O Erk

Precipitating factors for systolic and diastolic heart failure: a four-year follow-up of 192 patients

促成收縮性及舒張性心臟衰竭的因素：對192名病人作為期四年的跟進研究

Objectives. To investigate precipitating factors for systolic and diastolic heart failure.

Design. Prospective study.

Patients and methods. The study population consisted of 192 patients with heart failure treated for 536 episodes of acute decompensation of heart failure from 1998 to 2002. The patients were classified as having systolic or diastolic heart failure, and grouped according to aetiology and precipitating factors.

Results. Coronary heart disease was the most common cause of systolic heart failure, whereas rheumatic heart disease was the most frequent cause of diastolic heart failure. The most important precipitating factors in systolic heart failure were infections (38%), arrhythmias (35%), and vascular causes (24%), whereas the precipitating factors in diastolic heart failure were infections (50%), arrhythmias (46%), and uncontrolled hypertension (26%). Avoidable precipitating factors in systolic and diastolic heart failure were noted in 34% and 68% of cases, respectively.

Conclusions. Better patient education and better follow-up of patients by physicians according to the most recent guidelines may decrease the frequency of heart failure events and consequent morbidity and mortality.

目的：調查促成收縮性及舒張性心臟衰竭的因素。

設計：預期性研究。

患者及方法：研究對象有192名病人，他們在1998至2002年間，共536次因心臟衰竭急性代償而接受治療。先根據收縮性或舒張性心臟衰竭將病人分類，再按病因學及促成因素分組。

結果：冠心病是收縮性心臟衰竭最常見的起因，而風濕性心臟病則為舒張性心臟衰竭的最常見起因。收縮性心臟衰竭的主要促成因素包括感染（38%）、心律失常（35%）及血管因素（24%），而舒張性心臟衰竭的主要促成因素為感染（50%）、心律失常（46%）及不受控制的高血壓（26%）。分別有34%收縮性心臟衰竭及68%的舒張性心臟衰竭病例有可以避免的促成因素。

結論：加強病人教育，並由內科醫生依照最新的指引作較佳跟進，均可減少出現心臟衰竭的頻率，和所帶來併發症及死亡的比率。

Key words:
Heart failure, congestive;
Precipitating factors;
Ventricular dysfunction, left;
Ventricular dysfunction, right

關鍵詞：
心力衰竭，充血性；
促成因素；
心室機能障礙，左；
心室機能障礙，右

Hong Kong Med J 2004;10:97-101

Department of Emergency Medicine, Istanbul Faculty of Medicine, Istanbul University, Istanbul 34390, Turkey
O Erk

Correspondence to: Dr O Erk (e-mail: macalyst@lycos.com)

Introduction

Estimates of the prevalence of symptomatic heart failure in Europe in general populations range from 0.4% to 2%.[1] There are also asymptomatic individuals with myocardial dysfunction who constitute a sizable population, roughly equivalent to the population with heart failure.[2,3] Approximately half of the patients with a diagnosis of heart failure will die within 4 years, and more than 50% of those with severe heart failure will die within 1 year.[4,5] There are no reliable prevalence figures for heart failure in Turkey, but estimates place the prevalence of symptomatic heart failure in the range from 0.7% to 1.0%, which translates into approximately one million cases in the country in total.[6]

Table 1. Framingham study criteria for heart failure[7]

Symptom or sign	Diagnosis of heart failure
Paroxysmal nocturnal dyspnoea Neck-vein distension Pulmonary rales Cardiomegaly Acute pulmonary oedema S_3 gallop Increased jugular venous pressure Hepatojugular reflux	The presence of two or more of these criteria
Or	Or
Oedema Night cough Exertional dyspnoea Hepatomegaly Pleural effusion Tachycardia	The presence of two or more of these criteria plus a minimum of one criteria from the list above

This study was undertaken to assess the relative frequency of precipitating factors for acute decompensation in heart failure, their aetiology and type of ventricular dysfunction, with a view to informing decisions on patient management.

Patients and methods

The study population consisted of 192 patients with heart failure treated at a single centre from 1998 to 2002. All patients included in the study were previously investigated and diagnosed with heart failure, or were thoroughly evaluated after resolution of an acute episode of heart failure. Heart failure was diagnosed according to the criteria used in the Framingham study (Table 1).[7] A detailed history was taken and physical examination, chest X-ray, electrocardiography (ECG), and echocardiography was completed. If the diagnosis was unknown, echocardiography was done before hospital discharge, within a median of 15 days.[8,9] If the diagnosis was known, ECG, chest X-ray, echocardiography, and if necessary transoesophageal echocardiography was done for evidence of precipitating factors. Echocardiography was used at every admission to distinguish systolic from diastolic heart failure before hospital discharge. Systolic heart failure was diagnosed if the echocardiographic examination after treatment of the acute episode of heart failure revealed an ejection fraction (EF) of less than 40% (due to the lower reliability of M-mode echocardiography examination). If the EF was greater than 50% and compliance was reduced (restrictive pattern of the ratio of peak early to peak late diastolic velocity [E/A] ≥ 2 and left ventricular [LV] filling time <200 ms; non-restrictive pattern E/A <0.5 and LV filling time <200 ms, provided the heart rate was less than 110 beats per minute), diastolic heart failure was diagnosed.[10]

Patients with cor pulmonale and pericardial tamponade were excluded from the study. Patients with diastolic heart failure who developed systolic heart failure during follow-up, and those with an EF between 40% and 50% on M-mode echocardiography were also excluded due to ambiguity in the classification of the systolic and diastolic heart failure using this modality.

Coronary artery disease, cardiomyopathy, rheumatic heart disease, and alcoholic cardiomyopathy were defined according to the 9th edition of the Nomenclature and Criteria for Diagnosis of Diseases of the Heart and Great Vessels.[11] Cardiomegaly was diagnosed if the cardiothoracic ratio measured greater than 0.50 on chest X-ray. The diagnosis of cardiomegaly was confirmed by finding left ventricular enlargement on echocardiography. The diagnosis of acute pulmonary oedema was largely based on clinical findings, physical examination, and arterial blood gas analysis, and confirmed where possible by chest X-ray.

Patients who were not compliant with therapy or diet were classified as having heart failure precipitated by patient non-compliance. Non-compliance with medication was mostly assessed from prescription records, and non-compliance with diet from discussion with family members. Patients with systolic blood pressure (BP) greater than 180 mm Hg and/or diastolic BP greater than 105 mm Hg despite antihypertensive treatment at admission, were classified as having uncontrolled hypertension. Patients with sustained ventricular tachycardia, uncontrolled atrial fibrillation (ECG record of heart rate greater than 120 beats per minute and/or a pulse deficit of more than 20 beats per minute), atrial flutter, and chaotic atrial tachycardia were classified as having heart failure precipitated by arrhythmia. Patients with increased levels of tropinin T or creatine kinase–MB (higher than the 95% upper confidence limit for the laboratory) and Q waves on ECG, were classified as having a myocardial infarction (MI), regardless of the presence or absence of typical chest pain. Acute MI and pulmonary emboli were classified as vascular precipitating causes of heart failure. Misdiagnosed patients were excluded from the study. Patients who had received inappropriate treatment (eg patients given cardio-depressant drugs or massive infusions of saline, or patients not given appropriate treatment according to the guideline) were identified and considered as a group. Patients with haemoglobin levels lower than 115 g/L were designated anaemic. Systemic diseases, thyroid diseases, infectious diseases, and other diverse causes were diagnosed using their respective criterion. Anaemia and thyroid diseases were classified as precipitating metabolic causes of heart failure. If after investigation no reason for the acute precipitation of heart failure could be found, the patient was grouped with other cases of heart failure precipitated by no known cause.

Informed consent was obtained from each individual and the Declaration of Helsinki guidelines on biomedical research in human subjects was followed.[12]

Results

The study included 136 patients (91 men, 45 women; mean

Table 2. Precipitating factors for acute decompensation in systolic and diastolic heart failure

	Patient non-compliance	Uncontrolled hypertension	Arrhythmia	Vascular factors	Infection	Iatrogenic	Metabolic factors	Unknown
Systolic heart failure e* =425, n† =136	12%	14%	35%	24%	38%	8%	12%	12%
Diastolic heart failure e=121, n=56	21%	26%	46%	25%	50%	21%	21%	7%
All heart failure e=536, n=192	14%	16%	38%	25%	41%	11%	14%	11%

* No. of heart failure episodes
† No. of patients

Table 3. Precipitating factors for acute decompensation in systolic heart failure according to aetiology

	Patient non-compliance	Uncontrolled hypertension	Arrhythmia	Vascular factors	Infection	Iatrogenic	Metabolic factors	Unknown
Coronary heart disease e* =390, n† =118	8%	14%	34%	26%	38%	6%	10%	12%
Dilated cardiomyopathy e=11, n=6	27%	-	36%	9%	36%	18%	9%	36%
Alcoholic cardiomyopathy e=14, n=4	100%	7%	50%	-	43%	36%	43%	-
Rheumatic heart disease e=2, n=2	-	-	100%	-	100%	-	100%	-
Post-partum cardiomyopathy e=2, n=2	-	-	-	-	-	-	-	100%
Degenerative heart disease e=6, n=4	33%	33%	50%	50%	33%	17%	17%	-

* No. of heart failure episodes
† No. of patients

Table 4. Precipitating factors for acute decompensation in diastolic heart failure according to aetiology

	Patient non-compliance	Uncontrolled hypertension	Arrhythmia	Vascular factors	Infection	Iatrogenic	Metabolic factors	Unknown
Coronary heart disease e* =35, n† =16	11%	57%	37%	51%	14%	20%	9%	14%
Rheumatic heart disease e=61, n=27	28%	-	59%	3%	85%	25%	36%	3%
Degenerative heart disease e=20, n=8	20%	60%	35%	50%	20%	20%	5%	10%
Hypervolaemia e=5, n=5	-	-	-	-	-	-	-	-

* No. of heart failure episodes
† No. of patients

[standard deviation, SD] age, 61 [12] years) with systolic heart failure, and 56 patients (26 men, 30 women; mean [SD] age, 51 [17] years) with diastolic heart failure. Ejection fractions for the patient groups with systolic and diastolic heart failure were 33% (SD, 4%) and 57% (SD, 4%), respectively. The aetiology of systolic heart failure in the 136 cases were: coronary heart disease (118), dilated cardiomyopathy (6), alcoholic cardiomyopathy (4), rheumatic heart disease (2), post-partum cardiomyopathy (2), and degenerative heart disease (4). The aetiology for diastolic heart failure in the 56 cases were: coronary heart disease (16), rheumatic heart disease (27), degenerative heart disease (8), and hypervolaemia (5). The prevalence of comorbid conditions and signs for systolic and diastolic heart failure respectively were: diabetes mellitus (25% and 18%), hypertension (18% and 20%), acute pulmonary oedema (8% and 13%), S_3 (71% and 35%), S_4 (28% and 37%), cardiomegaly (100% and 31%), pulmonary congestion (94% and 88%), pleural effusion (71% and 70%), and jugular venous distension (90% and 52%). The precipitating factors for acute decompensation in systolic and diastolic heart failure are shown in Table 2. In patients with systolic heart failure, lack of compliance with therapy as a precipitating factor was most obvious in those with alcoholic cardiomyopathy (100%) [Table 3]. Uncontrolled hypertension was the most frequent precipitating factor for both systolic heart failure (33%) and diastolic heart failure (60%) in patients with degenerative heart disease (Tables 3 and 4).

The prevalence of arrhythmia as a precipitating factor is shown in Tables 3 and 4. The arrhythmias observed were atrial fibrillation with increased ventricular response (161 cases), atrial flutter (8), chaotic atrial tachycardia (8), ventricular tachycardia (13), and atrial fibrillation with normal ventricular response (13). Non-Q wave and Q wave MIs were present in 37 and 32 patients with systolic heart failure, respectively, and in 18 and six patients with diastolic heart failure, respectively.

The rates of infection as a precipitating factor varied widely between 38% in ischaemic systolic heart failure and 85% in rheumatic diastolic heart failure (Tables 3 and 4). In systolic heart failure cases, the majority of precipitating infections were pulmonary (101 cases), followed by urinary (38), sepsis (10), diabetic foot (7), acute rheumatic fever (1), and infective endocarditis (1). In diastolic heart failure cases, the respective rates of infections were pulmonary (17 cases), urinary (11), acute rheumatic reactivation (27), and infective endocarditis (6).

Iatrogenic causes of decompensation in systolic heart failure were incorrect diagnosis (8 cases), insufficient treatment (18), and inappropriate therapy (13). The same figures were 10, eight, and eight cases, respectively, for patients with diastolic heart failure. In six patients with systolic heart failure, bleeding due to oral anticoagulant use caused serious anaemia. According to the New York Heart Association (NYHA) classification, 65% patients were NYHA class IV, 25% class III, and 10% class II. Drug therapy included angiotensin-converting enzyme inhibitors in 53% of cases, diuretics in 86%, nitrates in 42%, digitalis in 32%, beta-blockers in 14%, and spironolactones in 8%. Compared with the new European Society of Cardiology guidelines for heart failure,[13] this suggests underuse of drug therapy, especially of beta-blockers and spironolactone. The prescription rates in this study are similar to the rates seen in Turkey in the IMPROVEMENT study.[14]

Analysis of the number of precipitating factors per decompensated heart failure event showed that among 425 events of systolic decompensation, 164 decompensation events had one precipitating factor (39%), 188 events had two precipitating factors (44%), 19 events had three precipitating factors (4%), and three events had four precipitating factors (1%). In 51 systolic decompensation events (12%), no discernible predisposing factor was found. In 121 diastolic heart failure events the same figures for 1, 2, 3, and 4 precipitating factors were 11 (9%), 33 (27%), 53 (44%), and 10 (8%), respectively. Four precipitating factors per event were the norm in alcoholic cardiac disease causing systolic heart failure (21%) and rheumatic heart disease leading to diastolic heart failure (16%). Two or more precipitating factors per event were present in 49% of systolic and 79% of diastolic heart failure events. The most frequent precipitating events were arrhythmias and infections. During the 4-year follow-up, 28 (21%) patients with systolic heart failure and eight (14%) patients with diastolic heart failure died.

Discussion

Re-admission of patients with heart failure relates to medical factors (eg uncontrolled hypertension, infections), environmental factors (eg failing social support), behavioural factors (eg non-compliance with drugs, diet or other life-style modifications), or to factors related to discharge planning (eg early discharge, inadequate patient education).[15]

Though there are a large number of studies evaluating precipitating factors for heart failure, there is currently little information about the relative frequency of these precipitating factors in systolic and diastolic heart failure.[16-19] The centre from which this prospective data collection from 1998 to 2002 was undertaken was a tertiary care facility, implying that complicated cases would be referred and therefore included.

The frequency of precipitating factors for heart failure and the aetiologies of cardiac disease differ from country to country. Precipitating factors, left ventricular dysfunction types, and aetiologies seen in the present study were in keeping with those noted in reports from developing countries.[16-19] In the present study, the most frequent aetiologies noted for systolic heart failure were ischaemic heart disease (87%) and idiopathic dilated cardiomyopathy (4%), and for diastolic heart failure were rheumatic heart disease (48%) and ischaemic heart disease (29%). Ischaemic heart disease can cause systolic or diastolic heart failure; rheumatic heart disease, depending on the degree of valvular or myocardial involvement may also cause systolic or diastolic heart failure.[20,21] Hypervolaemia caused diastolic heart failure in five (9%) patients with acute or chronic renal disease. The common findings in these five patients were the lack of history of heart disease, normalisation of cardiac function after dialysis, normal coronary arteries on coronary angiography, and a single admission to hospital for heart failure.

Though the relative rates differed for systolic and diastolic heart failure events, the most frequent precipitating factors for both were infection and arrhythmia. In systolic and diastolic heart failure, the third most common precipitating factors were vascular events and uncontrolled hypertension, respectively. Patient non-compliance, iatrogenic causes, or uncontrolled hypertension were factors precipitating acute decompensation in 34% of patients with systolic heart failure and 68% of patients with diastolic heart failure. As these factors are preventable, patient education and better management of hypertension may decrease admissions for acute cardiac decompensation. Systematic review of possible precipitating factors in patients admitted for acute decompensated heart failure may have a positive impact on the management of these patients and increase the overall success of treatment.

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