

POST DOCTORAL FELLOWSHIP
CLINICAL CARDIAC ELECTROPHYSIOLOGY

I. Section 1 Basic Sciences

A. Cardiac Anatomy and Physiology

B. Cardiac Pharmacology – Basic & applied

Pharmacology of Antiarrhythmic Drugs

1. Pharmacokinetics, Pharmacodynamics, Pharmacogenetic
2. Adverse effects & Drug interactions
3. Applications in specific arrhythmias

Pharmacology in Adult Population

1. Antihypertensives, diuretics, ACE inhibitors, statins
2. Anticoagulation management in adult population

C. Electrocardiography

1. Recognition and localization of arrhythmia; ECG abnormalities
2. Recognition of pacemaker, cardiac resynchronization device ECG

D. Basic Electrophysiology

1. Anatomy of the conduction system
2. Cellular electrophysiology; Action Potential, ion channels, gap junctions
3. Electrophysiology / abnormalities of the conduction system
4. Mechanisms of arrhythmia

II. Section 2 CLINICAL ASPECTS

A. Clinical Patient Assessment and Clinical Electrophysiology

1. Clinical history, examination, diagnostic workup, non-invasive tests
 - a. No structural heart disease
 - b. Acquired structural heart disease
 - c. Congenital heart disease
 - d. Inherited arrhythmia syndromes, channelopathies
2. Clinical evaluation of arrhythmia

- a. Response to drugs
 - b. Response to autonomic maneuvers, diagnostic maneuvers
 - c. Emergency management of arrhythmia, symptoms
- B. Clinical Assessment and Clinical Electrophysiology in Adult Population
 - 1. Arrhythmias in co-morbid conditions
 - a. Coronary artery disease, renal disease, diabetes, stroke, pulmonary disease, valvular heart disease, inflammatory heart disease
 - b. Adult congenital heart disease, cardiomyopathies
 - 2. Arrhythmias in pregnancy, athletes, post heart transplant
 - 3. Cellular Electrophysiology, Autonomics, Genomics of Sudden Cardiac Death in Adult Population

III. Section 3: E.P. LABORATORY

- A. Laboratory / Surgical / Implant Procedure
 - 1. Catheterization techniques, transseptal catheterization; intracardiac echocardiography
 - 2. Surgical techniques for device implantation
 - 3. Surgical management of arrhythmias
 - 4. Procedural risks, complications; recognition and management of complications
 - 5. Radiation safety
- B. Anesthesia in EP Laboratory: Moderate to Deep Sedation, Monitored Anesthesia Care, and General Anesthesia in the EP Lab
- C. Invasive Electrophysiology - Basics
 - 1. Baseline assessment
 - 2. Methods of electrogram recording and evaluation
 - 3. Stimulation protocols
 - 4. Evaluation of arrhythmias
 - a. Differentiation of arrhythmias
 - b. Response to pacing maneuvers
 - c. Response to antiarrhythmic drugs
 - d. Evaluation of arrhythmias post ablation
- D. Catheter Mapping and Ablation
 - 1. Procedural considerations
 - 2. Methods/strategies
 - 3. Mapping / ablation of arrhythmias

- a. SVT (Accessory pathway mediated, AV nodal, Atrial Tachycardia)
- b. VT (Bundle branch reentrant, idiopathic VT)

E. Imaging in EP

- 1. Fluoroscopic or Radiographic Interpretation: Implanted devices
- 2. Fluoroscopic or Radiographic Interpretation: Clinical Symptoms/Diagnosis
- 3. Fluoroscopic or Radiographic Interpretation: Catheter positions
- 4. CT, MRI, Echo, 3D mapping.

F. Invasive Electrophysiology Studies -Applied

- 1. Procedural indications and contraindications
- 2. Atrial arrhythmias / Atrial fibrillation / Atrial flutter
- 3. Ventricular arrhythmias (associated with ischemic heart disease, cardiomyopathies, genomic syndromes, adult congenital heart disease)

IV. Section 4: IMPLANTABLE DEVICES

A. Implantable Devices (Pacemaker, ICD, CRT, Loop recorder)

- 1. Fundamentals of electronics, pacemaker modes and timing cycles
- 2. Indications and Contraindications for implantation of devices, implant threshold testing and implant troubleshooting
- 3. Pacemaker therapy, programming, antitachycardia pacing, algorithms
- 4. ICD therapy, programming, detection algorithms, discrimination algorithms
- 5. CRT therapy, programming, optimization
- 6. Implantable loop recorder / cardiac monitor diagnostic assessment, programming
- 7. Recognition and management of device problems: EMI, sensing, capture, inappropriate therapy

B. Applications of Implantable Devices (Pacemaker, ICD, CRT, Loop recorder) in Adult Population

- 1. Indications and uses of implantable devices to manage or to diagnose arrhythmias
- 2. Recognition and management of device implant complications; Lead extraction in adults and adult congenital heart disease patients
- 3. Geriatrics, end of life management, device deactivation, ethics

V. Section : 5 Adult – Research and Literature

A. Research Ethics, Methodology, Statistics & Interpretation of clinical trials

B. Translation from Clinical Research to Adult Patient Management

- 1. Clinical trials in implantable device

2. Clinical trials in drug management
3. Clinical trials in arrhythmia management

VI. Section : 6, Paediatrics -A

A. Developmental Electrophysiology – Basic Science to Clinical Impact in Pediatrics

1. Embryology of the specialized conduction system
 - a. in normal heart
 - b. in congenital heart disease
2. Development of electrophysiology
 - a. depolarizing currents
 - b. autonomic nervous system effects on the cardiac conduction system
 - c. electrophysiological properties and substrates of arrhythmias
3. Developmental pharmacokinetic and pharmacodynamic of antiarrhythmic drugs
 - a. related to maturation, from fetus to adolescent
 - b. the pregnant adult
 - c. breast milk feeding
4. Biophysical effects
 - a. radiofrequency energy delivery in growing hearts
 - b. cardioversion and defibrillation energy through physical maturation

B. Electrophysiology of Congenital Heart Disease in Pediatrics

1. congenital substrates of arrhythmias
(eg. Anatomy of conduction system in L-TGA, canal, TOF/VSD ; Association of WPW with specific CHD; Concept of twin AV nodes in heterotaxy)
2. Etiology of AV block and congenital heart disease
 - a. Transcription factor mutations
3. Acquired substrates of arrhythmia
 - a. Natural history – eg. Cyanosis, volume or pressure overload
 - b. Related to open heart surgery
 - c. Comorbid condition

VII. Paediatrics - B

A. Clinical Management of Pediatric Electrophysiology

1. Fetal arrhythmias
2. newborn arrhythmias
3. Ventricular arrhythmias in the structurally normal heart
4. inherited arrhythmia syndromes, channelopathies
5. Arrhythmias in CHD and post-CHD surgery

6. Sudden death risk assessment for all cardiac and non-cardiac conditions in children
7. Arrhythmias associated with non-cardiac conditions affecting children

B. Invasive Electrophysiologic Testing in Children and in Patients with Congenital Heart Disease

1. Sedation and anesthesia
2. Procedural Indications and contraindications
3. Procedural considerations regarding vascular and cardiac access of catheters
4. EP testing, mapping and ablation strategies
 - a. In the structurally normal heart
 - b. In the congenital heart disease
 - i. Twin nodal SVT,
 - ii. Accessory pathways associated with CHD
 - c. post-surgical CHD
 - i. Scar-related IART
 - ii. Scar-related FAT
 - iii. Scar-related VT
5. Techniques and results of surgical ablation in patients with congenital heart disease

VIII. Paediatrics - C

A. Implantable Devices in Children and Patients with Congenital Heart Disease

1. Indications and contraindications for implantation
2. Strategies for hardware placement
 - a. in children too small for transvenous approaches
 - b. in congenital heart defects
3. Recognition and management of device and lead complications for epicardial and endocardial systems
4. Lead extraction / lead burden issues in pediatrics
5. Lifestyle issues and psychological effects of device implantation and device malfunction in children
6. Ancillary testing to optimize device programming in children and patients having congenital heart disease

