Electrograms 101

Dr Stuart Tan
Essex CTC
Definition

- A graph of voltage over time
Definition

• A graph of voltage over time

• 12L ECG

• Intra-cardiac Electrograms
Definition

• A graph of voltage over time

• 12L ECG

• Intra-cardiac Electrograms
1. Basics of Electrograms

2. Electrograms in the EP lab
Recording modes

- Unipolar
- Bipolar
- Laplacian
- Monophasic action potentials
Recording modes

- Unipolar
- Bipolar
- Laplacian
- Monophasic action potentials
Recording modes

- Unipolar
- Bipolar
- Laplacian
- Monophasic action potentials
Unipolar Recording mode

• Different electrode at the recording site

• Indifferent electrode at point of zero reference
Jacques M.T. de Bakker, and Fred H.M. Wittkampf Circ Arrhythm Electrophysiol. 2010;3:204-213
Recording modes

- Unipolar
- **Bipolar**
  - Laplacian
  - Monophasic action potentials
Bipolar Recording mode

• Different Electrode and indifferent electrode close together

• Created by subtracting two unipolar electrograms
Bipolar Electrogram Construction

Uni1 (+) - Uni2 (-) = Bipolar
Direction dependence
Direction dependence
Direction dependence
Unipolar vs Bipolar recordings

• Unipolar recordings measure an amplified version of voltage at a single electrode and retain both near and far field signal components

• Bipolar recordings measure the amplified signal between two unipolar electrodes which reduces common-mode noise and far-field signal components
Unipolar
• Local + remote
• Catheter orientation independent
• Interference
• Directionality of propagation

Bipolar
• Local
• Catheter orientation dependant
• Reduces interference
• No directionality of propagation
• Times when a unipolar electrogram is useful

• Looking for points of earliest activation
  – Pathways
  – Focal AT/VT
Issa ZF, Miller JM, Zipes DP; Clinical Arrhythmology and Electrophysiology
• Times when a unipolar electrogram is useful

• Looking for points of earliest activation
  – Pathways
  – AT

• Examining farfield events
# Recording Artefacts

## Sources of Intracardiac Recording Artefact

<table>
<thead>
<tr>
<th>Cause</th>
<th>Manifestation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrode Polarisation</td>
<td>Electrogram Drift</td>
</tr>
<tr>
<td>Excessive Contact Pressure</td>
<td>ST elevation</td>
</tr>
<tr>
<td>Catheter motion</td>
<td>Fractionation</td>
</tr>
<tr>
<td>Poor contact</td>
<td>Low amplitude</td>
</tr>
<tr>
<td>Contact with other catheters</td>
<td>High-frequency signals</td>
</tr>
<tr>
<td>Repolarisation</td>
<td>Late or mid diastolic potentials</td>
</tr>
<tr>
<td>Electromagnetic Interference</td>
<td>High Frequency noise</td>
</tr>
<tr>
<td>Poor Grounding</td>
<td>High Frequency noise</td>
</tr>
</tbody>
</table>
Filtering

• Filtering necessary
  • High/Low/Band pass filters
  • Notch Filters

• Can affect EGM
  • Amplitude
  • Timing
  • Morophology
Complex Electrograms

- Double potentials
- Fractionated Potentials
Double potential

• Lines of functional block
• Lines of anatomical block
• Adjacent structures
Turn around point = End of a fixed or functional barrier such as scar tissue (fixed) or the crista terminalis (functional)
Fractionated electrograms

Where do they arise?

Where is the activation time?
First Deflection?

Largest Deflection?

Last deflection?
1. Basics of Electrograms

2. Electrograms in the EP lab
Electrograms

- Recording mode
- Sources of error
- Complex electrograms
- Multiple electrograms in different anatomical sites to interpret the EP study
Thank you