Intracardiac echo (ICE) for ablation of ventricular arrhythmias

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- Research Grants: Biosense Webster, Iowa approach, Vytronus, Medlumics, Luxcath, Abbott, Cardionext:
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Images: Helmsley Electrophysiology Service at Mount Sinai Medical Center

V Y Reddy, S Dukkipati, W. Whang, M. Miller, A Sofi, S Choudhry
Utility of ICE for VA
(Above and beyond that of Mapping Systems and X-ray)

• Pre ablation:
  – Endocardial thrombus identification, LV function, Scar/etiology assessment
  – Trans-septal access (visualization of interatrial septum and location of puncture)
  – Creation of anatomical boundaries and identifying critical structures

• Ablation:
  – Catheter tissue contact
  – Lesion formation, Steam pop
  – Continued assessment of LV function, pLVAD position, PEA after defibrillation
  – Management of tamponade
# Types of Intracardiac Echo (ICE)

<table>
<thead>
<tr>
<th>Device name</th>
<th>Company</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>UltraICE</td>
<td>Boston Scientific</td>
<td>9-Fr nonsteerable rotational motor-driven grayscale-only.</td>
</tr>
<tr>
<td>AcuNav</td>
<td>Siemens, Biosense Webster</td>
<td>Side-looking 64-element phased-array 4-way steerability, 8-Fr and 10-Fr, grayscale, color Doppler, tissue Doppler.</td>
</tr>
<tr>
<td>ViewFlex Xtra</td>
<td>St. Jude Medical</td>
<td>Side-looking 64-element phased-array 4-way steerability, 8-Fr, grayscale, color Doppler.</td>
</tr>
<tr>
<td>EP Med ViewFlex</td>
<td>St. Jude Medical</td>
<td>Run side-looking 64-element catheter on the ViewMate scanner, 10-Fr introducer, 2-way flex color Doppler, grayscale, tissue Doppler 8 to 2 MHz.</td>
</tr>
<tr>
<td>ClearICE</td>
<td>St. Jude Medical</td>
<td>Derived from the hockey stick, 64-element side-looking highly steerable 4-way side-looking array with 2 sets of electrodes for integration of 3D localization with EnSite NavX, runs on the GE Vivid/scanner, grayscale, tissue Doppler, synchronization mapping, 2D speckle tracking.</td>
</tr>
<tr>
<td>Soundstar</td>
<td>Biosense Webster</td>
<td>10-Fr device with integrated ultrasound array with the Carto magnetic sensor in the tip, allows for integration of ICE and 3D map.</td>
</tr>
</tbody>
</table>

Step-by-Step Workflow for Ventricle

- Home view
- Anteriorly flex (TV in view)
- Advance gently into the RV
- Release deflection - view inferior RV

Step-by-Step Workflow for Ventricle

- Clock- Septum & LV Apex

Scan the heart to look
- At valves
- LV function
- Presence/absence of pericardial effusion

- Clock- PM papillary, Septum and LV Anterior wall

- Clock- AL papillary, LV Inf Wall, Mitral valve
• Clock- LVOT/Aortic root short axis
• LAA and LSPV, left main artery

• Advance into RVOT-long axis RVOT & PV
• Clock- Aorta, Lateral RV
Anteriorly biased Transseptal access

LAA

LSPV

Carina

LIPV
Utility of ICE for VA 
(above and beyond that of mapping systems and X-ray)

• For Scar based VT
  – Non-ischemic CMP: Identification of mid-myocardial scar, epicardial scar
  – Ischemic CMP- Identifying transmural scar, wall motion abnormalities
  – Identifying endocavitary structures- esp infarcted papillary muscles
  – Monitoring long RF applications, (use of HNS)- looking out for myocardial steam formation (pre-pop)
Incorporation of Scar into map

- Most useful when scar is mid-myocardial

Mid myocardial scar identification can allow directed approaches such a long duration ablation to target such scar
Incorporation of Scar into Map

Sarcoid nodule under papillary muscle

Sub-epicardial scar under papillary muscle
Identification of LVAD Cannula
Lesion directed at the apical septum

Lesion in the inferior lateral wall

Needle ablation for VT
Utility of ICE for VA
(above and beyond that of mapping systems and Xray)

• For idiopathic VT
  – Creation of Right ventricular and LV outflow tract anatomy
  – Location of Critical strictures- R and L coronary cusp, Left main artery
  – Identification of site of ablation catheter- below the aortic cusp or above, identification of pulmonary annulus to identify PA cusp VA
  – Identifying endocavitary structures- papillary muscles, moderator band -site of origin
Outflow Tract VT workflow
Anatomical reconstruction of RV
Anatomical Reconstruction RV
Anatomical Reconstruction of RVOT
Anatomical reconstruction of the LVOT
Specific advantages of ICE imaging

• LVOT
  – Reduce the need for coronary angiography prior to cusp ablation for LVOT VT
  – If in long axis view the catheter is in cusp nadir- then safe to ablate or if near junction of cusps

• Papillary VT & Moderator band VA
  – Complex anatomical rendering
  – Ensure contact is on the papillary muscle and not the adjacent walls
ICE for Tricuspid valve arrhythmias

Enriquez, Garcia: HR case reports 2018
Anterolateral Papillary muscle

Catheter in contact with base of papillary muscle
Posteromedial Papillary Muscle

Catheter in contact with apical and lateral aspect of papillary muscle
Complication Detection

- LV function monitoring (PEA, decompensation)
- Lesion monitoring - steam formation (suggesting impending pop formation)
- Pericardial effusion/ thrombus
Steam formation and Steam Pop - Swine *In vivo*

Tissue Temperature Sensing During Irrigated Radiofrequency Ablation: A Novel Strategy To Predict Steam Pops - JCE Koruth et al
Complications
Loculated Effusion with Thrombus
Thank you
• 10F shaft, capable of being deflected and torqued, and an inner shaft capable of being telescoped and rotated within the outer shaft.

• An imaging transducer assembly is housed within a 10F tip mounted to the distal end of the inner shaft.

• The imaging field emanates perpendicular to the axis of one side of the imaging tip. A proximal handle allows the user to deflect the outer shaft and to advance/rotate the inner shaft relative to the outer shaft.