Catheter Ablation to Improve ICD Performance

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Implantable cardioverter defibrillator therapy in heart failure patients

- primary prevention of arrhythmic death
- secondary prevention of arrhythmic death
- cardiac resynchronization therapy

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<tr>
<th>Recommendation</th>
<th>Patient population</th>
<th>Class</th>
<th>Level</th>
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<tr>
<td>CRT preferentially by CRT-D is recommended to reduce morbidity or to prevent disease progression</td>
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<tr>
<td>NYHA function class II</td>
<td>LVEF ≤35%, QRS ≥150 ms, SR</td>
<td>I</td>
<td>A</td>
<td>9, 20–22</td>
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<td>Optimal medical therapy</td>
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<td>CRT-P/CRT-D is recommended to reduce morbidity and mortality</td>
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<tr>
<td>NYHA function class III/IV</td>
<td>LVEF ≤35%, QRS ≥120 ms, SR</td>
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<td>Class IV patients should be ambulatory</td>
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Device Therapy in Heart Failure Patients
Performance

✓ continuous surveillance for ventricular arrhythmia
  - anti-tachycardia pacing
  - shock therapy

✓ cardiac resynchronization therapy
  - continuous delivery of ventricular pacing

95% bi-ventricular pacing
The Paradox of ICD therapy

Observation

HF patients experiencing shocks have a higher mortality rate than those who do not

? Merely a marker of disease severity ?

Mortality : ATP ≠ Shocks

The **Paradox** of ICD therapy

✓ ICD therapy is immediately life saving
  - does not alter arrhythmic risk
  - shocks impact on quality of life

**THUS:**

decreasing the frequency of both inappropriate and appropriate shocks

atrial tachyarrhythmias
ventricular tachyarrhythmias
Catheter Ablation

“Fire” or “ICE”
Catheter Ablation

✓ only curative treatment modality for both AT/VT

✓ localization of the arrhythmogenic substrate difficult
  (distortion of cardiac anatomy)

✓ extensive mapping prior to ablation is therefore essential

✓ innovation mapping/navigation technology

✓ recurrences of VT/AT after ablation
  (progressive cardiomyopathy)
Mapping and Ablation Technologies

Epicardial Mapping

Endocardial Mapping

Contact Mapping

Non-Contact Mapping

Multi-Site Mapping

simultaneous

sequential
3-Dimensional Electro-Anatomical Mapping Technologies

NavX CARTO
Catheter Navigation

Manual Navigation

Remote Navigation

magnetic navigation

robotic navigation
Magnetic Navigation System
Stereotaxis NIOBE®

“Floppy” Catheter Design
- Less harmful
- No curve

Effective enough?

By courtesy of Dr. T. Szili-Torok
Remote Catheter Navigation

Robotic Navigation System

(Sensei Hansen Medical)
Robotic Arm
Artisan Sheath

outer sheath  inner sheath  ablation catheter
Reduction Appropriate ICD shocks

Ventricular Tachycardia
Ventricular Tachycardia and Heart Failure

- sudden cardiac death
  - 40% of deaths in HF patients!
- VTs in HF patients
  - PVCs
  - non-sustained VTs

present in **up to 70%** of HF patients with systolic heart failure!
Prophylactic Catheter Ablation for the Prevention of Defibrillator Therapy

Vivek Y. Reddy, M.D., Matthew R. Reynolds, M.D., Petr Neuzil, M.D., Ph.D., Allison W. Richardson, M.D., Milos Taborsky, M.D., Ph.D., Krit Jongnarangsin, M.D., Stepan Kralovec, Lucie Sediva, M.D., Jeremy N. Ruskin, M.D., and Mark E. Josephson, M.D.

From the Cardiac Arrhythmia Service, Massachusetts General Hospital, Boston (V.Y.R., K.J., J.N.R.); the Harvard-Thorn-dike Electrophysiology Institute and Arrhythmia Service, Beth Israel Deaconess Medical Center, Boston (M.R.R., A.W.R., M.E.J.); and the Cardiac Arrhythmia Service, Homolka Hospital, Prague, Czech Republic (P.N., M.T., S.K., L.S.)
Mechanism of Ventricular TachyArrhythmias

- reentrant arrhythmias around a scar border
- focal activity
Catheter Ablation of Ventricular Tachycardias

- documentation of the clinical VT
- hemodynamically, stable VT
Mapping of Ventricular Tachycardias

Focal VT

-34 ms

Anterior Wall

Posterior Wall

Apex

Reentrant VT

Line of ablation

Mitral annulus

Unipolar

Line of ablation

Mitral annulus

Unipolar
Catheter ablation of Ventricular Tachycardias

✓ hemodynamically unstable VTs
✓ voltage mapping during SR/pacing
✓ selection target site for ablation
Reduction InAppropriate ICD shocks

Atrial Fibrillation

[Heart rate monitor image]
CRT and Atrial Fibrillation

- 20% of the patients receiving CRT have permanent AF.

- Prevalence AF related with severity heart failure:
  - NYHA class I: 5%
  - NYHA class III-IV: 25-50%

- Death from HF AF patients > SR patients
  - (13.5% vs 4%, P<0.001)
CRT and Atrial Fibrillation

- **irregular R-R intervals**
  - spontaneous beats/pseudo-fusion beats/fusion beats

- **high ventricular rate**: inappropriate shocks
  - reduction bi-ventricular pacing

By courtesy of Dr. D. Theuns
SPONTANEOUS INITIATION OF ATRIAL FIBRILLATION BY ECTOPIC BEATS ORIGINATING IN THE PULMONARY VEINS

Cardiac resynchronization therapy and Atrial Fibrillation

2010 Focused Update of ESC Guidelines on device therapy in heart failure

| considered to reduce morbidity | LVEF ≤35%, QRS ≥130 ms  
Pacemaker dependency induced by AV nodal ablation |  

| CRT-P/CRT-D<sup>d</sup> should be considered to reduce morbidity | NYHA function class III/IV  
LVEF ≤35%, QRS ≥130 ms  
Slow ventricular rate and frequent pacing<sup>e</sup> |  

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<sup>a</sup>Class of recommendation.

<sup>b</sup>Level of evidence.

<sup>c</sup>References.

<sup>d</sup>Reasonable expectation of survival with good functional status for >1 year for CRT-D. Patients with a secondary prevention indication for an ICD should receive a CRT-D.

<sup>e</sup>Frequent pacing is defined as ≥95% pacemaker dependence.

CRT = cardiac resynchronization therapy; CRT-P = CRT with pacemaker function; CRT-D = CRT with defibrillator function; LVEF = left ventricular ejection fraction; NYHA = New York Heart Association; SR = sinus rhythm.
4. Cardiac resynchronization therapy with pacemaker/defibrillator function in patients with heart failure and permanent atrial fibrillation

However, there is consensus that essentially complete ventricular capture is mandatory in order to maximize clinical benefit and improve the prognosis of patients with permanent AF. This often requires creation of complete heart block by ablation of the AV junction given the frequently inadequate efficacy of pharmacological treatment of ventricular rate control at rest and during exercise. Frequent pacing is defined as $\geq 95\%$ pacemaker dependency.
AV junction ablation is the only tool that allows complete heart rate control favoring a constant delivery of CRT

‘Ablate and Pace’ Approach
Positive effect of AV junction ablation

- Improvements in NYHA functional class
- Left ventricular ejection fraction
- Exercise capacity
- Reduction of cardiovascular mortality

Ganesan AN. Role of AV nodal ablation in cardiac resynchronisation therapy in patients with coexistent AF and heart failure, a systematic review. JACC 2012;59:719-726.
AV junction ablation

RF ablation

AV block  V-pace junctional escape
AV junction ablation

RF ablation

AV block
V-pace junctional escape

A:V > 1
CRT and Atrial Fibrillation

🌿 CASTLE-AF

_Catheter Ablation versus Standard conventional Treatment in patients with Left ventricular dysfunction and Atrial Fibrillation_
Pulmonary Veins Isolation

PV triggers
Pulmonary Vein (PV)
Left atrial - PV junction
Ablation catheter

ECG
PVs
CS
LSPV
RSPV
LIPV
RIPV
MA

AF
PV isolation
Cryothermal energy ablation

-80 °C

By courtesy of Dr. R. Bhagwandien

5 minutes per vein
Update CRT, AF and Ablative Therapy
Heart Failure Patients

☑ ICDs: prevention sudden cardiac death paradox of ICD therapy !!

☑ Effective CRT is mandatory: improve survival

☑ Reduction (in) appropriate shocks

☑ Ablative therapy: curative treatment modality
Update CRT, AF and Ablative Therapy

Heart Failure Patients

✓ Advances in mapping/ablation technology have improved *success rate* and extended indications

✓ Catheter ablation: important *adjunctive therapy* to medical and ICD therapy

✓ Ablative therapy: unstable and stable VT

✓ AVJ ablation is a fundamental step in CRT
Questions?

When we asked you to turn off all electronic devices, we didn't mean your husband's pacemaker.

Your new pacemaker runs on advanced shareware technology... if your insurance company doesn't pay in thirty days, it stops working...