Management of VT in Non-ischemic Cardiomyopathy: Catheter Ablation and Beyond

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Acknowledgements

• NIH
• NIH-Bioengineering Research Partnership
• American Heart Association

• DISCLOSURES:

• University of California (UCLA) Holds Patents in This Area: catheter technology, embolism prevention technology, minimally invasive methods for cardiac interventions

Management of VT in Non-ischemic Cardiomyopathy

• Clinical Approach

• Pathophysiology

• Catheter Ablation

• Beyond Catheter Ablation
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- Clinical Approach
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- Beyond Catheter Ablation

Causes of VT in NICM

- Scar based macroreentry
- BBR
- 'Functional' VT's

Adapted from: John Miller, MD, Univ of Indiana

SUMMARY OF SPECIFIC REGIONS OF VT ORIGIN

Multiple VT’s with basal exits

Hutchinson MD, Marchlinski FE: Epicardial Ablation of VT in patients with non ischemic LV cardiomyopathy: Cardiac Electrophysiology Clinics, 2(1);93-103. 2010
Neural Remodeling
Myocardial Level

FROM SCAR TO VENTRICULAR ARRHYTHMIAS

RESPONSE TO CARDIAC INJURY INVOLVES NEURAL REMODELING BEYOND THE HEART

NL  ICM  NICM

Mean Neuronal Area (µm²)

250  300  350  400


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- Beyond Catheter Ablation

Knowledge about VT Circuits: Limits of our Extrapolation of Knowledge from Post-MI

- MMVT Circuits Are Deep Within Scar: ICM > NICM
- Scar Border Zones Are Critical: NICM ±
- Late potentials an ‘electrical footprint’: ICM > NICM
- Clinical Imaging Is Providing New Insights
- Mapping Techniques Have Greatly Improved
- Epicardial vs Endocardial Scar: NICM > ICM
- Interplay Between Structural VT And Functional Components: NICM possibly > ICM

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Voltage map: non-ischemic cardiomyopathy


Voltage Map-Anatomical Correlation: NICM


Non-Ischemic Cardiomyopathy: Epicardial 'Scar'


Epicardial Map: Non-Ischemic Cardiomyopathy


Hutchinson MD, Marchlinski FE: Epicardial Ablation of VT in patients with non ischemic LV cardiomyopathy: Cardiac Electrophysiology Clinics, 2(1):93-103, 2010
Examples Of Late Potentials: Moderate (mLP) and Very Late (vLP)

Characterization of the arrhythmogenic substrate in ischemic and nonischemic cardiomyopathy implicating for catheter ablation of hemodynamically unstable ventricular tachycardia. J Am Coll Cardiol 2010;55(21):2355-2365

Endocardial (ENDO) and epicardial (EPI) electroanatomical LV voltage maps from a representative patient with nonischemic cardiomyopathy (NICM)

Differences In Scar Area And Late Potentials Between NICM And ICM

Substrate Differences Between ICM and NICM


INTRA-SEPTAL VT : MAPPING AND ABLATION
DELIVERY OF COILS INTO THE SECOND SEPTAL PERFORATOR

RVOT

Septal Perforator 1

Septal Perforator 2

Epicardial VT Originating from LV base in a patient with a VAD

Mathuria NS, Vaseghi M, Buch E, Shivkumar K. Successful ablation of an epicardial ventricular tachycardia using a surgical ablation tool. Circ Arrhythm Electrophysiol. 2011;4:e84-86
Surgical Access to LV base via lateral thoracotomy and Epicardial ablation with closed irrigated catheter and surgical ablation pen

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Mathuria NS, Vaseghi M, Buch E, Shivkumar K. Successful ablation of an epicardial ventricular tachycardia using a surgical ablation tool. *Circ Arrhythm Electrophysiol*. 2011;4:e84-86
The Autonomic Nervous System regulates all cardiac physiological functions

- Chronotropy (depolarization, repolarization)
- Dromotropy
- Inotropy
- Lusitropy

Sympathetic Modulation is Central to Pathogenesis of Arrhythmias Due to Structural and Functional VT's (reentrant and non-reentrant…e.g. LQTS, CPVT)


CARDIAC SYMPATHETIC CHAIN IN HUMANS

Anatomy and histology of left sympathetic chain

<table>
<thead>
<tr>
<th>Table 1. Baseline Characteristics</th>
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<tbody>
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<td>Age (y)</td>
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Effect of Thoracic Epidural Anesthesia (TEA)

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<thead>
<tr>
<th>Therapies before TEA</th>
<th>Therapies during TEA</th>
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<tbody>
<tr>
<td>MMVT</td>
<td>3</td>
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<tr>
<td>PMVT</td>
<td>3</td>
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<tr>
<td>Total</td>
<td>6</td>
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Complete/partial sympathectomy: 68% CI


Stellate Control of the Heart

Randall W., Circ Res, 1968

Bilateral Stellate Ganglionectomy for VT/VF Storm


**SYMPATHETIC MODULATION TO TREAT VENTRICULAR ARRHYTHMIAS**

**INTERVENTION**

- General Anesthesia
- TEA, SCS and Intrathecal clonidine
- Beta blockers
- Renal Denervation

**NEURAXIAL LEVEL**

- Higher centers
- Thoracic T1-T4 Spinal Cord
- Beta blockers
- Renal Denervation

**FOCAL VF**

- MACRO REENTRY

**FUNCTIONAL VT AND VF**


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**RENAL DENERVATION FOR THE MANAGEMENT OF VT STORM**


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**MANAGEMENT OF VT IN NON-ISCHEMIC CARDIOMYOPATHY**

- General Anesthesia
- TEA, SCS, and Intrathecal Clonidine
- Cervicothoracic Sympathectomy
- Beta Blockers
- Renal Denervation

**FOCAL VF**

- MACRO REENTRY

**FUNCTIONAL VT AND VF**

Myocardial Scars and VT Circuits

Heart Rhythm, 2006;3:1-10