Non Transplant Surgery for Heart Failure

Stephen Westaby, BSc, PhD, MS, FETCS, FESC FRCS FACC
Oxford, UK
CARDIOLOGISTS

surgeons
Surgical Options in Advanced Heart Failure

Stage C/D heart failure. Dilated left ventricle

- Lesion amenable to conventional surgery
  - Hibernating myocardium
    - CABG/PTCA
  - Grade III/IV mitral regurgitation
  - Anterolateral scar
    - Valve repair
    - Remodeling operation

- Potentially recoverable myocardium
  - IDCMI, myocarditis, etc.

- No target lesion or recoverable myocardium
  - LVAD or BIVAD unloading
    - LVAD or BIVAD
    - Stem cell therapy ± LVAD
      - Cardiac transplant
    - Biological replacement
      - LVAD
    - Lifetime circulatory support
      - BIVAD

- Functional improvement
  - Explant - medical therapy
  - Cardiac Transplant

- No improvement
  - Cardiac Transplant
  - Lifetime support
75% of Advanced Heart Failure Patients have Ischaemic Heart Disease
The Spectrum of Myocardial Dysfunction in Ischaemic Heart Disease

Hibernation: myocardial dysfunction due to chronic reduction in resting myocardial blood flow

Stunning: myocardial dysfunction after an acute ischaemic event

Poorly contracting but viable myocardium recovers contractile performance after revascularisation.
# Relationship between infarct size and mortality

(from Yoshida and Gould JACC 1993;22:984-997)

<table>
<thead>
<tr>
<th></th>
<th>3 Year Mortality</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Myocardial infarction or scar &gt; 23%</td>
<td>43%</td>
<td>P = 0.014</td>
</tr>
<tr>
<td>&lt; 23%</td>
<td>5%</td>
<td></td>
</tr>
<tr>
<td>Ejection fraction (EF) &lt; 43%</td>
<td>38%</td>
<td>P = 0.029</td>
</tr>
<tr>
<td>&gt; 43%</td>
<td>6%</td>
<td></td>
</tr>
<tr>
<td>EF &lt; 43% without viable myocardium</td>
<td>63%</td>
<td>P = 0.059</td>
</tr>
<tr>
<td>EF &lt; 43% with viable myocardium</td>
<td>13%</td>
<td></td>
</tr>
</tbody>
</table>

For all patients with viable myocardium the 3 year mortality rate was 8% (80% had CABG).
For patients with only fixed scar > 23% mortality rate was 50% (p = 0.018).
Only 40% had CABG with no difference in mortality with or without CABG.
Revascularisation in Heart Failure

- Patient selection is critical: Stress ECHO, PET, MRI
- Partial thickness scar precludes recovery in wall motion
- Only 60% of hibernating segments improve
- No improvement in survival when no reversible ischemia.
- If LV function improves, survival exceeds transplantation
## Guidelines for Coronary Bypass Versus Transplantation in End Stage Coronary Artery Disease

<table>
<thead>
<tr>
<th>CABG</th>
<th>Transplant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prevailing hibernation</td>
<td>Prevailing scar</td>
</tr>
<tr>
<td>Short duration of heart failure</td>
<td>Prolonged heart failure</td>
</tr>
<tr>
<td>Low dose diuretics</td>
<td>High dose diuretics</td>
</tr>
<tr>
<td>No right ventricular failure</td>
<td>Chronic R.V. failure</td>
</tr>
<tr>
<td>Stable cardiac output</td>
<td>Progressively lower output</td>
</tr>
<tr>
<td>CI $\geq$ 2.0 L.min.m$^2$</td>
<td>CI $&lt; 2.0$ L.min.m$^2$</td>
</tr>
<tr>
<td>LVEDP $&lt; 24$ mm.Hg.</td>
<td>LVEDP $&gt; 24$ mm.Hg.</td>
</tr>
<tr>
<td>Good target vessels</td>
<td>Poor vessels</td>
</tr>
<tr>
<td>First operation</td>
<td>Previous revascularisation</td>
</tr>
</tbody>
</table>

**OXFORD HEART CENTRE**
Time Course of Functional Recovery of Stunned and Hibernating Segments After CABG (26 Patients)

266 dysfunctional segments--- 22% Stunned
23% Hibernating
55% Scar

<table>
<thead>
<tr>
<th>Segmental wall motion recovery</th>
<th>3 months</th>
<th>14 months</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stunning</td>
<td>61%</td>
<td>70%</td>
</tr>
<tr>
<td>Hibernating</td>
<td>31%</td>
<td>61%</td>
</tr>
</tbody>
</table>

*Bax JJ. Circulation 2001, 104 (Suppl I) 314-318

OXFORD HEART CENTRE
ENDOVENTRICULAR CIRCULAR PATCH PLASTY

Antero apico septal scar

Septal exclusion

Curvature restoration

A.A.T.S New Orleans, April 1999

L.V.R.
Indications for Surgical Left Ventricular Remodelling in Ischaemic Heart Disease

- Discrete anterior scar
- Left ventricular dilatation ± thrombus (LVESVI > 60 ml/m²)
- Compensated congestive heart failure
- In addition to CABG/AVR/MVR as indicated.

* High risk CABG alone improves ejection fraction only if LVESVI < 100ml/m²
Dor Procedure. An Extreme Case

L.V. Dimensions

<table>
<thead>
<tr>
<th></th>
<th>Pre</th>
<th>Post</th>
</tr>
</thead>
<tbody>
<tr>
<td>EDV (mls)</td>
<td>1423</td>
<td>167</td>
</tr>
<tr>
<td>ESV (mls)</td>
<td>1380</td>
<td>77</td>
</tr>
<tr>
<td>SV (%)</td>
<td>43</td>
<td>90</td>
</tr>
<tr>
<td>EF (%)</td>
<td>3</td>
<td>54</td>
</tr>
</tbody>
</table>
Mitral Regurgitation in Ischemic and Dilated Cardiomyopathy

• Mitral regurgitation is the best predictor of mortality
• With grade IV regurgitation one year survival is 20%
Cardiac Support Device for Heart Failure
Class III/Early Class IV

*The CSD is an implantable device and is intended to*

- Provide ventricular support to reduce wall stress and myocardial stretch
- Promote myocardial reverse remodeling
- Halt progressive dilation and improve cardiac function and patient functional status
Myosplint™ Concept

- Stress Reduction through ventricular shape change

* Canine model
LONG-TERM USE OF A LEFT VENTRICULAR ASSIST DEVICE FOR END-STAGE HEART FAILURE

ERIC A. ROSE, M.D., ANNETINE C. GELJNS, PH.D., ALAN J. MOSKOWITZ, M.D., DANIEL F. HEITJAN, PH.D., LYNNE W. STEVENSON, M.D., WALTER DEMBITSKY, M.D., JAMES W. LONG, M.D., PH.D., DEBORAH D. ASCHEIM, M.D., ANITA R. TIERNEY, M.P.H., RONALD G. LEVITAN, M.S.C., JOHN T. WATSON, PH.D., AND PAUL MEIER, PH.D., FOR THE RANDOMIZED EVALUATION OF MECHANICAL ASSISTANCE FOR THE TREATMENT OF CONGESTIVE HEART FAILURE (REMATCH) STUDY GROUP*

ABSTRACT

**Background** Implantable left ventricular assist devices have benefited patients with end-stage heart failure as a bridge to cardiac transplantation, but their long-term use for the purpose of enhancing survival and the quality of life has not been evaluated.

**Methods** We randomly assigned 129 patients with end-stage heart failure who were ineligible for cardiac transplantation to receive a left ventricular assist device (68 patients) or optimal medical management (61). All patients had symptoms of New York Heart Association class IV heart failure.

**IMPROVING** the survival and the quality of life of patients with end-stage heart failure has been the underlying goal of decades of research on mechanical circulatory-support devices. This effort was stimulated by the increasing prevalence of this disorder and its grave prognosis. Heart failure affects an estimated 4.7 million Americans, with 550,000 new cases diagnosed annually and annual cost estimates ranging from $10 billion to $40 billion. The aggregate five-year survival rate of patients with heart failure is approximately 50 percent, where-
## Rematch Trial
### Causes of Death During Treatment

<table>
<thead>
<tr>
<th>Event</th>
<th>Medical Therapy Group (n=54)</th>
<th>LVAD Group (n=41)</th>
<th>Total (n=95)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heart failure</td>
<td>50 (93%)</td>
<td>1 (2.4%)</td>
<td>51</td>
</tr>
<tr>
<td>Sepsis</td>
<td>1 (1.8%)</td>
<td>17 (42%)</td>
<td>18</td>
</tr>
<tr>
<td>LVAD failure</td>
<td>0</td>
<td>7 (17%)</td>
<td>7</td>
</tr>
<tr>
<td>Pulmonary embolism</td>
<td>0</td>
<td>2 (5%)</td>
<td>2</td>
</tr>
<tr>
<td>Cerebrovascular disease</td>
<td>0</td>
<td>4 (10%)</td>
<td>4</td>
</tr>
<tr>
<td>Other C.V. causes</td>
<td>3 (5%)</td>
<td>2 (5%)</td>
<td>5</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>0</td>
<td>8 (20%)</td>
<td>8</td>
</tr>
</tbody>
</table>

Rose E.A and others, NEJM 2001. 345, 1435-43

*Oxford Heart Centre*
Surgery for Heart Failure. Which Operation?

- Left ventricular ejection fraction: normal 60%  
- Left ventricular end systolic volume index: normal 25 ml/m²  
- LVESVI >60 ml/m² when 40% of the L.V. circumference is not functional
Extending operability in high risk ischemic heart failure patients

Stephen Westaby
BSc, MS, PhD, FRCS, FESC, FECTS, FICA, FACC
Oxford, UK
Levitronix Centrimag cannulation
Never, never, never, never, never give up!

Winston Churchill, World War II