Choosing the Optimal Candidate for Durable MCS

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Division of Cardiology
Columbia University Medical Center
The following relationships exist related to this presentation:

- Research Grant: Abbott
- Consultant: Abbott (no honoraria)
Choosing the Optimal Candidate for Durable MCS

or

I, the HF specialist, should choose the right candidate (i.e. right time) for LVAD implantation
The root of the problem…

John - July 2015

• 62 yo man h/o, HTN, AWMI, CABG, ICM, HFrEF for 7 years, LVEF 25%, LVEDd 7.0 cm, stable on neurohomonal blockade, until…
• 2 admissions for ADHF 2/2 in the past year for diet indiscretion (“I ate a pizza the night before”)
• Increased lasix requirement from 20 to 60 mg daily
• ICD shock x1
• Creat 1.5 (1.1) mg/dl
• Na: 136
• “I can walk at least 2 blocks without stopping”
• He asks his cardiologist how sick he is: “Do not to worry, we got the water out of your body, you have not had a shock in more than 3 weeks, and you will be fine”
Defining Advanced Heart Failure
(≈250,000 patients in the US)

- HF HOSPITALIZATIONS
- SEVERE FUNCTIONAL LIMITATION:
  - 6-MWD <300 m
  - Peak VO₂ <14 mL kg⁻¹ min⁻¹ or <50% of predicted
- DE-ESCALATION of HF medications due to renal failure and hypotension
- DIURETIC RESISTANCE
- LOW NA
- Recurrent ARRHYTHMYAS: Afib/VT/ICD shocks
- RV FAILURE
- Need for IV INOTROPES for symptomatic relief or to maintain hemodynamics and end-organ function

Yancy CW JACC 2017 & Fang JC J Cardiac Failure 2015
Hospitalization and Prognosis

Setoguchi et al AHJ 2007;154:260
Heart Failure and Research Funding

- Lung Cancer: 390,000 patients
- HF: 5 million pts

- HF: $29 millions
- Lung cancer: $132 millions

AHA.org
Objective Assessment of Functional Capacity: CPET and 6-Minute Walk Test

RHC = Objective Assessment of Hemodynamics

- 35 yo man, DCM on ACEI, BB, Aldo-antagonist (recent dose reduction 2/2 hypotension); creat 1.6 mg/dl (1.3 mg/dl, 6 months ago). States: “I feel good, I can walk at least 10 blocks non-stop”. BP 90/60; 12 cm JVD; Lungs: clear
- \( \text{VO}_2\text{max} \): 12.7 ml/kg/min
- RHC
  - RA 13
  - RV 55/24
  - PAP 51/28 (37)
  - PCWP 26
  - PA sat 48.5%
  - CO/CI 3.14/1.8

<table>
<thead>
<tr>
<th>Class</th>
<th>Functional Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>NYHA I</td>
<td>Patients with cardiac disease but resulting in no limitation of physical activity.</td>
</tr>
<tr>
<td>NYHA II</td>
<td>Patients with cardiac disease resulting in slight limitation of physical activity. They are comfortable at rest.</td>
</tr>
<tr>
<td>NYHA III</td>
<td>Patients with cardiac disease resulting in marked limitation of physical activity. They are comfortable at rest.</td>
</tr>
<tr>
<td>NYHA IV</td>
<td>Patients with cardiac disease resulting in inability to carry on any physical activity without discomfort. Symptoms of heart failure or the anginal syndrome may be present even at rest.</td>
</tr>
</tbody>
</table>
Inability to Tolerate Beta-blockers or ACE Inhibitors Predicts Mortality in Patients with Heart Failure

Fonarow GC/ Stevenson LW JACC 2018

Kettleson M / Stevenson LW JACC 2003
Diuretic Resistance & Hyponatremia Predict Mortality in Patients with Heart Failure

Neuberg GW / Packer M AHJ 2002

Rusinaru D / Doughty RN AHJ 2012
The most common cause of death among patients who received any ICD shock was progressive heart failure.

Poole J / Bardy GH NEJM 2008

**ICD shocks**

Predict Mortality in Patients with Heart Failure

<table>
<thead>
<tr>
<th>Shock Type</th>
<th>Hazard Ratio for Death (95% CI)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥1 App vs. no App</td>
<td>2.99 (2.04–4.37)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>≥1 Inapp vs. no Inapp</td>
<td>1.57 (0.99–2.50)</td>
<td>0.06</td>
</tr>
<tr>
<td>Both shock types vs. no shock</td>
<td>4.70 (2.70–8.18)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>
Seattle Heart Failure Model

Heart Transplant: 84%
LVAD: 68%

Survival Mortality
Mean life expectancy

Baseline
1 Year 2 Year 5 Year
80% 64% 32%
20% 36% 68%
4.0 years

Intervention
1 Year 2 Year 5 Year
94% 88% 73%
6% 12% 27%
9.3 years

Clinical
Medications
Diuretics
Lab Data

Age: 65
Gender: Male
NYHA Class: 3A
Weight (kg): 80
EF: 30
Syst BP: 120

ACE-I
Beta-blocker
ARB
Statin
Allopurinol
Aldosterone blocker

Furosemide: 80
Bumetanide: 0
Torsemide: 0
Metolazone: 0
HCTZ: 0

Hgb (g/dL): 14
Lymphocyte %: 24
Uric Acid (mg/dL): 8
Total Chol (mg/dL): 190
Sodium: 137

QRS > 120 msec

Devices

Note: Some devices may be disabled if CMS clinical criteria are not met

Copyright 2004-2007 Wayne Levy and David Linker

Columbia University Medical Center

New York Presbyterian
Importance of the RV

- Progressive RV dysfunction causes end-organ damage (irreversible?)

- We do NOT have great solution for long-term RV MCS (RVAD)
Palliation – i.v. Inotropes

Death sentence: patients sit on the death row

Hershberger RE J Card Fail 2003;9:180
Rose EA NEJM 2001;345:1435
Advanced Heart Failure

Promptly!

HF specialist

LVAD
EXIT HERE

Yancy CW JACC 2017 & Fang JC J Cardiac Failure 2015
CMS criteria for LVAD- Destination Therapy (DT)

LVAD-DT

- Not Transplant candidate
- LVEF ≤ 25%
- Intra-Aortic Balloon Pump >7 days
- i.v. Inotropes >14days
- Peak VO2≤14 or unable to exercise
- Failed to respond to medications (class IV) for >45 out of last 60d

or

or

or

or
# THANK YOU INTERMACS!

<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 * 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$_2$ $\leq$ 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$_2$ $\leq$ 12</td>
<td></td>
<td>“Housebound”, 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></td>
<td>Advanced Class III</td>
<td>III</td>
<td>A only</td>
</tr>
</tbody>
</table>

* Intravenous inotropic therapy only approved for refractory Class IV symptoms

- **Too sick?**
- **Would this patient feel better if on inotropes?**
- **Too well**
MedaMACS:
- 166 patients
- class III–IV HF
- ejection fraction ≤30%
- ≥1 HF hospitalization in the previous year
- excluding patients listed for transplant or receiving chronic intravenous inotropic therapy

Survival Free from LVAD Rescue is 2 Times Higher in INTERMACS 6/7 than INTERMACS 4: 78% vs. 39%

Stewart GC / Stevenson LW Circ Heart Fail 2016
Can we safely and effectively treat less sick patients?

<table>
<thead>
<tr>
<th>NYHA Class III</th>
<th>Class IIIB</th>
<th>Class IV (Ambulatory)</th>
<th>Class IV (On Inotropes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTERMACS Profiles</td>
<td>7</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>1.0%</td>
<td>1.4%</td>
<td>3.0%</td>
<td>14.6%</td>
</tr>
</tbody>
</table>

**CURRENTLY NOT APPROVED**

**LIMITED ADOPTION**

**GROWING ACCEPTANCE**

Prosperspective, nonrandomized, observational, multicenter clinical trial N= 200

ROADMAP Non-inotrope dependent

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1Kirklin et al J Heart Lung Transplant 2014; 33:555-64
GL-HM2-04150215

Jerry D. Estep, MD – Presented on April 17
### Patient reasons: LVAD, n = 95

<table>
<thead>
<tr>
<th>Reason</th>
<th>Count</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>It will improve chances to live longer</td>
<td>81 (85)</td>
<td></td>
</tr>
<tr>
<td>It will improve QoL</td>
<td>79 (83)</td>
<td></td>
</tr>
<tr>
<td>It will help improve HF symptoms</td>
<td>72 (76)</td>
<td></td>
</tr>
<tr>
<td>It will help me return to activities I enjoy</td>
<td>72 (76)</td>
<td></td>
</tr>
</tbody>
</table>

### Patient reasons: OMM, n = 101

<table>
<thead>
<tr>
<th>Reason</th>
<th>Count</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Don't like the idea of major device implantation surgery</td>
<td>40 (40)</td>
<td></td>
</tr>
<tr>
<td>Don't want to depend on a machine</td>
<td>26 (26)</td>
<td></td>
</tr>
<tr>
<td>Don't feel sick enough</td>
<td>25 (25)</td>
<td></td>
</tr>
<tr>
<td>Worried about too many complications with a LVAD</td>
<td>21 (21)</td>
<td></td>
</tr>
<tr>
<td>Don't think an LVAD will improve QoL</td>
<td>13 (13)</td>
<td></td>
</tr>
<tr>
<td>Don't think an LVAD will improve chances to live longer</td>
<td>10 (10)</td>
<td></td>
</tr>
</tbody>
</table>

### Physician reasons: OMM, n = 103

<table>
<thead>
<tr>
<th>Reason</th>
<th>Count</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient is not a good surgical candidate†</td>
<td>14 (14)</td>
<td></td>
</tr>
<tr>
<td>Patient is not sick enough</td>
<td>11 (11)</td>
<td></td>
</tr>
<tr>
<td>Other (e.g., substance abuse, financial, compliance concerns)</td>
<td>9 (9)</td>
<td></td>
</tr>
</tbody>
</table>
Risk Assessment and Comparative Effectiveness of Left Ventricular Assist Device and Medical Management in Ambulatory Heart Failure Patients

The ROADMAP Study 2-Year Results

Randall C. Starling, MD, MPH, Jerry D. Estep, MD, Douglas A. Horstmannhof, MD, Carmelo A. Milano, MD, Josef Stehlik, MD, MPH, Keyur B. Shah, MD, Brian A. Bruckner, MD, Sangjin Lee, MS, MD, James W. Long, MD, PhD, Craig H. Selzman, MD, Vigneshwar Kasirajan, MD, Donald C. Haas, MD, Andrew J. Boyle, MD, Joyce Chuang, PhD, David J. Farrar, PhD, Joseph G. Rogers, MD, for the ROADMAP Study Investigators
**FIGURE 2** Survival as Treated

- Event-Free Survival (%)
- Time Post-Enrollment (Months)
- LVAD arm free from death, urgent HTx, or urgent explant
- OMM arm free from death, delayed LVAD, or urgent HTx

P = 0.001
HR = 2.3 [1.5-3.7], OMM vs. LVAD

**TABLE 1** Primary Endpoint Evaluated at 2 Years

<table>
<thead>
<tr>
<th>Event</th>
<th>OMM (n = 77)</th>
<th>LVAD (n = 67)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alive at 2 yrs on original therapy with increase in 6MWD by 75 m</td>
<td>9 (12)</td>
<td>20 (30)</td>
</tr>
</tbody>
</table>

(OR: 3.2 [95% CI: 1.3 to 7.7], p = 0.012)

**FIGURE 3** Intention-to-Treat Survival

- Survival (%)
- Time Post-Enrollment (Months)
- LVAD: 60 on LVAD 4 HTx
- OMM: 35 on OMM 17 delayed LVAD 8 HTx*

* 2 patients received a delayed LVAD and then a HTx

---

Columbia University Medical Center

NewYork-Presbyterian
Improved 6MWT, NYHA, QOL and Depression in LVAD Patients
Adverse Events were More Frequent in LVAD patients

### Table 5: AEs During the First and Second Yr of Follow-Up

<table>
<thead>
<tr>
<th></th>
<th>Yr 1</th>
<th>Yr 2</th>
<th>Yr 1</th>
<th>Yr 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OMM AE Rate (eppy)</td>
<td>LVAD AE Rate (eppy)</td>
<td>OMM AE Rate (eppy)</td>
<td>LVAD AE Rate (eppy)</td>
</tr>
<tr>
<td>Bleeding</td>
<td>0.03</td>
<td>1.49*</td>
<td>0.02</td>
<td>0.60**</td>
</tr>
<tr>
<td>GI Bleeding</td>
<td>0.01</td>
<td>0.92*</td>
<td>0.02</td>
<td>0.39**</td>
</tr>
<tr>
<td>Infection</td>
<td>0.09</td>
<td>0.47*</td>
<td>0.13</td>
<td>0.68*</td>
</tr>
<tr>
<td>Driveline infection</td>
<td>NA</td>
<td>0.13§</td>
<td>NA</td>
<td>0.17§</td>
</tr>
<tr>
<td>Sepsis</td>
<td>0.01</td>
<td>0.23*</td>
<td>0.02</td>
<td>0.13*</td>
</tr>
<tr>
<td>Pump thrombus</td>
<td>NA</td>
<td>0.07‡</td>
<td>NA</td>
<td>0.09</td>
</tr>
<tr>
<td>Stroke</td>
<td>0.025</td>
<td>0.12*</td>
<td>0.04</td>
<td>0.04</td>
</tr>
<tr>
<td>Ischemic</td>
<td>0.013</td>
<td>0.07</td>
<td>0.04</td>
<td>0.04</td>
</tr>
<tr>
<td>Hemorrhagic</td>
<td>0.013</td>
<td>0.06</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Arrhythmias VT/VF</td>
<td>0.10</td>
<td>0.33§</td>
<td>0.16</td>
<td>0.07†</td>
</tr>
<tr>
<td>Worsening heart failure</td>
<td>0.90</td>
<td>0.16*</td>
<td>0.62</td>
<td>0.09*</td>
</tr>
<tr>
<td>Right heart failure</td>
<td>0.03</td>
<td>0.11†</td>
<td>0.02</td>
<td>0.01</td>
</tr>
<tr>
<td>Rehospitalizations</td>
<td>1.77</td>
<td>2.67†</td>
<td>1.04†</td>
<td>2.40*</td>
</tr>
</tbody>
</table>

"Composite" event rate: OMM/LVAD: 0.46 (0.31-0.68)*
Relative risk [95% CI]: OMM/LVAD: 0.79 (0.46-1.36)

### Figure 6: Risk-Benefit Analysis

- Primary End Point
  - Alive at timepoint with 
  - $\Delta$MWD ≥ 75m
- Event-Free Survival
  - As treated on original therapy
- Intent-to-Treat Survival
- NYHA Class, HRQoL, and Depression
  - Alive at timepoint with
  - $\Delta$NYHA improvement ≥ 1 class
  - $\Delta$VAS improvement > 20 pts
  - $\Delta$PHQ-9 improvement ≥ 5 pts
- Adverse Events
  - Composite rate for yr

<table>
<thead>
<tr>
<th>Ratio (95% CI)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>O.R</td>
<td></td>
</tr>
<tr>
<td>2.4 (1.2-4.8)</td>
<td>p=0.012</td>
</tr>
<tr>
<td>3.2 (1.3-7.7)</td>
<td>p=0.012</td>
</tr>
<tr>
<td>H.R</td>
<td></td>
</tr>
<tr>
<td>1.7 (1.1-2.7)</td>
<td>p=0.024</td>
</tr>
<tr>
<td>2.3 (1.5-3.7)</td>
<td>p&lt;0.001</td>
</tr>
<tr>
<td>1.0 (0.8-1.8)</td>
<td>p=0.931</td>
</tr>
<tr>
<td>1.3 (0.8-2.1)</td>
<td>p=0.307</td>
</tr>
<tr>
<td>O.R</td>
<td></td>
</tr>
<tr>
<td>8.9 (4.5-17.8)</td>
<td>p&lt;0.001</td>
</tr>
<tr>
<td>5.9 (2.8-12.6)</td>
<td>p&lt;0.001</td>
</tr>
<tr>
<td>4.1 (1.9-9.9)</td>
<td>p&lt;0.001</td>
</tr>
<tr>
<td>4.7 (2.1-14.9)</td>
<td>p&lt;0.001</td>
</tr>
<tr>
<td>4.2 (1.7-10.2)</td>
<td>p&lt;0.001</td>
</tr>
<tr>
<td>4.1 (1.5-10.8)</td>
<td>p=0.094</td>
</tr>
<tr>
<td>R.R</td>
<td></td>
</tr>
<tr>
<td>0.46 (0.31-0.68)</td>
<td>p=0.001</td>
</tr>
<tr>
<td>0.79 (0.46-1.36)</td>
<td>p=0.482</td>
</tr>
</tbody>
</table>
Suggested Management Pathway in non-Inotrope Dependent HF Patients

Discuss and weigh benefits and risks (LVAD implantation vs. ongoing medical management)

Every 1-3 months

HF specialist

Patient

Technology
<table>
<thead>
<tr>
<th>INTERMACS LEVEL 1</th>
<th>Met</th>
<th>X</th>
<th>“Crash and burn”</th>
<th>IV</th>
<th>TCS A</th>
</tr>
</thead>
<tbody>
<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 * 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 VO₂ ≤ 12</td>
<td>Resting symptoms on oral therapy at home</td>
<td>AMB IV</td>
<td>FF A</td>
<td></td>
</tr>
<tr>
<td>INTERMACS LEVEL 5</td>
<td>+ Peak VO₂ ≤ 12</td>
<td>“Housebound”, Comfortable at rest, symptoms with minimum activity ADL</td>
<td>AMB IV</td>
<td>FF A</td>
<td></td>
</tr>
<tr>
<td>INTERMACS LEVEL 6</td>
<td>“Walking wounded”-ADL possible but meaningful activity limited</td>
<td>IIIIB</td>
<td>FF A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>INTERMACS LEVEL 7</td>
<td>Advanced Class III</td>
<td>III</td>
<td>A only</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Intravenous inotropic therapy only approved for refractory Class IV symptoms

Too sick?
Case continued....

John - July 2017 (2 years later)

- had 8 hospitalizations over the past 2 years.
- his diuretics increased to Lasix 100 mg BID + Metolazone 5mg TIW
- is now on lisinopril 2.5 at night
- has been off BBs for the past 4 weeks
- has been admitted to the local hospital after her third ICD shock
- Transferred to Columbia

VS: BP 70/palp HR 105 SR
PE: cool to touch 1+
peripheral edema

Admitted to the CCU
Dobutamine 5 mcg/kg/min / Lasix IV

Labs:
SCr 2.10 / GFR 40 / BUN 76 / Na 127
TB 2.2 / Alb 3.1 / Alk Phos 250 / INR 2.5
NT-proBNP 7000
Urine protein 2+/ 24hr

RHC Dobutamine @ 5
RA 19 mmHg
PAP 51/28/38 mmHg
PCWP 22 mmHg
FCO 1.96 L/min
FCI 1.2L/min/m2
PVR 8.1 WU
RHC:
RA 8 mmHg
PAP 47/19/26 mmHg
PCWP 14 mmHg
FCO 3.5 L/min
FCI 2.1 L/min/m2

Labs:
Scr 1.6 GFR 48 BUN 40 Na 136 TB 1.3 DB 1 Alb 3.4 INR 1.2

VS: BP 100/70 HR 84 SR
Milrinone .25mcg/kg/min
Dobutamine 5 mcg/kg/min
IABP 1:1

Risk Profile:
MELD Score 15 (Low Risk)
CVP/PCWP 0.57 (Low Risk)
PAPi 3.5 (Low risk)
PVR 3.4 WU (Moderate risk)
RVSWi 650 mm Hg·ml/m² (Low Risk)
HeartMate II risk score 1.0 (Low risk)

US:
Liver: nodularities suggestive of cirrhosis
Liver Biopsy: Moderate centrilobular fibrosis, w/ some bridging central to central sinusoidal fibrosis and nodularity (stage 2)

LOW RISK, really?????
Triad of Evil

RV failure

Renal Failure

INOPERABLE?

Vasodilation (eg, liver failure, bleeding)
To VAD or NOT to VAD – That is the Question

**NO**
- Too high risk
  (i.e. patient will not benefit)
- Resource utilization $$$
  - Morbidity/re-hospitalization

Need to treat 2 patients to save 1 life!!

**YES**

![Graph showing survival by Intermacs Profiles]

- 58% survival
- 8% OMM REMATCH
An interesting day at the office ...
VASODILATION / VASOPLEGIA

Treatment:

• “Standard” vasopressors:
  PHE, EPI, NE, Vasopressin

• Methylene Blue
Post op MAP goal >70 mmHg

MAP = SVR ⬇️ X ⬆️ CO

RV ➔ LV ➔ CO

VULNERABLE RV
LIMITED RV RESERVE
RELATIVE RV FAILURE
Case continued….

POD0

- Milrinone 0.25
- DBA 5
- Levo 6
- Pitressin 3
- MAP 73
- CVP 14 / PAP 32 / W13
- CI 2.2
- Creat 1.6
- LA 3.5
- Lasix drip 5 mg/h
- UO 75 cc/h
- Heart Mate II 8800 / PI 3.4

For Vasoplegia w/ relative RV failure

- Milrinone 0.20
- Epi 3
- Levo 12
- Pitressin 6
- MAP 72
- CVP 16 / PAP 30 / W13
- CI 2.2
- Creat 2.2
- LA 3.4
- Lasix drip 10 mg/h
- UO 50 cc/h (going down)
- Heart Mate II 8800 / PI 3.0
# RV Support Devices

<table>
<thead>
<tr>
<th>Device</th>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>V-A ECMO</td>
<td>Bedside insertion</td>
<td>Gas exchange</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Risk of systemic emboli</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Need to allow enough pulm flow to feed the LV</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Less mobility</td>
</tr>
<tr>
<td>Protek Duo</td>
<td>More mobility</td>
<td>Less anticoagulation?</td>
</tr>
<tr>
<td></td>
<td>Compatible with any centrifugal flow pump</td>
<td>Catheter stability?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NOT feasible if TV intervention</td>
</tr>
<tr>
<td>Impella RP</td>
<td>Easy insertion/removal</td>
<td>More anticoagulation?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Less mobility</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NOT feasible if TV intervention</td>
</tr>
</tbody>
</table>
Similar Changes in Hemodynamics with pRVAD and sRVAD

A. CVP (mmHg)

B. Cardiac Output (L/min)

C. Cardiac Index (L/min/m²)

Coromelis / Garan ISHLT 2017
Case continued….

- pRVAD removed POD10
- ICU LOS 15 days
- Total LOS 42 days
- John was discharged to acute rehab
- Success????
- Sustainable????
Columbia - MULTIDISCIPLINARY APPROACH

9:10 AM

NEUROLOGY
Dr. Willey

HEMATOLOGY
Dr. Eisenberger

PALLIATIVE CARE
Dr. Nakagawa

RENAL
Dr. Radhakhrishnan

GI

EP / VT Ablation
Dr. Iyer

CARDIOLOGY CT Surgery
Intensivists

VAD PROGRAM MANAGER
B. Cagliostro

SOCIAL WORKER
M. Staker

PHARMACIST
D. Jennings

9:10 AM

Columbia - MULTIDISCIPLINARY APPROACH
Survival @ 2 years  
2006-2017  
COLUMBIA DESTINATION THERAPY

Post Implant Survival - Destination Therapy - CONTINUOUS FLOW  
Primary Prospective Implants: June 23, 2006 to June 30, 2017

<table>
<thead>
<tr>
<th>Months after Device Implant</th>
<th>Intermacs (n = 7973, Deaths = 3208)</th>
<th>NYCP-0093 (n = 153, Deaths = 45)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>93.5% (93.2%-93.8%)</td>
<td>98.0% (96.5%-98.9%)</td>
</tr>
<tr>
<td>3</td>
<td>88.1% (87.7%-88.4%)</td>
<td>91.4% (88.8%-93.4%)</td>
</tr>
<tr>
<td>6</td>
<td>83.5% (83.1%-83.9%)</td>
<td>89.3% (86.5%-91.6%)</td>
</tr>
<tr>
<td>12</td>
<td>76.9% (76.4%-77.4%)</td>
<td>86.2% (83.0%-88.8%)</td>
</tr>
<tr>
<td>24</td>
<td>64.7% (64.1%-65.3%)</td>
<td>76.5% (72.2%-80.2%)</td>
</tr>
<tr>
<td>36</td>
<td>53.7% (53.0%-54.4%)</td>
<td>69.0% (63.8%-73.5%)</td>
</tr>
<tr>
<td>48</td>
<td>44.4% (43.5%-45.2%)</td>
<td>62.3% (56.3%-67.7%)</td>
</tr>
<tr>
<td>60</td>
<td>37.1% (36.1%-38.0%)</td>
<td>46.7% (39.5%-53.5%)</td>
</tr>
</tbody>
</table>

Note: These results reflect unadjusted survival estimates. 
Selection, device selection, clinical care and/or other factors may impact survival. 
Shaded areas indicate 70% confidence limits. 

Percent Survival [% (70% CI)] Months after Device Implant 

INTERMACS 1-3: Columbia University: 96%  
National average: 82.6%
Yes: a great LVAD and transplant candidate:
2 years ago…

EARLY REFERRAL is KEY!
To avoid Renal, Liver and RV failure
Annual review by a heart failure specialist for patients with established advanced HF … discuss current and potential therapies for both anticipated and unanticipated events, possible HF disease trajectory and prognosis, patient preferences, and advanced care planning.

• An initial followed by routine annual (or biennial) assessment by a heart failure specialist should be the standard for all symptomatic heart failure patients to review response to treatment, and risk stratification based on cardiopulmonary exercise test and right heart catheterization when indicated.

• This specialized HF assessment will help to recognize early signs of clinical deterioration (ie, advanced HF) and should be embedded in providers’ (i.e. general cardiologists and practitioners) mindset similar to how mammogram and colonoscopy screenings are reflexively considered standard of care.