

University of Arkansas for Medical Sciences &
Central Arkansas Veterans Healthcare System



Clinical Cardiac Electrophysiology Fellowship

- **Patient Care**
- **Medical Knowledge**
- **Practice-Based Learning**
- **Systems-Based Practice**
- **Professionalism**
- **Interpersonal and Communication Skills**

The primary goal of the fellowship in Cardiac Electrophysiology is to facilitate advanced training in the diagnosis, management, and follow-up of patients with arrhythmia disorders, symptoms, and implanted arrhythmia management devices, and in the performance of the full range of non-invasive and invasive electrophysiologic tests and procedures. These include catheter ablation and implantation of permanent pacemakers and defibrillators, with a particular emphasis placed on learning complex diagnostic and interventional procedures, and on developing the resident research experience.

UAMS & CAVHS

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I. TAXONOMY OF OBJECTIVES, COMPETENCIES, TEACHING METHODS, AND ASSESSMENTS

Competencies*								
Objectives	Competency	Teaching Methods	Assessments	Objectives	Competency	Teaching Methods	Assessments	
1. Fellows will understand the formation and application of radiofrequency energy.	MK PC	A C D	A C	13. Fellows will understand the role of devices in the treatment of congestive heart failure.	MK PC	A C D	A C	
2. Fellows will distinguish between types of supraventricular tachycardia and formulate a plan for diagnosis and treatment.	MK PC	A C D	A C	14. Fellows will conduct a self-study program to improve understanding of the intracardiac electrograms and device activity.	MK PBL	A C D	A C	
3. Fellows will understand the indications for pacing and defibrillation and demonstrate proficiency in the steps for implantation of a dual chamber pacemaker.	MK PC	A C D	A C	15. Fellows will identify areas for improvement and implement strategies to improve knowledge and processes of care.	PBL	A D	A B C	
4. Fellows will determine the atrial flutter circuit and site for radiofrequency ablation.	MK PC	A C D	A C	16. Fellows will display willingness to learn from errors.	PBL	D E	A B C	
5. Fellows will understand the physiologic basis for ablation of atrial fibrillation.	MK PC	A C D	A C	17. Fellows will use information technology to support patient care decisions and personal education.	PBL	D	A B C	
6. Fellows will understand and demonstrate the skills required for defibrillator implantation, including biventricular ICD implantation.	MK PC	A C D	A C	18. Fellows will provide effective and professional consultation and communication with physicians and other health care professionals.	ICS	E	A B C	
7. Fellows will diagnose and treat pacemaker and ICD malfunction.	MK PC	A C D	A C	19. Fellows will sustain therapeutic and ethically sound relationships with patients, families and colleagues.	ICS	E	A B C	
8. Fellows will correctly interpret intracardiac tracings for patients with RVOT tachycardia, LVOT tachycardia, idiopathic left ventricular tachycardia, bundle branch reentry and related arrhythmias.	MK PC	A C D	A C	20. Fellows will demonstrate sensitivity and responsiveness to patients and colleagues in consideration of sex, age, culture, religion, sexual preference, socioeconomic status and beliefs.	P	E	A B C	
9. Fellows will diagnose and apply techniques and treatments for scar related ventricular tachycardia.	MK PC	A C D	A C	21. Fellows will demonstrate respect, compassion, altruism and integrity in their relationships with patients, families and colleagues.	P	E	A B C	
10. Fellows will understand and demonstrate proficiency in temporary pacing, transesophageal echo, and cardioversion.	MK PC	A C D	A C	22. Fellows will adhere to the principle of confidentiality, scientific and academic integrity and informed consent.	P	E	A B C	
11. Fellows will understand the formation of the cardiac action potential based on channel activity disorders of depolarization and repolarization.	MK PC	A C D E	A	23. Fellows will demonstrate understanding of the contexts and systems in which health care is provided and optimize this knowledge to improve health care.	SBP	A E	A B C	
12. Fellows will apply the principles of pacing to congenital and acquired heart block.	MK PC	A C D E	A	24. Fellows will understand the limitations and opportunities inherent in various practice types and delivery systems.	SBP	A E	A B C	

Competency	Teaching Method	Assessment
MK Medical Knowledge	A Independent Reading	A Observation
PC Patient Care	B. Rounds	B 360 Multirater Evaluation
ICS Interpersonal Communication Skills	C. Conferences	C. Rotation Evaluation
PBL Practice-based Learning & Improvement	D. Direct Patient Care	
P Professionalism	E. Attending/Fellow Mentoring	
SBP Systems-based Practice		

* Competencies are explained in detail in Section VII.

II. LEARNING & TEACHING TOOLS

Teaching Methods:

Independent Reading: Each fellow will read independently to answer questions about patient care that arise during the rotation. The fellow may use primary literature or other resources suggested by preceptors.

Rounds: Each fellow will round with CCEP staff at both UAMS and CAVHS for at least one hour per day on inpatient consultations as well as pre and post procedure evaluations. This may occur in between procedures or at the end of the day. During rounds, individual patients (or cases) are discussed with emphasis on education in all areas to include diagnosis and therapeutic decision-making, natural history of the disorder, pertinent clinical research, pathophysiology, molecular mechanisms of disease, and even the history of electrophysiology and medicine. During these rounds, the attending is responsible for educating both the EP fellow and the cardiology fellow rotating on the EP team. When possible, teaching rounds will include people from other disciplines. Pharmacists, nutritionists, EP lab staff and nurses, for example, can provide valuable education and insight to fellows during their training.

Conferences: The fellows will participate in all regularly scheduled CCEP conferences. CCEP program has 3 weekly conferences:

(A) Monday AM EP conference will have 2 case conferences per month which will include 10-15 minute literature review at the end of each case presentation, one to two core curriculum conferences per month, one journal club presentation per month, one research conference and one morbidity and mortality conference every two months.

(B) During the Wednesday AM EP Lab intracardiac electrogram interpretation conference, we review with the fellows, on a one-on-one basis, the interesting studies that we have performed.

(C) Friday AM ECG conference has two core curriculum lectures by the faculty. These include going over the ECG-SAP, one to two ECG presentations by the EP fellow and the cardiology fellow rotating in EP, and one ECG journal club. We also present interesting Holter ECG rhythm strips, event monitor rhythm strips, and exercise stress test ECGs during these conferences.

We invite local and national experts, one every 3-6 months, to join our above mentioned EP conferences as well as giving EP grand rounds.

Monthly EP Conference schedule will be distributed to all Cardiology and EP faculty and fellows and EP Lab staff of both hospitals.

Direct Patient Care: Hands-on direct and ongoing contact with patients during all types of electrophysiology procedures as well as inpatient and outpatient consultations and patient care.

Fellow/Attending Mentoring: Fellow/attending mentoring will provide an ongoing process of feedback regarding fellow performance.

Assessment Tools:

Direct and indirect observation by attending: Direct observation will include scheduled formal observations with feedback. Indirect observation will include informal, ongoing and daily casual observation.

Rotation Evaluation: Rotation evaluation is a monthly assessment based on the specific goals and objectives of the rotation as organized by competency to be completed by the attending physician.

360 Multi-rater Evaluation: The 360 Multi-rater evaluation measures Professionalism and Interpersonal and Social Skills. Evaluators include patients, other fellows, nurses, nurse practitioners, and social workers.

Monthly Evaluation: Monthly and quarterly evaluation by EP program director and other EP staff. Monthly evaluation meetings will address fellows goals and expectations for the rotation at the beginning of the month, and a “summative” monthly meeting will address performance and accomplishments. During the semi-annual evaluation review meeting, all EP staff and the fellow will meet to discuss the fellow’s performance to include, observations, 360 Multirater and rotation evaluation data. The second quarterly evaluation will serve as the required semiannual evaluation.

Skills Checklist: The skills checklist provides a source of evaluation of attainment of core skills that are expected in the CCEP program (see section IX.)

Educational Resources:

Combined work and teaching rounds at the outpatient and inpatient setting and in the EP Lab (daily)

Daily planning rounds, including bedside teaching and case presentations

EP Conferences

Morbidity and mortality conferences will be incorporated into Monday AM EP conference and Wednesday AM EP Lab conference.

Direct Patient Interaction

Division Clinicopathological Conference (monthly)

Journal Club (monthly)

Division Grand Rounds (weekly)

Department of Medicine Reference Library

UAMS and CAVHS Library (hard copy and on-line references)

Internet resources

National EP Conferences (once or twice per year)

III. ENCOUNTERS AND VENUES

Patient Characteristics

At University Hospital there is a diverse patient population, male and female, of all ages from adolescent to geriatric, representing most ethnic and racial backgrounds and from all social and economic groups. The University Hospital is a tertiary referral center that also serves as a primary health care facility for the local population of central Arkansas.

At CAVHS, patients are predominantly male, with over half over 65 years of age. With the increased return of soldiers from Iraq and Afghanistan, CAVHS is admitting more young veterans with PTSD and suicidal behaviors. Also, CAVHS serves a large urban homeless population, and many admitted veterans have challenging social issues. CAVHS Hospital is also a referral center for Arkansas, as well as for parts of several adjoining states, and thus receives patients with relatively complex medical problems.

Venues

University Hospital, UAMS, Little Rock AR

Central Arkansas Veterans Healthcare System, Little Rock AR

IV. SUPPORTIVE MATERIALS

Reading List

Zipes' *From Cell to Bedside* and Josephson's *Textbook of Electrophysiology* are two well respected resources that address all of the pertinent CCEP issues.

Other important resources included: ACC guidelines for management of atrial fibrillation, pacemaker and ICD indications, electrophysiology study and ablation indications.

All fellow work sites contain computers with Internet access to "Up to Date", MedLine, *New England Journal of Medicine*, Micromedex, MD Consult, clinical practice guidelines, and various electronic versions of standard medical text books.

V. POLICIES

Policies are available at http://www.uams.edu/dim/residency_program/

VI. SCHOLARSHIP

Understanding and participation in scholarship is an essential component of fellowship. Developing research competency including understanding of how research is conducted, evaluated, explained to patients and applied to patient care is supported throughout conferences, grand rounds and mentoring activities. CCEP fellows are expected to perform or participate in one clinical study and write at least one case report during their one year fellowship. A national expert in research, Dr. Jawahar Mehta from the Division of Cardiology will also guide the fellow and the EP program for the EP research activities. All CCEP fellows participate in presentation of research studies as part of the Monday morning EP Conference. Fellows also present posters, author journal articles and present original research at national and local conferences.

VII. CLINICAL ELECTROPHYSIOLOGY CURRICULUM

GOAL 1: UNDERSTAND THE FORMATION AND APPLICATION OF RADIOFREQUENCY ENERGY

Objective (A) Describe the generation of radiofrequency energy

Objective (B) Relate temperature, power, catheter tip size, irrigation, and impedance to lesion size.

Objective (C) Describe a plan for avoiding complications of radiofrequency energy.

GOAL 2: DISTINGUISH THE TYPES OF SUPRAVENTRICULAR TACHYCARDIA AND FORMULATE A PLAN FOR DIAGNOSIS AND TREATMENT BASED ON THE FOLLOWING OBJECTIVES:

Objective (A) Distinguish the AVA response from the AAV response during entrainment to separate atrial tachycardia from reentrant supraventricular tachycardia.

Objective (B) Separate avnodal reentrant tachycardia from orthodromic reciprocating tachycardia by programmed ventricular stimulation during His refractoriness

Objective (C) Define the three responses to Parahisian Pacing

Objective (D) Diagnose the type of supraventricular tachycardia based on aberrant intraventricular conduction during the tachycardia

Objective (E) Use premature atrial stimulation to diagnose Antidromic Tachycardia

Objective (F) Describe the morphology of Mahaim Preexcitation, the response to atrial pacing, and the optimal site for ablation

Objective (G) Localize atrial tachycardia by activation mapping , and entrainment mapping when applicable

Objective (H) Identify nonreentrant supraventricular tachycardia (2 for 1 conduction) and the appropriate site for ablation

Objective (I) Divide avnodal reentrant tachycardia into slow-fast, slow-slow, and fast-slow based on electrophysiological criteria and determine the most suitable location for ablation

Objective (J) Describe a method for avoiding complete Heart Block during Radiofrequency Ablation of AV Nodal Reentry

Objective (K) Recognize the presence of an Accessory Pathway as an Innocent Bystander

Objective (L) Explain the Criteria for Diagnosis and Treatment of Reentrant Supraventricular Tachycardia using more than one Accessory Pathway

GOAL 3: UNDERSTAND THE INDICATIONS FOR PACING AND DEFIBRILLATION AND DEMONSTRATE PROFICIENCY IN THE STEPS FOR IMPLANTATION OF A DUAL CHAMBER PACEMAKER

Objective (A) List the Class One indications for Permanent Pacing and ICD Implantation

Objective (B) Describe the anatomy and external landmarks for location of the cephalic vein, subclavian vein, and axillary vein site for lead placement

Objective (C) Understand the optimal sites for Atrial and Ventricular lead placement.

Objective (D) Demonstrate satisfactory lead parameters through lead testing in 50 patients.

Objective (E) Demonstrate the formation and closure of a pacemaker pocket for permanent implantation in 50 Patients.

Objective (F) Determine the cause for failure to Pace and or Sense and the appropriate treatment.

GOAL 4: DETERMINE THE ATRIAL FLUTTER CIRCUIT AND SITE FOR RADIOFREQUENCY ABLATION

Objective (A) Describe the anatomic barriers and location of the circuit in counterclockwise and clockwise isthmus dependent atrial flutter.

Objective (B) Establish diagnostic criteria for lower loop reentry

Objective (C) Formulate a plan for separating the circuits present in at least 3 types of left atrial flutter and determining the appropriate sites for ablation.

Objective (D) Utilize 3 dimensional mapping system to guide ablation procedure.

GOAL 5: UNDERSTAND THE PHYSIOLOGIC BASIS FOR ABLATION OF ATRIAL FIBRILLATION

Objective (A) Review the original report by Dr. Schwartz and describe the plan and results.

Objective (B) Describe the types of electrograms reported in the original NEJM paper on pulmonary vein isolation.

Objective (C) Separate pulmonary vein potentials from left atrial electrograms based on response to pacing

Objective (D) Learn fully the indications, contraindications, risks and limitations of ablation treatment for paroxysmal and persistent atrial fibrillation.

Objective (E) The fellow will also learn the technical skills for implementing this therapy while working closely with the primary operator. The fellow will be expected to be given increasing responsibility in invasive procedures in the CCEP laboratory progressively throughout the year. The electrophysiology laboratory experience will result in mastery of the pre and post-operative management of atrial fibrillation ablation and the related complications, either acute or chronic.

GOAL 6: UNDERSTAND AND DEMONSTRATE THE SKILLS REQUIRED FOR DEFIBRILLATOR IMPLANATATION

Objective (A) Place a defibrillator ventricular lead in the correct anatomical position for 75 Patients

(B) Demonstrate correct placement of left ventricular lead via the coronary sinus in 75 Patients

(C) Test the ICD using an external programmer to achieve satisfactory pacing and defibrillation thresholds.

(D) Describe a plan for follow-up testing of pacemakers and defibrillators

GOAL 7: DIAGNOSIS AND TREATMENT OF PACEMAKER AND ICD MALFUNCTION

Objective (A) Based on a review of the literature, formulate and describe an algorithm for detecting and treating pacemaker malfunction including T Wave sensing, Pacemaker Mediated Tachycardia, Myopotential Sensing, External Interference, Exit Block and differentiate these problems from normal Pacemaker Function such as Managed Ventricular Capture, PVARP extension, Upper Rate Behavior, and Hysteresis.

Objective (B) Devise a practical algorithm for detection and treatment of ICD Arrhythmias

Objective (C) Describe device-device, and drug interaction including the effects of anti arrhythmic drugs on pacing and defibrillation thresholds

GOAL 8: DIAGNOSIS AND RF ABLATION OF PVC'S AND VENTRICULAR TACHYCARDIA IN THE SETTING OF A STRUCTURALLY NORMAL HEART

Objective (A) correctly interpret intracardiac tracings for Patients with RVOT tachycardia, LVOT tachycardia, Idiopathic Left Ventricular Tachycardia, Bundle Branch Reentry, and related arrhythmias

GOAL 9: DIAGNOSE AND APPLY TECHNIQUES FOR DIAGNOSIS AND TREATMENT OF SCAR RELATED TACHYCARDIA

Objective (A) interpret the outcomes of ventricular entrainment pacing maneuvers for localization of sites within the ventricular tachycardia circuit

Objective(B) Describe 3 limitations of pacing Entrainment for Ventricular Tachycardia

Objective(C) Report the History of application of Sodium and Potassium Channel Blocking Drugs in the treatment of Ventricular Tachycardia, starting with the Cardiac Arrhythmia Suppression Trial

Objective(D) Explain the Limitations of the Vaughn Williams Classification of Antiarrhythmic Drugs

GOAL 10: UNDERSTAND AND DEMONSTRATE PROFICIENCY IN TEMPORARY PACING, TRANSESOPHAGEAL ECHO, AND CARDIOVERSION

OBJECTIVE (A) Describe the ACC_AHA guidelines for medical treatment of atrial fibrillation including the use of TEE, Cardioversion, and Anticoagulation

Objective (B) Define the indications for temporary and permanent pacing in acute myocardial infarction

GOAL 11: UNDERSTAND THE FORMATION OF THE CARDIAC ACTION POTENTIAL BASED ON CHANNEL ACTIVITY DISORDERS OF DEPOLARIZATION AND REPOLARIZATION

Objective (A) Describe the physiology of sodium channels.

Objective (B) Explain the types and actions of potassium channels active in Cardiac Repolarization

Objective (C) Demonstrate understanding of the interaction of antiarrhythmic medications with sodium, potassium, and calcium channels

Objective (D) Describe the basis for the congenital and acquired long QT Syndrome, Clinical Syndromes, and Treatment.

Objective (E) Relate the Brugada Syndrome to channel activity and describe the diagnosis and treatment

Objective (F) List the clinical criteria for the diagnosis of arrhythmogenic right ventricular dysplasia and molecular basis.

Objective (G) Describe the clinical findings in Patients with the Short QT Syndrome

GOAL 12: APPLY THE PRINCIPLES OF PACING TO CONGENITAL AND ACQUIRED HEART BLOCK.

Objective(A) Correlate the site of Heart Block with the indications for pacing.

Objective (B) Select Patients for Electrophysiologic Study with Heart Block to assist in the decision for pacing

Objective (C) Describe the clinical manifestations of the Sick Sinus Syndrome and the effects of Atrial and Ventricular Pacing.

GOAL 13: UNDERSTAND THE ROLE OF DEVICES IN THE TREATMENT OF CONGESTIVE HEART FAILURE

Objective (A) Review the history of device use in CHF

Objective (B) list the Class One criteria for the implantation of Pacemakers and ICDs in Patients with Congestive Heart Failure, including Biventricular Pacing.

Objective (B) Describe the outcomes of major clinical trials in this area

GOAL 14: TO CONDUCT A SELF STUDY PROGRAM TO IMPROVE UNDERSTANDING OF INTRACARDIAC ELECTROGRAMS AND DEVICE ACTIVITY

Objective (A) Interpretation of 400 intracardiac electrograms and 400 Pacemaker-ICD Electrograms including all electrogram illustrations in the standard textbook by Dr. Josephson. PLEASE BRING PROBLEM TRACINGS TO THE STAFF, OR SHOW THE TRACINGS IN WEDNESDAY AM CONFERENCES

Objective (B) Attend a review course in arrhythmias, pacing, or ablation

Objective (C) Read and Review the Chapters on basic sodium, potassium, and calcium channel activity in the standard textbook by Dr. Zipes

VII. Mix of Diseases in CCEP

- A. Sinus node function and diseases
- B. AV node function and diseases
- C. His-Purkinje system function and diseases
- D. Supraventricular tachycardias
- E. Ventricular tachyarrhythmias
- F. Pacemaker recipients
- G. ICD recipients
- H. Ischemic and nonischemic cardiomyopathy
- I. Congestive heart failure
- J. Congenital heart disease
- K. Congenital and acquired electrical diseases of the heart

VIII. Types of Clinical Encounters and Services

- A. Outpatient CCEP and Device clinics at UAMS and CAVHS supervised by an attending electrophysiologist two half days per week.
- B. Inpatient consultations and CCEP and device patient care.
- C. EP Lab pre, peri and post procedure patient care.
- D. Telemedicine CCEP and device consultations at CAVHS supervised by an attending electrophysiologist.
- E. Emergency Room CCEP and device consultation and interventions.
- F. Intensive Care Unit CCEP and device consultation and interventions.

IX. Types of Procedures

- A. Diagnostic and comprehensive electrophysiology studies at baseline and with utilization of medications.
- B. Simple and complex mapping and ablation procedures.
- C. Implantation of single, dual and biventricular pacemakers and ICD's.
- D. Implantation of implantable loop recorders.
- E. Tilt-table tests and carotid sinus massage.
- F. Exercise stress tests for arrhythmia induction and antiarrhythmic medications.
- G. Direct current cardioversion and antiarrhythmic medication use for facilitation of cardioversion.
- H. Interpretation of Holter EKG and 30 day event monitors.
- I. Interrogation of pacemakers, ICD's and implantable loop recorders.
- J. Interpretation of "over the internet" pacemakers, ICD's and implantable loop recorders.

X. Measureable CCEP Skills

Fellows will be presented with all expected skills at the beginning of the EP Fellowship and these will be evaluated and reviewed at the semi-annual and summative final evaluation meetings.

- (1) The fellow will be able to implant single, dual, and biventricular pacemakers and defibrillators.
- (2) The fellow will be able to interrogate single, dual, and biventricular pacemakers and defibrillators and interpret the findings.
- (3) The fellow will be able to perform diagnostic EP studies and interpret the findings for supraventricular and ventricular tachyarrhythmias as well as bradyarrhythmias and syncope.
- (4) The fellow will be able to perform simple and complex radiofrequency catheter ablation of all forms of supraventricular tachycardias as well as PVCs and ventricular tachycardias.
- (5) The fellow will be able to utilize and interpret 3 dimensional mapping techniques, entrainment techniques as a guide to perform complex ablations.
- (6) The fellow will be able to utilize and interpret intracardiac echocardiograms as a guide to perform transseptal punctures as well as complex ablations such as pulmonary vein isolation.
- (7) The fellow will be able to perform DC cardioversion and also utilize antiarrhythmic medications, such as, ibutilide as an adjunct to this procedure.
- (8) The fellow will be able to perform and interpret head up tilt table tests and carotid massage.
- (9) The fellow will be able to read and interpret 24-48 hour Holter ECGs, 30 day event monitors, and transtelephonic pacemaker interrogation.
- (10) The fellow will be able to interpret over the telephone recordings from pacemakers and defibrillators, such as Carelink and other transtelephonic systems.
- (11) The fellow will be able to read and interpret 12 lead ECGs and telemetry strips of arrhythmias.
- (12) The fellow will be able to take care of inpatient and outpatient routine and emergency arrhythmia consultations, and will be educated on the decision making process.
- (13) The fellow will be able to use all available antiarrhythmic medications in oral and intravenous forms in stable and emergency situations.
- (14) The fellow will be educated about the complications of implant and ablation procedures and will be able to manage these problems if they occur. If complications occur these patients will be presented in the monthly EP morbidity and mortality conference (Monday AM).
- (15) The fellow will be required to present at least one case per month during our weekly electrophysiology conference (Monday AM), and present interesting ECGs during our weekly ECG conference (Friday AM). In addition, he will be asked to interpret the intracardiac electrograms of the interesting studies that we have performed, during our weekly EP lab intracardiac electrogram interpretation conference (Wednesday AM).
- (16) The fellow will be required to follow the literature avidly and is expected to present the most interesting EP articles during our EP journal club conference (Monday AM).
- (17) The fellow is required to meet with the program director at the beginning of each month to discuss the expectations for that month, and meet at the end of each month to

evaluate the accomplishment of the goals for that month. In addition, the fellow will meet with all the EP staff of the division for a semi-annual evaluation formal meeting.

(18) The fellow will be evaluated by the EP staff of both the UAMS and CAVHS as well as EP lab managers on a monthly basis. The fellow will be required to fill out a monthly evaluation as well. We will also ask 1-2 patients a month to fill out a survey about the fellow's performance.

(19) The fellow will be required to perform and interpret exercise stress tests for arrhythmia induction and/or antiarrhythmic medication evaluation.

20) The fellow will be required to have a ½ day Device Clinic on Tuesday PM at the UAMS and and ½ day Arrhythmia EP Clinic at the CAVHS Wednesday PM. This will expose the fellow to preprocedure and postprocedure evaluations, and outpatient consultations. The fellow will be educated to develop the decision making process. He or she will also have hands-on experience with the pacemaker and defibrillator interrogations.