Acute Circulatory Support
Should We or Shouldn’t We?

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Monday Night – My House: On-Call – 3 AM

78 year old man with chronic ischemic HFrEF and COPD (FEV1: <50% predicted) and CKD Stage III with 3 weeks of dyspnea on exertion, orthopnea, and paroxysmal nocturnal dyspnea. Patient now presents with dyspnea at rest without chest pain.

Non-revascularizable coronary anatomy known.

HR: 100    BP: 70/50    RR: 28    O₂ Sat: 92% FM
JVP: 20cm at 45° angle.
+ S1/S2, S3 and S4.
3/6 holosystolic apical murmur.
Cool lower extremities. 2+ pitting edema.

Echocardiogram:
LVEF 10%
LVIDD 6.7cm
Moderate MR
Moderate TR
Moderate RV systolic dysfunction

<table>
<thead>
<tr>
<th>Admission</th>
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</thead>
<tbody>
<tr>
<td>RA</td>
<td>18</td>
</tr>
<tr>
<td>PA</td>
<td>60/25</td>
</tr>
<tr>
<td>PCWP</td>
<td>20</td>
</tr>
<tr>
<td>Fick CI</td>
<td>1.5</td>
</tr>
<tr>
<td>PA Sat</td>
<td>38%</td>
</tr>
<tr>
<td>FA Sat</td>
<td>94%</td>
</tr>
<tr>
<td>MAP</td>
<td>65</td>
</tr>
<tr>
<td>SVR</td>
<td>2100</td>
</tr>
<tr>
<td>Na⁺ (mEq/L)</td>
<td>123</td>
</tr>
<tr>
<td>Creatinine</td>
<td>2.8</td>
</tr>
</tbody>
</table>
This is what I am envisioning at 3 AM...

You are asked to provide circulatory support. What is the first question you should ask?

“What is the exit strategy?”
Goals of Acute Circulatory Support in Shock


2. Reduce myocardial oxygen demand by limiting LV wall stress.

3. Augment coronary perfusion.

4. Create a ‘window in time’ for:
   - Complete revascularization
   - Comprehensive evaluation (Neuro, Surgical, or Adv HF)
## Defining ‘Exit Strategy’

### Durable Mechanical Circulatory Support

<table>
<thead>
<tr>
<th>Bridge to Recovery/Explantation</th>
<th>Device intended for short term support for a condition that is anticipated to reversible</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bridge to Bridge</td>
<td>Device intended for short term support (typically inserted in an emergent situation) until a more permanent device can be implanted</td>
</tr>
<tr>
<td>Bridge to Transplant</td>
<td>Device typically intended for short- to intermediate-term support in patients actively listed for transplantation</td>
</tr>
<tr>
<td>Bridge to Decision</td>
<td>Device inserted to support a patient in whom the ultimate therapy is not able to be determined at the time of implantation. Device may be used for short or long-term support.</td>
</tr>
<tr>
<td>Destination Therapy</td>
<td>Device inserted with the intention of long-term support in patients who are not candidates for transplantation</td>
</tr>
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</table>
Defining ‘Exit Strategy’
Durable Mechanical Circulatory Support

Bridge to Transplant (BTT) Strategy

• Listed for cardiac transplantation
• Qualifies as a Status 1A or 1B Listing
• NYHA Class IV (refractory heart failure)
Defining ‘Exit Strategy’
Durable Mechanical Circulatory Support

Destination Therapy (Regulatory Definition)

- Not a transplant candidate
- LVEF < 25%
- Peak VO2 < 14 ml/kg/min
  (or <50% of age/sex predicted)
- Plus any of the following:
  - NYHA Class IIIb-IV despite OMT for >45/60 days
  - IV Inotrope dependent for > 14 days
  - IABP dependent for > 7 days
Contraindications to Durable MCS

* Age is not a contraindication to VAD Therapy
  - Mechanical aortic valve without plan to replace or close
  - Thrombocytopenia, coagulopathy
  - Uncontrolled, systemic infection
  - Recent stroke or cerebrovascular disease that increases risk for intra-operative CVA
  - Contraindication to systemic anticoagulation or antiplatelet therapy
  - Significant right heart failure
  - Psychosocial instability (ongoing substance abuse, lack of care giving plan, non-compliance)
  - Other condition that limits survival to < 24 months
The Go/No-Go Decision for Device Therapy in Advanced HF & Cardiogenic Shock

Adapted from Miller LW Circ 2011
Defining ‘Futility’

Definition 1:
An action, intervention, or procedure that may be physiologically effective in a given case, but cannot benefit the patient, no matter how often it is repeated.

Definition 2:
A futile treatment is not necessarily ineffective, but it is worthless, either because the medical action itself is futile (no matter what the patient's condition) or the condition of the patient makes it futile.

Surgical Strategies: Durable MCS

Adapted from Miller LW Circ 2011
This is what your VAD surgeon is thinking.
<table>
<thead>
<tr>
<th>ADULT PROFILES</th>
<th>Current CMS - DT Functional Indication</th>
<th>IV INO*</th>
<th>Official Shorthand</th>
<th>NYHA CLASS Assumed</th>
<th>Modifier option</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTERMACS LEVEL 1</td>
<td>Met</td>
<td>X</td>
<td>“Crash and burn”</td>
<td>IV</td>
<td>TCS A</td>
</tr>
<tr>
<td>INTERMACS LEVEL 2</td>
<td>Met</td>
<td>X</td>
<td>“Sliding fast” on inotropes</td>
<td>IV</td>
<td>TCS A</td>
</tr>
<tr>
<td>INTERMACS LEVEL 3</td>
<td>Met</td>
<td>X</td>
<td>“Stable” continuous inotrope dependent *&lt;br&gt;Can be in hospital or at home</td>
<td>IV</td>
<td>TCA if hosp FF if home A</td>
</tr>
<tr>
<td>INTERMACS LEVEL 4</td>
<td>+ Peak VO$_2$ ≤ 12</td>
<td></td>
<td>Resting symptoms on oral therapy at home</td>
<td>AMB IV</td>
<td>FF A</td>
</tr>
<tr>
<td>INTERMACS LEVEL 5</td>
<td>+ Peak VO$_2$ ≤ 12</td>
<td></td>
<td>“Housebound”,&lt;br&gt;Comfortable at rest, symptoms with minimum activity ADL</td>
<td>AMB IV</td>
<td>FF A</td>
</tr>
<tr>
<td>INTERMACS LEVEL 6</td>
<td></td>
<td></td>
<td>“Walking wounded”-ADL possible but meaningful activity limited</td>
<td>IIIB</td>
<td>FF A</td>
</tr>
<tr>
<td>INTERMACS LEVEL 7</td>
<td></td>
<td>Advanced Class III</td>
<td>III</td>
<td>A only</td>
<td></td>
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*Intravenous inotropic therapy only approved for refractory Class IV symptoms*
This is what your VAD surgeon is thinking:
INTERMACS Profiles and Mortality

Adult primary continuous flow LVADs & BIVADS, DT and BTT, n=5436
Implants: June 2006 – June 2012

Predicted 1-year mortality according to patient age. The 3 lines illustrate the effect of INTERMACS level and the prevalence of risk factors in the specified level.

Call the Cath Lab!

Kirklin et al. JHLT 2013
Surgical Strategies: Durable MCS

‘NO’ for Durable MCS, *may be* a ‘GO’ for Acute MCS

1. Irreversible end-organ damage
2. Neurologic status unknown
3. Severe hemodynamic instability
4. Major coagulopathy
5. Prolonged mechanical ventilation
6. Sepsis or active infection
7. **RV failure**
8. Noncompliant
MCS: Go vs No-Go Decision Making

Percent of Durable MCS Device Implants

- BTR
- Rescue Therapy

2006-2007
2008-2010
2011-2013

Adapted from Kirklin et al JHLT 2014
‘Short Term (Acute/Percutaneous/Non-Durable) MCS’ Use is Growing: Now Let’s get Smart..

Stretch and Bonde JACC 2014
Mechanical Circulatory Support
Patient Selection and Outcomes
Heart Failure Society of America
Board Review Course
September 26-28, 2014
Dallas, TX

Percutaneous MCS Devices

- Acute cardiogenic shock
- Chronic decompensated heart failure
- Post-cardiotomy
- Hemodynamically assisted high risk PCI
- Supported percutaneous valves
- Supported VT ablation

TandemHeart

Impella
Indications for Acute Circulatory Support in HF

ISHLT Mechanical Circulatory Support Guidelines 2012
Class 1: Non-durable MCS indicated for acute decompensated heart failure failing maximal medical therapy, multi-organ failure, sepsis, or ventilator-dependent patients to optimize hemodynamics and evaluate neurologic status.

Class 1: RVAD indicated for post-operative RV failure refractory to maximal medical therapy after LVAD implantation

AHA Heart Failure Guidelines 2013
Class 2A (LOE: B): Non-durable MCS is reasonable as a bridge to recovery or decision for carefully selected patients with HF and acute profound disease

HFSA Heart Failure Guidelines 2010:
Urgent MCS indicated for bridge to decision in unstable HF refractory to maximal medical therapy complicated by multi-organ dysfunction and with a relative contraindication to transplant or durable MCS
Risk Scores and Algorithms for Defining the Use of Acute MCS do not exist.
Stage D; NYHA IV – Acute on Chronic HFrEF

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Patent initiated on milrinone.

Within 24 hours → worsening multi-organ failure.

Palliative care consultation obtained and extensive discussions held with the patient and family about hospice.

Discharged home on IV milrinone to die in peace surrounded by family and friends.

“Patient and family were very appreciative that we did NOT put him on a pump if we thought this might not help him.”
The Mechanical Circulatory Support Team

Multi-disciplinary Decision Making is Critical

Interventional Cardiology

Cardiac Surgery

Advanced Heart Failure

Cardiac Intensive Care

Patient Care
Education
Research
Innovation
Take Home Messages

• Do NOT be a technician, be a Doctor.

• Know the indications and contraindications for (chronic/surgical) durable and non-durable (acute/percutaneous) circulatory support.

• Take a step-wise approach:
  – Assess the clinical scenario
  – Define the exit-strategy before implantating a pump
  – If the exit strategy is not defined, discuss as a team
Thank you.

nkapur@tuftsmedicalcenter.org