The Canadian Cardiovascular Society

IS IT

HEART FAILURE

AND WHAT SHOULD I DO?

Canadian Cardiovascular Society
About this Pocket Guide

This pocket guide is a quick-reference tool that features diagnostic and management recommendations based on the CCS Heart Failure Comprehensive Guidelines (2017).

These recommendations are intended to provide a reasonable and practical approach to the care of patients with HF. The intended audience is primary care physicians, specialists and allied health professionals. Recommendations are subject to change as scientific knowledge and technology advance and practice patterns evolve, and are not intended to be a substitute for clinical judgment. Adherence to these recommendations will not necessarily produce successful outcomes in every case.

Please visit www.ccs.ca for more information or additional resources.

Acknowledgements

The CCS would like to thank the many Heart Failure Guideline Panel members who have contributed countless hours to guideline development as well as our knowledge translation program. We appreciate their dedication and commitment to the CCS and to this important heart failure management resource. A complete list of guideline authors can be found at www.ccs.ca and our Heart Failure Program co-chairs are listed below:

CCS Heart Failure Guideline Co-Chairs

Table of Contents

Standard Assessment ........................................................................................................................................................................ 1
Etiology of Heart Failure (HF) ............................................................................................................................................................ 2
Algorithm for the Diagnosis of HF in the Ambulatory Setting ........................................................................................................ 4
Educate Patient about Heart Failure ................................................................................................................................................ 6
Evidence-based Drugs and Oral Doses as Shown in Large Clinical Trials ........................................................................................ 7
Initial Referral and Follow-up Frequency ........................................................................................................................................ 8
Therapeutic Approach to Patients with Heart Failure and Reduced Ejection Fraction ................................................................. 10
Practical Tips for Heart Failure with Preserved EF (HFpEF) ................................................................................................................ 12
Algorithm for Management of Different Stages of HF Using Natriuretic Peptides ................................................................. 13
Acute Heart Failure (AHF)
  Diagnosis ........................................................................................................................................................................ 14
  Acute Management ........................................................................................................................................................ 15
  Diuretic Dosing ................................................................................................................................................................ 16
  Therapeutic Goals and Diuretic Dosing ........................................................................................................................ 17
  Admit or Discharge from the Emergency Department ................................................................................................ 18
Exercise Modalities According to Clinical Scenario .................................................................................................................. 20
Approach to Assessment for CAD in Patients with HF .................................................................................................................. 21
Decision Regarding Coronary Revascularization in HF .................................................................................................................. 22
Referral Pathway for Device Therapy in Patients with Heart Failure (HF) .................................................................................. 23
Clinical Trials that Might Influence Practice .......................................................................................................................... 24
**Standard Assessment**

**Suspect Heart Failure**

<table>
<thead>
<tr>
<th>Risk Factors</th>
<th>Symptoms</th>
<th>Signs</th>
<th>Key Electrocardiographic Findings</th>
<th>Chest X-ray (CXR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypertension</td>
<td>Breathlessness</td>
<td>Lung crackles</td>
<td>Q Waves</td>
<td>Cardiomegaly</td>
</tr>
<tr>
<td>Ischemic heart disease (IHD)</td>
<td>Fatigue</td>
<td>Elevated Jugular Venous Pressure (JVP)</td>
<td>Left Ventricular Hypertrophy (LVH)</td>
<td>Pulmonary venous redistribution</td>
</tr>
<tr>
<td>Valvular heart disease</td>
<td>Leg swelling</td>
<td>Positive Abdominal jugular reflux (AJR)</td>
<td>Left Bundle Branch Block (LBBB)</td>
<td>Pulmonary edema</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>Confusion*</td>
<td>Peripheral edema</td>
<td>Tachycardia</td>
<td>Pleural effusion</td>
</tr>
<tr>
<td>Heavy alcohol or substance use</td>
<td>Orthopnea</td>
<td>Displaced apex</td>
<td>Atrial Fibrillation</td>
<td></td>
</tr>
<tr>
<td>Chemotherapy or radiation therapy</td>
<td>Paroxysmal nocturnal</td>
<td>3rd heart sound, 4th heart sound (S₃, S₄)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Family history of cardiomyopathy</td>
<td>dyspnea</td>
<td>Heart murmur</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Smoking</td>
<td></td>
<td>Low blood pressure (BP)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hyperlipidemia</td>
<td></td>
<td>Heart rate &gt; 100mmHg</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*especially in the elderly

If Heart Failure Diagnosis Remains in Doubt

<table>
<thead>
<tr>
<th>B-type Natriuretic Peptide (BNP) or NT-proBNP, if available</th>
<th>Echocardiogram (ECHO)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BNP</strong>* &lt; 100 pg/ml, - HF unlikely</td>
<td>Decreased left ventricular (LV) ejection fraction</td>
</tr>
<tr>
<td>= 100-500 pg/ml, HF possible, but other diagnoses need to be considered</td>
<td>Increased LV end-systolic and end-diastolic diameter</td>
</tr>
<tr>
<td>&gt; 500 pg/ml, HF likely</td>
<td>LVH</td>
</tr>
<tr>
<td><strong>NT-proBNP</strong>* &lt; 300 pg/ml, - HF unlikely</td>
<td>Wall motion abnormalities and diastolic dysfunction</td>
</tr>
<tr>
<td>= 300-900 pg/ml, HF possible, but other diagnoses need to be considered (age 50-75)</td>
<td>Increased RV size and/or RV dysfunction</td>
</tr>
<tr>
<td>= 300-1800 pg/ml, HF possible, but other diagnoses need to be considered (age &gt; 75)</td>
<td>Valve dysfunction</td>
</tr>
<tr>
<td>&gt; 900 pg/ml, HF likely (age 50-75)</td>
<td>Elevated pulmonary arterial pressures (PAP)</td>
</tr>
<tr>
<td>1800 pg/ml, HF likely (age &gt; 75)</td>
<td></td>
</tr>
</tbody>
</table>

*Values correspond to decompensated heart failure and do not apply for diagnosis of stable heart failure.
Echocardiogram, ECG, plus recommended lab testing for all patients (CBC, creatinine, ferritin, TSH, troponin, BNP)

- **HFrEF (and HFmEF)**
  - LVEF ≤ 40%, up to 49%
  - **Common etiologies**
    - Tachyarrhythmia
    - Valve disease
    - Known or risk factors for CAD
    - LVH
      - CAD workup
      - Hx of HTN
    - Significant CAD (Ischemic)
    - No Significant CAD
    - Probable hypertensive HF/ hypertensive cardiomyopathy

- **HFpEF**
  - LVEF ≥ 50%
  - **Common etiologies**
  - Congenital Heart Disease
  - Pericardial Disease
  - Further workup and referral as appropriate
A detailed medical and family history may guide investigations and should be completed in all patients (see recommendation 19).

Direct testing based on pre-test probability, availability and expertise.

ARVC, arrhythmogenic right ventricular cardiomyopathy; CAD, coronary artery disease; CBC, complete blood count; CMP, cardiomyopathy; CMR, cardiac magnetic resonance; ECG, electrocardiogram; HCM, hypertrophic cardiomyopathy; HFmEF, HF with a mid-range ejection fraction; HFpEF, HF with a reduced ejection fraction; HTN, hypertension; LV, left ventricle; LVEF, left ventricular ejection fraction; LVH, left ventricular hypertrophy; NP, natriuretic peptide; PPCM, peripartum cardiomyopathy; TSH, thyroid stimulating hormone.
Suspected Heart Failure

Clinical History
- Symptoms
- Functional limitation
- Prior cardiac disease
- Risk factors
- Exacerbating factors
- Comorbidities
- Drugs

Physical Examination
- Vital signs
- Weight
- Volume status
- Heart
- Lung
- Abdomen
- Peripheral Vascular

Initial Investigations
- Chest radiograph
- Electrocardiogram
- Lab work (CBC, electrolytes, renal function, urinalysis, glucose, thyroid function)

Still Suspect Heart Failure?
Assessment of Ventricular Function

**Assess Natriuretic Peptides***
- NT-proBNP > 125 pg/mL
- BNP > 50 pg/mL (if available)

**Additional Diagnostic Investigations**
- Cardiac catheterization
- Cardiopulmonary exercise testing
- Others (CMR, MIBI, MUGA, CT scan)

**Heart failure likely, treat accordingly**

* Natriuretic peptides are not available in all jurisdictions in Canada

‡ Includes both systolic and diastolic parameters (eg, numeric left ventricular ejection fraction, transmitial and pulmonary venous flow patterns, or mitral annulus velocities); a preserved ejection function on a routine echocardiogram does not rule out the clinical syndrome of heart failure and therefore clinical judgment is required if other indicators point to heart failure as a diagnosis.

A lower BNP cutoff for suspecting HF in the ambulatory setting facilitates earlier implementation of guideline directed care.
### Educate Patient about Heart Failure

**Warning Signs and Symptoms**

- Dyspnea
  - With less exertion
  - During sleep
  - When flat
- Fatigue with less exertion
- Increased swelling in fat, ankles, legs or abdomen
- Dyspnea at rest
- Weight gain > 2 kg in 2 days or 3 kg in 7 days
- Lightheaded/faint
- Prolonged palpitations
- Chest pain that does not go away with rest or with medicine or is worsening
- Confusion

**Lifestyle**

- Treat cardiovascular risk factors
  - Control hypertension
  - Control Diabetes Mellitus (DM)
  - Smoking cessation
  - Obesity counselling
  - Annual influenza vaccine and periodic pneumococcal pneumonia immunizations
- No need to push oral fluids
  - Sodium restriction between 2g-3g/day is reasonable)
- Lose weight if significant obesity
- Regular physical activity, as tolerated
- Weigh daily if fluid retention

**Drug and Device Treatment Regimen**

- Medical therapy that improves survival and reduces hospitalization such as Acei, ARB, MRA, ARNi, If inhibitors at guideline directed doses should be emphasized as targets
- Diuretics, nitrates and digoxin
  - for symptom management
- Combination drug regimen is required
- Most will be used long term and generally life long
- Understand the common side effects which often requires occasional laboratory testing for patients with reduced EF and symptomatic HF
- Consider devices with low LVEF or wide QRS (e.g. ICD, CRT)
- Diuretics may need adjusting to maintain euvolemia

<table>
<thead>
<tr>
<th>Warning Signs and Symptoms</th>
<th>Lifestyle</th>
<th>Drug and Device Treatment Regimen</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dyspnea</td>
<td>Treat cardiovascular risk factors</td>
<td>Medical therapy that improves survival and reduces hospitalization such as Acei, ARB, MRA, ARNi, If inhibitors at guideline directed doses should be emphasized as targets</td>
</tr>
<tr>
<td>Fatigue with less exertion</td>
<td>No need to push oral fluids</td>
<td>Diuretics, nitrates and digoxin</td>
</tr>
<tr>
<td>Increased swelling</td>
<td>Lose weight if significant obesity</td>
<td>Combination drug regimen is required</td>
</tr>
<tr>
<td>Dyspnea at rest</td>
<td>Regular physical activity, as tolerated</td>
<td>Most will be used long term and generally life long</td>
</tr>
<tr>
<td>Weight gain &gt; 2 kg</td>
<td>Weigh daily if fluid retention</td>
<td>Understand the common side effects which often requires occasional laboratory testing for patients with reduced EF and symptomatic HF</td>
</tr>
<tr>
<td>Lightheaded/faint</td>
<td></td>
<td>Consider devices with low LVEF or wide QRS (e.g. ICD, CRT)</td>
</tr>
<tr>
<td>Prolonged palpitations</td>
<td></td>
<td>Diuretics may need adjusting to maintain euvolemia</td>
</tr>
<tr>
<td>Chest pain that does not</td>
<td></td>
<td></td>
</tr>
<tr>
<td>go away with rest or with</td>
<td></td>
<td></td>
</tr>
<tr>
<td>medicine or is worsening</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Confusion</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Evidence-based Drugs and Oral Doses as Shown in Large Clinical Trials

<table>
<thead>
<tr>
<th>Drug</th>
<th>Start Dose</th>
<th>Target Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ace-Inhibitors (ACEi)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Enalapril</td>
<td>1.25-2.5 mg BID</td>
<td>10 mg BID/ 20 mg BID in NYHA class IV</td>
</tr>
<tr>
<td>Lisinopril</td>
<td>2.5-5 mg daily</td>
<td>20-35 mg daily</td>
</tr>
<tr>
<td>Perindopril</td>
<td>2-4 mg</td>
<td>4-8 mg</td>
</tr>
<tr>
<td>Ramipril</td>
<td>1.25-2.5 mg BID</td>
<td>5 mg BID</td>
</tr>
<tr>
<td>Trandolapril</td>
<td>1-2 mg daily</td>
<td>4 mg daily</td>
</tr>
<tr>
<td><strong>Angiotensin Receptor Blocker (ARB)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Candesartan</td>
<td>4-8 mg daily</td>
<td>32 mg daily</td>
</tr>
<tr>
<td>Valsartan</td>
<td>40 mg BID</td>
<td>160 mg BID</td>
</tr>
<tr>
<td><strong>Beta-blockers</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carvedilol</td>
<td>3.125 mg BID</td>
<td>25 mg BID/ 50mg BID (&gt; 85kg)</td>
</tr>
<tr>
<td>Bisoprolol</td>
<td>1.25 mg daily</td>
<td>10 mg daily</td>
</tr>
<tr>
<td>Metoprolol CR/XL*</td>
<td>12.5-25 mg daily</td>
<td>200 mg daily</td>
</tr>
<tr>
<td><strong>Mineralocorticoid Receptor Antagonists (MRA)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spironolactone</td>
<td>12.5 mg daily</td>
<td>50 mg daily</td>
</tr>
<tr>
<td>Eplerenone</td>
<td>25 mg daily</td>
<td>50 mg daily</td>
</tr>
<tr>
<td><strong>Angiotensin receptor–neprilysin inhibitor (ARNi)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sacubutril/Valsartan</td>
<td>50-100 mg BID</td>
<td>200 mg BID</td>
</tr>
<tr>
<td><strong>Ii Inhibitor</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ivabradine</td>
<td>2.5-5 mg BID</td>
<td>7.5 mg BID</td>
</tr>
<tr>
<td><strong>Vasodilators</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Isosorbide dinitrate</td>
<td>20 mg TID</td>
<td>40 mg TID</td>
</tr>
<tr>
<td>Hydralazine</td>
<td>37.5 mg TID</td>
<td>75-100 mg TID-QID</td>
</tr>
</tbody>
</table>
INITIAL REFERRAL
Situational wait time benchmarks

ROUTINE, ELECTIVE REFERRAL
- Chronic HF disease management, NYHA II
- NYHA I – no symptoms

见于12周内，理想情况下为6周

SEMIURGENT, INTERMEDIATE RISK
- New diagnosis of HF, stable, compensated
- NYHA II/III
- Worsening HF with therapy
- Mild symptoms with valvular or renal disease or hypotension

见于6周内，理想情况下为4周

URGENT
- New diagnosis of HF, not improving with therapy (unstable decompensated)
- Progression to NYHA IV HF
- Posthospitalization or ER visit for HF
- Severe HF with valvular or renal disease or hypotension
- Postmyocardial infarction HF

见于2周

EMERGENT
- Acute severe myocarditis
- Rapidly progressive heart failure/cardiogenic shock
- Heart failure with ACS
- Transplant and device evaluation of unstable patient
- New-onset acute pulmonary edema

见于24小时
HEART FAILURE CARE

LOW-RISK INDIVIDUAL
- NYHA I or II
- No hospitalizations in past year
- No recent changes in medications
- Receiving optimal medical/device HF therapies

Follow-up every 6-12 months

INTERMEDIATE-RISK INDIVIDUAL
- No clear features of high or low risk

Follow-up every 1-6 months

HIGH-RISK INDIVIDUAL
- NYHA IIIB or IV symptoms
- Recent HF hospitalization
- During titration of HF medications
- New onset heart failure
- Complications of HF therapy (rising creatinine, hypotension)
- Need to down-titrate or discontinue ß-blockers or ACEi/ARB
- Severe-concomitant and active illness (eg. COPD, frailty)
- Frequent ICD firings (1 month)

Follow-up every 1-4 weeks or as clinically indicated (remote monitoring possible for some titrations)

Make inactive or consider for discharge from HF clinic if a minimum of 2 of the following characteristics are present:

- NYHA I or II for 6-12 months
- Receiving optimal therapies
- Reversible causes of HF fully controlled
- Having access to family physician with expertise in management of HF
- Adherence to optimal HF therapy
- No hospitalization for > 1 year
- LVEF > 35% (consistently on >1 EF measurement)
- Primary care provider has access to urgent specialist reassessment

* Visit frequency may increase during medication titration

ACEi/ARB, angiotensin-converting enzyme inhibitor/angiotensin receptor blocker; ACS, acute coronary syndrome; AHA/ACC, American Heart Association/American College of Cardiology; COPD, chronic obstructive pulmonary disease; D/C, hospital discharge; ER, Emergency Department; FC, functional class; hrs, hours; ICD, implantable cardioverter defibrillator; MI, myocardial infarction; NYHA, New York Heart Association.
Therapeutic Approach to Patients with Heart Failure and Reduced Ejection Fraction

Patient with LVEF ≤ 40% and Symptoms

Triple therapy ACEi (or ARB if ACEi intolerant), BB, MRA
Titrate to target doses or maximum tolerated evidence-based dose

REASSESS SYMPTOMS

NYHA I
Continue triple therapy

NYHA II–IV: SR, HR ≥ 70 bpm
Add ivabradine and switch ACEi or ARB to ARNI* for eligible patients

NYHA II–IV: SR with HR < 70 bpm or AF or pacemaker
Switch ACEi or ARB to ARNI* for eligible patients

REASSESS SYMPTOMS AND LVEF

Nonpharmacologic therapies (teaching self-care, exercise)

Advance Care Planning and Documentation of Goals of Care

Diuretics to Relieve Congestion
Titrated to minimum effective dose to maintain euvolemia

Diuretics to Relieve Congestion
Titrated to minimum effective dose to maintain euvolemia

Diuretics to Relieve Congestion
Titrated to minimum effective dose to maintain euvolemia

Diuretics to Relieve Congestion
Titrated to minimum effective dose to maintain euvolemia

Diuretics to Relieve Congestion
Titrated to minimum effective dose to maintain euvolemia

Diuretics to Relieve Congestion
Titrated to minimum effective dose to maintain euvolemia

Diuretics to Relieve Congestion
Titrated to minimum effective dose to maintain euvolemia

Diuretics to Relieve Congestion
Titrated to minimum effective dose to maintain euvolemia

Diuretics to Relieve Congestion
Titrated to minimum effective dose to maintain euvolemia

Diuretics to Relieve Congestion
Titrated to minimum effective dose to maintain euvolemia
NYHA I or LVEF >35%
Continue present management

NYHA I–III and LVEF ≤ 35%
Consider LVEF reassessment every 1–5 years

NYHA IV
Consider:
- Hydralazine/nitrates
- Referral for advanced HF therapy (mechanical circulatory support/transplant)
- Palliative Care referral

Reassess every 1–3 years or with clinical status change‡

Diuretics to Relieve Congestion
Titrated to minimum effective dose to maintain euvolemia

Non-pharmacologic Therapies
(teaching self-care, exercise)

Advance Care Planning and Documentation of Goals of Care

* ARNI: angiotensin II receptor blocker neprilysin inhibitor (sacubitril/valsartan)
‡ Refer to Table 5
ACE, angiotensin-converting enzyme inhibitor; AF, atrial fibrillation; ARB, angiotensin receptor blocker; bpm, beats per minute; CRT, cardiac resynchronization therapy; HF, heart failure; ICD, implantable cardioverter defibrillator; LVEF, left ventricular ejection fraction; MRA, mineralocorticoid receptor antagonist; NYHA, New York Heart Association; SR, sinus rhythm.
Practical Tips for Heart Failure with Preserved EF (HFpEF)

- Minimum effective diuretic dose to maintain euolema
- Identification and treatment of underlying factors such as ischemia and valvular disease
- Treat hypertension according to current hypertension guidelines
- Usually loop diuretics are needed, renal function may be very volume dependant
- In most cases, an indication for ACE, ARB and/or BB is present
- Patients with atrial fibrillation should be anticoagulated unless there is a contraindication
- Individuals with HFpEF, serum potassium <50 mmol/L and eGFR >30mL/min, an MRA like spironolactone should be considered

Shortness of Breath and LVEF > 50%

Cardiac causes
- Heart Failure with preserved ejection fraction (HFpEF)
- Other Cardiac Entities
  - Coronary artery disease
  - Valvular heart disease
  - Hypertrophic cardiomyopathy
  - Restrictive cardiomyopathy
  - Constrictive pericarditis
  - Intracardiac shunt

Non-cardiac causes
- Lung disease
- Hyperventilation
- Pulmonary arterial hypertension
- Extracardiac shunt
- Obesity
- Anemia
- Thyrotoxicosis
- Deconditioning
Algorithm for Management of Different Stages of HF Using Natriuretic Peptides

Patient Population | Natriuretic Peptide Level | Actions
--- | --- | ---
Risk factors for HF | NT-proBNP > 125 pg/mL BNP > 50 pg/mL | More frequent follow-up, consideration of intensification of existing therapy
Ambulatory HF | > 30% ↑ from clinic baseline value | More frequent follow-up with or without intensification of HF therapy
Hospitalized for HF and before discharge | > 30% ↓ from admission value | Discharge if relatively free from congestion

BNP, B-type natriuretic peptide; HF, heart failure; NTproBNP, amino-terminal fragment propeptide B-type natriuretic peptide.
Acute Heart Failure (AHF) - Diagnosis

### INITIAL WORKUP

History, Physical, ECG, Chest x-ray, Biomarkers (electrolytes, Cr, CBC, with or without troponin, with or without BNP)

### Suspect Acute Heart Failure

- **Unlikely to be AHF**
- **Uncertain**
- **Test BNP / NT-proBNP**

#### Unlikely to be AHF

- BNP < 100 pg/mL
- NT-proBNP < 300 pg/mL

#### Uncertain

- BNP 100–400 pg/mL
- NT-proBNP 300–900 pg/mL (age 50–75)
- NT-proBNP 300–1800 pg/mL (age >75)

#### Test BNP / NT-proBNP

- BNP 100–400 pg/mL
- NT-proBNP 300–900 pg/mL (age 50–75)
- NT-proBNP 300–1800 pg/mL (age >75)

#### Consider other diagnosis

#### Likely to be AHF

- BNP > 400 pg/mL
- NT-proBNP > 900 pg/mL (age 50–75)
- NT-proBNP > 1800 pg/mL (age >75)

#### Consider use of AHF Score*

#### Treat

*PRIDE or other scoring systems

AHF, acute heart failure; BNP, B-type natriuretic peptide; CBC, complete blood count; Cr, creatinine; ECG, electrocardiogram; NT-proBNP, amino-terminal fragment propeptide B-type natriuretic peptide.
**Acute Heart Failure (AHF) - Acute Management**

**Target $O_2$ saturation $\geq 92\%$**

**CONSIDER:**
- Oxygen $\uparrow$ FiO$_2$
- CPAP / BiPAP
- Mechanical intubation

**Volume overload**

**REVIEW:**
- I.V. furosemide 20–80 mg bolus **OR** I.V. furosemide infusion 5–20 mg/h

**Review SBP / MAP**

- **SBP < 90 mm Hg / MAP < 60 mm Hg**
  - *Consider:*
    - Dopamine or other vasopressor
    - Dobutamine

- **SBP = 90–100 mm Hg / MAP = 60–65 mm Hg**
  - *Consider:*
    - If low cardiac output suspected to clinical exam and confirmed with PA catheter, additional use of dobutamine or milrinone

- **SBP > 100 mm Hg / MAP > 65 mm Hg**
  - *Consider:*
    - If not adequately responsive to I.V. diuretics, consider adding nitroglycerin I.V. / SL, nitroprusside I.V.

* See table for dosing.

BiPAP, bilevel positive airway pressure; BP, blood pressure; CPAP, continuous positive airway pressure; I.V., intravenous; MAP, mean arterial pressure; PA, pulmonary artery; PCWP, pulmonary capillary wedge pressure; SBP, systolic blood pressure.

---

*Consider:
- Dopamine or other vasopressor
- Dobutamine

*Consider:
If low cardiac output suspected to clinical exam and confirmed with PA catheter, additional use of dobutamine or milrinone

*Consider:
If not adequately responsive to I.V. diuretics, consider adding nitroglycerin I.V. / SL, nitroprusside I.V.
Acute Heart Failure (AHF) - Diuretic Dosing

**Patient with HF and volume overload**

Loop diuretic I.V. dose 20–80 mg/d

Assess weight change and/or urine output over 24 hours

- Weight change < 0.5 kg
  - < 3 L/d urine output
  - Increase loop diuretic dose by approximately 50%
  - Add metolazone 1.25–5 mg 1 to 7 times a week*
- Weight change 0.5–1.5 kg
  - 3–5L urine output
  - Continue on until appropriate diuresis achieved
- Weight change > 1.5 kg
  - > 5 L urine output
  - Consider reducing diuretic dose by 25%–50%

**Consider:**
Increasing or switching from bolus to continuous infusion of loop diuretic dose, increase metolazone, or use inotropic support in conjunction with nephrology or cardiology support.

* Assumes:
  1) Volume assessment with each step
  2) Monitoring of electrolytes, renal function, symptoms and vital signs
  3) Daily weights
  4) Urine output not often accurate or obtainable

≠ Titrate progressively, according to the degree of hypervolemia, furosemide doses and creatinine/kidney function
Therapeutic Goals for Patients with AHF

- Understanding the etiology of patient’s cardiomyopathy and precipitating factors for decompensation
- Alleviate presenting symptoms
- Optimize all indicated evidence-based treatment interventions

- Provide patient education
- Establish a transition of care plan and outpatient follow-up
- Establish euvolemic

Practical Tips when Response to Diuretic is Suboptimal

- Reevaluate the need for additional diuresis by frequent assessment of volume status
- Restrict sodium and fluid (Na+/H2O) intake (exercise caution reducing oral intake below 500 ml per 24 hours)
- Review diuretic dosing. Higher bolus doses will be more effective than more frequent lower doses. Diuretic infusions (eg, furosemide 20-40 mg bolus then 5-20 mg/h) can be a useful strategy when other options are not available
- Add another type of diuretic with different site of action (thiazides, spironolactone). Thiazide diuretics (eg oral metolazone 2.5-5 mg OD/BID or hydrochlorothiazide 25-50 mg) are often given at least 30 minutes before the loop diuretic to enhance diuresis, although this is not required to have an adequate effect
- Consider hemodynamic assessment and/or positive inotropic agents if clinical evidence of poor perfusion coexists with diuretic resistance
- Refer for hemodialysis, ultrafiltration, or other renal replacement strategies if diuresis is impeded by renal insufficiency
### Acute Heart Failure (AHF) - Admit or Discharge from the Emergency Department

<table>
<thead>
<tr>
<th>Variable</th>
<th>Consider for Hospital Admission</th>
<th>Consider for Discharge Home with Close Follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current clinical status</td>
<td>NYHA III / IV</td>
<td>NYHA II</td>
</tr>
<tr>
<td>Amount of improvement</td>
<td>Minimal or modest</td>
<td>Significant</td>
</tr>
<tr>
<td>$O_2$ saturation on room air</td>
<td>&lt; 91%</td>
<td>$\geq$ 92%</td>
</tr>
<tr>
<td>Systolic blood pressure</td>
<td>&lt; 90 - 100 mmHg</td>
<td>&gt; 100 mmHg or similar to prior</td>
</tr>
<tr>
<td>Heart rate</td>
<td>&gt; 90 bpm</td>
<td>&lt; 90 bpm</td>
</tr>
<tr>
<td>Respiratory rate</td>
<td>&gt; 20 breaths/minute</td>
<td>$\leq$ 20 breaths/minute</td>
</tr>
<tr>
<td>ECG findings</td>
<td>Active ischemia; ventricular arrhythmia; atrial arrhythmia not under control</td>
<td>Baseline</td>
</tr>
<tr>
<td>Renal function</td>
<td>Worsening</td>
<td>Stable</td>
</tr>
<tr>
<td>Comorbidity</td>
<td>Other comorbid condition requiring admission; syncope; pneumonia</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>New diagnosis of HF</td>
<td>Established etiology and precipitant</td>
</tr>
<tr>
<td>Follow-up</td>
<td>Uncertain</td>
<td>Established / Organized</td>
</tr>
</tbody>
</table>
### Acute Heart Failure (AHF) - Admit or Discharge (continued)

**Criteria for Discharge**

- Presenting symptoms resolved
- Vital signs resolved and stable for > 24 hrs, especially blood pressure & heart rate
- Returned to “dry” weight and stable for > 24 hours on oral diuretics
- Inter-current cardiac illness adequately diagnosed and treated
- Inter-current non-cardiac illness adequately diagnosed and treated
- Chronic oral HF therapy initiated, titrated and optimized (or outpatient plan for same)

- Education initiated, understood by patient and caregivers, continued education planned
- Discharge plan includes clear requirements for follow-up labs, office appointments and further testing
- Timely communication to primary care provider and/or specialist physician and/or multi-disciplinary disease management program is essential

### Acute Heart Failure (AHF) - Daily Follow-up

<table>
<thead>
<tr>
<th>Question/Query</th>
<th>How To Assess</th>
<th>Other symptoms improved (fatigue, orthopnea, paroxysmal nocturnal dyspnea, etc.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Have the patients symptoms improved?</td>
<td>• Dyspnea</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Overall well-being</td>
<td></td>
</tr>
<tr>
<td>What are the clinical findings compared with baseline?</td>
<td>• Blood pressure</td>
<td>Heart rate</td>
</tr>
<tr>
<td></td>
<td>• Respiratory rate</td>
<td>Physical examination findings</td>
</tr>
<tr>
<td></td>
<td>• Oxygen saturation</td>
<td>(especially JVP, $S_3$, rales, lower extremity edema)</td>
</tr>
<tr>
<td>What are the pertinent laboratory findings?</td>
<td>• Weight and net fluid balance</td>
<td>Hemoglobin</td>
</tr>
<tr>
<td></td>
<td>• Creatinine</td>
<td>Blood urea nitrogen</td>
</tr>
<tr>
<td></td>
<td>• Potassium</td>
<td>Sodium</td>
</tr>
<tr>
<td></td>
<td>• BNP or NT-proBNP</td>
<td></td>
</tr>
</tbody>
</table>

JVP, Jugular venous pressure. $S_3$, third heart sound.
### Exercise Modalities According to Clinical Scenario

<table>
<thead>
<tr>
<th>Exercises</th>
<th>Discharged with Heart Failure</th>
<th>NYHA I-III</th>
<th>NYHA IV</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Flexibility Exercises</strong></td>
<td>Recommended</td>
<td>Recommended</td>
<td>Recommended</td>
</tr>
<tr>
<td><strong>Aerobic Exercises</strong></td>
<td>Recommended</td>
<td>Recommended</td>
<td>Recommended</td>
</tr>
<tr>
<td>Suggested modality</td>
<td>• Selected population only</td>
<td>• Walk</td>
<td>• Selected population only</td>
</tr>
<tr>
<td></td>
<td>• Supervision by an expert team needed (see text)</td>
<td>• Treadmill</td>
<td>• Supervision by an expert team needed (see text)</td>
</tr>
<tr>
<td></td>
<td>• Ergocycle</td>
<td>• Ergocycle</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Swimming</td>
<td>• Swimming</td>
<td></td>
</tr>
<tr>
<td>Intensity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Continuous training:</td>
<td>Moderate intensity:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• RPE scale 3-5, or</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• 65%-85% HRmax, or</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• 50%-75% peak VO2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moderate intensity aerobic interval might be incorporated in selected patients</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Intervals of 15-30 minutes</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>with an RPE scale of 3-5</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Rest intervals of 15-30 minutes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frequency</td>
<td>• Starting with 2-3 days per week</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Goal: 5 days per week</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Duration</td>
<td>• Starting with 10-15 minutes</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Goal: 30 minutes</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Isometric / Resistance Exercises</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intensity</td>
<td>• 10-20 repetitions of 5 to 10-pound free weights</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frequency</td>
<td>• 2-3 days per week</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

HRmax, maximal heart rate; NYHA, New York Heart Association; RPE, rating perceived exertion; VO2, peak oxygen uptake.
Approach to Assessment for CAD in Patients with HF

Angina or angina-equivalent symptoms?

- **YES**
  - Is the patient a suitable risk for surgical revascularization?
    - **YES**
      - Coronary angiography*
    - **NO**
      - Noninvasive rest and stress imaging according to local preference†

- **NO**
  - Is the patient a suitable risk for surgical revascularization?
    - **YES**
      - Either
        - a) noninvasive rest and stress imaging according to local preferences or
        - b) directly to coronary angiography
    - **NO**
      - Is patient a potential candidate for PCI?
        - **YES**
          - Noninvasive rest and stress imaging according to local preferences†
        - **NO**
          - Medical therapy‡

* Some centres might additionally perform noninvasive imaging, especially when coronary anatomy is not optimal.
† If imaging indicates features of high risk, progression to coronary angiography is expected.
‡ Noninvasive imaging might be performed in certain centres for risk stratification or diagnosis.
CAD, coronary artery disease; PCI, percutaneous coronary intervention.
Decision Regarding Coronary Revascularization in HF

Angina or ischemic equivalent?

**YES**

Acceptable risk for surgical revascularization?

**YES**

- Surgical revascularization most appropriate according to coronary anatomy?
  - **YES**
  - PCI on culprit artery using noninvasive functional approach
  - Surgical revascularization
  - Medical therapy
  - Consider PCI

- **NO**
  - Medical therapy

**NO**

- Anatomically acceptable for PCI?
  - **YES**
  - PCI may be directed by noninvasive imaging or IC flow wire
  - Medical therapy

- **NO**
  - Medical therapy

**NO**

Acceptable risk for surgical revascularization?

**YES**

- Is LVEF < 35%?
  - **YES**
  - Medical therapy
  - Consider PCI

- **NO**
  - Medical therapy

**NO**

- Evidence of extensive ischemia on noninvasive imaging and/or another cardiac procedure (ie, TAVI, MV procedure) indicated?
  - **YES**
  - Surgical revascularization most appropriate according to coronary anatomy?
    - **YES**
    - Surgical revascularization with or without other indicated procedure
    - Medical therapy
    - Consider PCI

- **NO**
  - Medical therapy

* Coronary anatomy suitable for CABG includes:
  - Multivessel disease > 70% stenosis
  - Left main stem stenosis > 50%
  - Or diabetes with left anterior descending artery stenosis > 70%

† In selected cases in which there is non-invasive evidence of extensive cardiac ischemia, PCI might be considered.

AVR, aortic valve replacement; CABG, coronary artery bypass grafting; CAD, coronary artery disease; IC, intracoronary; LVEF, left ventricular ejection fraction; PCI, percutaneous coronary intervention.
Referral Pathway for Device Therapy in Patients with Heart Failure (HF)

Does the patient have an ischemic cause for heart failure?

YES

Has the patient been on optimal medical therapy for at least 3 months with resultant LVEF ≤ 35% by a reliable method?

NO

No referral at this time, continue to optimize therapy and review again at the next visit

YES

Has the patient been on optimal medical therapy for at least 3 months with resultant LVEF ≤ 35% by a reliable method?

NO

Does the patient have NYHA II–IV symptoms?

YES

Does the ECG show sinus rhythm QRS duration > 130 msec with LBBB morphology?

NO

Referral for consideration of ICD ONLY

YES

Referral for consideration of ICD and CRT

NO

Does the patient have NYHA II–IV symptoms?

YES

NO

ACE, angiotensin-converting enzyme inhibitor; AF, atrial fibrillation; ARB, angiotensin receptor blocker; bpm, beats per minute; CRT, cardiac resynchronization therapy; HF, heart failure; ICD, implantable cardioverter defibrillator; LVEF, left ventricular ejection fraction; MRA, mineralocorticoid receptor antagonist; NYHA, New York Heart Association; SR, sinus rhythm.
Clinical Trials that Might Influence Practice

Mineralocorticoid Receptor Antagonists in HFpEF

**Recommendation** - We suggest that in individuals with HFpEF, serum potassium < 5.0 mmol/L, and an estimated glomerular filtration rate (eGFR) > 30 mL/min, a MRA like spironolactone should be considered, with close surveillance of serum potassium and creatinine (Weak Recommendation, Moderate Quality Evidence).

**Values and Preferences** - This recommendation places a high value on the known etiologic factors for HFpEF and less on known outcome-modifying treatments which, unlike in HFrEF, are still limited. The MRA recommendation is based on the post-hoc geographic subgroup analyses of the TOPCAT trial conducted within North and South America mentioned above.

**Practical Tip** - After an MRA or ARB is initiated and with a change in dose, serum potassium and creatinine should be monitored in the first week, fourth week, and then fourth month, and whenever clinically indicated.

Combined Angiotensin/Nepriyisin Inhibition in HFrEF

**Recommendation** - We recommend that an ARNI be used in place of an ACEi or ARB, in patients with HFrEF, that remain symptomatic despite treatment with appropriate doses of GDMT in order to decrease cardiovascular death, HF hospitalizations, and symptoms (Strong Recommendation, High Quality Evidence).

**Values and Preferences** - This recommendation places high value on medications proven in large trials to reduce mortality, HF re-hospitalization, and symptoms. It also considers the health economic implications of new medications.
Get the All in One iCCS Guidelines App!

Our iCCS app contains the most up-to-date guideline information

Download the iCCS App today
For more information visit CCS.CA/apps