CORE CLINICAL CONCEPTS – HEART FAILURE – DEFINITIONS AND CLASSIFICATION

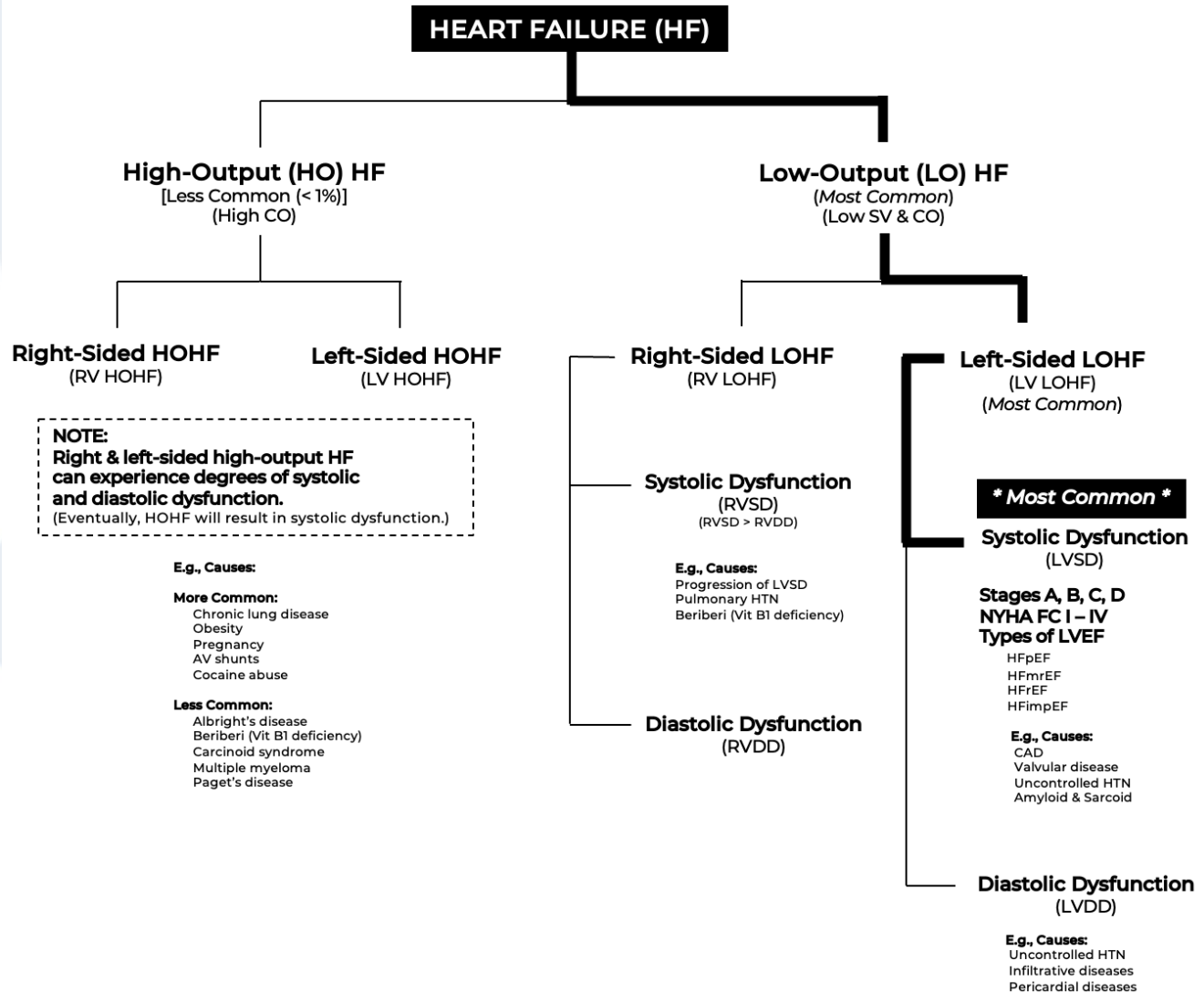
Note of Clinical Context

- This topic is part of a series of core clinical concepts specific to heart failure (HF).
  - The series is meant to provide focused information in addition to disease state reviews related to HF.
  - However, the series is not meant to be exhaustive of every point or observation that could be made but rather cover core concepts within a certain degree of context about a disease state that has variations.
- HF can result in significant morbidity and mortality if not correctly identified and staged for the purpose of proper treatment.
- When clinicians hear references made about HF or a patient with "HF," most of the time, that is in reference to a specific sub-type of HF categorized as low-output HF, specifically, left ventricular systolic dysfunction (LVSD).
  - At the same time, it is important to note that other categories, types, and sub-types of HF need to be recognized since the guidelines most clinicians refer to are in the context of LVSD, where the ejection fracture (EF) is usually < 50%.
  - The approach to treatment of the other types of HF is generally different and targets the unique underlying causes.

Background

- From a broad perspective, HF can be considered low-output or high-output HF.
  - **Low-Output (LO) HF (*most common*)***
    - This occurs when the right or left ventricle exhibits reduced cardiac outputs (CO), reducing forward flow.
    - Causes of LOHF commonly include ischemic heart disease, valvular disorders, and/or uncontrolled hypertension.
  - **High-Output (HO) HF (*rare, < 1% of cases*)**
    - This occurs when the heart works overtime to maintain the high demands of CO, and the heart "wears out" or the "pump" begins to fail.
      - Subsequently, HOHF starts to develop.
      - Causes of HOHF may include severe anemia, thyrotoxicosis, and pregnancy.
    - Similar to LOHF, HOHF can be right- and/or left-sided and, in most cases, involves both sides due to the overall demands on the heart for those underlying conditions.
      - Furthermore, many HO conditions can lead to states of LOHF if left untreated.
- **Low-Output Heart Failure (*most common*)***
  - **Left- or Right-Sided LOHF**
    - Since the CO is influenced by one of two ventricles in the heart, either the right or left side can exhibit reduced CO depending on the underlying etiology. Regardless, they are both considered LOHF.
      - **Left-sided LOHF (*most common*)**
        - This is most commonly called LVSD.
          - The most common causes are uncontrolled hypertension, ischemic heart disease or coronary artery disease, and valvular disorders.
          - It is also the type of HF that can present with acute decompensation where the patient is in cardiogenic shock. (See Figure 1)
      - **Right-sided LOHF**
        - This is most commonly due to increases in pulmonary artery pressures, as seen with pulmonary hypertension.
    - The underlying etiology determines the first side primarily impacted. Both sides can exhibit low-output (or low CO) HF that impairs the forward flow of blood.
      - Furthermore, left-sided HF can evolve or progress into right-sided HF.

- **Systolic or Diastolic Dysfunction with LOHF**
  - **Systolic Dysfunction:**
    - This is more common and results from a weakened force of contraction during systole, where a certain volume of blood is ejected from the ventricle.
    - This can occur with the right or left side of the heart, but the left side is the most common and, as mentioned above, is referred to as LVSD.
      - While LVSD goes through stages and more commonly falls on a disease "spectrum," many (not all) symptomatic patients have EF < 40%, but it can fluctuate at various times in the patient's history.
      - This is commonly referred to as HF with reduced EF (HFrEF).
        - The location on the disease spectrum is influenced by the degree of compliance with medications and lifestyle modifications.
  - **Diastolic Dysfunction:**
    - Diastolic dysfunction results from an impairment in the ventricle's relaxation during diastole (or the cardiac cycle's relaxation and ventricular filling phase).
    - This type of HF has an EF > 40% and is also referred to as HF with preserved EF (HFpEF) when the EF is > 50% and "mid-range" or "mildly reduced" when the EF is between 41 to 49% (i.e., HFmrEF). ***Note:** The abbreviation "mr" varies depending on the source.
- Regardless, both LOHF and HOHF can evolve on a spectrum of the disease and result in varying degrees of symptoms due to reduced CO and increased hospitalizations, morbidity, and mortality.



Clinical Context for the Diagram

- The breakdown of the types of HF presented in this diagram is meant to help clinicians recognize how the various types of HF exist in a general clinical context. This diagram has not been published elsewhere and is not intended to be comprehensive in context. The represented causes are also not meant to be comprehensive lists and, at times, are more challenging to classify only in one type of HF compared to causes found in LVSD.
- The bolded line represents the most common type of HF in clinical practice, which the guidelines and their references most often address. The other types of HF are also relevant and usually require different approaches to treatment because of differing underlying etiologies.
- The abbreviations used for low-output (LO) and high-output (HO) HF are utilized for context in the diagram and are not necessarily represented that way in other sources.
- Other abbreviations:
  - CAD = coronary artery disease, CO = cardiac output, DD = diastolic dysfunction, EF = ejection fraction, HTN = hypertension, LV = left ventricle, LVSD = left ventricular systolic dysfunction, NYHA FC = New York Heart Association Functional Class, RV = right ventricle, RVSD = right ventricular systolic dysfunction, SV = stroke volume

Diagnostic Criteria

- Most of the criteria for diagnosis centers around states of LOHF and, specifically, LVSD.
  - Patients being worked up for either will need a 12-lead ECG, ECHO, chest radiograph, and basic labs, which should also include Hgb/Hct, thyroid studies, and BNP.
- **Note of Clinical Context:**
  - The below use of stages, functional classification, and types of HF are centered mainly around the most common form of HF, low-output LVSD, where the EF and CO are both typically reduced.
    - All staging and classification strategies for the more common LOHF are useful in helping to choose the correct evidence-based therapies for each patient.
    - They also assist in guiding the clinician to additional management considerations as the patient moves along the spectrum of LOHF where the EF can improve (i.e., HFimpEF; see below).
  - Given the ability of HF to move along a spectrum of the disease, patients with HF can be evaluated through several perspectives based on symptoms, functionality, and findings of structural heart disease.
  - A number of classification tools have been used over time to help clinicians to stratify patients, especially when certain information is not available at the time of needing to make a diagnosis. Some of these classification tools may require more objective evidence, and some rely on subjective information.
    - Furthermore, some diagnostic tools require more invasive testing and thus have declined in their use, but they can still help understand how HF can shift on a spectrum of the disease and thus require specific interventions.
      - This is most apparent in the acute care environment where time-sensitive interventions cannot wait for more objective or invasive data.
    - **Forrester Classification (Figure 1)**
      - Commonly and historically used for assessing HF in acute decompensated HF (ADHF).
      - Estimates of LV filling pressures may require either:
        - Invasive testing (i.e., if using pulmonary artery occlusion pressure (PAOP) or pulmonary artery wedge pressure (PAWP)
        - Noninvasive testing using Doppler ECHO measurements of early mitral filling velocity (E)/early-diastolic mitral annular velocity (e') ratio, or
        - Clinician interpretation of signs and symptoms on presentation
      - Regardless, it is still a valid and useful way to classify the patient generally when time is limited to make an intervention.
    - **New York Heart Association (NYHA) Functional Class I, II, III, or IV (Table 1 & 2)**
      - One of the earliest attempts to classify HF in the context of its progression.
      - Describes symptoms and functional capacity for only patients in Stages C and D.
    - **AHA/ACC Stages A, B, C, or D (Table 2)**
      - Incorporates HF symptoms with the presence of structural heart disease.
    - **Types of left ventricular ejection fraction (LVEF) (Table 3)**
      - Represents the spectrum of LVSD for which HF can present or maneuver based on treatment and control of underlying causes.

– ***NOTE:** *Some patients can start out with an EF < 40% but then undergo improvement where the EF is > 40%. This type is referred to as HFimpEF.*

Figure 1:

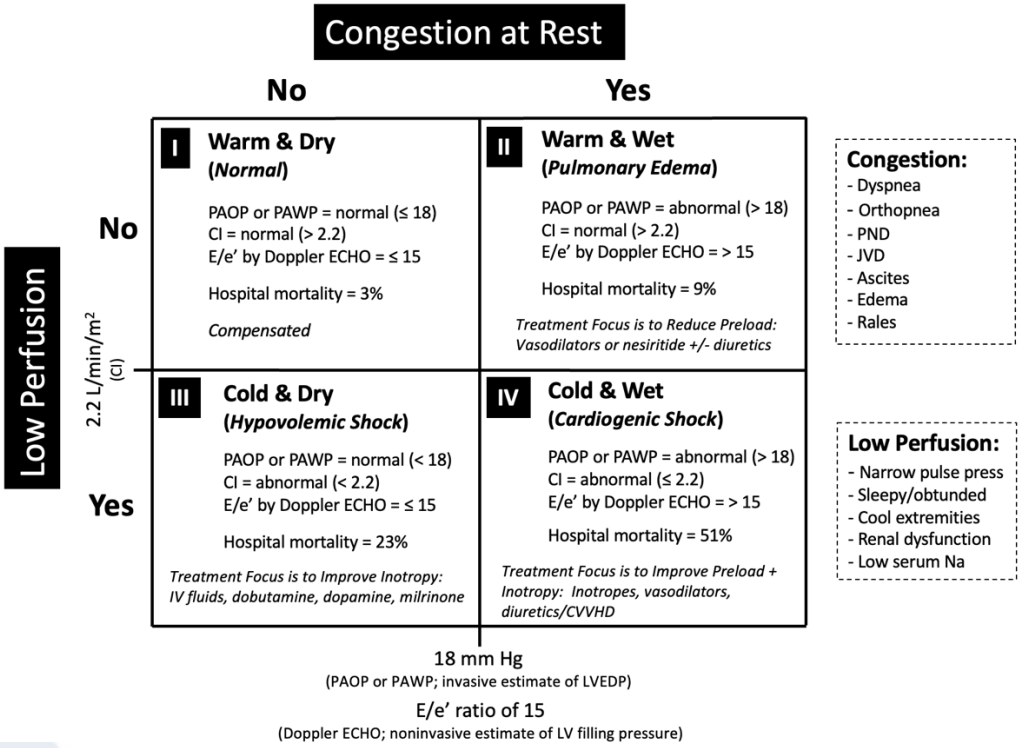


Table 1

NYHA FUNCTIONAL CLASS OF LOW-OUTPUT HEART FAILURE High-Yield Med Reviews		
NYHA Class	**General Description of Function**	**Measurable Activity Scale**
I	Patients with CVD but no limitations with physical activity (i.e., no fatigue, dyspnea, chest pain, and/or palpitations)	Can perform any activities that have ≥ 7 metabolic equivalents: – Carry up to 24 lbs. up 8 steps – Basic outdoor work (shoveling) – Can do common recreational activities (ski, basketball, handball, job or walk 5 mph)
II	Patients with CVD who are comfortable at rest, but have slight limitations with moderate physical activity (i.e., fatigue, dyspnea, chest pain, and/or palpitations)	Can perform any activities that have ≥ 5 metabolic equivalents: – Sexual intercourse without stopping – Basic outdoor work (garden, rake, weed, roller skate, and walk at 4 mph on level ground) – Unable to do any activities meeting ≥ 7 metabolic equivalents
III	Patients with CVD who have marked limitations with minimal physical activity (i.e., fatigue, dyspnea, chest pain, and/or palpitations)	Can perform any activities that have ≥ 2 metabolic equivalents: – Shower and dress without stopping – Strip and make a bed, clean window, bowl, play golf, walk at 2.5 mph – Unable to do any activities meeting ≥ 5 metabolic equivalents
IV	Patients with CVD who cannot do any physical activity without experiencing discomfort. Can even have chest pain at rest at times.	Cannot perform any activities that have ≥ 2 metabolic equivalents.

Table 2:

COMBINED STAGES & NYHA FUNCTIONAL CLASS OF LOW-OUTPUT HEART FAILURE High-Yield Med Reviews				
STAGE	**A**	**B**	**C**	**D**
Description	***At Risk for HF***	***Pre-HF***	***Symptomatic HF***	***Advanced HF***
Definition & Criteria	At risk due to presence of risk factors (RF), but *without*: - Symptoms - Structural heart disease - Elevated biomarkers	Absence of signs or symptoms of HF, but with at least 1 of: - Structural heart disease - Increased filling pressures - RF + elevated BNP or cardiac troponin	Structural heart disease with current or previous symptoms	Significant HF symptoms that: - Interfere with ADLs - Result in recurrent hospitalization
NYHA Functional Class	N/A with Staging	N/A with Staging	I. No symptoms II. Symptoms with moderate activity III. Symptoms with minimal activity IV. Symptoms at rest	II. Symptoms with moderate activity III. Symptoms with minimal activity IV. Symptoms at rest

Table 3:

TYPES OF LEFT VENTRICULAR EJECTION FRACTION (LVEF) High-Yield Med Reviews			
Type of LVSD	**LVEF**	**Descriptor**	**Notes**
HFpEF	≥ 50%	***Preserved***	▪ Historical or current evidence of elevated BNP and ECHO evidence of EF ≥ 50% ▪ Usually comfortable with normal activity
HFmrEF	41-49%	***Mid-Range or Mildly Reduced***	▪ Note: The abbreviation of "mr" can vary depending on source. ▪ Historical or current evidence of elevated BNP and ECHO evidence of EF 41 - 49% ▪ Little evidence to guide treatment if repeat ECHO ≥ 50% ▪ Symptoms *may* become present with normal activity.
HFrEF	≤ 40%	***Reduced***	▪ Repeat ECHO may result in HFimpEF if > 40%. ▪ Symptoms *may* become present even at rest or with no activity.
HFimpEF	Previous ≤ 40%, Repeat > 40%	***Improved***	▪ Considered a sub-category of HFrEF. ▪ Initial diagnosis will never be HFimpEF because you must have a baseline that is worse but now better.

High-Yield Clinical Knowledge

HF can result in significant morbidity and mortality if not correctly identified and staged for the purpose of proper treatment.

HF can be staged by risk, structural or physiologic cardiac changes, and the presence and severity of symptoms.

The functional class can be determined based on the level of activity that produces HF symptoms.

Appropriate treatment should include non-pharmacologic and pharmacologic strategies oriented to the type of HF present and its severity.

There are numerous treatments that are known to reduce mortality, especially for cases of LVSD. Those include (but are not limited to): beta-blockers, ACE inhibitors, mineralocorticoid receptor antagonists, etc.

The choice of medications is also partially influenced by the presence or absence of other diseases.

HF is also a dynamic disease that can fluctuate from time to time.

For example, some patients can start out with an EF < 40% but then undergo improvement where the EF is > 40%. This type is referred to as HFimpEF.

Monitoring Considerations

Given that HF can progress on a spectrum of the disease, there are times when appropriate elements of the initial work-up are repeated, especially when patient signs, symptoms, and/or concern for disease progression dictates.

During acute exacerbations, patients can present in a different NHYA FC than as an outpatient. Recognizing this is relevant as acute fluid overload can exacerbate HF and lead to atrial stretching.

This can result in new-onset atrial fibrillation, further reducing forward flow and acutely worsening HF.

In patients with HFrEF after an NSTEMI, repeated ECHOs should be performed within 6-12 weeks to optimize medical management and determine the need for implantable cardioverter-defibrillator implantation.

Patient Education

Recognition of signs and symptoms, including alarm symptoms that warrant an office visit or possible hospital observation/admission for additional evaluation for disease progression.

This especially includes the close monitoring of weight, dyspnea on exertion, orthopnea, and paroxysmal nocturnal dyspnea, which can all reflect fluid accumulation.