CIED related artifact

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Outline
- Determinants of artifact
- Distribution of artifact

Strategies to reduce artifact for:
- Cine
- LGE
- Mapping

Risk vs Benefit

<table>
<thead>
<tr>
<th>Indication</th>
<th>N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amyloid</td>
<td>1 (2%)</td>
</tr>
<tr>
<td>Pre VT ablation scar imaging</td>
<td>15 (22%)</td>
</tr>
<tr>
<td>Cardiomyopathy</td>
<td>26 (39%)</td>
</tr>
<tr>
<td>Cardiomyopathy follow up</td>
<td>8 (12%)</td>
</tr>
<tr>
<td>EF assessment post mortem</td>
<td>1 (2%)</td>
</tr>
<tr>
<td>Ischemia and viability</td>
<td>6 (9%)</td>
</tr>
<tr>
<td>Myocarditis</td>
<td>6 (9%)</td>
</tr>
<tr>
<td>Thrombosis</td>
<td>2 (3%)</td>
</tr>
</tbody>
</table>

Risk vs Benefit

**RISK**
- No clinical complications
  - 13%
- Minor lead parameter change
  - 3%

**BENEFIT**
- Change in management
  - 49%
- Unexpected new diagnoses
  - 6%

Conventional LGE

**BENEFIT**
- Change in management
  - 88%
- Unexpected new diagnoses
  - 14%

**WB-MOCO LGE**

Device related artifact: device type

ILR

PPM

ICD

CRT-D

ILRs

ILRs
Larger ILRs

Device related artifact: device proximity

Medtronic Reveal DX

Device related artifact: device proximity
Device related artifact: sequence selection

- SSFP sequences (cine, perfusion, T1 scout)
  - Balanced gradients require field homogeneity

- Late enhancement
  - Inversion pulse requires field homogeneity to null myocardial signal intensity
  - Dark zone adjacent to generator
  - More remote hyperintensity from incomplete inversion

- Reduce inhomogeneity
  - Push generator up
  - Right sided

- Use sequences less affected by inhomogeneity
  - Spin echo instead of gradient echo imaging
  - Non balanced GRE cine
  - Reduced TE (increase bandwidth)
  - Adjust inversion pulse for LGE

But sometimes...

Slice thickness thinner

Slice thickness thinner
Free breathing

Perfusion

T1 mapping in device patients

T1 mapping in device patients

Amyloidosis with reveal device

T2 mapping in device patients
T2 star mapping in device patients

Hemochromatosis with permanent pacemaker

Scar imaging is key

- LGE imaging prone to device artifacts

Conventional LGE

MOCO SSFP
BH FLASH
WB MOCO FLASH PSIR

Lead artifact can make subtle LGE difficult to tell
Device artifacts in LGE imaging

- Hyperintensity artifact
  - From off-resonance
  - Signal is not inverted due to narrow bandwidth of inversion pulse

- Signal void artifact
  - Dephasing across voxel due to susceptibility gradient
  - Predominately in slice direction

Combatting artifacts

- Wideband inversion
- Thinner slices

Acquisition sequence

- Wideband, 4 mm slices, single shot FLASH, flip angle 11°
  - Cost: Loss of SNR

- To gain SNR: respiratory MOCO averaging
  - 24 averages

- Benefits include:
  - Free breathing
  - PSIR

56 year old, LAD infarct, LV 30%
Conclusions

- Cardiovascular MR imaging is diagnostic in non-defibrillator patients
- Artifact is related to device, location and sequence
- Artifact reduction may require 'on the fly' sequence adjustment