

Cardiac Electrophysiology Fellowship (1-year)

Name of Institution: McGill University Health Centre

Type of Fellowship: Cardiac Electrophysiology Fellowship

Program Information:

Number of fellowship positions: Maximum 2 per year

Academic affiliation: McGill University

Name of hospitals involved in training and % of time spent in each institution:

Glen Site 50 %

Montreal General Hospital 50%

Background:

Cardiac electrophysiology is one of the fastest growing subspecialty areas in cardiology. This subspecialty focuses on diagnosis and management of cardiac arrhythmias. It is recognized that the technical and cognitive skills required for performance of cardiac electrophysiology are considerable and take extensive time and training to acquire. Fellowship includes training in appropriate history, investigation and ECG diagnosis of arrhythmia, pharmacologic management of arrhythmias, and catheter ablation, as well as patient selection, implantation techniques, complications and management for pacing, implantable cardiac defibrillator (ICD) and cardiac resynchronization therapy (CRT).

The McGill University Health Centre (MUHC) is the electrophysiology referral centre for several referral hospitals serving a large geographical area covering a population of greater than 1.9 Million. The MUHC has a long history of device implantation at both the Royal Victoria Hospital (RVH) and the Montreal General Hospital (MGH) sites. In 2007, an electrophysiology device implantation laboratory was constructed at the MGH and dedicated full time to device implantations. In 2011, a state-of-the-art biplane electrophysiology laboratory was added to the electrophysiology suite at the MGH. This MGH biplane laboratory has been equipped with 3D mapping systems (CARTO 3, and EnSite Precision), 3D rotational angiography, a number of ablation systems (including Cryocath, Ablation Frontiers and novel systems including pulsed field ablation), to perform complex catheter ablation procedures (e.g. atrial fibrillation and ventricular tachycardia ablation). Since 2015, the activities are split between the Montreal General Hospital and the new MUHC Glen (relocated RVH site) facilities where a new electrophysiology laboratory was inaugurated. Combined across both MGH and Glen/RVH sites, our cardiac electrophysiology team performs over 1000 EP studies and ablation as well as 1300 device procedures including pacemakers, ICDs, CRT, conduction system pacing, complex mechanical and laser lead extractions, leadless pacemaker implantation, and subcutaneous ICD. The MUHC has also developed expertise in novel therapies such as sympathetic neuromodulation for the control of arrhythmia, as well as stereotactic radiation for refractory ventricular arrhythmia in collaboration with the radiation oncology team.

Specialized electrophysiology clinics happen at the Glen site and provide cardiac electrophysiology expertise to patients with heart failure, congenital cardiac anomalies or complex cardiac arrhythmias. A new family heart centre was inaugurated at the MGH in 2021. A cardiac genetics clinic has been developed and combines the expertise of cardiologists trained in the management of inherited cardiac arrhythmia syndromes, medical geneticists, and genetic counselors. Specialized device follow-up clinics also exist at both sites and treat over 5000 patients per year. On call coverage for electrophysiology emergencies is provided 24hr per day throughout the year by MUHC electrophysiologists.

Mission:

Our mission is to be a referral centre of excellence in interventional electrophysiology integrated within the Centre of Excellence in Cardiovascular Sciences at McGill University. Our goal is to provide excellence in patient care, research, and education in interventional electrophysiology.

Research Activity:

Clinical research is an integral part of the MUHC electrophysiology program. The research performed includes drug trials as well as research on implantable devices and catheter ablation. A number of trials are ongoing or in the process of being planned. Examples of research studies are listed below:

Clinical Studies with MUHC Electrophysiology Principal Investigators (selected studies):

- 1) AWARE: Augmented Wide Area Circumferential Catheter Ablation for Reduction of Atrial Fibrillation Recurrence - A Multicentre Randomized Clinical Trial. (Funding: Canadian Institutes of Health Research (CIHR); Principal Investigators: Girish Nair and **Vidal Essebag**)
- 2) AWARE-2: Ablation Strategy for Paroxysmal Atrial Fibrillation - Trigger and Substrate Guided Wide Area Radiofrequency Ablation Compared to Cryoablation Pulmonary Vein Isolation- A Patient Specific Precise Approach to Paroxysmal Atrial Fibrillation Ablation. (Funding: Canadian Institutes of Health Research (CIHR); Principal Investigators include: Girish Nair and **Vidal Essebag**)
- 3) BRUISE CONTROL: BRidge or continUe coumadIn for device SurgEry randomized CONTROLled Trial. (Funding: CIHR; Principal Investigators: David H Birnie and **Vidal Essebag**)
- 4) BRUISE CONTROL-2: A randomized controlled trial to investigate whether a strategy of Continued versus Interrupted NOAC at the time of device surgery, in patients with moderate to high risk of thrombo-embolic events. (Principal Investigators: David Birnie, Jeff Healey and **Vidal Essebag**)
- 5) CAPCOST: The Prospective, Multicenter Canadian Atrial Fibrillation Pulmonary Vein Ablation Catheter Cohort Study. (Principal Investigators: **Atul Verma** and **Vidal Essebag**).
- 6) Population Level Evaluation of Ablation Therapies in Atrial Fibrillation. (Funding: CIHR; Principal Investigators: Louise Pilote and **Vidal Essebag**)
- 7) LEFT HF: LEFT Bundle Pacing vs Standard Right Ventricular Pacing for Heart Failure. (Funding: CIHR; Principal Investigators include: **Jacqueline Joza**, **Atul Verma** and **Vidal Essebag**)
- 8) OCEAN: The Optimal Anticoagulation for Enhanced Risk Patients Post-Catheter Ablation for Atrial Fibrillation Trial. (Funding: CIHR; Principal Investigators: **Atul Verma** and David Birnie)
- 9) STAR AF 3: Strategies for Catheter Ablation of Persistent Atrial Fibrillation: A Randomized, Comparative Study (Principal Investigator: **Atul Verma**)
- 10) PULSED AF: Pulsed Field Ablation to Irreversibly Electroporate Tissue and Treat AF. (Principal Investigator: **Atul Verma**)

Clinical Studies with MUHC Local Principal Investigators / co-applicants (selected studies):

- 1) RAFT-PerMAF: Resynchronization/defibrillation for Ambulatory Heart Failure Trial in patients with Permanent AF. (Funding: CIHR)
- 2) RAFT-AF: A Randomized Ablation-based atrial fibrillation rhythm control versus rate control trial in patients with heart failure and high burden Atrial Fibrillation. (Funding: CIHR)
- 3) VANISH-2: Ventricular Tachycardia Antiarrhythmics Or Ablation In Structural Heart Disease 2. (Funding: Heart and Stroke Foundation of Canada (HSFC))
- 4) VANISH: Ventricular tachycardia Ablation vs. enhanced drug therapy In Structural Heart disease
- 5) Cardiac Sarcoidosis Multi-Center Prospective Cohort. (Funding: CIHR)
- 6) SYNCAV: The SyncAV Post-Market Trial
- 7) EARLY-AF: Early Invasive Intervention for Atrial Fibrillation. (Funding: CANet)
- 8) ARTESIA: Apixaban for the Reduction of Thrombo-Embolism in Patients with Device-Detected Sub-Clinical Atrial Fibrillation. (Funding: CIHR)
- 9) AdaptResponse: Multi-center, randomized, single-blinded study to assess the effect of preferential LV-only pacing in cardiac resynchronization therapy
- 10) MORE CRT MPP: MORE RESPONSE on Cardiac Resynchronization Therapy with MultiPoint Pacing
- 11) ATLAS S-ICD: Avoid Transvenous Leads in Appropriate Subjects
- 12) PADIT: Prevention of Arrhythmia Device Infection Trial
- 13) COAST-AF: Characterization of arrhythmia substrate to ablate persistent atrial fibrillation randomized clinical trial
- 14) REFINE ICD: Risk Estimation Following Infarction, Non-invasive Evaluation – ICD efficacy
- 15) BRAIN-AF: Blinded Randomized trial of Anticoagulation to prevent Ischemic stroke and Neurocognitive Impairment in Atrial Fibrillation
- 16) Adagio VT: Cryoablation for Monomorphic Ventricular Tachycardia
- 17) STAR-VT: Stereotactic Arrhythmia Radioablation for Ventricular Tachycardia: A Phase II Trial
- 18) ARVC: Arrhythmogenic Right Ventricular Cardiomyopathy (Funding: Heart and Stroke Foundation of Ontario (HSFO))
- 19) CASPER: Cardiac Arrest Survivors with Preserved Ejection Fraction. (Funding: HSFC)
- 20) LQTS: Impact on Early Repolarization on Long QT Syndrome. (Funding: HSFC and CIHR)

Fellowship Program Directors: Dr. Martin Bernier and Dr. Vidal Essebag (co-director)

Teaching Faculty:

Dr. Martin Bernier, Dr. Vidal Essebag, Dr. Tom Hadjis, Dr. Jacqueline Joza, and Dr. Atul Verma are full time cardiac electrophysiologists at the MUHC. Drs Bernier, Essebag and Hadjis trained in interventional cardiac electrophysiology at Harvard University and Dr. Joza returned to the MUHC after completing her cardiac electrophysiology fellowship at NYU. Dr. Atul Verma did his EP training at the Cleveland Clinic and was the director of the Heart Rhythm Program at the Southlake Regional Health Centre in Ontario until moving to Montreal as the director of cardiology for the MUHC in 2022. The faculty's clinical expertise includes all aspects of device implantation, complex ablation, and non-invasive electrophysiology diagnosis and management. Part time MUHC electrophysiology faculty includes Dr. Teresa Kus, Dr. Giuliano Becker and Dr. Jean Francois Roux. A new full-time pediatric electrophysiologist is currently being recruited and will collaborate with heart rhythm management of adult congenital heart disease and cardiogenetics.

Academic Facilities:

Ablation procedures (simple and complex) are performed in the electrophysiology laboratories at the MGH and Glen sites. Device implantation is concentrated at the Glen site but also performed at the MGH. Pacemaker clinics are located at both MGH and Glen sites. Electrophysiology clinics are located at the Glen site. A list of recommended books and readings will be provided. Attendance at a national or international conference will be strongly encouraged.

Program Entry Requirements:

Electrophysiology fellows should have completed Cardiology core training at an institution with Royal College certification or equivalent for foreign fellows. Knowledge of diagnosis and management of arrhythmia is considered part of core cardiology training, and the ability to function as a cardiologist is a prerequisite for cardiac electrophysiology training. Patient management issues such as heart failure, ischemic heart disease, hypertension, and stroke prevention all intersect with arrhythmia management. The ability to perform an appropriate history, physical examination and conduct appropriate investigations related to cardiovascular symptomatology or disease is assumed to be integral to cardiology training.

Curriculum:

The complete cardiac electrophysiology fellowship is a 2-year program providing training in advanced noninvasive and invasive arrhythmia management including all aspects of device implantation as well as simple and complex ablation procedures (see 2-year fellowship description on website for details). The 1-year curriculum is primarily intended for candidates who will have already completed dedicated cardiac electrophysiology training and desire an additional year of particular clinical and/or research expertise. Requests for a 1-year fellowship with a focus on advanced skills or specific procedures will be evaluated on a case-by-case basis. Depending on the specific clinical needs of the future working environment of the trainees, applicants may be encouraged to apply for the 1-year fellowship. The curriculum will include cognitive skills, technical skills, research, and education. Progress is assessed regularly and feedback is given every 3 months to trainees.

Cognitive Skills:

Cognitive skills are acquired both by experience in clinical care on the wards, clinic, and in the electrophysiology lab as well as by structured instruction in rounds and other structured sessions. Many of the cognitive skills will be acquired by discussion with staff and colleagues and attendance and presentation at rounds. Participation in a structured research project will develop the skill to critically appraise the science behind clinical guidelines and clinical decision-making.

Cognitive skills required in cardiac electrophysiology training

Roles:	Strategies	
	Clinical Care	Structured Instruction
Medical expert/ Clinical Decision-Maker	<ol style="list-style-type: none"> 1. Knowledge of current indications and contraindications for an electrophysiology study. 2. Knowledge of potential complications with EP studies and management of such complications. 3. Knowledge of various methods of programmed electrical stimulation. 4. Ability to measure conduction intervals and refractory periods; knowledge of their significance in normal and pathological states. 5. Knowledge of the predictive value of EP-testing in patients with various arrhythmias and clinical syndromes. 6. Ability to interpret data derived from EP testing. 7. Knowledge of the indications for and complications of therapy with antiarrhythmia devices. 8. Knowledge of the indications for and complications of ablative therapy. 9. Detailed knowledge of recent clinical trials that affect the selection of patients for EPS. 10. Indications for ICD therapy. 11. Indications for CRT. 12. Review of implant techniques, including coronary sinus lead placement. 13. Knowledge of performance, complications of and contraindications to defibrillation threshold testing. 14. Knowledge of external defibrillation/cardioversion techniques. 15. Programming and troubleshooting of ICD's and CRT devices. 16. Knowledge of ICD emergencies. 17. Knowledge of indications and contraindications of tilt-table testing – protocol of administration and interpretation of results. 18. Knowledge of radiation safety protection for staff and patients. 	<ol style="list-style-type: none"> 1. Know normal and abnormal cardiac anatomy and electrophysiology. 2. Know anatomy and physiology of the normal atrioventricular conduction system and accessory pathways. 3. Understanding of intracardiac electrocardiographic signals. 4. Understand the pathogenesis of cardiac arrhythmias including primary electrophysiology abnormalities and secondary causes of rhythm disturbances 5. Know the pharmacology of antiarrhythmic drugs and of sympathetic and parasympathetic antagonists 6. Know the causes of syncope 7. Understand the basic concepts of artificial pacemaker function 8. Understand the concept of proarrhythmia 9. Be able to interpret Holter Recordings 10. Be able to interpret intracardiac device interrogation including electrograms. 11. Understand the advantages and limitations of genetic testing in patients and families with inherited arrhythmia syndromes of sudden death 12. Understand the investigations and management of inherited arrhythmia syndromes in patients and their families.

Communicator	<ol style="list-style-type: none"> 1. Be able to inform the patient and their family about their problem, its prognosis, management and plans for follow-up 2. Communicate with the health care team regarding the patient management plan 3. Be able to write consultation/ discharge letters to referring physicians 4. Prepare the final EP study reports 	<ol style="list-style-type: none"> 1. Participate actively in teaching sessions 2. Prepare and present rounds as scheduled
Collaborator	<ol style="list-style-type: none"> 1. Work with the house-staff team in the care of patients 2. Participate in the performance of the EP study 3. Understand and support the roles of allied health professionals (nurse, EP technologist) in the EP lab 	<ol style="list-style-type: none"> 1. Contribute to organized rounds
Scholar	<ol style="list-style-type: none"> 1. Recognize gaps in knowledge regarding patient problems and develop strategies to fill the gap through reading and consulting other members of the health care team 2. Contribute knowledge learned to service rounds 	<ol style="list-style-type: none"> 1. Read the articles provided 2. Critically review relevant published material at Journal Club 3. Participate in and understand arrhythmia research project
Professional	<ol style="list-style-type: none"> 1. Deliver care with integrity, honesty and compassion 2. Understand the professional, legal and ethical codes to which physicians are bound 	

Education:

EP fellows take an active part in the education curriculum. Weekly teaching rounds are organized to the benefit of EP fellows. The sessions will include review of interesting tracings, device troubleshooting, discussion of interesting cases and review of relevant topics. The EP fellows are expected to attend and to also routinely present at those rounds. Sporadically, rounds are video-conferenced between several hospitals. The fellows are expected to attend and will also be asked to present on occasion.

Non-invasive EP is part of the curriculum, mostly through weekly attendance at 1 or 2 general EP clinics, under the supervision of an electrophysiologist. Participation in other specialized clinics (congenital, heart failure and genetics) is also expected and can be tailored according to individual objectives.

EP fellows are expected to attend an average of 1-2 days of device clinic per week. During that time, they will routinely have general cardiology residents shadowing them. The EP fellows are expected to teach the basics of device interrogation and troubleshooting.

In addition, the EP fellows are involved in the teaching to general cardiology residents as well as more junior residents rotating on the coronary care unit (CCU). EP fellows take turns in giving 30-minute weekly introductory presentations to the CCU team.

Technical Skills:

Technical skills will be obtained by exposure to simple and complex procedures in the cardiac electrophysiology laboratory. The focus during the first year of training will be on developing excellent device implantation techniques and acquiring skills at catheter placement and interpretation of tracings in the electrophysiology (EP) lab (including independent manipulation of EP recording system and

cardiac stimulator to perform EP studies and ablation). The senior EP fellow in the second year of fellowship will focus more time on complex device implantation as well as ablation procedures, simple and complex.

Basic technical skills required for performing electrophysiology studies include the following:

- 1) Operational skills to perform right and left heart catheterization with percutaneous techniques via femoral and other venous and arterial access sites.
- 2) Manual dexterity to safely place and manipulate electrode catheters in the appropriate chambers for the arrhythmia under study.
- 3) Ability to obtain appropriate recordings from various locations.
- 4) Ability to safely perform programmed electrical stimulation.
- 5) Ability to recognize and manage procedural complications.
- 6) Proficiency in the use of external defibrillation and intravenous cardiac medications.
- 7) Proficiency in the appropriate use of sedation including airway management
- 8) Proficiency on anticoagulation issues in cardiac arrhythmia, affecting risk of strokes and hemorrhagic complications of the invasive procedures
- 9) Proficiency in the testing, interrogation, and programming of implantable antiarrhythmia devices, including pacemakers and defibrillators
- 10) Technical knowledge of electrical safety and pertinent radiation-related issues

It is recognized that different fellows may acquire technical skills at somewhat different rates. As a result, the evaluation of technical skills will not be based simply upon the number of procedures performed. Ultimately, the Fellowship Program Director will be responsible for evaluation of technical skills acquired by each trainee. Nevertheless, there are a certain minimum number of procedures required in order to have adequate exposure to techniques and complications of electrophysiology procedures and device implantation. The expected minimum experience for these procedures is outlined below:

- 1) Primary operator and analysis of 100-150 diagnostic electrophysiology studies, of which 50 involve patients with supraventricular arrhythmias.
- 2) Performance of at least 75 ablations for supraventricular tachycardia (SVT)
- 3) Primary operator of at least 100 ICD/PPM implantations and at least 30 revisions
- 4) Performance of at least 15 coronary sinus (LV) lead placements
- 5) Supervised performance of at least 20 transseptal punctures
- 6) For left sided procedures, at least 15 procedures using the retrograde aortic approach
- 7) For training in atrial fibrillation (AF) ablation, 30-50 supervised ablations
- 8) For training in scar-related ventricular tachycardia (VT) ablation, 15-20 procedures

Research:

Clinical research is an integral part of the cardiac electrophysiology program at the MUHC. Several research protocols are ongoing at any given time. EP fellows work closely with the physicians, research nurses and coordinators at all stages of the research. Protected time for research activities will be provided. All fellows will be expected to participate in research in the following ways:

- 1) During the course of a year, each fellow should identify at least one project. Ideally this would be a prospective project that would include a full research cycle of data collection, abstract preparation and completion of a manuscript.

- 2) Fellows will be expected to perform peer-review of articles under the supervision of an attending electrophysiologist.
- 3) Fellows should avail themselves of the opportunity to i) do a retrospective study, ii) write a review article, or iii) write a book chapter with one of the consultants.
- 4) Fellows are expected to actively participate in all ongoing clinical trials in electrophysiology including the screening and follow-up of patients enrolled in such trials.
- 5) Fellows are expected to present their research progress at rounds on a quarterly basis, and annually at Cardiology Resident Research Day.

Fellow Duties and Responsibilities:

- 1) The standard workday extends from 7:00 AM to 5:00 PM. Presence on site during these hours is expected. The fellow is responsible for supervision of the inpatient electrophysiology service including admission and discharge of patients admitted under the electrophysiology service for elective device implantation or ablation procedures. Evaluation of patients prior to their procedure and obtaining informed consent is expected of the fellows. Occasionally, fellows will be asked to help triage urgent EP requests. It is expected that fellows will function as a team to assist colleagues when they have completed their assigned task (assist with inpatient or outpatient consultations, Holter reading and/or research activities).
- 2) On call for cardiac electrophysiology: generally, one week (including weekend) per calendar month, under supervision of the on-call electrophysiologist. When on weekend duty, the fellow is expected to round on EP inpatients and perform EP consultation as required.
- 3) Weekly attendance at both EP clinics and device clinics (total 1-2 days per week). Participation in other specialized clinics (heart failure, congenital and genetics) is also expected. This includes supervision and teaching of cardiology residents in device clinics.
- 4) Teaching of cardiology residents during CCU teaching sessions or academic half-days.
- 5) Pre-procedure evaluation of patients in outpatient clinics referred for interventional electrophysiology procedures and device implantation.
- 6) Attendance and participation at cardiac electrophysiology service rounds.
- 7) Participation in academic activities involving the residents including organization and presentation of rounds.
- 8) Attendance at least at one national or international electrophysiology/device conference.
- 9) Participation in ongoing research activities with supervised participation in protocol development and manuscript preparation. This includes active participation in screening and follow-up of patients involved in a number of different research protocols.
- 10) The fellow is encouraged to prepare for and perform the **International Board of Heart Rhythm Examiners (IBHRE) Cardiac Rhythm Device Therapy Examination for the Physician** following the completion of training (the examination is held annually in July). For more information see website: <http://www.ibhre.org/ExamInformation/ExamInformation.htm>
- 11) The fellow is strongly encouraged to become a member of the **Heart Rhythm Society**. Affiliate Membership during training is complimentary. For more information see website: <http://www.hrsonline.org/About/Membership/Benefits/index.cfm>
- 12) The fellow is also strongly encouraged to become a member of the **Canadian Cardiovascular Society (CCS)** and the **Canadian Heart Rhythm Society (CHRS)**. Affiliate Membership during training is complimentary.