Assessment and Diagnosis of Heart Failure

Heart failure (HF) is a complex clinical syndrome resulting from any structural or functional impairment of ventricular filling or ejection of blood. Heart failure symptoms include those related to fluid retention, such as leg swelling, dyspnea, or abdominal discomfort from ascites, and/or those related to a reduction of cardiac output, including fatigue and weakness, which are more pronounced with exertion. Heart failure remains a leading cause of morbidity and mortality globally (Heidenreich et al., 2022). Nurses need to know the signs and symptoms, classification, evaluation, diagnosis, and treatment of HF to improve patient outcomes.

Classification of Heart Failure by Left Ventricular Ejection Fraction (LVEF) (Heidenreich et al., 2022)

Type of Heart Failure	Criteria
HFrEF (HF with reduced ejection fraction [EF])	LVEF less than or equal to 40%
HFimpEF (HF with improved EF)	Previous LVEF less than or equal to 40% and a follow-up measurement of LVEF greater than 40%
HFmrEF (HF with mildly reduced EF)	LVEF 41%-49%; evidence of spontaneous or provokable increased left ventricular (LV) filling pressures (i.e., elevated natriuretic peptide, noninvasive and invasive hemodynamic measurement)
HFpEF (HF with preserved EF)	LVEF greater than or equal to 50%; evidence of spontaneous or provokable increased LV filling pressures (i.e., elevated natriuretic peptide, noninvasive and invasive hemodynamic measurement)

Stages of Heart Failure (Heidenreich et al., 2022)

Stage	Definition/Criteria	Therapeutic Interventions
Stage A: At risk of HF	At risk for HF but without symptoms, structural heart disease, or cardiac biomarkers of stretch or injury (i.e., patients with hypertension, atherosclerotic CVD, diabetes, metabolic syndrome and obesity, exposure to cardiotoxic agents, genetic variant for cardiomyopathy, or hereditary risk)	Aim to modify risk factors
Stage B: Pre-HF	No symptoms or signs of HF and evidence of 1 of the following:	Treat risk factors and structural heart disease to prevent HF

	• Structural heart disease (reduced left or right ventricular systolic function and ejection fraction, reduced strain, ventricular hypertrophy, chamber enlargement, wall motion abnormalities, valvular heart disease) • Evidence of increased filling pressures by invasive hemodynamic measurements or noninvasive imaging (i.e., Doppler echocardiography) • Patients with risk factors and increased levels of B-type natriuretic peptides (BNPs) or persistently elevated cardiac troponin in the absence of acute coronary syndrome, chronic kidney disease (CKD), pulmonary embolus, or myopericarditis	
Stage C: Symptomatic HF	Structural heart disease with current or previous symptoms of HF	Aim to reduce symptoms, morbidity, and mortality
Stage D: Advanced HF	Marked HF symptoms that interfere with daily life and with recurrent hospitalizations despite attempts to optimize guideline directed medical therapy (GDMT)	

New York Heart Association (NYHA) Functional Classification (The Criteria Committee of the New York Heart Association, 1994/1964) (Emphasis on exercise capacity, functional limitations, and severity of symptoms due to heart failure)	
I	No limitation of physical activity; ordinary activity does not cause HF symptoms
II	Slight limitation of physical activity; comfortable at rest, ordinary physical activity results in HF symptoms
III	Marked limitation of physical activity; comfortable at rest, less than ordinary (or minimal) activity causes symptoms of HF
IV	Unable to carry on any physical activity without symptoms of HF, or symptoms of HF at rest

Major Risk Factors for Heart Failure (Vasan and Wilson, 2022)

- Coronary heart disease
- Hypertension
- Obesity
- Diabetes
- Cigarette smoking
- Valvular heart disease

Causes of HF (Heidenreich et al., 2022)

- Ischemic heart disease
- Myocardial infarction
- Valvular heart disease
- Hypertension
- Familial or genetic cardiomyopathies
- Stress-induced cardiomyopathy (Takotsubo)
- Myocarditis (infectious, toxin or medication, immunological, hypersensitivity)
- Infiltrative cardiac disease (sarcoidosis, hemochromatosis, amyloidosis)
- Endocrine/metabolic disorders (obesity, diabetes, thyroid disease)
- Chemotherapy or other cardiotoxic agents
- Substance abuse
- Tachycardia or dysrhythmia
- Right ventricular (RV) pacing
- Peripartum cardiomyopathy
- Autoimmune or rheumatologic causes
- Nutritional causes

Signs and Symptoms (Colucci, W.S. and Borlaug, B.A., 2022)	
Acute and Subacute Presentation	**Chronic Presentation**
Pulmonary congestion: tachypnea, cough, crackles, wheezes, blood-tinged sputum	Fatigue, anorexia, abdominal distension, and peripheral edema may be more pronounced than dyspnea
Orthopnea and paroxysmal nocturnal dyspnea	Withdrawal from physical activity
Shortness of breath, at rest and/or with exertion; may show signs of air hunger	Hepatomegaly and splenomegaly
Right upper quadrant pain from acute hepatic congestion, positive hepatojugular reflex test	Ascites
Tachycardia with/without atrial and/or ventricular arrhythmias (can be associated with palpitations and lightheadedness)	Pleural effusions resulting from chronic elevation in pulmonary venous pressure
Confusion and restlessness	Exertional dyspnea
Elevated jugular venous pressure	
Edema	
Hypoxemia	
Elevated blood pressure or hypotension if cardiogenic shock is present	

Medical History & Physical Exam

A thorough history and physical examination, as well as a detailed review of systems, are essential to identify cardiac and noncardiac disorders that might cause or accelerate HF progression.

Medical History

When taking a medical history, be sure to ask:

- When did your symptoms begin?
- What and where are your symptoms? What triggers your symptoms?
    - What triggers dyspnea and fatigue?
    - Do you have chest pain? Where?
    - What is your exercise capacity?
    - Does physical activity aggravate your symptoms?
    - Are you sexually active, and if so, does it aggravate your symptoms?
- How long do the symptoms last?
- Have you experienced unintentional weight loss or gain or a recent decrease in appetite?
- Have you experienced palpitations, syncope, or ICD shocks?
- Do you have sleep problems?
- Have you experienced symptoms of transient ischemic attack (TIA) or thromboembolism?
- Have you had recent or frequent prior HF hospitalizations?
- Have you stopped your HF medications for any reason in the past?
- What medications are you taking? Do any of your medications exacerbate your HF?
- Tell me about your diet. Are you on a low-sodium diet?
- Are you compliant with your medical regimen?
- Do you have a first-degree relative with heart failure?

Physical Exam

Measure and assess the following:

- Body mass index (BMI), assess for weight loss or weight gain
- Blood pressure (supine and upright); assess width of pulse pressure
- Pulse; assess strength and regularity
- Jugular venous pressure (at rest and following abdominal compression)
- Presence of extra heart sounds and murmurs
- Size and location of point of maximal impulse
- Presence of right ventricular heave (lift)
- Pulmonary status: respiratory rate, crackles, pleural effusion
- Hepatomegaly and/or ascites
- Peripheral edema
- Temperature of lower extremities

Diagnosis

Diagnostic Tests (Yancy et al., 2017; Heidenreich et al., 2022)	
Test	**Clinical Considerations**
Initial blood work should include CBC, electrolytes including calcium and magnesium, renal function studies, LFTs, fasting glucose, fasting lipid profile, iron studies (serum iron, ferritin, transferrin saturation) and TSH	• Anemia or infection may cause HF; electrolytes may be abnormal due to fluid retention or renal dysfunction; liver dysfunction due to HF; lipid and TSH may reveal cardiovascular or thyroid disease as causes of HF.
B-Type Natriuretic Peptide (BNP) Normal < 100 pg/mL N-terminal pro-B-type natriuretic peptide (NT-proBNP) Normal < 300 pg/ml	• BNP and NT-proBNP are released by cardiac cells during myocardial stretch. • Assist in screening of HF in patients at risk (HTN, diabetes, known vascular disease). • Support diagnosis or exclusion of HF in patients presenting with dyspnea. • Assist in prognosis in chronic HF, prognosis of acutely decompensated HF and post-discharge prognosis. *Note: Values may be increased by weight, age, in females, in acute stroke, severe sepsis or shock, subarachnoid hemorrhage or renal impairment.*
Biomarkers for myocardial infarction: High Sensitivity Cardiac troponin	• When there is a suspicion of ACS, troponin may be used for risk stratification and to establish prognosis in acute decompensated HF.
Genetic testing	• When a genetic or inherited cardiomyopathy is suspected, perform and diagram three generation family history. Consider genetic testing and/or genetic counseling in first-degree relatives of selected patients with genetic or inherited cardiomyopathies.
Urinalysis	• Proteinuria is associated with cardiovascular disease.
Chest X-ray	• Assess heart size and pulmonary congestion; to detect other cardiac, pulmonary, or other diseases that may contribute to patient's symptoms.
12-lead ECG	• Assess for left ventricular hypertrophy, MI, arrhythmias, heart blocks, and prolonged QT interval.

2D Echocardiogram with Doppler	• The most useful initial test for evaluation of HF to assess left ventricular (LV) function, size, wall thickness, wall motion and valve function. Repeat EF measurement is useful in HF patients who have had a significant change in clinical status.
Cardiac Computed Tomography	• Provides assessment of cardiac structure and function, including coronary arteries.
Cardiac MRI	• Useful to assess left ventricular ejection fraction (LVEF) and volume when echocardiography is inadequate and used to assess for infiltrative and inflammatory processes or scar burden.
Non-invasive testing to assess for ischemic disease (stress echocardiography, nuclear stress testing, PET cardiac stress testing, cardiac MRI)	• May be used to assess for ischemia in HF patients who have known CAD or risk factors for CAD. Myocardial ischemia can contribute to new or worsening HF symptoms and non-invasive stress testing can help guide revascularization strategies.
Invasive Testing	• Invasive hemodynamic evaluation (right heart catheterization) can be useful to guide management in patients with acute HF who have persistent symptoms despite treatment or when hemodynamics are unclear. • Coronary angiography (left heart catheterization) may be useful in patients for definitive assessment of CAD and who are candidates for revascularization. • Endomyocardial biopsy may be useful when seeking a specific diagnosis that would influence treatment and should also be considered in patients suspected of having acute cardiac rejection status after heart transplantation.
Wearable and Remote Monitoring	• May be helpful to reduce recurrent hospitalization(s) in patients with NYHA Class III HF, a history of HF hospitalization in the past year on maximum tolerated doses of GDMT with optimal device therapy but further research is necessary to prove this end point. • Strategies include an implantable pulmonary artery (PA) pressure sensor (CardioMEMS), noninvasive telemonitoring, or monitoring via existing implanted electronic devices.

NYHA Functional Class	• Assess and document NYHA classification at baseline at time of initial diagnosis and after treatment through the continuum of care. • NYHA functional classification is an independent predictor of mortality.
Cardiopulmonary Exercise Testing (CPET)	• CPET is the gold standard measure of exercise capacity. • In patients with unexplained dyspnea, CPET can help to distinguish respiratory versus cardiac etiologies of dyspnea, or if cardiopulmonary responses are normal, it can point other causes such as metabolic abnormalities and/or deconditioning. • Limitations include lack of availability at many hospitals and clinics and not well tolerated by some patients. • CPET is useful to risk stratify HF patients and to guide treatment decisions about timing of advanced HF therapies (e.g., heart transplantation and LVAD)
6-Minute Walk Test	• The 6-minute walk test is an alternative way to measure exercise capacity; it is widely available and well tolerated by patients. • Prognosis can be predicted by total distance walked in the 6-minute walk test.

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