Overview

- Describe the natural history of heart failure with reduced ejection fraction
- Identify poor prognostic indicators in chronic heart failure
- Recognize the role of diuretics, vasodilators, and inotropes in the management of decompensated heart failure
- Understand the role of left ventricular assist devices in the management of advanced heart failure

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Progression of CHF

	NYHA I	NYHA II-III	NYHA IV
At Risk for CHF Hypertension Diabetes Atherosclerosis Obesity Metabolic synd Toxins/Family Hx	Structural Heart Disease No symptoms	Past or Current HF symptoms	Refractory symptoms Advanced Heart Failure
Stage A	Stage B	Stage C	Stage D

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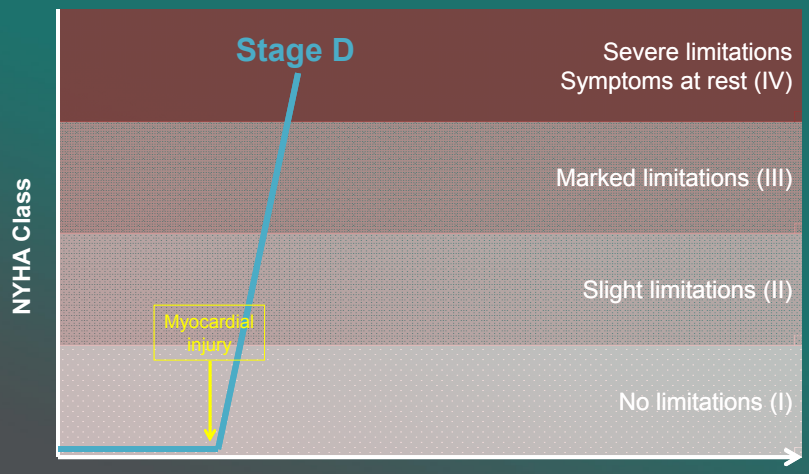
Profile A: Crash and Burn



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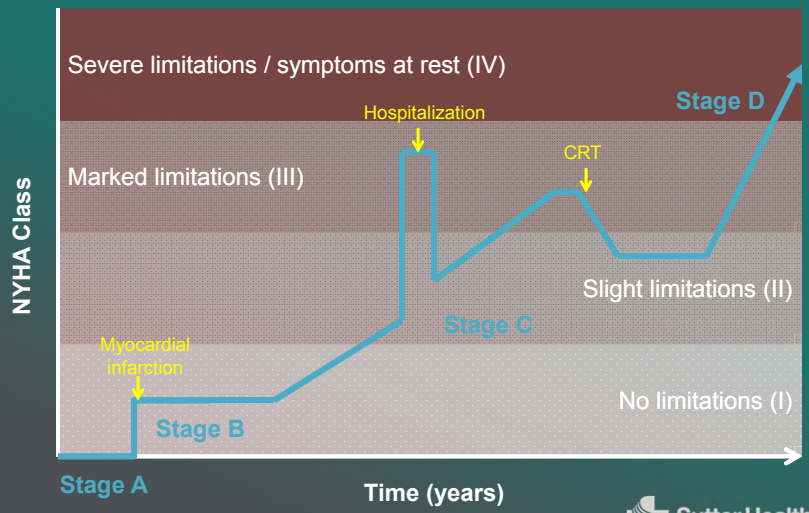
Profile B: Chronic Progression



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Epidemiology of Acute Heart Failure

- Heart failure is the #1 cause of hospitalization among Medicare beneficiaries
- Hospitalization account for 80% of HF-related costs
- Hospitalization for HF is associated with significant morbidity & mortality
  - Re-admission high: Up to 25% within 1 month among Medicare patients and 50% within 6 months
  - Mortality after HF hospitalization is 30% at 3 years

Heidenreich et al., Circ Heart Fail 2013

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ADHF Demographics (2001-2006)

	Percentage N = 187,565
Median Age (years)	75
Gender	
Male (%)	49
Female (%)	51
Past Medical History	
Prior Heart Failure (%)	76
Coronary artery disease (%)	57
Myocardial infarction (%)	30
Hypertension (%)	74
Diabetes (%)	44
Atrial fibrillation (%)	31
Chronic renal insufficiency (History of Cr >2) (%)	30
COPD or Asthma (%)	31

ADHERE Registry Final Benchmark Report 2001-2006

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ADHF Initial Presentation

	Percentage N = 187,565
Signs and Symptoms	
Any dyspnea (%)	89
Dyspnea at rest (%)	34
Fatigue (%)	31
Rales (%)	66
Peripheral edema (%)	65
Diagnostic testing	
Pulmonary congestion on CXR (%)	74
LVEF assessed (%)	58
<40% or moderate/severe LVD (% of subgroup)	47
Serum markers	
Initial BNP assessed (%)	51
Median BNP (pcg/mL)	843
Initial NT-proBNP assessed (%)	4
Median NT-proBNP (pcg/mL)	3385

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ADHF Treatment

	Percentage N = 187,565
Diuretics	
Furosemide (%)	84
Bumetanide (%)	6
Torsemide (%)	2
Vasodilators	
Nesiritide (%)	13
Nitroglycerin (%)	9
Inotropes	
Dopamine (%)	6
Dobutamine (%)	6
Milrinone (%)	3

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History

Congestion (common)

- Dyspnea
- Orthopnea
- PND
- LE edema
- Weight gain
- Abdominal fullness / bloating
- Anorexia, nausea, vomiting

Low output (rare)

- Fatigue
- Light-headed
- Sleepy, obtunded, poor concentration
- Intolerant to medications (hypotension)

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Assessing Congestion

	Sensitivity (%)	Specificity (%)
Elevated JVP	48	78
LE edema	10	94
S3 gallop	36	81
Rales	13	90

Capomolla et al., Eur J Heart Fail 2005; 7(4):624-30

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Chest Radiography

	Sensitivity (%)	Specificity (%)
Cardiomegaly	97	10
Redistribution	60	68
Interstitial edema	60	73
Pleural effusion	43	79

Chakko et al., Am J Med 1991

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Assessing Low Output

- Hypotension
- Narrow proportional pulse pressure1
  - (SBP – DBP) / SBP < 25%
- Cool extremities
- Sleepy, obtunded
- Renal dysfunction

Stevenson LW et al., JAMA 1989

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Treatment

Congestion (PCW ≥ 18)

Low Perfusion (CI ≤ 2.2)	No	Yes	
No	**Dry and Warm**	**Wet and Warm** (most common)	IV Diuretics Continue or ↓β-blocker Vasodilator (nitrates)
Yes	**Cold and Dry** (rare) ↑ oral vasodilator ↓ or stop β-blocker Advanced therapies • LVAD • Heart transplant	**Cold and Wet** (less common)	IV Diuretics Stop β-blocker IV vasodilator (nipride) Inotropes

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Diuretics in ADHF

- Start with an IV loop diuretic. Initial dose depends upon:
  - Outpatient oral dose
  - Renal function
  - Initial IV dose should be equal to or higher than chronic daily oral dose
  - Lower GFR should prompt higher diuretic dose
- Assess response in 1-2 hours.
  - If UOP < 500 cc, double the dose (typically up to 80 mg)
  - Poor response to diuretics is common

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Vasodilators in ADHF

- If symptomatic hypotension is absent, IV nitroglycerin, nitroprusside, or nesiritide may be considered an adjuvant to diuretic therapy for relief of dyspnea in patients admitted with acutely decompensated HF *(Class IIb, Level of Evidence A)*
- None of the vasodilators have been shown to reduce re-hospitalization or cardiovascular mortality.

Yancy et al., ACC/AHA 2013 Heart failure guidelines

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Inotropes

	Dobutamine	Milrinone
Mechanism	Inotrope (β_1 agonist) Vasodilator	Inotrope (PDE-I) Vasodilator
Dosing	2.5 – 10 mcg/kg/min	0.125-0.75 mcg/kg/min NO BOLUS
Half-life	2-3 min	2.5 hours
Side effect profile	Hypotension, arrhythmias, myocardial ischemia	
Unique features	Use higher doses to "overcome" β-blockade Tolerance after 24-48h	Can cause over-vasodilation syndrome due to renal clearance and long half-life

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Use of the PAC

- The routine use of invasive hemodynamic monitoring in patients with ADHF is not recommended.
- Invasive HD monitoring should be considered in a patient:
  - who is refractory to initial therapy
  - whose volume status and cardiac filling pressures are unclear
  - who has clinically significant hypotension (SBP <80 mmHg) or worsening renal function during therapy
- Because complications increase with duration of use, the PAC should be removed as soon as it is of no further help

HFSA 2006, ESC 2005 Guidelines

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How do I recognize advanced heart failure?

Congestion

- Multiple (>1) heart failure hospitalizations or ED visits in past 12 months
- High diuretic dose requirement (furosemide requirement >160 mg/day or need for combination therapy with thiazides)

Pump failure

- Fatigue or shortness of breath when performing household activities or after minor activities outside the home, such as visiting friends or going to a restaurant.
- Intolerance of heart failure medications (ACE-inhibitors, ARB, beta-blockers) due to hypotension or renal dysfunction
- Hypotension (SBP <100 mmHg) despite normal/high filling pressures or tachycardia (HR >100 bpm) at rest

Electrical instability

- Recurrent ICD discharges

Stable but at high risk for rapid decompensation

- Low EF and severe LV enlargement despite medical therapy with ACE-inhibitors, beta-blockers, and aldosterone antagonists

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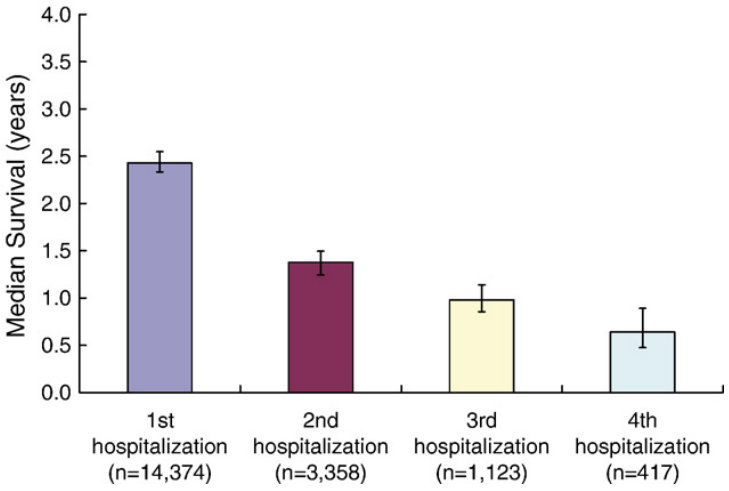
Frequent Heart Failure Hospitalizations Predict Poor Prognosis



Setoguchi et al. American Heart Journal 2007

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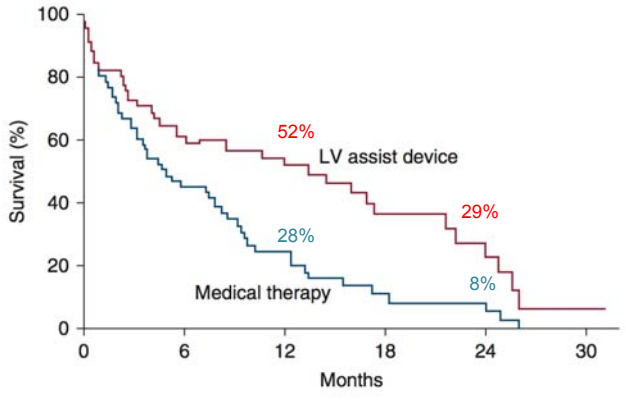
Prognosis in Advanced HF

REMATCH Population:
1. LVEF ≤ 25%
2. NYHA Class IV
   - 90 days
   - Optimal meds
3. VO2 ≤12 cc/kg/min or continuous inotropes

Expanded Criteria:
4. NYHA Class III-IV
   - 28 days and
   - Inotropes (14 d)
   - IABP (14 d)
5. VO2 ≤14 cc/kg/min



No. at risk						
LV assist device	68	38	22	11	5	1
Medical therapy	61	27	11	4	3	0

Rose et al., NEJM 2001

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Therapies for Advanced Heart Failure

- Stage D Heart Failure
  - Heart Transplantation
  - Durable Mechanical Circulatory Support
    - Ventricular Assist Device
    - Total Artificial Heart
  - Palliation of Symptoms

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Mechanical Circulatory Support

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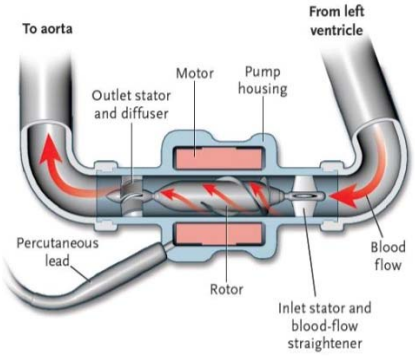
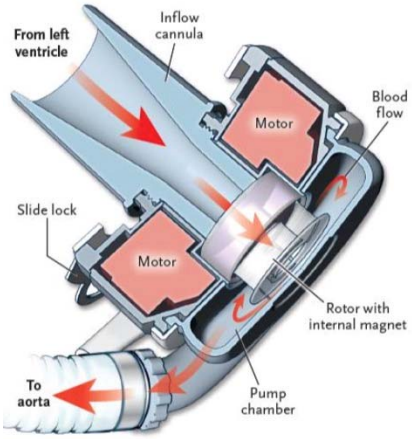
Axial vs. Centrifugal Flow





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HeartMate 3

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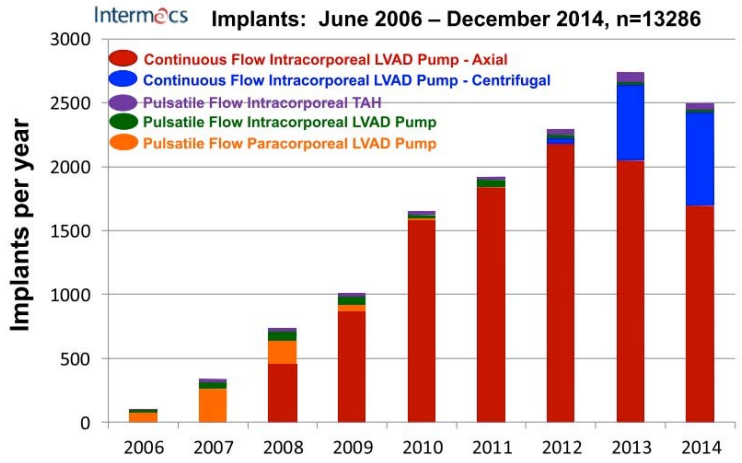
Durable MCS Implants in the U.S.



Intermacs

Kirklin et al., J Heart Lung Transplant 2015

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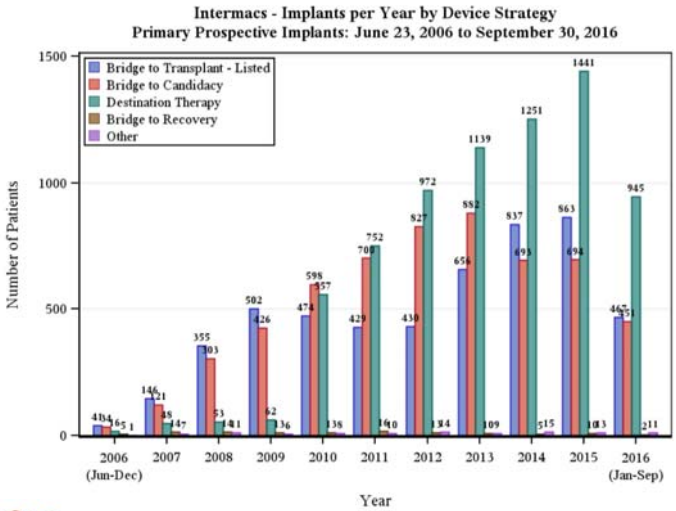
Indications for LVAD



Intermacs

INTERMACS Quarterly Report – 2016 Q3

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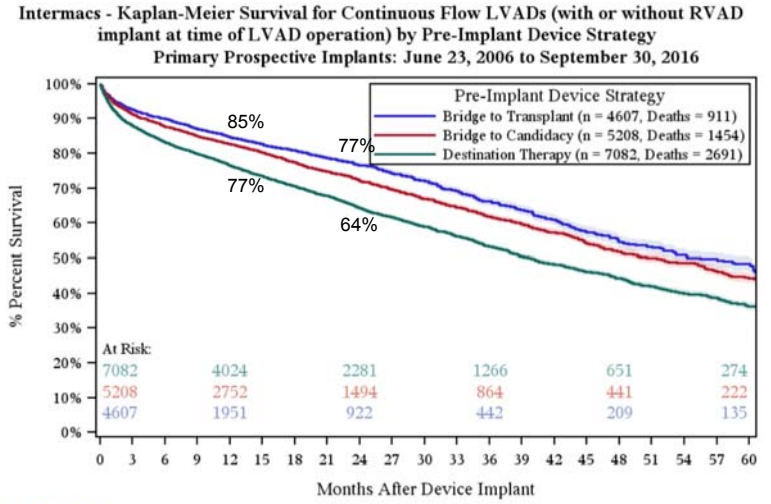
Survival after LVAD



Intermacs

INTERMACS Quarterly Report – 2016 Q3

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When do we implant LVADs?

- INTERMACS 1: Critical Cardiogenic Shock - Crash & Burn
  - Rapidly escalating inotropes, hypotension, end-organ dysfunction
- INTERMACS 2: Progressive decline on inotropes (NYHA IV)
- INTERMACS 3: Stable but inotrope dependent (NYHA IV)
- INTERMACS 4: Resting symptoms or intolerant of ADL's (NYHA IV)
- INTERMACS 5: Exertion intolerant; housebound (NYHA IV)
- INTERMACS 6: Exertion limited (NYHA IIIB)
  - Fatigue within minutes of meaningful exertion
- INTERMACS 7: Advanced Class III
  - Can walk more than a block

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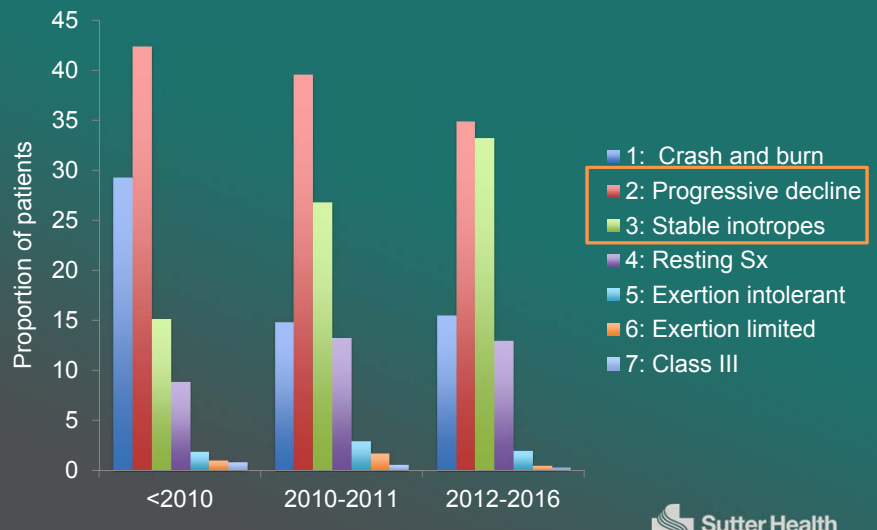
INTERMACS Profile at Implant



INTERMACS Quarterly Report – 2016 Q3

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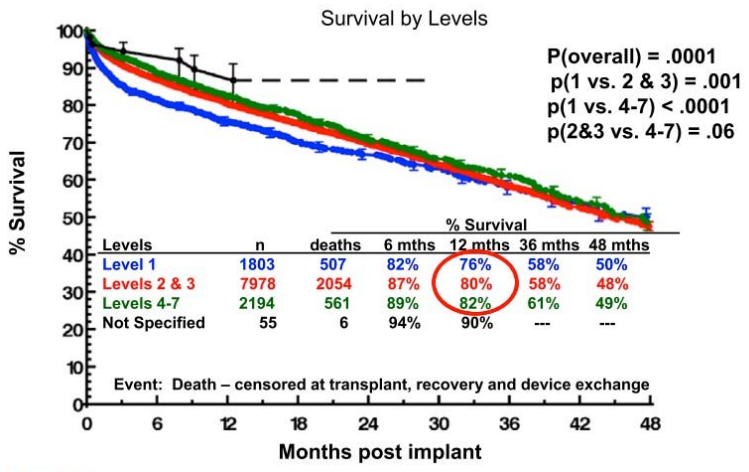
INTERMACS Profile and Survival



Intermacs

Kirklin et al., J Heart Lung Transplant 2015

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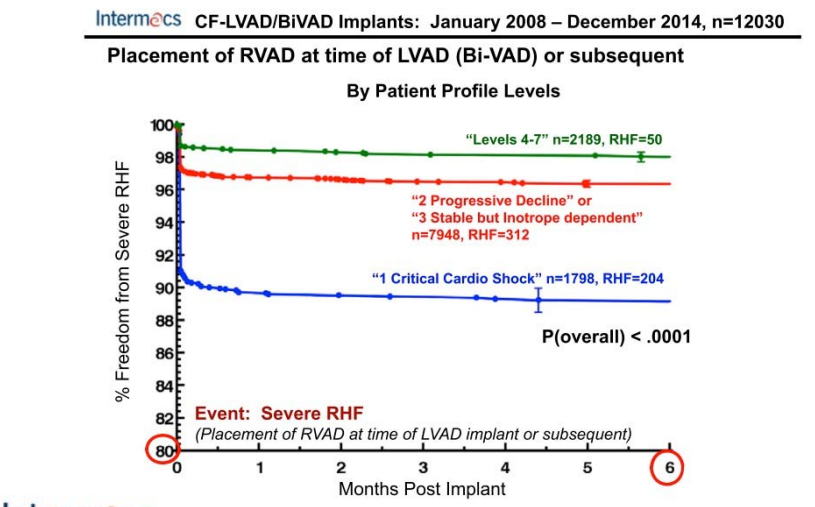
INTERMACS Profile and RHF



Intermacs

Kirklin et al., J Heart Lung Transplant 2015

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When Advanced Therapies are Not an Option

Palliative Care

- Available at any point in a serious illness.
- Can be combined with life-prolonging treatment (hemodialysis, defibrillator)
- Focus on symptom relief and emotional support
- Can be inpatient or outpatient
- Coordinated by PCP or specialist
- Often available but coverage varies

Hospice

- For patients with terminal diagnosis (<6 months).
- Some life-prolonging treatments are not recommended or supported
- Focus on symptom relief, emotional support, and end-of-life care
- Can be inpatient or outpatient
- Coordinated by PCP
- Typically available, covered by Medicare/Medicaid

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EXIT