Indications for Electrophysiological Testing

Samuel C. Dudley, Jr., M.D., Ph.D.
Division of Cardiology
Department of Physiology
Emory University/Atlanta VAMC
What EP testing can do

- Measure conduction intervals
  - good for bradyarrhythmias
- Add extrastimuli
  - good for reentrant tachyarrhythmias
- Ablation
  - good for focal and reentrant tachycardias
Conduction system
Measurements made

- Recovery of automaticity
- Conduction velocity
- Refractoriness
- Activation mapping
- Pace mapping
Mechanisms of arrhythmia

- **Automaticity**
  - normal (e.g. sinus tachycardia)
  - abnormal (e.g. reperfusion arrhythmias)

- **Triggered activity**
  - Early afterdepolarizations associated with QT prolongation (torsades de pointes)
  - Delayed afterdepolarizations associated with Ca$^{2+}$ overload (e.g. digoxin)

- **Reentry**
  - fixed obstruction (e.g. atrial flutter)
  - leading circle (e.g. ventricular fibrillation)
Reentry - initiation

Reentry - response to extrastimulus

A) Nothing

B) Entrainment

C) Termination

Triggered activity

EADs - Bradycardia Dependent

DADs - Tachycardia Dependent

# Responses of arrhythmias during PES

<table>
<thead>
<tr>
<th></th>
<th>Normal Automaticity</th>
<th>Abnormal Automaticity</th>
<th>EADs</th>
<th>DADs</th>
<th>Reentry</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Initiated by drive train</strong></td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Initiated by extrastimuli</strong></td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Variable</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Suppression by overdrive</strong></td>
<td>Yes, no termination</td>
<td>No, no termination</td>
<td>Yes</td>
<td>Variable</td>
<td>Rare, possible entrainment</td>
</tr>
<tr>
<td><strong>Termination by extrastimulus</strong></td>
<td>No</td>
<td>No</td>
<td>Variable</td>
<td>Unlikely</td>
<td>Yes, termination in a range</td>
</tr>
</tbody>
</table>
Problems addressed by EP studies

- Bradyarrhythmias (site of block)
  - Sinus node function
  - AV block
  - IVCD

- Tachyarrhythmias
  - SVT
    - AV reentrant tachycardia
    - AV nodal reentry
  - VT

- Syncope
  - Evaluate implanted device programming options
  - Evaluate efficacy of therapy
Basic rules

- Always try to make an EKG diagnosis first.
- Fix ischemia first
- If you cannot bring on the tachycardia, it is hard to ablate it.
  - Think twice about starting drugs
- If the rhythm is not stable, it is hard to ablate it.
When not to do EPS

- Symptoms correlating with ECG findings
- Asymptomatic patients with sinus slowing or Wenckebach during sleep only
- Asymptomatic bifascicular block
- Asymptomatic preexcitation

- Congenital long QT and acquired long QT correlating with symptoms
- Asymptomatic patients without risk factors for SCD
- Patients with cardiac arrest within 48 hrs of ischemia/MI
- Cardiac arrest from other causes
Complications (<2%)

- Hemorrhage
- Phlebitis
- Thromboembolus
- Arrhythmias
- Tamponade
- CVA (Left sided procedures)
- Pneumothorax
- RF ablation
  - valve damage
  - AV block
Catheters positions

HRA

HIS

CS

RV

EP catheters placed in High RA, HIS, and RV apex
Normal Electrogram

Sinus node dysfunction

AV block

AV Block

- Type I 2° AVB or 3° AV block with narrow QRS
  - AV node
  - rarely intra His
- Type I 2° AVB or 3° AV block wide QRS
  - anywhere
- Type II 2° AVB, wide QRS
  - infra His
  - intra His
  - AV node (rare)

HV intervals & bifascicular block

- HV > 55 ms high sensitivity but low specificity for progression (2-3%/yr CHB)
- Infra His block during atrial pacing has low sensitivity but high specificity

Induced monomorphic VT

VT or SVT?

MUSTT registry

![Graph showing Kaplan-Meier estimates of the rates of death from all causes. EPG denotes electrophysiologically guided.]

Rhythms managed by RF ablation

- PSVT (i.e. AV reentry) - success > 90%
- Wolff-Parkinson-White
- Atrial flutter
- VT
  - 1° for idiopathic VT - success 85%
  - 2° for monomorphic VT associated with heart disease - success 50-60%
- Ectopic atrial tachycardias - success 75%
- Sinus node reentry or inappropriate tachycardia
- Atrial fibrillation - His bundle vs. maze
SVT ablation

Pre ablation
SVT - Long RP

Post ablation
Mapping WPW

SVT ablation

AV nodal reentry
Mapping SVT

Ablating SVT - Triangle of Koch

- Crista terminalis
- Tendon of Todaro
- Tricuspid annulus
- Compact AV node
- Coronary os
- IVC os
- Slow pathway
- Fast pathway