Role of Echo for Heart Failure Prognosis

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Echocardiography and Survival in Heart Failure Patients

![Graph showing survival probability with and without echo](image)

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WHY IS EJECTION FRACTION SO IMPORTANT?

LV EJECTION

\[
EF = \frac{\text{STROKE VOLUME}}{\text{END-DIASTOLIC VOLUME}}
\]

REMODELING

Clinical Approach to Heart Failure

Low EF

- ACE Inhibitors/ARBs
- \(\beta\)-Blockers
- Spironolactone
- Defibrillator
- CRT with Wide QRS
- Ivabradine

Normal EF

- Usually Hypertensive Heart Disease
- Treat: Hypertension and CV Risk

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HOW TO MEASURE EF BY ECHO?

Apical 4-Chamber View

Apical 2-Chamber View

QUANTITATIVE STANDARD

Modified Simpson’s Rule

Volume = \(\sum \left(\frac{1}{4} \pi D^2\right) h\)

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EF = EDV-ESV/EDV
## Ejection Fraction and Mortality After Acute Myocardial Infarction


**ACE Inhibitor Therapy: Enalapril**

**SOLVD Trial II**

Asymptomatic LV Dysfunction

<table>
<thead>
<tr>
<th>EF &lt; 35%</th>
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<table>
<thead>
<tr>
<th></th>
<th>Enalapril</th>
<th>Controls</th>
<th>Risk</th>
<th>Reduction</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>No of Deaths</td>
<td>313 (14.8%)</td>
<td>334 (15.8%)</td>
<td>8.0%</td>
<td>0.30</td>
<td></td>
</tr>
<tr>
<td>Death or Hospitalization</td>
<td>434 (20.6%)</td>
<td>518 (24.5%)</td>
<td>20.0%</td>
<td>0.001</td>
<td></td>
</tr>
<tr>
<td>Myocardial infarction</td>
<td>46 (2.2%)</td>
<td>52 (2.5%)</td>
<td>14.0%</td>
<td>0.74</td>
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## Defibrillator Therapy to Prevent Sudden Death

**MADIT II** Multicenter Automatic Defibrillator Implantation Trial II

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<thead>
<tr>
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<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Probability of Survival</td>
<td>1.0</td>
<td>0.9</td>
<td>0.8</td>
<td>0.7</td>
</tr>
</tbody>
</table>

Defibrillator + Medical Therapy

Conventional Medical Therapy

p<0.05

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**SUDDEN CARDIAC DEATH HEART FAILURE TRIAL**

Mortality by Intention-to-treat

<table>
<thead>
<tr>
<th>Amiodarone Placebo</th>
<th>Defibrillator</th>
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<tbody>
<tr>
<td>23% Reduction in Mortality p&lt;0.007</td>
<td></td>
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</table>

**Selection Criteria for Resynchronization Therapy**

- Heart Failure: NYHA Functional Class III or IV
- QRS > 120 msec
- EF < 35%

**Improvements in EF by Echo**

- Harmonic Imaging
- Digital Acquisition
- Echo Contrast Enhancement
- Continued Improvements in computer technology

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**LOOK FOR EF !**
Pocketsize Ultrasound

89 y.o woman with apical MI

**Visual Estimates of the Experts**

Visual – Manual EF (%)

Bias = 3 ± 5 %

n = 130

r = 0.97

y = 0.88x + 7

p < 0.0001

**3 Critically Important Situations to Trace EF**

1) DEVICE THERAPY
   Implantable Defibrillations
   Cardiac Resynchronization Therapy

2) CHRONIC MITRAL REGURGITATION

3) CHRONIC AORTIC REGURGITATION
WHAT OTHER THAN EF CAN PREDICT PROGNOSIS IN HEART FAILURE?

RESTRICTIVE INFLOW PATTERN
Mitral E Deceleration Time

DECELERATION TIME AND SURVIVAL IN DILATED CARDIOMYOPATHY

DECELERATION TIME AND SURVIVAL IN AMYLOID HEART DISEASE

TISSUE DOPPLER
LV Shortening Velocities
E' PREDICTS OUTCOME WITH ABNORMAL EF

- n = 182
- EF < 50%


ASSESSMENT OF LV FILLING PRESSURE

Routine Doppler Mitral Inflow
Tissue Doppler Mitral Annulus

E, E'

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E/E' PREDICTS PROGNOSIS AFTER MI

n = 205 with Acute MI

p < 0.0002


E/E' PREDICTS OUTCOME IN HEART FAILURE

n = 116


E/E' and E' ADDS PROGNOSTIC VALUE

Speckle Tracking: CIRCUMFLENTIAL STRAIN ANALYSIS

Global Circumferential Strain & Prognosis in Heart Failure
- 201 HF patients
- EF = 23%
- HF Hospitalization or Death 5 yrs

Global Longitudinal Strain & Prognosis in Heart Failure
- 194 heart failure patients
- EF = 26%
- Death, transplant or LVAD over 5 yrs

TAKE HOME MESSAGES
- EJECTION FRACTION
  - Clinically Here To Stay – Used Daily for Pharmacological, Device, and Surgical Therapy
  - Essential to Trace EF Pre Defibrillator, Pre CRT, in Chronic AR and in Chronic MR
  - Mitral Inflow Deceleration Time
  - Tissue Doppler of Mitral Annulus
  - Additive to EF for Prognosis
- 2D Strain Imaging
  - Emerging as a Quantitative Measure of LV function
  - Global Longitudinal and Circumferential Strain
- Future: 3D Strain Imaging
- Future Applications Continue to Emerge!