis of heart failure and its treatment. The authors review the definitions and classifications of heart failure.

Keywords: Heart Failure; Guidelines; Classification; Definition

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Introduction

Heart failure is defined by the European Society of Cardiology (ESC) as a clinical syndrome characterised by symptoms such as shortness of breath, persistent coughing or wheezing, ankle swelling and fatigue, that may be accompanied by the following signs: jugular venous pressure, pulmonary crackles, increased heart rate and peripheral oedema.[1] However, these signs may not be present in the early stages and in patients treated with diuretics. When apparent, they are due to a structural and/or functional cardiac abnormality, leading to systolic and/or diastolic ventricular dysfunction, resulting in a reduced cardiac output and/or elevated intra-cardiac pressures at rest or during stress.[2,3] According to the most recent ESC guidelines[1] the initial evaluation of patients with suspected heart failure should include a clinical history and physical examination, laboratory assessment, chest radiography, and electrocardiography. Echocardiography can confirm the diagnosis. Beyond detecting myocardial abnormality, other impairments such as abnormalities of the valves, pericardium, endocardium, heart rhythm, and conduction may be found.[4,2] The identification of the underlying aetiology is pivotal for the diagnosis of heart failure and its treatment.[5]

Clinical course of heart failure

According to the “progressive model”[4], heart failure may be considered as a progressive disorder that starts from a trigger, or “index event”, that damages the heart muscle and consequently impairs cardiac myocytes, therefore reducing the myocardium’s ability to fill with or eject blood, and finally precluding the heart from contracting normally. This inciting event may have a sudden onset (e.g., myocardial infarction) or a gradual or insidious onset (e.g., haemodynamic pressure or volume overloading), or it may be hereditary. Regardless of the aetiology, the consequence is a decline in pump function.
of the heart [4]. Also, a progressive, albeit non-linear, decline in health-related quality of life is observed; [6] this course can be interrupted at any time either by sudden cardiac death usually caused by an arrhythmia or can end in a more gradual death caused by progressive pump failure. Patients may also experience progressive episodes of acute decompensation, further reducing the heart’s ability to fill with or eject blood appropriately.

**Acute heart failure** is defined as the rapid onset of symptoms and signs secondary to abnormal cardiac function, which may occur with or without previous cardiac disease [7]. The cardiac dysfunction can be related to systolic or diastolic dysfunction, to abnormalities in cardiac rhythm, or to preload and afterload mismatch [8]. Acute heart failure is often life threatening and requires urgent treatment. In addition, the patient with acute heart failure may present with one of several distinct clinical conditions [9].

Finally, subclinical forms of heart failure also exist, with asymptomatic cardiac abnormalities. These silent forms of heart failure are considered as its precursors, and should be identified as early intervention may improve outcomes and reduce mortality [10,11]. Unfortunately, subclinical forms of heart failure remain unnoticed and are frequently underdiagnosed [12]. For these reasons, given the heterogeneity of heart failure phenotypes [13], classification systems and diagnostic algorithms have been developed.

**Classifications of heart failure**

**Heart failure with preserved (HFpEF), mid-range (HFmrEF) and reduced ejection fraction (HFrEF)**

From the ‘90s clinical trials began to select patients based on left ventricular ejection fraction (LVEF), usually measured using echocardiography, a radionuclide technique, or cardiac magnetic resonance. Table 1 shows the diagnostic criteria to define heart failure with preserved (HFpEF), mid-range (HFmrEF) and reduced ejection fraction (HFrEF) according to ESC guidelines [1]. Figure 1 shows typical echocardiographic pictures of HFrEF and HFpEF. An old definition for HFpEF was “diastolic’ heart failure”, as opposed to “systolic” heart failure that corresponded to HFrEF. However, the term diastolic heart failure was replaced by HFpEF given that diastolic dysfunction of the left ventricle may also characterise HFrEF [14]. On the other hand, the term systolic heart failure was substituted by HFrEF given that subtle abnormalities of systolic function may be also found in patients with HFpEF [15].

The definition of the range of “normality’ of LVEF in heart failure has been long debated [16,17]. According to the European Study Group on Diastolic Heart Failure [18], diagnostic criteria for HFpEF were: a) clinical symptoms and signs; b) normal or mildly reduced LV systolic function (LVEF >50% and LVEDVI <97 mL/m²); c) diastolic dysfunction. In contrast, criteria from the Framingham study [19] were more pragmatic and less dependent on detailed testing and included: a) clinical symptoms and signs, and b) LVEF ≥50% within 72 h of heart failure; whereas assessment of diastolic function was not needed for diagnosis.

Recent and more stringent criteria for HFpEF and HFrEF have been proposed by the new ESC guidelines [1] (see Table 1).

Selecting patients according to LVEF is relevant as these heart failure syndromes have distinct patterns of underlying aetiologies, demographics, comorbidities and response to therapies [2,20]. Typically, patients with HFpEF are older, more likely female, and present the following co-morbidities more commonly: arterial hypertension, atrial fibrillation, kidney dysfunction, metabolic syndrome, obesity, physical deconditioning, pulmonary disease, pulmonary hypertension and sleep apnoea [1]. Due to polymorbidity, the diagnosis may be more difficult, especially in older adults [21].

In HFrEF, LVEF is considered as 40% or below. The heart muscle does not contract effectively and less oxygen-rich blood is pumped out to the body. In HFrEF only, therapies have been shown to reduce both morbidity and mortality [1].

The recent ESC guidelines [1] have finally provided diagnostic criteria for a newly defined group HFmrEF standing for Heart Failure with mid-range Ejection Fraction. Such an ‘intermediate group’ or ‘grey area’ presents as mild systolic dysfunction, with a LVEF in the range of 40–49%. Further studies are warranted to clarify its risk factors, demographics, co-morbidities and pathophysiological processes and, consequently, whether its treatments should be similar to those used for HFrEF [23].

**Classifications of heart failure according to the severity of symptoms**

The ACC/AHA guidelines have proposed a staging of severity of heart failure based on the structure and damage of the heart muscle [3]. According to this classification, patients may
be classified as follows: Stage A patients are at high risk for developing heart failure but do not present any structural or functional abnormality or symptoms of heart failure; Stage B comprises patients with structural heart disease that is associated with the development of heart failure but signs or symptoms of heart failure are not apparent; Stage C includes patients with symptomatic heart failure associated with underlying structural heart disease; Stage D patients have advanced structural heart disease and marked symptoms of heart failure at rest despite maximal medical therapy.

A widely-used classification is the New York Heart Association (NYHA) functional classification (1994), which describes heart failure according to severity of its symptoms and impairment of physical activity. Class I patients present no limitation in physical activity; therefore symptoms such as breathlessness, fatigue or palpitations are absent during ordinary physical activity. Class II includes patients characterised by slight limitation of physical activity. Undue breathlessness, fatigue or palpitations are present during ordinary physical activity, whereas the patient is comfortable at rest. Class III comprises patients with a marked limitation of physical activity. The patient is still comfortable at rest, but less than ordinary physical activity results in undue breathlessness, fatigue or palpitations. Class IV patients are unable to carry on any physical activity without discomfort and symptoms at rest can also appear [24]. Other classifications developed in the '70s describe the severity of heart failure in the context of acute myocardial infarction, the Killip (1967) [25] and Forrester (1977) [26] classifications.

**Advanced heart failure**

Advanced heart failure was first defined in 1998 as a syndrome requiring a resting left ventricular ejection fraction <30% and NYHA class III to IV or a peak oxygen uptake (\(\text{VO}_2\)) below 14 mL/kg/min [27] In 2004, a U.S. consensus statement defined advanced heart failure as a “state in which patients have significant cardiac dysfunction with marked symptoms of dyspnoea, fatigue, or symptoms relating to end-organ hypoperfusion at rest or with minimal exertion despite maximal medical therapy” [28] This definition did not include the criterion of a previous hospitalisation and did not try objectively to assess the impairment of cardiac dysfunction and functional capacity. In 2007, the Heart Failure Association (HFA) of the ESC [9] published a position statement in which the definition and clinical characteristics of advanced chronic heart failure were outlined. According to this definition, both symptoms of severe heart failure and objective evidence of severe cardiac dysfunction, impaired exercise capacity and an unstable clinical course must be present, despite optimal medical treatment. Clinical characteristics and classifications of advanced heart failure are shown in Table 1.

The HFA criteria of the ESC were inserted into the AHA/ACC Foundation criteria for destination therapy with cardiac devices.
The Inregency Registry for Mechanically Assisted Circulatory Support (INTERMACS), a prospective registry that collects data on all patients who receive a durable, FDA approved mechanical circulatory support device in the United States, developed seven profiles that can be used further to stratify patients with advanced heart failure [30] INTERMACS patient profiles were defined based on clinical descriptors at the time of mechanical circulatory support implant (1=hyper dynamic shock to 7=advanced NYHA Class III symptoms) (Table 1.2). Such a system classification may be useful to predict outcomes after mechanical assist device implantation [31]. Despite these classification systems, mostly descriptive, it is vital to realise that a consensus definition for advanced heart failure still needs to be developed. Indeed, there is still considerable variation in the definition of advanced heart failure utilised for clinical trial purposes [32]. Clinicians must recognise the transition to advanced heart failure in order to provide timely and appropriate therapeutic options [33].

Other definitions of heart failure
End-stage heart failure
Advanced heart failure should be kept distinct from end-stage heart failure. This term indicates an extremely advanced condition where no improvement with conventional heart failure treatment is possible and where palliative care, ventilatory assist devices or heart transplantation are indicated. Indeed, there are remarkable differences between advanced and end-stage heart failure in terms of quality of life and outcomes. End-stage heart failure should be also distinguished from acute heart failure in which a certain degree of reversibility can be achieved [6].

Refractory heart failure
Refractory heart failure is similar to end-stage heart failure and is observed in clinical practice when patients continue to be symptomatic at rest or develop recurrence of heart failure despite optimal contemporary pharmacotherapy proven to be of benefit in clinical trials. Physical examination, laboratory testing, multi-modality imaging, and cardiopulmonary exercise testing are pivotal for the definition of refractory heart failure. These patients commonly have rapid clinical deterioration and may require inotropic agents to augment cardiac performance [34,35].

Declarations of Interest
The authors declare no conflicts of interest.

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