Non-Ischaemic VT ablation

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How to do VT ablation in NICM less badly

“Everything in our favour was against us”

Danny Blanchflower
NI International
Results of ablation in NICM

* P<0.001

Dinov et al. Circulation 2014

Kumar, Stevenson Heart Rhythm 2016
Why is VT ablation in NICM so difficult
• It’s not just one condition
**Genetic**
- Titin
- Lamin A/C
- Myosin heavy chain
- Desmoplakin
- Other

**Neuromuscular disorders**
- e.g. Anthracyclines
- e.g. Alcohol
- e.g. Viral myocarditis
- e.g. Myocarditis
- Sarcoid
- Peripartum
- Endocrine e.g. Acromegaly

Vaseghi JACC 2018
• It’s not just one condition
  – Even then there is significant variation between individuals who apparently have the same thing

• It’s often a progressive disease
  – There is a moving target
• It’s not just one condition
  – Even then there is significant variation between individuals who apparently have the same thing

• It’s often a progressive disease
  – There is a moving target

• Mapping and ablation is difficult
  – Limited or patchy scar and few or no late potentials to target
  – Scar which is difficult to access
    • Septal, midmyocardial, epicardial
Scar is difficult to get to - epicardial

Nakahara JACC 2010
How can we make it easier?
There are two predominant patterns of scar in NICM.
Patterns of scar in NICM

<table>
<thead>
<tr>
<th>Endocardial</th>
<th>Anteroseptal scar</th>
<th>Inferolateral scar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bipolar scar, cm²</td>
<td>2 (0-7)</td>
<td>0 (0-3)</td>
</tr>
<tr>
<td>Unipolar scar, cm²</td>
<td>28 (9-49)</td>
<td></td>
</tr>
<tr>
<td>LP presence</td>
<td>4 (11%)</td>
<td>5 (27%)</td>
</tr>
</tbody>
</table>

Roughly 50:50 split between the two patterns

<table>
<thead>
<tr>
<th>Epicardial</th>
<th>Anteroseptal scar</th>
<th>Inferolateral scar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bipolar scar, cm²</td>
<td>1 (0-6)</td>
<td></td>
</tr>
<tr>
<td>Unipolar scar, cm²</td>
<td>15 (5-23)</td>
<td></td>
</tr>
<tr>
<td>LP presence</td>
<td>1 (7%)</td>
<td>12 (80%)</td>
</tr>
</tbody>
</table>

Mid myocardial or periaortic
Few or no LPs
Not much epicardially

Epicardial scar predominates
LPs are epicardial
Phrenic nerve and coronary artery issues
Knowing where the scar is beforehand seems key to a successful ablation

“We try to equalize before the other team have scored”

Danny Blanchflower
NI International
Clues from the ECG

Anteroseptal scar

ECG in VT
LBBB morphology (75% of the time)
Inferior Axis

Evidence of conduction system disease

Need for CRT

Oloriz Circ AEP 2014
Inferolateral scar

ECG in VT
RBBB morphology
QS in lead 1
Does the etiology help us?

<table>
<thead>
<tr>
<th>Etiology</th>
<th>Predominant scar position</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARVC</td>
<td>RV, perivalvular, epicardial</td>
</tr>
<tr>
<td>Myocarditis</td>
<td>Inferolateral scar, epicardial</td>
</tr>
<tr>
<td>Lamin A/C</td>
<td>Anteroseptal, intramural</td>
</tr>
<tr>
<td>Sarcoid</td>
<td>Patchy septal</td>
</tr>
</tbody>
</table>
MRI can tell you where the scar is

- **Endocardial**
- **Transmural**
- **Mid myocardial**
- **Epicardial**
There are limitations...
CT can be useful too...

Wall thinning on CT correlates with scar on EAM

Can also identify coronary arteries
Incorporating imaging

**Issues**
- Segmentation (especially MRI)
- Registration

- Identify phrenic nerve
- Identify coronaries
- CT wall thinning
- MRI LGE
- Wall thinning
- Contrast-enhanced
- Hypodensity

Images courtesy of Dr S Mahida
Identifying ablation targets using electroanatomical mapping
Mapping in NICM

• Know where the scar is
  – ECG in SR and VT
  – Etiology
  – Imaging

• Be in the right place to start with
  – Go epicardially when you know you need to
  – Don’t bother where it won’t help
The unipolar EGM can point to epicardial scar
Sometimes the unipolar EGM is all you have to go on

Endocardial map can be normal

... and so can the epicardial map

Unipolar EGMs can suggest intramural scar

Haqqani HM et al. Heart Rhythm 2011;8:1169-76
Cut off values for unipolar mapping

• Intramural scar <6.78mV (Hutchinson Circ AEP 2011)
• Epicardial scar <8.27mV (Desjardins Circ AEP 2013)

• For midmyocardial scar, may need even higher voltages (Zeppenfeld)
  – Bipolar <2mV
  – Unipolar <9.8mV
Make the decision to go epicardial early

Establish the diagnosis of NICM

- ECG criteria in sinus suggestive of LV basal lateral scar
- ECG criteria predictive of epicardial PVC/VT
- Evidence of epicardial substrate on imaging
- Failure of prior endocardial ablation

Endocardial mapping

- Unipolar low voltage abnormality - non-septal
- Unipolar low voltage abnormality - septal
- Aortic cusp/AIV/RV mapping

Epicardial mapping
LPs are small and easy to miss

Use a multipole mapping catheter with small electrode spacing

4mm ablation signal at the same site
Ablation in NICM

“Ideas are very funny things. They never work unless you do.”

Danny Blanchflower
NI International
Issues with ablation in NICM

- LPs may be very low amplitude, patchy or non existent
  - Be prepared to ablate LAVAs and scar border
  - Use pace mapping to locate exit and ablate there
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• There are the usual issues with epicardial ablation
  – Epicardial fat
  – Risk of collateral damage
  – Contact force in pericardial space
Epicardial fat thickness should not be underestimated.
Issues with ablation in NICM

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• Septal scar is difficult to ablate
  – Approach and contact force are important
  – Consider novel ablation approaches
Septal ablation - use a big stick

Newer ablation technology  Bipolar RF  Alcohol septal ablation
Non-inducibility seems to be important
Summary

- NICM is several diseases which have distinct patterns of scar
- Progressive disease - be honest with your patients
- Using ECG and imaging to identify scar and plan your procedure
- If there is inferolateral or RV scar, go epicardial
- There may not be many LPs
  - be prepared to ablate exits, LAVAs, healthy myocardium adjacent to scar
If all else fails...