Congestive Heart Failure (CHF) Exacerbation

Acute worsening of heart failure symptoms due to impaired cardiac function, causing fluid overload and reduced perfusion.

Epidemiology

Affects ~6 million US adults; leading hospitalization cause in >65 age group.

Risk factors: Hypertension, CAD, diabetes, obesity, prior MI.

Triggers: Non-compliance (meds, diet), ischemia, arrhythmias, infection.

Pathophysiology

Systolic (HFrEF) or diastolic (HFpEF) dysfunction elevates filling pressures.

Fluid overload causes pulmonary/peripheral edema; low CO leads to fatigue, hypoperfusion.

RAAS and sympathetic activation worsen fluid retention and cardiac strain.

Causes and Triggers

HFrEF (EF <40%):

Ischemic: MI, chronic CAD.

Substance Use: Alcohol (chronic toxic cardiomyopathy), cocaine (direct myocardial damage, ischemia), methamphetamine (tachycardia, hypertension-induced cardiomyopathy).

Non-Ischemic: Dilated cardiomyopathy, myocarditis (viral, autoimmune), chronic tachycardia (e.g., AFib), HIV, thyroid disease (hyper/hypothyroidism).

Infiltrative: Amyloidosis (AL, ATTR), sarcoid.

Other: High-output HF (cirrhosis, anemia).

HFpEF (EF ≥50%):

Hypertension: Most common, causing LV hypertrophy.

Other: Diabetes, obesity, amyloidosis, sarcoid, aging, renal disease.

Valvular HF:

Aortic stenosis (AS), mitral/aortic regurgitation (MR/AR); papillary muscle rupture/ acute MR (post-MI) causes severe MR, pulmonary edema, shock.

Triggers:

High salt intake, missed diuretics, infection, anemia, ischemia, AFib, thyrotoxicosis, AV fistulas

Clinical Presentation and Exam Findings

Symptoms: Dyspnea (orthopnea, PND), fatigue, weight gain (>2 kg), edema.

Exam: Tachypnea, tachycardia, hypoxia, JVD, crackles, edema, hepatomegaly (right-sided), murmurs (AS: systolic, MR: holosystolic, acute MR: soft, shock).

Red Flags: SBP <90 mmHg, altered mental status, SpO2 <90%, cardiogenic shock.

Differential Diagnoses

Pneumonia: Fever, cough, CXR infiltrates.

COPD: Wheezing, no JVD/edema.

PE: Acute dyspnea, clear lungs.

ACS: Chest pain, ECG changes.

Tamponade: Beck's triad.

Key Tip: BNP, CXR, echo differentiate CHF.

Diagnostic Workup

Labs:

- **BNP/NT-proBNP:** >400 pg/mL supports CHF.
  - **Less Reliable:** Obesity (>500 pg/mL), ESRD (trend levels), HFpEF (lower), early edema.
- **Troponin:** Rule out MI; (can also be elevated in ESRD, CHF strain, cocaine/meth use).
- **CBC:** Anemia (IV iron for iron deficiency improves outcomes).
- **BMP:** AKI, hyponatremia;
  - Note, ACEi can cause Cr rise <30% is not AKI (hold if >50% or eGFR <20 mL/min).
- **LFTs:** Hepatic congestion (cirrhosis, alcohol).
- **Electrolytes:** Keep K+ >4 mEq/L, Mg2+ >2 mg/dL for arrhythmias.

Cause-Specific:

- **TSH:** Thyroid disease.
- **SPEP:** Amyloidosis.
- **HIV/Chagas Serology:** If risk factors.
- **Ferritin/TSAT:** Iron deficiency, hemochromatosis.
- **Alpha-Galactosidase A:** Fabry disease (if young, renal/cardiac issues).
- **Urine Drug Screen:** Cocaine, methamphetamine in suspected substance use.

Imaging:

- **CXR:** Pulmonary edema, cardiomegaly.
- **Echocardiogram:** EF, valves (AS, MR, AR), amyloid (speckled), substance-related dilated cardiomyopathy.
- **Cardiac MRI:** Myocarditis, amyloidosis, sarcoid, Fabry, substance-induced fibrosis.
- **CT Chest:** If PE/pneumonia suspected.

Heart Catheterization Indications:

RHC: Unclear volume status, refractory CHF. Data: RA (>6 mmHg), PCWP (>15 mmHg), CI (<2.2 L/min/m^2).

LHC: Ischemic trigger, valvular surgery. Data: Coronary stenosis (cocaine-related), valve function.

Other:

ECG (AFib, ischemia, tachycardia from meth/cocaine), ABG (hypoxemia).

Key Tip: BNP <100 pg/mL rules out CHF

Echocardiogram Findings

HFrEF: EF <40%, dilated LV, evaluate for WMA or valvular pathology

HFpEF: EF ≥50%, LV hypertrophy, diastolic dysfunction.

HFrecEF: previously reduced EF that has recovered

Right-Sided HF: RV dilation, tricuspid regurgitation.

Valvular: AS, MR (flail leaflet in acute), AR.

HOHF (high output heart failure): Seen in obesity, cirrhosis, longstanding anemia

Key Tip: Urgent echo for acute MR.

Treatment

General:

O2 for SpO2 >90%, BiPAP, telemetry, strict I/O, daily weights, low-sodium diet (<2 g/day), fluid restriction (1.5-2 L/day).

Acute Management:

- Diuresis:
  - **Loop Diuretics:** See table below.
  - **Dosing:** If no prior use: furosemide 20-40 mg IV; If on home diuretics: 1-2x PO dose IV; if not responding to diuretics: double q6-8h, or metolazone (2.5-5 mg PO).
  - **Urine Sodium:** 2h post-dose; Na >50-70 mmol/L = good; <50 mmol/L = escalate.
- **Electrolytes:** Keep K+ >4 mEq/L, Mg2+ >2 mg/dL.
- Vasodilators:
  - Hydralazine, Isordil, Nitroglycerin (10-20 mcg/min IV, SBP >100 mmHg). (used in ICU)
- Ventilation (if severe pulmonary edema)
  - BiPAP/CPAP.

- Evalutate Triggers:
  - **AFib:** Rate control (beta-blockers, digoxin).
  - **Ischemia:** Nitrates, PCI.
  - **Infection:** Antibiotics.
  - **Anemia:** IV iron for iron deficiency.
  - **Substance Use:** Cessation counseling, avoid beta-blockers in acute cocaine/meth intoxication.
  - **Valvular/Acute MR**: (papillary muscle rupture)
- **Chronic:** GDMT, valve repair (TAVR, MitraClip); acute MR: urgent surgery, IABP, nitroprusside.

Cardiogenic Shock:

Inotropes (dobutamine), Milrinone (good for PH as well), norepinephrine, IABP/ECMO.

GDMT:

- **New Patients:** Start GDMT when euvolemic, stable (SBP >90 mmHg).
  - HFrEF:
    - **Beta-blocker:** Metoprolol succinate, carvedilol, bisoprolol
    - ACEi/ARNI (lisinopril 2.5-5 mg), MRA (spironolactone 12.5 mg), SGLT2i (dapagliflozin 10 mg).
      - Titrate q1-2 weeks outpatient.
  - HFpEF:
    - SGLT2i, MRA, BP control.
      - Titrate q1-2 weeks outpatient.
- **Existing patients already on GDMT:**
  - **Continue:**
    - **Beta-blockers, SGLT2i, MRA if SBP >90 mmHg, HR >50.**
  - **Hold:**
    - **ACEi/ARB/ARNI (IF SBP <90 mmHg, AKI, K+ >5.5 mEq/L), MRA (K+ >5.5 mEq/L, Cr >2.5 mg/dL), beta-blockers (rarely, severe shock or acute cocaine/meth use).**
- Restart:
  - Resume ACEi/ARB/ARNI when stable; Cr rise <30% is acceptable after starting

Key Tip: Educate on diet, weights, substance cessation.

Complications

AKI, arrhythmias, cardiogenic shock, respiratory failure, electrolyte imbalances.

Prognosis

1-year mortality: ~20-30% (HFrEF), ~10-15% (HFpEF). Poor prognosis: EF <30%, acute MR, substance use.

Key Pearls

- BNP <100 pg/mL rules out CHF; adjust for obesity/ESRD.
- K+ >4 mEq/L, Mg2+ >2 mg/dL; telemetry, I/O, weights, low-sodium diet.
- IV iron for iron deficiency improves outcomes.
- Screen for EtOH, cocaine, meth in HFrEF; avoid beta-blockers in acute intoxication.
- Metoprolol succinate preferred for GDMT; urgent surgery for acute MR.

Miscellaneous: Rare Causes of CHF

Fabry Disease: Lysosomal storage disorder causing HFrEF/HFpEF; young patients with renal/cardiac issues.

Chagas Disease: Trypanosoma cruzi infection (Latin America) causing HFrEF.

Chemotherapy-Induced: Anthracyclines (e.g., doxorubicin) cause HFrEF.

Scleroderma: Myocardial fibrosis causing HFpEF.

Endomyocardial Fibrosis: Tropical restrictive cardiomyopathy causing HFpEF.

Key Tip: Use MRI, serology for rare causes in atypical cases.

Loop Diuretic Comparison Table

Diuretic	IV Dose (mg)	PO Dose (mg)	IV:PO Ratio	Equiv. to	Notes
Furosemide	20-200	20-400	1:2	40 mg IV	First-line; monitor K+, Mg2+.
Bumetanide	0.5-5	0.5-10	1:1	1 mg IV	Potent; faster onset.
Torsemide	10-100	10-200	1:1	20 mg IV	Longer half-life; better PO absorption.

Chronic Treatment Summary Table:

Type	EF	Causes	Key Exam	Echo	Treatment
HFrEF	<40%	MI, myocarditis, amyloid	JVD, rales, edema	Low EF, dilated LV	ACEi/ARNI), BB, MRA, SGLT2i
HFpEF	≥50%	HTN, amyloid, sarcoid	Edema, HTN	LV hypertrophy	SGLT2i, BP control
Right-Sided	Variable	PH, cirrhosis	JVD, hepatomegaly	RV dilation	Diuresis, PH therapy
Valvular	Variable	AS, MR, papillary rupture	Murmurs, shock	Valve dysfunction	Valve repair/surgery

CHF Acute Treatment in Decompensated State Notes

Type		Notes
HFrEF, EF <40%	-Diuresis: Loop diuretics (furosemide 20-40 mg IV, escalate if urine Na <50 mmol/L). -Afterload Reduction: Hydralazine (10-25 mg PO TID, titrate if SBP >100 mmHg) or isosorbide dinitrate (20-40 mg PO TID, SBP >100 mmHg). -O2/BiPAP: SpO2 >90%. -Inotropes: Dobutamine (5-20 mcg/kg/min) if cardiogenic shock (CI <2.2 L/min/m²). -Address Triggers: PCI for ischemia, cessation counseling for substance use (avoid beta-blockers in acute cocaine/meth intoxication). -IV Iron: For iron deficiency anemia.	Monitor K+ >4 mEq/L, Mg2+ >2 mg/dL; start GDMT when euvolemic
HFpEF, EF ≥50%	-Diuresis: Loop diuretics (furosemide 20-40 mg IV, cautious to avoid hypotension). SGLT2i (dapagliflozin) once stable. -BP Control: Hydralazine (10-25 mg PO TID, if HTN crisis, SBP >100 mmHg) or isosorbide dinitrate (20-40 mg PO TID, SBP >100 mmHg). -O2/BiPAP: SpO2 >90%. -Avoid Inotropes: Unless clear hypoperfusion. -Address Triggers: Rate control for AFib (digoxin, cautious beta-blockers).	Avoid over-diuresis (risk of AKI); Use hydralazine for HTN control.
Right-Sided HF	-Diuresis: Loop diuretics (furosemide 20-40 mg IV, monitor renal function). -O2: SpO2 >90%. -Optimize Preload: Avoid excessive diuresis; cautious fluids if hypovolemic. -PH Therapy: If pulmonary hypertension, consider vasodilators (e.g., sildenafil, per specialist). -Address Triggers: Treat underlying HFrEF, cirrhosis, or PE.	Monitor for hepatic congestion; telemetry for arrhythmias. Hydralazine/isosorbide dinitrate rarely used unless HFrEF overlap.

Type		Notes
Valvular HF	-Chronic Valvular: Diuresis (furosemide 20-40 mg IV), hydralazine (10-25 mg PO TID, SBP >100 mmHg) or isosorbide dinitrate (20-40 mg PO TID, SBP >100 mmHg), refer for valve repair (TAVR for AS, MitraClip for MR). -Acute MR (Papillary Rupture): Urgent surgery (mitral valve repair/replacement), IABP, nitroprusside (0.3-10 mcg/kg/min IV)for afterload reduction, inotropes (dobutamine) for shock. -O2/BiPAP: SpO2 >90%.	Urgent echo for acute MR; high mortality without surgery. Nitroprusside in acute MR shock.

References

AHA/ACC HF Guidelines (2022).

ESC HF Guidelines (2021).

UpToDate: “Heart Failure Etiology.”