Cardiology Fellowship Manual

Goals & Objectives
-Electrophysiology-

Electrophysiology Rotation for Categorical Fellows:
UNMC-Pediatric Cardiology / Children's Hospital & Medical Center
Omaha, NE

EP Faculty:

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I. Academic Requirements:
   a. First Year Rotation
      i. 30 Minute presentation on an EP topic of the fellow's choice or review of a pertinent EP specific Journal article (Interpersonal & Communication Skills, Medical Knowledge, Practice-based Learning, Professionalism)
   b. Second Year Rotation
      i. 30 minute presentation on an EP topic of the fellow's choice or review of a pertinent EP specific journal article (IPCS, MK, PBL, P)
   c. Third Year Rotation
      i. 45 minute presentation on an advanced EP topic of the fellow's choice or review of a series of journal articles relative to an EP specific topic for group discussion (IPCS, MK, PBL, P)

II. Clinical Responsibilities (Patient Care, MK, IPCS)
   a. The daily clinical responsibilities will be determined by the EP physician on daytime duty for the day/week. This will allow proper balance between clinics, consults, procedures, and non-invasive testing. For example, a 1st year fellow will not be expected to read ECGs on a day when there are 2 ablations. However when there is no clinical activity that time should be used for reading ECGs and other non-invasive testing as appropriate for level of training.

   b. ECGs - When there are no clinical assignments, attempt to read ECGs in CardioServer.
      i. The "Inbox" of daily ECGs in the CardioServer program is the top priority and should be read and sent to the "Read" bin for review at a time coordinated between the categorical cardiology fellow and the EP staff. The studies will be reviewed and confirmed with the EP staff on a daily basis.
      ii. ECGs should be completed and read for review by 4:00 pm daily or at a mutually agreed time with the daytime EP attending.
      iii. Fellows should have a goal to read a minimum of 200 ECGs per EP month.

iv. PERFORMING ECGs – This will be done during each of the fellow's echocardiography months.
    1. Immediately following Cardiac Care Conference and reporting to Cardiac Diagnostics, the 1st study will be performing an ECG with the supervision of an echo/ECG technician
    2. Only one ECG per week during the echo rotation needs to be done.

c. Holter Studies
    i. A minimum of 10 Holter studies per month should be read in coordination with the EP attendings. Holters will be pre-reviewed on CardioServer similar to reading ECGs on CardioServer. First year fellows will most likely need to read ECGs for the 1st couple of weeks of their EP rotation before starting to read Holters.
d. Event Recordings
    i. Event recordings sent in by patients either via telephone or internet will be stored in CardioServer and available to read by the 2nd or 3rd year fellows. Similar to reading ECGs or Holters, the fellow will make an interpretation and then file in the "Read" bin of CardioServer.
e. Participation in a minimum of two ½ days per week of outpatient Arrhythmia or Genetic Arrhythmia Clinics with Drs. Erickson or Robinson.
f. Participation in the management of in-house EP patients
    i. The fellow will evaluate each EP patient admitted to the hospital
        1. Review the case with the EP attending
        2. Communicate to the resident house staff about admissions plan
    ii. The fellow will perform all EP consults
        1. Review the case with the EP attending
        2. Communicate to the resident house staff about admission plan
    iii. Assessment of temporary thresholds on post-operative patients
    iv. Patients with EP issues should be rounded on daily or as determined by EP staff. This includes review of telemetry either in an intensive care unit or on the floor. Notes should be written in Epic which require cosignature by the EP attending. The patients' care will be coordinated with the EP service attending. The Epic notes should be kept daily on all in house EP patients.
g. Tilt table studies

i. Tilt table studies are very rare. Participation in tilt table examinations is encourage if one occurs including interpretation of results and dictation of study as determined by the EP attending for the day/week.

h. Exercise studies
    i. Attend exercise studies in which there is an increased risk for life threatening arrhythmias as screened by the exercise staff as determined by the EP attending for the day/week.
    ii. Attend a minimum of four exercise testing studies/month on EP patients (for maximum learning, attempt to attend studies for a variety of indications i.e. long QT evaluation, syncope, congenital heart disease).
    iii. Review of exercise study ECGs – 1st year fellows should start looking at these in the last 2 weeks of their EP rotation as they become more familiar with ECGs and rhythms. 2nd and 3rd year fellows should try to review at least 10 exercise ECGs for their EP months.

i. Pacemaker/ICD/ILR Evaluations
    i. Fellows should attend a minimum of 10 pacemaker, ICD, or ILR interrogations each month in coordination with the EP nurses. These pacemaker checks occur mostly in clinic but also occur 1-2 days after a device implant
    ii. Telephone/internet transmissions of pacemaker/ICD/ILR data from patients on a regular basis are now stored in CardioServer. An attempt to interpret should be made and reviewed with the EP attending commensurate with level of EP/ECG experience. By the fellow's 3rd year, basic pacing rhythms should be mastered.

j. Participation in EP Procedures
    i. EP procedures scheduled in advance for each week will be discussed with the EP team each Monday. The fellow should be notified by the EP nurses of all cases scheduled for the month as well as add-ons.
        1. A comprehensive understanding of the patient's primary arrhythmic issue, medications, other medical problems, indications for the given procedure and basic plan for the procedure should be developed. Cases for the week should be reviewed with the EP team each Monday.
        2. The fellow should have all necessary data related to the case available for review with the attending.

k. Pacemaker/ICD/ILR Implantations
    i. Fellows should attend all device implants as directed by the EP attending for the day/week

1. Keep a copy of all implant dictations as these count towards device numbers should you decide to pursue EP fellowship.

ii. Transvenous Device Implants in the Cardiac Catheterization Lab
    1. Fellows are responsible for peri-operative orders, H&P and procedural consent.
    2. Fellow will coordinate with the EP nurse for device interrogation prior to discharge

iii. Surgical Epicardial Device Implants
    1. Fellows are required to attend epicardial pacemaker and non-thoracotomy ICD implants as directed by the EP attending for the day/week
    2. Fellow will coordinate with the EP nurse for device interrogation prior to discharge

l. EP Studies
    i. The fellow's participation in each EP case will be determined by the EP attending of the day/week. Depending on the case load for the month, the fellow's level of experience, the fellow's aptitude for EP, etc will determine which cases (or portions of cases – i.e. starting lines and placing catheters) will be attended by the fellow
    ii. Fellows should consent and complete pre-procedural work for all patients in whom they will be participating in the procedure.
    iii. Esophageal and Transvenous Studies
        1. Fellows are responsible to coordinate with the EP attending of the case for procedural consent, preoperative and postoperative orders
        2. The fellow should document on the pre-operative H&P the procedure and specific risks discussed with the patient/parents.
    iv. If the fellow is unable to attend an EP case, he/she should notify the EP attending of the procedure more than 24hrs prior to the procedure.
    v. The EP fellow should have a comprehensive understanding of the patient's medical history including:
        1. Previous and ongoing arrhythmia issues and medical therapies. When was the patient's last documented arrhythmia? How frequent are their symptoms? Etc.
        2. Pervious EP related studies or invasive testing
        3. Have copies of relevant ECG or other testing for review during the case

4. Understand all medications and other medical conditions the patient may have
5. There should be an understanding of the indications for the scheduled procedure and the plan for the case. Why are we doing an ablation vs. medical therapy? What catheters are needed for a given case or what additional mapping or ablation systems may be used?

vi. The fellow will keep a "EP Study Fellow Worksheet" during each EP study and discuss with the attending during or immediately after each case. An example is at the end of this document.

m. Cardioversions
   i. The fellow will attend cardioversions while on the EP service as directed by the EP attending for the day/week
      1. Includes medical, pacing (transesophageal and using i8mplatned pacemaker system or temporary pacing leads) and DC cardioversions
   ii. The fellow will be responsible for H&Ps, peri-procedure orders, and procedure dictation
n. Monthly fellow evaluations will be based on the above criteria. For minimum procedural requirements of pacemaker/ICD/ILR interrogations, ECG, Holter, event recordings an exercise studies, the fellow should keep a record of patient's name and medical record number for submission and tracking at the end of the month. It is similarly important to log all procedures including EP studies, ablations, and device implants (it is important to know that, in the event that you would decide to go on for further EP training, your procedures completed in general cardiology training would count for your total EP volume).
   i. It should be noted that one feature of CardioServer is that all of your ECGs, Holters, pacemaker/ICD/ILR, and event recordings that have been read by the fellow can be retrieved but this should be checked periodically to ensure that you are getting adequate volume completed.

III. Administrative Experience/Responsibilities
   a. Attend bi-monthly EP service meeting when on the EP service (also welcome when not committed to another clinical rotation)
   b. Participate in clinical service billing of inpatient and outpatient consults and patient visits, non-invasive testing, as well as EP procedures
   c. Develop an understanding of the financial impact of EP clinical medicine to patient care

IV. Ideas for Monthly Presentation or Journal Articles:
    a. Channelopathies
        i. General overview of channelopathies
        ii. Long QT Syndrome
            1. Diagnosis
            2. Risk-Stratification
            3. Medical therapies
            4. Genetic applications/testing
        iii. Brugada Syndrome
        iv. Catecholaminergic Polymorphic Ventricular Tachycardia (CPVT)
    b. Differential diagnosis of a wide complex tachyarrhythmia
        i. Ventricular tachycardias
        ii. Differential between SVT with conduction abnormalities and ventricular tachycardias
    c. Management of ventricular tachycardia
        i. Common forms of ventricular tachycardias
        ii. Who is at risk for ventricular arrhythmias follow cardiac surgical palliation
        iii. Ventricular tachycardias and heart failure
        iv. Ventricular tachycardia and cardiomyopathies
    d. Supraventricular tachycardias
        i. Atrial tachycardias
        ii. AVNRT
        iii. AVRT
            1. Accessory pathways
            2. Wolff-Parkinson-White Syndrome
                a. Risk of sudden death
                b. Risk stratification
    e. Anti-arrhythmic medications
        i. Treatments
        ii. Drug classifications
    f. Catheter ablation
        i. Indications for ablation
        ii. Differential diagnosis of tachycardias by intracardiac electrograms
    g. Cardiomyopathies with ventricular arrhythmias
        i. Arrhythmogenic Right Ventricular Cardiomyopathy
        ii. Hypertrophic Cardiomyopathy
        iii. Dilated Cardiomyopathy
    h. Pacemaker and ICD devices
        i. Basic device functions
        ii. Indications for device implantation
            1. ICD implantation (primary vs. secondary indications)

2. Pacemakers (bradyarrhythmia/tachyarrhythmia indications)

iii. Common complications of device implantation in children of adults with congenital heart disease

i. Risk of sudden death in the young

V. Clinical Knowledge Expectations by Rotation

a. MAKE IT A GOAL TO ACHIEVE EACH OF THE ITEMS BELOW BY READING ON EACH TOPIC BY THE END OF THE EP MONTH! FIFTEEN MINUTES PER DAY SHOULD BE THE MINIMUM!

b. Evaluations

i. During each month of EP the fellow will meet with one of the staff EP faculty after 2 weeks and after 4 weeks of service to review the progress of the clinical competencies listed below:

c. Year 1: (MK, PC)

i. Fellows should focus on the basics of electrophysiology including:

1. Surface electrocardiograms

_____Understand the fundamentals of the ECG

_____Differentiate between wide and narrow complex tachycardias

2. Diagnosis and management of the common forms of supraventricular tachycardias

_____Develop a differential diagnosis of different forms of SVT

3. Wide complex tachycardia

_____Develop a differential diagnosis for wide complex arrhythmias

_____Differentiate between SVT with conduction disturbance or pre-excitation and ventricular tachycardia

4. Basic fundamentals of the invasive electrophysiologic study

_____Know the indications for invasive testing

_____Know the basic channels used for a basic EP study

_____Know normal baseline intracardiac intervals

Basics of pacemaker and ICD/defibrillator management

_____Develop an understanding of basic pacing systems including:

_____Basic modes of operation

_____Differences between pacemakers and ICDs

5. 5 Med/Surg and PICU Management

a. Gather pertinent data for an EP consultation
    i. Pertinent diagnostic studies
    ii. Pertinent history and physical exam

d. Year 2: (MK, PC)
    i. Fellow should focus on advancing their understanding of the basics of electrophysiology
        1. Surface ECGs
            _____Have a firm grasp of the fundamentals of the basic ECG
            _____Develop a differential diagnosis for narrow and wide complex tachycardias
    ii. Invasive EP Studies
        _____Master the basics of intra-cardiac electrograms, intervals, and catheter placement
        _____Differentiate the common types of SVT and be able to describe basic diagnostic maneuvers to induce, terminate and differentiate these rhythms.
        _____Understand the basic strategies for ablation
        _____Know typical intra-cardiac catheters used and what information is provided by each catheter
        _____Understand basic pacing maneuvers performed during EP studies
    iii. Channelopathies
        _____Fellows should have a firm understanding of the common forms of cardiac channelopathies
        _____Basic diagnosis and differential diagnosis
        _____Basic risk stratification techniques
    iv. Advanced concepts in device management
        _____Become fluent in the basics of temporary pacing
        _____Understand indications for device implantation and modes of pacing
        _____Know the common complications with cardiac devices
    v. Patient Care
        _____Fellow should be adept at taking an EP focused history and physical exam and develop an initial plan for management.
        _____Develop an understanding of the common anti-arrhythmic medications and their uses and contraindications
            _____Know the ECG changes seen with treatment and with toxicity

e. Year 3: (MK, PC, PBL)

i. Fellows during this month should transition from the "reporting stage" to being able to develop patient specific treatment for EP issues
    1. Invasive EP Studies
        _____Describe and follow an invasive EP study from beginning to end.
        _____Understand basic concepts in arrhythmia differential and indications for ablation
        _____Understand ablation target selection process
    2. Advanced concepts in arrhythmia management
        _____Have a firm understanding of diagnosis and management of narrow complex tachycardia
        _____Have an understanding of the basic management of complex arrhythmias
            _____Ventricular arrhythmias
            _____Channelopathies
            _____Post-operative arrhythmias
    3. Pacemakers and ICDs
        _____Describe a full pacemaker or ICD device interrogation
        _____Understand how to program a pacemaker or ICD

f. Month 4 (elective): (PBL)
    i. The fellows should use this month to focus on areas of weakness or areas of interest in preparation for transition to a fully functional cardiologist or before an EP fellowship
        _____Perform EP consults and management with little intervention
        _____Diagnose and manage all forms of narrow complex tachycardias as well
        _____Place basic EP catheters (HRA, His, RVA)
        _____Run a basic EP study from the stimulator

Appendix A – EP knowledge checklist ***throughout*** fellowship

TABLE 1 Core Curricular Competencies and Evaluation Tools for Pediatric Electrophysiology

Medical Knowledge:

- Know the cellular and whole-organ electrophysiology.
- Know the anatomy and embryology of conduction tissues.
- Know the developmental changes in cardiac rates and rhythm with age.
- Know the basic mechanism of arrhythmias.
- Know the clinical presentation and mechanisms of supraventricular tachycardias.
- Know the clinical presentation and mechanisms of ventricular tachycardias.
- Know the clinical presentations and mechanisms of channelopathies and hereditary cardiomyopathies.
- Know the clinical presentations of and mechanisms of bradycardia and atrioventricular block.
- Know the clinical presentations and diagnoses of fetal arrhythmias.
- Know the presentations and mechanisms of palpitations, syncope, and sudden cardiac death in the young.
- Know the specifics for clearance for sports participation.
- Know the mechanisms and types of arrhythmias in CHD.
- Know pacing modes, basic pacemaker interrogation, pacemaker or ICD types, and basic trouble-shooting for pacemaker and implantable defibrillator therapy.
- Know the indications and risks for invasive electrophysiology studies.
- Know the basic principles of mapping and catheter ablation.
- Know the indications for arrhythmia surgery.
- Know the indications for utilizing antiarrhythmic drug therapy.

Evaluation Tools: direct observation, conference participation and presentation, procedure logs, and in-training examination

Patient Care and Procedural Skills:

- Have the skills to utilize ECG, Holter monitoring, exercise testing, and event monitors as diagnostic tools.
- Have the skills to use pharmacological agents, esophageal or intracardiac pacing, and direct current cardioversion in the acute stabilization of arrhythmias.
- Have the skills to interpret basic electrophysiology information obtained through electrophysiology studies and catheter ablation therapy.
- Have the skills to apply adult arrhythmia data to pediatric practice where relevant.

Evaluation Tools: direct observation, conference participation, and procedure logs

CHD indicates congenital heart disease; ECG, electrocardiography; and ICD, implantable cardioverter-defibrillator.

Appendix B

TABLE 2 Recommended Minimal Procedural Experience to Assess Competency in Pediatric Cardiac Electrophysiology

Procedure	"Core" Suggested No. of Procedures	"Advanced" Suggested No. of Procedures
Noninvasive		
ECG interpretation	500	1500
Holter/event/rhythm strips	50	400
Exercise testing rhythm	10	20
Postoperative epicardial wire/esophageal study	5	20
D/C cardioversion	4	10
Simple electrophysiology studies/ablation		
Diagnostic study	10	10
Ablation for AP and AVNRT	5	50
Complex ablation		
Small/young patients	–	5
3D mapping in CHD	–	10
Intraoperative electrophysiology		
Assist epicardial pacemaker	–	5
Assist epicardial ICD	–	3
Intraoperative ablation	–	3
Simple devices		
Test and program pacemaker/ICD	20	100
TV pacemaker implant/revision	–	20
TV ICD implant/revision	–	15
Complex devices		
Implant pacemaker/ICD in young/CHD	–	10
Resynchronization pacing	–	5
Lead extraction	–	5

3D indicates 3-dimensional; AP, accessory pathways; AVNRT, atrioventricular nodal re-entrant tachycardia; CHD, congenital heart disease; ECG, electrocardiogram; ICD, implantable cardioverter-defibrillator; and TV, transvenous.

VI. Reading list

a. Moss and Adams' Heart Disease in Infants, Children, and Adolescents – Including the Fetus and Young Adult – 9th edition. Editors: Allen HD, Shaddy RE, Penney DJ, Feltes TF, Cetta F. Wolters Kluwer. Philadelphia 2016.
    i. Entire section on Electrophysiology pp. 523-653
    ii. Exercise Screening and Sports Participation pp. 261-285
    iii. Exercise Testing pp. 287-302
    iv. The Adolescent and Adult with Congenital Heart Disease pp. 1559-1599
b. Ackerman MJ, Priori SG, Willems S, et al. HRS/EHRA Expert Consensus Statement on the State of Genetic Testing for the Channelopathies and Cardiomyopathies. Heart Rhythm 2011; 8:1308-1339.

c. Gersh BJ, Maron BJ, Bonow RO, et al. 2011 ACCG/AHA Guideline for the Diagnosis and Treatment of Hypertrophic Cardiomyopathy: Executive Summary: A Report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines. Circulation 2011 Dec 13; 124:2761-2796.

d. Epstein AE. DiM Epstein AE, DiMarco JP, Ellenbogen KA, et al. ACC/AHA/HRS 2008 guidelines for device-based therapy of cardiac rhythm abnormalities: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. J Am Coll Cardiol 2008; 51:e1-62.

e. Tracy CM, Epstein AE, Darbar D, et al. 2012 ACCF/AHA/HRS focused update of the 2008 guidelines for device-based therapy of cardiac rhythm abnormalities: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. J Thorac Cardiovasc Surg. 2012 Dec;144(6):e127-45.

f. Rosen MR. The Sicilian Gambit: A new Approach to the Classification of Antiarrhythmic Drugs Based on Their Actions on Arrhythmogenic Mechanisms. Circulation 1991; 84:1831-1851.

g. Priori SG, Schwartz PJ, Napolitano C, et al. Risk Stratification in the Long QT Syndrome. N Engle J Med 2003; 348:1866-1874.

h. Van Bergen NH, Atkins DL, Dick M, et al. Multicenter Study of the Effectiveness of Implantable Cardioverter Defibrillators in Children and Young Adults with Heart Disease. Pediatr Cardiol 2011; 32:399-405.

i. Kugler JD, Danford DA, Beal BJ, et al. Radiofrequency catheter ablation for tachyarrhythmias in children and adolescents. The Pediatric Electrophysiology Society. N Engl J Med. 1944; 330:1481-1487.

j. Van Vare GF, Javitz H, Carmelli D, et al. Prospective assessment after pediatric cardiac ablation: demographics, medical profiles, and initial outcomes. J Cardiovasc Electrophysiol. 2004; 15:759-770.

k. Saul JP, Kanter RJ. PACES/HRS Expert Consensus Statement on the use of catheter ablation in children and patients with congenital heart disease. Heart Rhythm 2016; 13: e251-89.

l. Cohen MI, Triedman JT. PACES/HRS Expert Consensus Statement of the Management of the Asymptomatic Young Patient with a Wolff-Parkinson-White (WPW, Ventricular Preexcitation) Electrocardiographic Pattern. Heart rhythm 2012; 9: 1006 – 1024.

m. Khairy P, Van Hare GF, Balaji S, et al. PACES/HRS Expert Consensus Statement on the Recognition and Management of Arrhythmias in Adult Congenital Heart Disease: Executive Summary. Heart Rhythm 2014; 11: e81 – e101

n. American Academy of Pediatrics - Campbell R, Berger S, Ackerman MJ. Pediatric Sudden Cardiac Arrest. Pediatrics 2012;129;e1094

o. Khairy P, Harris L, Landzberg MJ, et al. Implantable Cardioverter-Defibrillators in Tetralogy of Fallot. Circulation 2008;117:363-370.

Attachment:

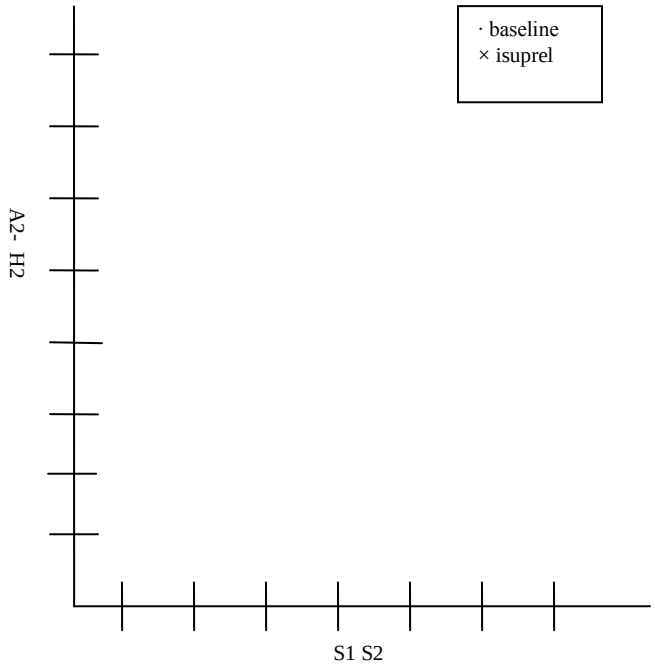
EP Study Fellow Worksheet

HPI_____

_____

_____

Differential Dx:



Decremental AV conduction? Y N

AVNERP _____

Fast ERP _____ Slow ERP _____

APERP _____

AERP _____ VERP_____

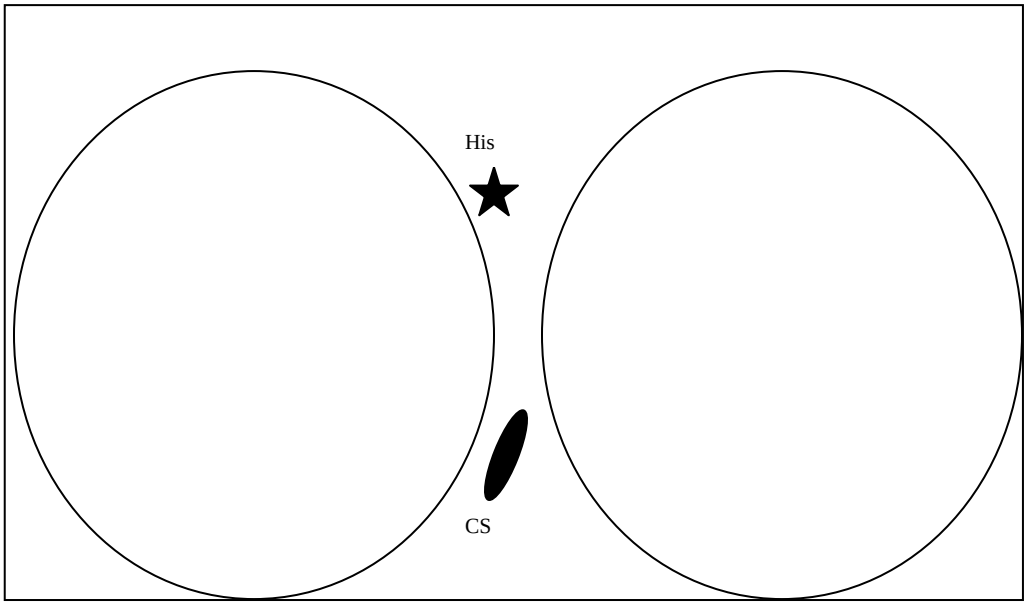
Tachycardia _____

Adenosine Response _____

Other Diagnostic Maneuvers:

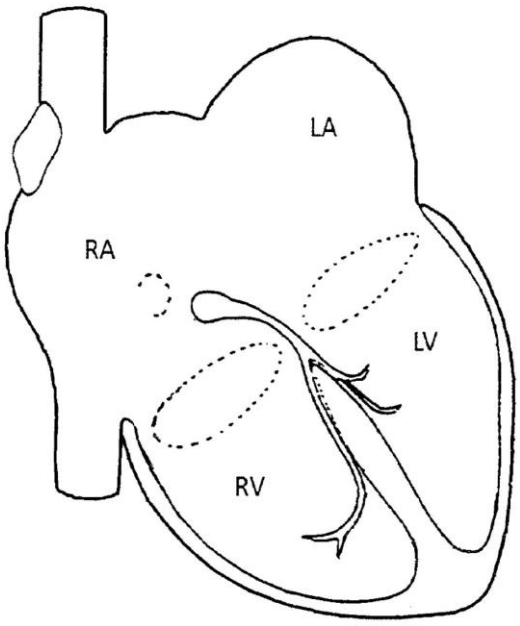
_____

_____



Pathway Location:

_____



Mechanism location: _____

Total RFA Lesions: _____ Total Cryo Lesions:_____

Successful? _____ Final Diagnosis: _____

Notes: