How to Become a Cardiovascular Investigator

Careers in Electrophysiology Research

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Careers in EP Research
Backgound

• Reduce incidence cardiac arrhythmias is desirable
  – Accurate identification of patients at risk
  – Effective treatments

• Achievement of goal requires
  – Elucidation of basic molecular/cellular mechanisms
  – Development of innovative methods to establish proof-of-concept in humans
  – Novel therapies
  – Focused clinical trials
  – Expertise in management of patients with arrhythmias
Careers in EP Research
Outline

• Division structure/philosophy
• Training program
• Maintenance program/challenges
• Research theme examples
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Division Structure/Philosophy

• Triple-threat division
  – Basic scientist
  – Clinical scientist
  – Clinical scholar
• Disease-oriented research
• Diverse research training programs
• Encouragement/protected time
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ACGME/ABIM Training Requirements

- Internal medicine (2-3 yrs)
- Cardiovascular medicine (3 yrs)
- Clinical cardiac electrophysiology (1-2 yrs)
- Mentored research training (1-3 yrs)
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Training Programs - Common Features

• Pre-fellowship research opportunities
  – Sarnoff/Hughes endowments
  – MSTP/PSTP
  – House staff research electives

• CV fellowship 01 year
  – Research discovery rotation (research essay)

• Career differentiation
  – Investigator pathway
    • Basic scientist
    • Clinical scientist
  – Master clinical pathway
    • Clinical scholar
Careers in EP Research
Basic Scientist Pathway

- 01-02 yrs: Clinical CV medicine
- 03 yr: Clinical cardiac EP
- 04-06 yrs: Mentored research training
  - Training grant 04 yr
  - Research trainee award 05 yr (AHA, NRSA)
  - Trainee/faculty transition award 06 yr (NIH/AHA)
  - Limited clinical cardiac EP
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Basic Scientist Research Training Program

• Core Curriculum
  – Human/animal welfare/scientific integrity/ethics
  – Laboratory safety/federal regulations
  – Grant/manuscript preparation
  – Gel to animal/basic laboratory to human
  – Biostatistics

• Mentored/collaborative research
  – Specific research tools/methods

• Trainee research seminars

• Scientific advisory committee
Careers in EP Research
Clinical Scientist Pathway

• 01-02 yrs: Clinical CV medicine
• 03-04 yrs: Mentored research training
  – Training grant 03 yr
  – Research trainee award 04 yr (AHA, NRSA)
• 05 yr: Clinical cardiac EP
• 06 yr: Faculty transition award (NIH/AHA)
Careers in EP Research
Clinical Scientist Research Training Program

• Core Curriculum
  – Human/animal welfare/scientific integrity/ethics
  – Laboratory safety/federal regulations
  – Grant/manuscript preparation
  – Evidence-based medicine/designing outcomes and clinical research
  – Biostatistics

• Mentor/collaborative research
  – Specific research tools/methods

• Trainee research seminars

• Scientific advisory committee
Careers in EP Research
Maintenance - Basic/Clinical Scientist

• Adequate protected time
• Adequate start-up package (3 yrs)
  – Incentive (retain 50% unused start-up monies) to acquire grant support
• Faculty advisory committee
  – Clear expectations of goals
  – Feedback 1-2 times each year
  – Formal written evaluation 04 yr
• Shared resource mentality
• Access to trainees
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Challenges – Basic/Clinical Scientist

• Protected time
  – Independent grant support
  – Center/SCCOR/PPG grants

• Integration into clinical service
  – Part-time FTE in a 24/7 clinical service

• Maintenance of clinical skills/volumes
  – Acceptance of loss of some skills
Careers in EP Research
Clinical Scholar Pathway

• 01-02 yrs: Clinical CV medicine
• 03 yr: Clinical research experience/clinical cardiac EP
• 04 yr: Clinical cardiac EP
Careers in EP Research
Clinical Scholar Research Training Program

• Core Curriculum
  – Human/animal welfare/scientific integrity/ethics
  – Laboratory safety/federal regulations
  – Industry grant/manuscript preparation
  – Evidence-based medicine/designing outcomes and clinical research
  – Biostatistics

• Participation in clinical trial
• Trainee research seminars
• Trainee advisory committee
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Challenges – Clinical Scholar

• Protected time
  – Acquisition of industry-sponsored project
  – Participation in clinical trials
  – Participation in Center/SCCOR grants
  – Scholarly publications

• Participation in a 24/7 clinical service
  – Loss of academic mission

• Maintenance of clinical skills/volumes
  – Developing/learning innovative procedures
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Research Theme—Sudden Cardiac Death

• Mechanisms of VT/VF
  – Ion channels
  – Gap junctions
  – Wave fragmentation
  – Border zone remodeling

• Develop pathophysiologically-based risk stratification method

• Establish proof-of-concept in select patient group

• Clinical trial
Electrophysiologic Basis for VT after MI
Activation During Sinus Rhythm
(Patients with Macroreentrant VT)
Methods for Mapping and Imaging Arrhythmias

Intraoperative mapping

Catheter Mapping

Electrocardiographic Imaging (ECGI)
ECGI Procedure

Subject undergoing CT scan

CT images

Heart-torso geometry

Electrode vest

Body Surface potentials

CADIS® (ECGI Software)

Epicardial Surface

Potentials (mV)

Electrograms (mV)

Isochrones (ms)
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Research Theme-Sudden Cardiac Death

• VT/VF in heart failure
  – Maladaptive switch FA/glucose energy utilization
  – Accumulation of long-chain FA proarrhythmic
  – Type-2 diabetes/ischemia augments FA accumulation

• Proof-of-concept in diabetic/heart failure patients
  – Positron emission tomography
  – MRI interrogation infarct border zones

• Development novel therapies

• Clinical trial