Advanced HF Therapies:
When to Refer Patients

Dr. Stephanie Poon
Disclosures

Consulting/Advisory Board:
Novartis
Servier
Objectives

1. Recognize the signs and symptoms of early-onset cardiogenic shock
2. Learn how to manage patients awaiting a transfer for advanced HF treatment
3. Identify the indications and potential contraindications for advanced therapies
PART I:
WHAT IS CARDIOGENIC SHOCK?
Case 1

- **30M**
- **PMHx:**
  - Congenital abnormality renal vessels:
    - Left lower pole heminephrectomy (1993)
  - CVA secondary to embolic phenomenon at 7 y/o
  - Polycythemia rubra vera: newly diagnosed, non-compliant with treatment
Case 1

- May 2016: Patient in custody at police station, came home angry and smoked marijuana
- Lost consciousness ~1:38 a.m.
- Family called 911 and initiated CPR
- VSA on arrival of EMS -> VF, shocked and intubated in field
ECG 3 months ago...
ECG 2:30 a.m. peripheral hospital
First ECG in our ER
Case 1: Cath Lab

- 100% LAD, 100% LCx
- Difficulty recanalizing due to recurrent thrombosis
  - Heme consulted: phlebotomy 550 cc, integrilllin, 21,000 UFH, hydroxyurea
- PCI to LAD and LCx with 2 drug-eluting stents
- Vitals: systolic blood pressure 70-80 mmHg, 118 beats/min
Is the patient in cardiogenic shock?

- A. Yes
- B. No
- C. Need more information
Risk Stratification by Clinical Assessment

DRY + WARM
Normal PCWP, Normal CI

DRY + COLD
Normal PCWP, Low CI

WET + WARM
High PCWP, Normal CI

WET + COLD
High PCWP, Low CI

Nohria A et al. JACC 2003;41: 1797-804
What is cardiogenic shock?

- Inadequate tissue (end-organ) perfusion due to cardiac dysfunction
- Hemodynamic parameters (Reynolds HR Circulation 2008;117:686):
  - Persistent hypotension (sBP < 80-90 mmHg or MAP 30 mmHg lower than baseline) WITH
  - Severe reduction in cardiac index (< 1.8 L/min/m² without support or < 2-2.2 L/min/m² with support) AND
  - Adequate or elevated filling pressures (LVEDP > 18 mmHg or RVEDP > 10-15 mmHg)
<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
<th>Hemodynamic Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Critical cardiogenic shock, “crash and burn”</td>
<td>Persistent hypotension despite rapidly escalating inotropic support and eventually IABP, and critical organ hypoperfusion</td>
</tr>
<tr>
<td>2</td>
<td>Progressive decline on inotropic support, “sliding on inotropes”</td>
<td>Intravenous inotropic support with acceptable values of blood pressure and continuing deterioration in nutrition, renal function, or fluid retention</td>
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<td>3</td>
<td>Stable but inotrope dependent, “dependent stability”</td>
<td>Stability reached with mild-moderate doses of inotropes but demonstrating failure to wean from them because of hypotension, worsening symps or progressive renal dysfunction</td>
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<tr>
<td>4</td>
<td>Resting symptoms, “frequent flyer”</td>
<td>Possible weaning of inotropes but experiencing recurrent relapses, usually fluid retention</td>
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<td>5</td>
<td>Exertion intolerant, housebound</td>
<td>Severe limited tolerance for activity, comfortable at rest with some volume overload and often with some renal dysfunction</td>
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<tr>
<td>6</td>
<td>Exertion limited, “walking wounded”</td>
<td>Less severe limited tolerance for activity and lack of volume overload, fatigue easily</td>
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<tr>
<td>7</td>
<td>Advanced NYHA III</td>
<td>Patient without current or recent unstable fluid balance, NYHA class II or III</td>
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What is the 30 day mortality rate for cardiogenic shock?

- A. 40%
- B. 25%
- C. 20%
- D. 10%
Case 1: Cardiogenic shock or not?

- Systolic blood pressure ~70 mmHg even after patient was revascularized
- Lactate 4.6, creatinine went up from 92 to 217
- Hemoglobin (despite phlebotomy in cath lab) was 160
- CVP 15 mmHg
PART II: MANAGEMENT OF CARDIOGENIC SHOCK
What options do we have to treat patients in cardiogenic shock?

- Medical therapy: still first line
  - Inotropes
  - Vasopressors
Inotropes

- Which inotrope do you prefer using in cardiogenic shock?
  - A. Dobutamine
  - B. Milrinone
Dobutamine

- Beta-receptor agonist
- Inotropic response may be reduced in patients treated with a beta-blocker
- Most patients will experience an increase in heart rate and blood pressure with use of dobutamine
Dobutamine

- Can start at 2 mcg/kg/min, titrating by 1-2 mcg/kg/min every 2 hours until optimal hemodynamic response or max dose of 20 mcg/kg/min is achieved.
- Usual maintenance dose: 2-7.5 mcg/kg/min.
- Half-life: 2 minutes, can be uptitrated quickly.
Milrinone

- Phosphodiesterase inhibitor
- Does NOT require use of beta receptor to exert its effect
- In addition to inotropic properties, also a vasodilator for both systemic and pulmonary circulation
- Limiting factor: hypotension
Milrinone

- Start at 0.125 mcg/kg/min, titrating by 0.125 mcg/kg/min every 6 hours until optimal hemodynamic response or max dose 0.75 mcg/kg/min achieved
- Usual maintenance dose: 0.125-0.5 mcg/kg/min
- Doses > 0.25 mcg/kg/min are not recommended in patients with significant renal impairment
Comparison of dobutamine versus milrinone therapy in hospitalized patients awaiting cardiac transplantation: A prospective, randomized trial

Juan M. Aranda, Jr, MD, Richard S. Schofield, MD, Daniel F. Pauly, MD, PhD, Timothy S. Cleston, ARNP, Tracy C. Walker, ARNP, V. Steven Monroe, Jr, MD, Dana Leach, RN, Larry M. Lopez, Pharm D, and James A. Hill, MD, MS Gainesville, Fla

- Dobutamine (n=17) vs milrinone (n=19)
- No differences between the 2 groups:
  - Right heart hemodynamics
  - Death
  - Need for additional vasodilator/inotropic therapy or mechanical cardiac support before transplantation
- Ventricular arrhythmias occurred frequently in both groups
- Total cost of milrinone was significantly higher than that of dobutamine ($16,270 ± 1334 vs $380 ± 533 P <.00001)
Clinical Pearls

- Prefer use of dobutamine in patients with baseline hypotension or chronic renal insufficiency
- Prefer use of milrinone in patients with elevated pulmonary vascular resistance and/or RV failure
Which Vasopressor?

Comparison of Dopamine and Norepinephrine in the Treatment of Shock

- No significant difference in the rate of death between patients with shock who were treated with dopamine and those who were treated with norepinephrine.
- A subgroup analysis showed that dopamine was associated with an increased rate of death at 28 days among patients with cardiogenic shock.
- The use of dopamine was associated with a greater number of adverse events.

Vasopressors for Hypotensive Shock

Systematic Review Snapshot

**TAKE-HOME MESSAGE**

There is no significant difference in mortality between norepinephrine and dopamine when investigated in heterogeneous populations of hypotensive shock. Current research suggests that norepinephrine confers mortality benefit in subgroup populations of cardiogenic and septic shock.

Target $O_2$ Sats $\geq 92\%$

Volume Overload

Consider $sBP/\text{MAP}$

$sBP < 90 \text{ mmHg}/\text{MAP} < 60 \text{ mmHg}$
- Consider: 
  - Levophed
  - Dopamine
  - Dobutamine

$sBP = 90-100 \text{ mmHg}/\text{MAP} = 60-65 \text{ mmHg}$
- Consider: 
  - If low CO suspected by clinical exam and confirmed with PA catheter, add dobut or milrinone

$sBP > 100 \text{ mmHg}/\text{MAP} > 65 \text{ mmHg}$
- Consider: 
  - If not adequately responsive to iv diuretics, consider adding nitro iv/sl or nipride

Consider: 
- $\text{Oxygen} \uparrow \text{FiO}_2$
- CPAP/BiPAP
- Mechanical intubation

Consider: 
- iv furosemide 20-80 mg bolus OR
- iv furosemide infusion 5-20 mg/hr
Case 1

- Patient was started on levophed 20, epinephrine 20, vasopressin 4, milrinone, and nitric oxide
- Systolic blood pressure still between 70-80 mmHg
- ....now what?
What is mechanical circulatory support (MCS)?

- Group of technologies that increase forward output in patients
- Consist of ventricular assist devices (VADs) that augment or replace the ventricle
- Can assist LV (LVAD), RV (RVAD), or both ventricles (BiVAD)
- 2 categories: temporary or long term
What are the different types of temporary MCS?

- Intraaortic balloon pump (IABP)
- Percutaneous non-IABP mechanical circulatory assist devices (ex. Impella, TandemHeart)
- Extracorporeal membrane oxygenator pumps (ECMO)
- Non-percutaneous centrifugal pumps (ex. Centrimag)
Which device should you use?

- Based on many factors:
  - Patient characteristics
  - Desired hemodynamic support
  - Operator abilities
  - Institutional resources
Case 1

- IABP inserted
- Brought to OR for Centrimag insertion
Intraaortic balloon pump (IABP)

- Improves coronary and peripheral perfusion via diastolic balloon inflation
- Augments LV performance via systolic balloon deflation with an acute decrease in afterload
- Widely used due to ease of insertion in emergencies
Does the IABP improve survival in infarct-related cardiogenic shock?

- A. Yes
- B. No
- C. Not sure
IABP-SHOCK II Trial

- IABP Class I indication for cardiogenic shock
- All 600 patients expected to undergo early revascularization (PCI or CABG)
- Primary endpoint: 30 day all cause mortality

IABP-SHOCK II Trial

**Figure 1. Time-to-Event Curves for the Primary End Point.**
Time-to-event curves are shown through 30 days after randomization for the primary end point of all-cause mortality. Event rates represent Kaplan-Meier estimates.

The use of IABP did not significantly reduce 30-day mortality in patients with cardiogenic shock complicating acute myocardial infarction for whom an early revascularization strategy was planned.

What is the CentriMag?

- Single-use extracorporeal centrifugal blood pump based on bearingless motor technology.
- Motor generates magnetic force that levitates the rotor in the pump housing and creates torque to produce unidirectional flow.
How do you implant it?

- **LVAD:**
  - Inflow: LV apex/LA
  - Outflow: ascending aorta or arch

- **RVAD:**
  - Inflow: RA
  - Outflow: proximal main PA

- **BiVAD:**
  - Both circuits
CentriMag System

Figure 2. The core components of the CentriMag VAS includes a centrifugal blood pump, a motor, primary console, flow probe, a backup console, backup motor, cannulae, and tubing.
Retrospective study of all patients who underwent CentriMag placement at Columbia from Jan 2007-Aug 2009 (n=63)

43% placed due to failure of medical management (n=27)
Survival by Indication

1 yr survival = 68%

Worku B et al. *J Heart Lung Transplant* 2012;31:611-7
Complications

- Thromboembolic
- Device-related bleeding
- Sternal wound infection

- 10 strokes
- 2
- 1
Conclusions

- Use of CentriMag appears to be a safe and effective method of ventricular support in the setting of acute cardiac decompensation
- Most versatile: can be used as LVAD, RVAD, BiVAD
- FDA approved up to 4 weeks of use
- Con: requires sternotomy
When would you think of using a CentriMag?

- Acute RV failure
- Bridge to decision
  - Unclear if heart will recover or whether the patient will need alternative, longer-term therapy
  - Uncertain neuro status
  - Hemodynamically unstable, failure to wean from cardiopulmonary bypass
Algorithm for Bridge to Decision and Recovery

Acute Refractory Cardiogenic Shock
(Multiple Inotropes & Pressors, IABP)
with
Multisystem Organ Failure +/- Prior Cardiac Arrest
Uncertain Neurologic Status

CentriMag Biventricular Support
(Monitor End-organ Function, Nutritional Support, Wean Sedation, Echocardiography)
MCS Pathways

Bridge To Transplant (BTT)
- Approved and listed for transplant
- Unable to survive until transplant without VAD
- Mostly INTERMACS 1, 2, 3
- Patients who might profit from VAD therapy
  - End organ function
  - Rehabilitation

Bridge to Candidacy (BTC)
- Patients who have modifiable contraindications for Tx
  - Pulmonary hypertension
  - Obesity
  - Cancer within 5 years
- Patients who might become candidates for Tx
- Time for decision can be months to years

Destination Therapy (DT)
- Refractory NYHA Class IV HF
- Poor EF
- VO$_2$ < 12 ml/kg/min
- Not transplant eligible
- Failing optimal medical therapy (for 60 of last 90 days)
- Poor life expectancy
- Absence of co-morbidities limiting survival
Case 1: Bridge to Recovery

- Patient stabilized and recovered LVEF to 37%
- Centrimag explanted May 20, 2016
- VVI ICD implanted July 18, 2016 for transient episodes of complete heart block and LV dysfunction
- Last clinic January 8, 2018: can now walk 3 km continuously without getting short of breath
PART III:

INDICATIONS AND CONTRAINDICATIONS FOR ADVANCED THERAPIES
Case 2: Background

- 63M when I first met him September 2016
- PMHx: non-ischemic cardiomyopathy with severe LV dysfunction, diagnosed in 2010 (normal cath)
  - VVI ICD implanted for secondary prevention
  - Recurrent VT: multiple admissions since July 2010 for recurrent shocks and VT storm
    - Unsuccessful attempt at epicardial and endocardial VT ablation December 21, 2010
Case 2: Background

- Recurrent HF hospitalizations:
  - Cardiogenic shock November 28-Dec 8, 2015
  - January 2-6, 2016 after sustaining ICD shocks followed by syncope and frank pulmonary edema
  - February 10-17, 2016 due to dietary and medication non-compliance, required milrinone
- Chronic renal insufficiency: baseline Cr ~160
- Hyperthyroidism – thought to be amiodarone-induced, treated with methimazole and prednisone
Case 2: Clinic Visit

- September 20, 2017: patient is now 64 years old, weight stable at 155-156 lbs on lasix sliding scale
- Energy levels “very good all the time. I don’t feel anything is wrong with my heart”
- Had presented to ER on August 23 for left-sided periumbilical abdominal pain, without nausea or vomiting
- Was planning on seeing a “bush doctor” for his GI symptoms
- Vitals: 92/47 mmHg, 47 beats/min, lungs clear, JVP at jaw, no peripheral edema
Case 2: Hospitalization

- September 27, 2017: was working at hair salon when he suddenly developed abdominal pain and started coughing, became very short of breath and agitated
- Flash pulmonary edema in ER -> BiPAP -> intubated
- Vitals: 79/64 mmHg, 81 beats/min on levophed, epinephrine, vasopressin, and milrinone 0.375
- Had to be shocked once externally for slow VT (105 beats/min)
- Lactate up to 8, creatinine 438, patient anuric despite being given lasix 160 mg iv, pH 7.0, ALT 844, total bilirubin 30
Case 2: What would you do next?

- A. Consider putting patient on ECMO
- B. Initiate dialysis (CRRT/SLED)
- C. Discontinue epinephrine, since BP not that far from his usual baseline
- D. Call transplant centre for possible transfer and consideration of advanced therapies
# Checklist Assessment for MCS

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<th>Assessment Items</th>
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| Cardiac Assessment     | • Full assessment of ventricular, valvular function, and hemodynamics with view to potential reversibility of condition  
                          • RV function? (BiV support is higher risk)  
                          • Rapidity of cardiac decompensation (rapid deterioration mitigates toward temporary support) |
| Surgical history       | • Previous sternotomy  
                          • Is this early postpericardiectomy? (higher risk)  
                          • Does the patient have a prosthetic valve? (will need replacement at time of VAD insertion)  
                          • Vascular access, device, and patient technical considerations  
                          • Ability to withstand major surgical procedure |

2017 CCS HF Guidelines
## Checklist Assessment for MCS

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| Other medical issues         | • Active infection, coagulopathy, liver dysfunction, renal function, cognitive/neurological status  
                                • Are other conditions that limit operational or long-term survival present?                                                                 |
| Cardiac transplantation eligibility | • Is there time to consider eligibility for transplant  
                                • If not, temporary MCS consideration suggested                                                                                                                                 |
| Advanced care planning       | • Patient preferences for care  
                                • Has the patient outlined goals of care?                                                                                                                                 |
| Psychosocial considerations  | • Can the patient maintain self-care at home?  
                                • Are sufficient home/family supports available, and are they engaged in pre-op planning and decision making? |
Case 2: Cardiogenic Shock

- Contacted our transplant centre regarding possibility of initiating ECMO
  - Advanced age of patient (> 60 years old) has been associated with 100% mortality in their ECMO case series -> not a viable option, especially given the fact that patient was anuric and liver enzymes elevated
  - Would possibly have been candidate for Impella, but this is not available at our site
Case 2: Medical Management

- Patient too unstable for transfer
- Initiated CRRT
- Continued on pressors, milrinone, and iv amiodarone
- Next day: maintaining MAP > 65 mmHg, pH 7.5, lactate down to 3.5, urine output 200-300 cc/hr
- Started weaning off epinephrine
Case 2: Road to Recovery?

- Able to wean off all remaining pressors and milrinone over next few days
- Creatinine returned to baseline ~160-170 and liver enzymes normalized by October 3
- Patient extubated successfully and switched to po amiodarone
Case 2: Repeat Deterioration

- Within hours, patient went back into VT and flash pulmonary edema with ICD shocks.
- Intubated again, back on milrinone and pressors, but no need for dialysis this time.
- Improved the next day and able to extubate.
- Stabilized again.
- TTE October 13: LV severely dilated (LVd 9.4, LVs 8.6), LVEF 11%, RV function mildly reduced, mild-moderate MR, RVSP 23 mmHg.
Case 2: Here We Go Again...

- Not candidate for sacubitril/valsartan (systolic BP ~90 mmHg) and ivabradine (resting HR 50 bpm)
- About to be discharged when went back into VT at 130 bpm for 1-2 hours on October 22
- Restarted on iv amiodarone and BiPAP
- Maintained systolic blood pressure ~90-100 mmHg
- Labs: hemoglobin 123, wbc 23.8, platelets 369, sodium 137, potassium 4.8, creatinine 286, lactate 6.6
- Transferred to TGH October 22 for consideration of advanced therapies
Is this patient a candidate for advanced therapies?

- A. Yes, LVAD as destination therapy
- B. Yes, LVAD as bridge to transplant
- C. Yes, LVAD as bridge to candidacy
- D. Yes, heart transplant
- E. No
- F. More information needed
2017 CCS HF Guidelines: Indications for Durable Mechanical Support

- Patients who continue to exhibit progressive/persistent NYHA III or IV HF symptoms on optimal medical therapy (OMT) and accompanied by more than one of the following:
  - Inability to perform activities of daily living
  - Six-minute walk distance < 300 m
  - LVEF < 25% and VO$_2$ max < 14 mL/kg/min (or < 50% predicted)
  - Cardiac cachexia
  - Recurrent HF hospitalizations (≥ 2 in 12 months) not due to a clearly reversible cause
  - Progressive end organ dysfunction due to reduced perfusion
2017 CCS HF Guidelines: Indications for Durable Mechanical Support

- Diuretic refractoriness associated with worsening renal function
- Need to progressively reduce or eliminate evidence-based HF therapies such as ACEis, MRAs, or β-blockers, because of circulatory-renal limitations such as renal insufficiency or symptomatic hypotension.
- Requirement for inotropic support for symptomatic relief or to maintain end organ function
- Increased 1-year mortality (eg, > 20%-25%) predicted by HF risk scores (ex. Seattle Heart Failure Model, Heart Failure Survival Score)
- Persistent hyponatremia (serum sodium < 134 mEq/L).
- Worsening RHF and secondary pulmonary HTN
Absolute Contraindications to Durable Mechanical Support

- Irreversible hepatic disease
- Irreversible renal disease
- Irreversible neurological disease
- Medical non-adherence
- Severe psychosocial limitations

Cook JL et al, *Circulation. 2017;135*
Relative Contraindications to Durable Mechanical Support

- Age over 80 for destination therapy
- Obesity or malnutrition
- MSK disease that impairs rehabilitation
- Active systemic infection or prolonged intubation
- Untreated malignancy
- Severe PVD
- Active substance abuse
- Impaired cognitive function
- Unmanaged psychiatric disorder
- Lack of social support

Cook JL et al, *Circulation*. 2017;135
RV Failure in Patients with LVADs

  - 484 patients enrolled in HMII LVAD bridge to transplantation (BTT) clinical trial were examined for the occurrence of RV failure
  - RV failure defined as requiring RVAD, ≥ 14 d of inotropic support after implantation, and/or inotropic support starting >14 d after implantation
Survival in HMII recipients stratified by RVF

**FIGURE 1.** Kaplan–Meier survival for patients with and without early RVF receiving the HeartMate II LVAD, which includes the need for RVADs or extended inotropic support for more than 14 days.

Kormos RL et al. JTCVS 2010;139:1316-24
Indications for Transplantation

- Cardiogenic shock requiring either iv inotropic support or MCS to maintain adequate organ perfusion
- Persistent NYHA IV symptoms refractory to optimal medical therapy and surgery
  - $\text{VO}_2 \text{ max} \leq 12 \text{ mL/kg/min (on beta-blocker)}$
  - $\text{VO}_2 \text{ max} \leq 14 \text{ mL/kg/min (intolerant of beta-blockers)}$
  - If submaximal CPET (RER < 1.05), $V_E/V_{CO2}$ slope $> 35$ may be used
Indications for Transplantation

- Intractable or severe anginal symptoms with coronary artery disease not amenable to PCI or surgical revascularization
- Intractable life-threatening arrhythmias unresponsive to medical therapy, catheter ablation, surgery, and/or ICD
Absolute Contraindications to Cardiac Transplantation

- Systemic illness with a life expectancy < 2 years despite heart transplantation
- Irreversible pulmonary hypertension
- Clinically severe symptomatic cerebrovascular disease
- Active substance (drug or alcohol) abuse
- Multiple demonstrations of inability to comply with drug therapy
- Multisystem disease with severe extracardiac organ dysfunction

Mancini D et al. *Circulation* 2010; 122:174
Mehra MR et al. *JHLT* 2016; 35:1
Influence of Preoperative Pulmonary Artery Pressure on Mortality After Heart Transplantation: Testing of Potential Reversibility of Pulmonary Hypertension With Nitroprusside Is Useful in Defining a High Risk Group

Figure 1. Cause of death in the 1st 3 months after heart transplantation in 301 consecutive patients. CVA = cerebrovascular accident; PE = pulmonary embolism; PHT = pulmonary hypertension; RHF = right heart failure.
Pulmonary Hypertension

- Patients with pulmonary hypertension are at risk of developing fatal right heart failure after transplantation\(^1\)

- Right heart catheterization
  - PA systolic pressure > 50 mmHg
  - Transpulmonary gradient > 15 mmHg
  - Pulmonary vascular resistance > 3 Wood units

\(^1\)Costard-Jackle A et al. JACC 1992;19:48
Vasodilator Challenge

- Patients with pulmonary HTN should be tested with an acute vasodilator challenge:
  - Nitroprusside 0.5-1.5 mcg/kg/min iv
  - Milrinone 50 mcg/kg over 1 min
- If PVR is reduced to \( \leq 3 \) Wood units (320 dynes-sec/cm\(^5\)) while maintaining a systolic blood pressure \( \geq 85 \) mmHg, usually considered acceptable candidates for heart transplant
“Failed” Vasodilator Challenge

- 2-8 week trial of optimized medical therapy including milrinone +/- PDE 5 inhibitor (sildenafil)
- Trial of mechanical circulatory support as bridge to candidacy
- Repeat RHC after 3-6 months
Relative Contraindications to Cardiac Transplantation

- Age > 70 years
- Obesity (ie BMI > 35 kg/m2)
- DM with poor glycemic control (HbA1c > 7.5%) despite optimal effort or end-organ damage other than retinopathy
- Irreversible renal dysfunction (eGFR <30 mL/min/1.73m2)
- Neoplasm and infection (requires individualized assessment of severity, treatment options, and prognosis)
- Acute PE (within 6-8 weeks)
- Tobacco use and recent past substance abuse (within 6 months)
- Inadequate social support or cognitive-behavioural disability that would prevent compliant care

Mehra MR et al. JHLT 2016; 35:1
Case 2: More Information

- Patient was dobutamine-dependent
- Creatinine still in 200’s
- Left and RHC October 24: no CAD
  - PA systolic 44 mmHg, TPG 16 mmHg
Is this patient a candidate for advanced therapies?

- A. Yes, LVAD as destination therapy
- B. Yes, LVAD as bridge to transplant
- C. Yes, LVAD as bridge to candidacy
- D. Yes, heart transplant
- E. No
- F. More information needed
Case 2: Epilogue

- HeartWare LVAD implanted November 14, 2017 as bridge to candidacy (pulmonary HTN)
- Nephrology consult: fluctuations in creatinine thought to be related to cardiorenal syndrome
- Repeat RHC March 8, 2018: PA 34/12/21, TPG 6 mmHg, PVR 1.4 Woods
- Listed for heart transplant April 5, 2018
- Called in as back-up for transplant May 1, 2018, but sent home as other candidate was suitable
SUMMARY:
TAKE HOME MESSAGES
Part I: Definition of Cardiogenic Shock

- Cardiogenic shock occurs when there is inadequate tissue (end-organ) perfusion due to cardiac dysfunction:
  - sBP < 80-90 mmHg or MAP 30 mmHg lower than baseline) WITH
  - cardiac index < 1.8 L/min/m2 without support or < 2-2.2 L/min/m2 with support AND
  - LVEDP > 18 mmHg or RVEDP > 10-15 mmHg
Part II: Management of Cardiogenic Shock

- Medical therapy still first line: vasopressors, inotropes
- 2017 CCS HF Guidelines Recommendation 67: “Patients in cardiogenic shock be considered for temporary MCS to afford an opportunity for evaluation for long-term options (Strong Recommendation, Moderate-Quality Evidence)”
- “Practical tip: ECMO or other mechanical circulatory temporary devices should be preferred over IABP except if the patient is suffering an acute ischemic event, as the increase in cardiac output offered by IABP is usually minimal”
Part III: Advanced Therapies

- Process of evaluating candidates for advanced therapies includes: 1) determining if there is an indication, 2) identifying and assessing contraindications, as well as 3) weighing potential risks and benefits of therapeutic options.

- LVADs can be implanted as a bridge to decision (short-term), candidacy, transplant, recovery OR as DT.