Curriculum

Postdoctoral fellowship training programme

(Cardiac electrophysiology)

Department of Cardiology

Sree Chitra Tirunal Institute for Medical Sciences and Technology

Thiruvananthapuram, India

(An Institution of National Importance, Department of Science and Technology, Govt. of India)

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(The document was approved by the Academic committee of the Institute on ….)

Introduction

The Electrophysiology Fellowship Training Program at the Sree Chitra Institute for Medical Sciences and Technology (SCTIMST), Trivandrum, Kerala was established in 2002, and is the first structured fellowship training programme in this subspeciality in India. The program seeks to train cardiologists to become independent and fully competent in all aspects of invasive as well as non-invasive electrophysiology. The training is comprised of a one-year dedicated program with emphasis on clinical and interventional skills along with special focus on research.

General objectives

The trainee in Clinical Cardiac Electrophysiology should acquire broad knowledge in all aspects of arrhythmology, including but not limited to brady-arrhythmias, tachyarrhythmias, syncope, non-invasive and invasive diagnostic electrophysiology, and interventional electrophysiology including catheter ablation and device implantation. The trainee should have sufficient knowledge of basic electrophysiology to understand current theories of the mechanisms of cardiac dysrhythmias and the rationale for both pharmacologic and nonpharmacologic therapy. This curriculum is consistent with the Heart Rhythm Society policy statement on the CCEP Fellowship Curriculum that was updated in 2011 (HRS policy statement: Clinical Cardiac Electrophysiology Fellowship Curriculum: update 2011. Heart Rhythm 2011; 8:1340-1356).

Unique features of the program

One of the major strengths of the training program is the high clinical volume of patients and procedures - both simple and complex - available to fellows-in-training. The electrophysiology (EP) division does close to 500 electrophysiology procedures and more than 300 device implantations every year being one of the largest volume centres in EP in India. The program is structured to facilitate the development of requisite procedural and technical skills necessary to perform diagnostic and therapeutic procedures. As a tertiary referral centre, SCTIMST exposes the fellow-in-training to complex cardiovascular issues within cardiac electrophysiology, including advanced heart failure and adult congenital heart disease.

Fellows are exposed to all electrophysiology procedures, including ablation procedures to treat the wide spectrum of supraventricular tachycardias (atrial tachycardia, AV-node re-entrant tachycardia, accessory pathway-mediated tachycardia). Complex ablations for atypical atrial flutter (left atrial flutter, post-surgical atrial flutter, and atrial flutter in congenital heart disease) are very common. Exposure to ablation for ventricular arrhythmias similarly ranges from simple to complex. Fellows are exposed to patients with conditions from idiopathic premature ventricular contractions to complex scar-related ventricular

tachycardias in patients with advanced cardiomyopathy. Techniques for epicardial access and ablation of epicardial arrhythmias are also encountered during ablation of ventricular arrhythmias.

Implantation and management of cardiac implantable electronic devices is an essential part of training in cardiac electrophysiology. Exposure to the newest technology in implantable loop recorders, pacemakers, defibrillators and cardiac resynchronization therapy devices is standard. Physiological pacing including His bundle pacing and left bundle branch pacing are routinely done. Successful mastery of these essential skills also includes an understanding of the indications, contraindications and potential complications, of invasive electrophysiology procedures.

Description of Training

The clinical cardiac electrophysiology fellowship is a 12-month position offered to trainees who have completed all of the requirements of advanced training in cardiology (DM) or its equivalent. The focus of the year is an in-depth exposure to cardiac electrophysiology, in order to build on learning from the previous electrophysiology rotations in the 3 years of advanced training in cardiology. The fellow will be formally evaluated by faculty on a 3-monthly basis, as well receive a 360-degree evaluation from members of the associated professional staff on an annual basis.

Assessment Summary and Competencies

1. **Patient Care:** By the end of the program, the fellow will demonstrate the basic knowledge, attitudes and skills necessary to provide patient care that is compassionate, appropriate and effective in patients with cardiac arrhythmias seen in consultation in the hospital or in the outpatient centre as well as patients referred from interstate for cardiac electrophysiology assessment, diagnostic and therapeutic procedures.

Clinical Cardiac Electrophysiology fellow will

- Be able to describe, understand the mechanisms, and determine appropriate diagnostic and treatment strategies of all types of supraventricular and ventricular arrhythmias.
- Be able to describe, understand the mechanism, and determine appropriate diagnostic and treatment strategies for arrhythmias commonly encountered in patients with or without cardiovascular disease and post cardiac surgery patients.
- Be able to describe, understand the mechanism, and determine appropriate diagnostic and treatment strategies for patients with atrial fibrillation and ventricular arrhythmias.
- Be able to determine appropriate diagnostic and treatment strategies for symptoms such as palpitations, near syncope, syncope and aborted sudden cardiac death.

- Be able to describe, understand the mechanism, and determine appropriate diagnostic and treatment strategies for various types of brady-arrhythmias.
- Summarize history and physical exam findings in a cogent presentation, both verbal and written.
- Develop and execute patient management plans.
- Perform device interrogations and optimize device programming for the specific needs of the individual patient as well as troubleshoot device related problems as related to the specific device or the specific arrhythmia of the individual patient.
- Counsel patients and their families about their cardiovascular disease, specifically their arrhythmia condition or risk arrhythmia, as well as the treatment of their arrhythmia.
- Work with the team.
- Understand and employ the appropriate drug or other maneuvers to terminate of control common and uncommon arrhythmias.
- In a stepwise fashion, be able to perform cardiac electrophysiologic procedures including device implantation and diagnostic and therapeutic catheter based electrophysiologic procedures.

2. **Medical Knowledge:** By the end of the fellowship program, the fellow will acquire a basic working knowledge of the common acute and chronic medical conditions that an EP specialist sees.

    - The fellow will understand the differential diagnosis of brady-arrhythmias and both narrow and wide-complex tachyarrhythmias.
    - The fellow will understand the electrophysiological effects, indications, contraindications, and potential adverse/proarrhythmic effects of antiarrhythmic drugs.
    - The fellow will understand the indications, contraindications, and potential complications of implantation or extraction of implantable cardiac devices, including permanent pacemakers, implantable cardioverter defibrillators, biventricular pacemakers and ICD's, and implantable loop recorders.
    - The fellow will understand the indications, contraindications, and potential complications of common tests and procedures such as electrophysiologic study, percutaneous catheter ablation, and tilt table testing.
    - The fellow will demonstrate an understanding of the common acute medical problems encountered by an EP consultant.
    - The fellow will demonstrate an understanding of the common chronic medical problems encountered by an EP consultant.

3. **Practiced-Based Learning and Improvement:** By the end of the rotation, the candidate will gain an understanding of the knowledge, attitudes and skills necessary to initiate self-

directed and independent learning skills that an electrophysiology consultant must perform to keep up-to-date with the ever-changing medical landscape of consultative cardiology.

- The candidate will demonstrate an ability to locate, appraise and assimilate evidence from the medical literature as it relates to patient care.

4. **Interpersonal and Communication Skills:** The fellow should demonstrate the interpersonal and communication skills that enable him/her to establish and maintain professional relationships with adult cardiac patients, to whom they will be providing initial and ongoing management. The candidate should demonstrate professional working relationships with cardiology consultants, senior resident medical officers (DM trainees), nursing personnel, cardiac scientists, allied health professionals, and other hospital staff members.

- The fellow will develop advanced communication skills for various situations, including delivering bad news, the difficult patient encounter, informing patients of different options with regard to treatment and obtaining informed consent for procedures and/or research studies.
- The fellow will work collaboratively with all health care professionals.

5. **Professionalism:** The candidate should demonstrate behaviours that reflect a commitment to continuous professional development, and to the ethical practice of medicine in their interaction with patients, their families and their colleagues.

- The fellow will interact with patients, families and co-workers, taking into consideration the age, disability, differences in ethnicity, culture and gender issues of the patient.
- The fellow will demonstrate ethically sound practice.
- The fellow will abide and support the code of conduct of the Medical council of India

6. **Systems-Based Practice:** The candidate should gain an understanding of the context and systems in which healthcare is provided and gain and understanding of the importance of applying this knowledge to both improved and optimize healthcare.

- The fellow will work with the EP health care team to examine specific patient care issues related to our health care delivery at SCTIMST and support the clinical operations of the institution.
- The fellow will attend and participate actively in weekly EP Meeting to discuss patient and procedural matters. The fellow will present any complications related to invasive electrophysiological procedures at the morbidity and mortality meetings and endeavour to rectify any system issues at these meetings to improve patient care.

- The fellow will be expected to teach, instruct and support advanced trainees in cardiology and other medical students in the department of Cardiology, SCTIMST

Duty hours

Each week will be composed of some time spent in EP lab, outpatient and research. This flexibility allows alteration in the fellow's time commitments to allow concentration on areas of interest or specific educational needs. However, it is anticipated that approximately 60% of the fellow's time will be spent in the electrophysiology laboratory, 20% in the various in-patient and outpatient settings, and 20% in research.

Faculty supervision

The advanced clinical cardiac electrophysiology fellow will be supervised every day directly by a consultant cardiologist. It is the consultant cardiologist's responsibility to ensure that the procedure or patient evaluation is being performed appropriately and to educate the fellow in proper techniques and procedures. This includes assessing the fellow's knowledge of the aetiology, pathogenesis, clinical presentation and natural history of the diseases involved and the decision-making process in designing a course of treatment. Feedback will be given to the candidates continuously in all areas of clinical care during these supervised activities. These daily interactions between faculty and advanced clinical cardiac electrophysiology fellow during patient care provide continuous practice-based learning opportunities for the fellow.

Educational meetings

The advanced clinical cardiac electrophysiology fellow will attend conferences to complement their patient care educational activities. These include the electrophysiology teaching conferences, the electrophysiology research conferences, electrophysiology journal club, clinical case conferences, ECG conferences, and cardiology grand rounds. A teaching session specific for clinical electrophysiology will be held every Monday from 2.00 pm to 3.00 pm in addition to the ECG and case discussion meetings on all Fridays between 8.00 am and 9 am. During these sessions, specific problems related to patient care will be discussed, as will problems relate to running the EP Service and Laboratories, quality assurance, morbidity and mortality report, and related patient care issues. Teaching conferences will be composed of didactic talks, literature reviews, and reviews of complex and/or interesting cases. Research conferences will be aimed at discussing on-going research or devising new research projects and will entail reviews of the relevant literature. Fellows will be expected to present the results of their research near the end of their year of training in EP in one of these research conferences. In addition to the EP specific conferences, they will be encouraged to participate in general cardiology conferences, especially cardiology grand rounds and hospital grand rounds.

Learning objectives

Fellows are responsible for the pre-procedure history and physical, including obtaining informed consent; performing as much of the procedure as they are capable under direct supervision of an electrophysiology faculty member; and sharing in the post-procedure documentation including the procedure note, communication with the patient's family, post-procedure orders, and completion of quality-assurance or registry forms. The fellow is directly supervised by the electrophysiology faculty member, for all critical aspects of the procedure. Over time, as the fellow progresses and attains autonomy, he/she performs more and more of the procedure until the faculty electrophysiologist mainly assists the fellow in a supportive role. Both the cognitive and technical aspects of invasive electrophysiologic procedures are discussed in a tutorial fashion on a daily basis.

Electrophysiology Lab (The fellow is posted at least for 3 days a week in the invasive EP lab)

- Learn indications for invasive electrophysiologic testing
- Learn techniques of catheter placement and manipulation
- Learn techniques of intra-cardiac recording
- Learn techniques of programmed intra-cardiac stimulation as a method of arrhythmia induction and termination and to assess mechanisms of arrhythmias (resetting and entrainment)
- Learn strategies to map abnormal rhythms using 2D and 3D mapping systems
- Learn methods of catheter ablation for treatment of rhythm disturbances
- Learn methods of external cardioversion using direct current shocks
- Learn use of conscious sedation for prolonged studies

Pacemaker (PM)/Implantable Cardioverter Defibrillator (ICD) Lab

- Learn indications for pacemaker or ICD implantation
- Learn surgical skills required for implantation of PM/ICD
- Learn lead placement skills
- Learn principles of pacemaker function including pacing and sensing threshold evaluation with emphasis on acute measurements
- Learn principles of pacemaker function including pacing and sensing threshold evaluation with emphasis on acute measurements

- Learn principles of cardioverter/defibrillator function including pacing and sensing threshold evaluation, defibrillation threshold testing, and anti-tachycardia pacing therapies
- Learn pacemaker/ICD troubleshooting
- Gain experience with lead extraction
- Learn conscious sedation techniques for PM/ICD implantation

PM/ICD Clinic (The fellow is posted in the Device outpatient clinic at least for one day per week)

- Learn PM/ICD chronic evaluation and troubleshooting
- Learn methods of trans-telephonic follow-up of PMs
- Learn electrocardiography of pacemaker rhythms

Outpatient Arrhythmia Clinic

- Learn appropriate use of diagnostic tests including:
    - Event recorders
    - Holter Monitors
    - Signal-averaged electrocardiogram
    - Tilt Table Testing
    - Invasive electrophysiologic testing
    - MRI/CT scan of the heart
- Gain exposure to a variety of arrhythmia patients in an ambulatory setting to assess response to therapy and to monitor for problems

In-patient consultation service

- Learn appropriate use of diagnostic tests including:
    - Event recorders
    - Holter Monitors
    - Signal-averaged electrocardiogram
    - Tilt Table Testing

- Invasive electrophysiologic testing
- MRICT scan of the heart

- Gain exposure to variety of arrhythmia patients in an acute setting to initiate therapy, assess response to therapy and to monitor for problems

Research Experience

- Gain exposure to clinical research projects
- Review current literature in Journal conferences
- Participate in weekly Cardiology Research Conference
- To do at least one clinical research project as thesis

In-patient services

The patients on the Electrophysiology Service include patients admitted after same day admit electrophysiologic procedures, patients admitted through the emergency department, or patients transferred directly from outside hospitals. Fellows are also responsible for performing inpatient electrophysiology consults. The fellow's responsibilities include, but are not limited to, performing histories and physicals on admissions or consults, appropriate documentation in the electronic medical record, communication with patient families, coordination of consultations or procedures, and managing the discharge process including the discharge summary on selected patients. Later in the training experience, the fellow will assume responsibility for running the service, including assisting the associate providers, with back up from the attending electrophysiologist.

Call frequency

Clinical electrophysiology fellows serve as first call for post-ablation and post-device implant patients. Timely evaluations are done by the electrophysiology fellow on call and supervised directly by the consultant. Fellows provide device troubleshooting and programming services every day.

Awarding the fellowship certificate: Prerequisites

Competencies in lab

A successful fellow should

- Demonstrate competence in the performance of invasive electrophysiologic testing for syncope, sudden death risk stratification, differential diagnosis of SVT, and differential diagnosis of wide-complex tachycardias. Each fellow must perform a minimum of 150 invasive electrophysiology studies, half of which should involve patients with SVT.
- Demonstrate competence in electrode catheter positioning in all cardiac chambers and the coronary sinus, incorporating 3-D mapping and intracardiac ultrasound where appropriate.
- Demonstrate competence in catheter ablation procedures, including post-diagnostic testing. Each fellow must perform a minimum of 75 ablation procedures including left atrial ablation for atrial fibrillation.
- Demonstrate competence in device implantation, including a minimum of 25 ICD implantations, 50 dual-chamber pacemaker implantations, and 25 CRT implantations.
- Demonstrate competence in electrophysiologic evaluations of implantable devices, such as noninvasive programmed stimulation for arrhythmia induction through the device and defibrillation threshold testing. Each fellow must perform a minimum of 25.
- Demonstrate competence in various mapping techniques, such as activation sequence mapping and entrainment mapping.
- Demonstrate understanding of recording techniques, including amplifiers, filters, and signal processors.
- Demonstrate understanding of programmed electrical stimulation techniques to determine conduction times and refractory periods, and to initiate and terminate tachyarrhythmias.
- Demonstrate understanding of radiation of physics, and safety related to the use of x-ray imaging equipment.
- Demonstrate understanding of the biophysics of catheter ablation including factors affecting lesion formation, covering a variety of modalities (solid electrode, irrigated electrode, cryoablation).
- Demonstrate understanding of sterile operating room techniques, multiple techniques for vascular access, and creating pockets for pulse generators.
- Demonstrate understanding of how to troubleshoot implantable device malfunction with external programmers.

Clinical Cardiac Electrophysiology fellows must perform a minimum number of the following procedures:

- EP diagnostic studies —150 intra-cardiac procedures as assistant or primary operator in at least 75 patients, with an average of three or more EP diagnostic/interventional catheter procedures per week as primary assisting operator

- Catheter ablations — 75, of which at least 50 percent are supraventricular, including atrioventricular nodal reentrant tachycardia, accessory pathway-mediated tachycardia, atrial flutter, atrial fibrillation and ventricular tachycardia ablation
- Pacemakers — 50 implants as primary operator; 100 follow-up visits
- Implantable cardioverter defibrillator (ICD) — 50 implants as assistant or primary operator; minimum 50 follow-up visits
- Cardiac resynchronisation therapy (CRT) - 50 implants as assistant or primary operator; minimum 50 follow-up visits

Competence -Clinics

- Demonstrate competence in the evaluation and management of outpatients with supraventricular tachycardias including atrial fibrillation; patients requiring acute or chronic anticoagulation; ventricular tachyarrhythmias including congenital and acquired long QT syndrome; and patients with syncope.
- Demonstrate competence in prevention of tachyarrhythmias, including primary prevention of sudden death.
    - Demonstrate care of patients before and after an electrophysiology procedure.
    - Demonstrate care in monitoring of patients with permanent pacemakers of all types and ICDs of all types. This skill set includes device interrogation and programming.
    - Demonstrate competence in testing that is relevant to arrhythmia diagnosis and treatment.
    - Demonstrate knowledge of the scientific method of problem solving and evidence-based decision making.
    - Demonstrate competence in understanding the indications for and complications from invasive electrophysiologic procedures. This includes demonstrating competence in obtaining informed consent on patients undergoing these procedures.
    - Demonstrate knowledge of basic electrophysiology that is relevant to clinical practice, including but not limited to determinants of the normal cardiac rhythm (ionic currents), determinants of normal conduction, mechanisms of tachyarrhythmias and various modulators such as autonomic tone and ischemia, and the cellular electrophysiologic effects of various classes of antiarrhythmic drugs.
    - Demonstrate knowledge of the epidemiology and genetic basis for various dysrhythmia syndromes.

- Demonstrate knowledge of the various antiplatelet agents and anticoagulants and their role in the management of the CCEP patient.
- Demonstrate knowledge of basic pharmacokinetics and pharmacodynamics.
- Demonstrate knowledge of the engineering aspects of pulse generator design, and the engineering aspects of electrical sensing and stimulation relevant to implantable cardiac rhythm devices.
- Demonstrate knowledge of the pathophysiology and differential diagnosis for the various types of SVT, polymorphic VT, and monomorphic VT.
- Understand the test characteristics (for example predictive value) of advanced electrocardiographic methods of risk stratification.
- Demonstrate knowledge on how to interpret the results of non-invasive and invasive tests, such as Holter monitoring, signal-averaged electrocardiography, exercise treadmill testing for arrhythmia evaluation, invasive electrophysiologic testing, and remote monitoring of implantable cardiac devices.
- Demonstrate understanding of the differences in pathophysiology and similarities in treatment for neurocardiogenic syncope, orthostatic hypotension, and POTS syndrome.
- Demonstrate understanding of the value of diagnostic tests for the assessment of syncope, including tilt table tests, ambulatory ECG monitoring, and electrophysiologic testing.

Log book

Candidate should maintain a log book which records all the procedures and academic activities done by him/her during his/her tenure. This should be submitted at the end of course to the department.

Thesis /Projects

Fellows are encouraged to conduct more than one project work during their fellowship program and get them published in reputed journals. Minimum one project work as thesis is mandatory for successful completion of fellowship program.

Titles for academic presentation

Additional topics are covered, though not limited, via didactic and journal club session as listed:

1. Cardiac Preexcitation Syndromes
2. Defibrillation and cardioversion
3. Noninvasive electrophysiologic testing for device follow-up
4. Cardioversion of atrial fibrillation
5. Normal cardiac conduction
6. Atrioventricular nodal reentrant tachycardia
7. Electrocardiographic recognition and diagnosis of wide complex
8. Catheter ablation
9. Permanent pacemakers
10. Carotid sinus hypersensitivity: recognition, indications for pacemaker
11. Atrial fibrillation
12. Atrial flutter
13. Pediatric arrhythmic issues
14. Long QT syndromes
15. Signal averaged electrocardiography: theoretical rationale, indications, interpretation
16. Monophasic action potential recording
17. Techniques for evaluation of sympathetic and parasympathetic nervous system

For further details on the fellowship program, you may please contact Dean's office SCTIMST, Trivandrum.