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Atrioventricular Nodal Reentry Tachycardia

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Continuing Education Activity

Atrioventricular nodal reentrant tachycardia (AVNRT) is a type of paroxysmal supraventricular tachycardia that results due to the presence of a re-entry circuit within or adjacent to the AV node. The diagnosis of AVNRT requires visualization of an electrocardiogram (ECG). In most cases, an ECG will show heart rate between 140 and 280 beats per minute (bpm), and in the absence of aberrant conduction, a QRS complex of fewer than 120 milliseconds. This activity describes the evaluation, diagnosis, and management of AV nodal reentry tachycardia and highlights the role of team-based interprofessional care for affected patients.

Objectives:

- Identify the etiology of atrioventricular nodal reentrant tachycardia.
- Review the presentation of atrioventricular nodal reentrant tachycardia.
- Summarize the treatment and management options available for atrioventricular nodal reentrant tachycardia.
- Explain the interprofessional team strategies for improving care coordination and communication regarding the management of patients with atrioventricular nodal reentrant tachycardia.

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Introduction

The atrioventricular (AV) node is a subendocardial structure located in the inferior-posterior right atrium. In an average adult, an AV node measures approximately 1 x 3 x 5 millimeters and sits within an anatomic region bordered posteriorly by the coronary sinus ostium, superiorly by the tendon of Todaro, and anteriorly by the septal tricuspid valve annulus. This anatomic region is also commonly referred to as the triangle of Koch. The blood supply to the AV node is from the AV nodal branch of the right coronary artery (90%) or the left circumflex artery (10%) depending on the right or left dominant blood supply to the heart. The first septal perforator of the left anterior descending artery also supplies blood to the AV node.[1][2][3][4][5][6][7]

Atrioventricular nodal reentrant tachycardia (AVNRT) is a type of paroxysmal supraventricular tachycardia that results due to the presence of a reentry circuit within or adjacent to the AV node. The diagnosis of AVNRT requires visualization on an electrocardiogram (ECG). In most cases, an ECG will show heart rate between 140 and 280 beats per minute (bpm), and in the absence of aberrant conduction, a QRS complex of fewer than 120 milliseconds.[8][9][10] ECG criteria based on the reentrant circuits are as follows:

Slow-Fast AVNRT

- Pseudo-S wave in leads II, III, and AVF
- Pseudo-R' in lead V1.

Fast-Slow AVNRT

- P waves between the QRS and T waves (QRS-P-T complexes)

Slow-Slow AVNRT

- Late P waves after a QRS - often appears as atrial tachycardia

Etiology

Atrioventricular nodal reentry tachycardia is usually not prevalent in patients with structural heart disease. The anatomy of the reentrant circuit defines the type of AVNRT present. A slow-fast AVNRT accounts for 90% of AVNRTs with anterograde conduction by the slow AV nodal pathway and retrograde conduction by the fast AV nodal pathway. Fast-slow AVNRT represents approximately 5% to 10% of AVNRTs with anterograde conduction by the fast AV nodal pathway and retrograde conduction by the slow AV nodal pathway. Slow-slow AVNRTs account for 1% to 5% of AVNRTs with anterograde conduction by slow AV nodal pathways and retrograde conduction by slow atrial fibers. [10][11]

Epidemiology

The prevalence of atrioventricular nodal reentry tachycardia globally is similar to the United States. Close to 60% of the paroxysmal supraventricular tachycardia is AVNRT, with approximately two-thirds of that in women. A study found that the majority of patients presenting with symptoms due to AVNRT are in their twenties, but some patients might present with AVNRT in their seventh or eighth decade.[12]

Pathophysiology

A reentry circuit requires a difference in conduction velocity and refractory period. A fast conduction pathway has rapid conduction but a slow refractory period, whereas a slow conduction pathway has a rapid refractory period coupled with slow conduction.[10][13]

Histopathology

Despite being examined, it remains controversial whether fast and slow AV nodal conduction pathways share anatomical distinction or whether they represent functional diversity in the nodal structure.[14]

History and Physical

Patients with atrioventricular nodal reentrant tachycardia usually present with symptoms of dizziness, syncope, shortness of breath, intermittent palpitations, pain/discomfort in the neck, pain/discomfort in the chest, anxiety, and polyuria secondary atrial natriuretic factor secreted mainly by the heart atria in response to atrial stretch. Patients with AVNRT and a known history of coronary artery disease may present with a myocardial infarction secondary to the stress on the heart. Patients with AVNRT and a known history of heart failure may present with acute exacerbation and possibly reduced ejection fraction secondary to tachycardia-induced cardiomyopathy.[15]

Although syncope is an uncommon symptom in patients with AVNRT, it is typical in patients who have a heart rate above 170 bpm as less filling of the ventricles leads to the reduction in cardiac output and the decreased perfusion of the brain. Depression of the sinoatrial node secondary to tachycardia also may contribute to syncopal symptoms of patients who present with AVNRT.[16]

Patients with AVNRT usually present with a heart rate within the range of 140 to 280 bpm. If a patient has known heart failure or coronary artery disease, they may complain of chest pain. They also may have symptoms of heart failure such as tachypnea with wheezes or swelling in the lower extremities on physical exam. During a physical exam, a provider might be able to appreciate Cannon A waves as the atrium contracts in conjunction with the ventricular contractions against a closed tricuspid valve. Hypotension secondary to decreased ventricular filling also may be a significant physical exam finding in patients presenting with AVNRT.[17]

Evaluation

The most significant component of the assessment for a patient who presents with signs and symptoms of atrioventricular nodal reentrant tachycardia is a history and physical exam. These should include vital signs (respiratory rate, blood pressure, temperature, and heart rate) and an electrocardiogram. A patient presenting with AVNRT should undergo evaluation for any unknown underlying coronary artery disease or heart failure. During an assessment, the clinician should establish whether the patient is hemodynamically stable based mainly on his blood pressure, mental status, and respiratory rate. Initial evaluation of patients with AVNRT can include testing to assess the patient's thyroid and pulmonary function, together with routine blood work and echocardiography.[18][19]

Treatment / Management

Management of patients presenting with atrioventricular nodal reentry tachycardia begins with an initial evaluation of their hemodynamic stability. Hemodynamically unstable patients present with tachycardia associated with hypotension, ischemic chest pain, altered mental status, respiratory failure, or shock. These patients need their AVNRT terminated electrically with an urgent electrical cardioversion. Hemodynamically stable patients should be treated first with vagal maneuvers to cease the rhythm acutely. If attempted twice and the patient remains in AVNRT, the clinicians should perform modified vagal exercises at least twice to terminate the arrhythmia. Once such maneuvers are unsuccessful or are inappropriate, intravenous (IV), it warrants medical therapy.[20][21][22]

First-line medical therapy is IV adenosine, administered up to 18 mg given in increments of 6 mg in the absence of contraindications such as severe bronchospastic lung disease or severe coronary artery disease. In the event both vagal maneuvers and IV adenosine are unsuccessful or ruled inappropriate, IV non-dihydropyridine calcium channel blockers, IV beta-blockers, or IV digoxin are next in consideration. The selection of these IV medical agents is based upon the presence of concomitant factors, such as in patients with AVNRT and hypotension; IV digoxin may be appropriate as it lacks anti-hypertensive properties. Subsequently, in a patient who is actively wheezing secondary to a reactive airway, IV non-dihydropyridine calcium channel blockers should be used first.[23][24][25][26][27][28][29][30]

IV adenosine terminates approximately 80% of AVNRT arrhythmias. Patients in whom medical treatment and Valsalva maneuvers fail or those who cannot tolerate medication due to its side effects might opt for catheter ablation as a one-time definitive cure. Catheter ablations in patients with AVNRT have a high success rate, reported to be as high as 95%. Prolonged medical therapy with Class III or IC antiarrhythmics such as flecainide, propafenone, amiodarone, dofetilide, or sotalol can be done in instances where the patient does not respond to calcium channel blockers or beta-blockers and refuses catheter ablation. The selection of these antiarrhythmics usually is based on patients' comorbidities and the drug side effect profiles.[31][32][33]

Differential Diagnosis

Once a narrow QRS complex tachycardia is present on an electrocardiogram, and the rhythm becomes evaluated as regular, differential rhythms include the following[34]:

- Atrioventricular nodal reentrant tachycardia
- Atrioventricular reentrant tachycardia
- Intra-atrial reentrant tachycardia
- Sinoatrial nodal reentrant tachycardia
- Junctional ectopic tachycardia
- Atrial tachycardia
- Atrial flutter
- Sinus tachycardia
- Inappropriate sinus tachycardia

Prognosis

Prognosis is generally good when a healthcare provider promptly identifies the rhythm.

Complications

If not identified promptly, symptomatic complications such as syncope, fatigue, or dizziness can occur.

Deterrence and Patient Education

Educating patients at risk for this rhythm and making a closed-loop communication between them and their providers can help further improve the management of these rhythms.

Pearls and Other Issues

In rare instances, atrioventricular nodal reentry tachycardia can result in sudden cardiac arrest.[35]

Enhancing Healthcare Team Outcomes

An interprofessional team that provides an integrated approach in identifying that the patient is in atrioventricular nodal reentrant tachycardia and whether the patient is hemodynamically stable or not is integral towards managing patients with this arrhythmia. Upon establishing that the patient is hemodynamically stable, management decisions are possible through prompt communication between the physician, pharmacist, and nursing staff, which can significantly enhance healthcare team outcomes in patients with AVNRT. The clinician can consult with a board-certified cardiology pharmacist in selecting the most appropriate agent, verifying dosing parameters, and checking for interactions. Nursing will have a significant role as they will administer the drug chosen, and need to be aware of potential adverse event signs as well as assessing for therapeutic effectiveness. Once treated, if available, patient education is necessary, using resources familiar to the patient, including online resources and pamphlets. This interprofessional approach optimizes patient outcomes through open communication and collaborative effort. [Level 5]

Review Questions

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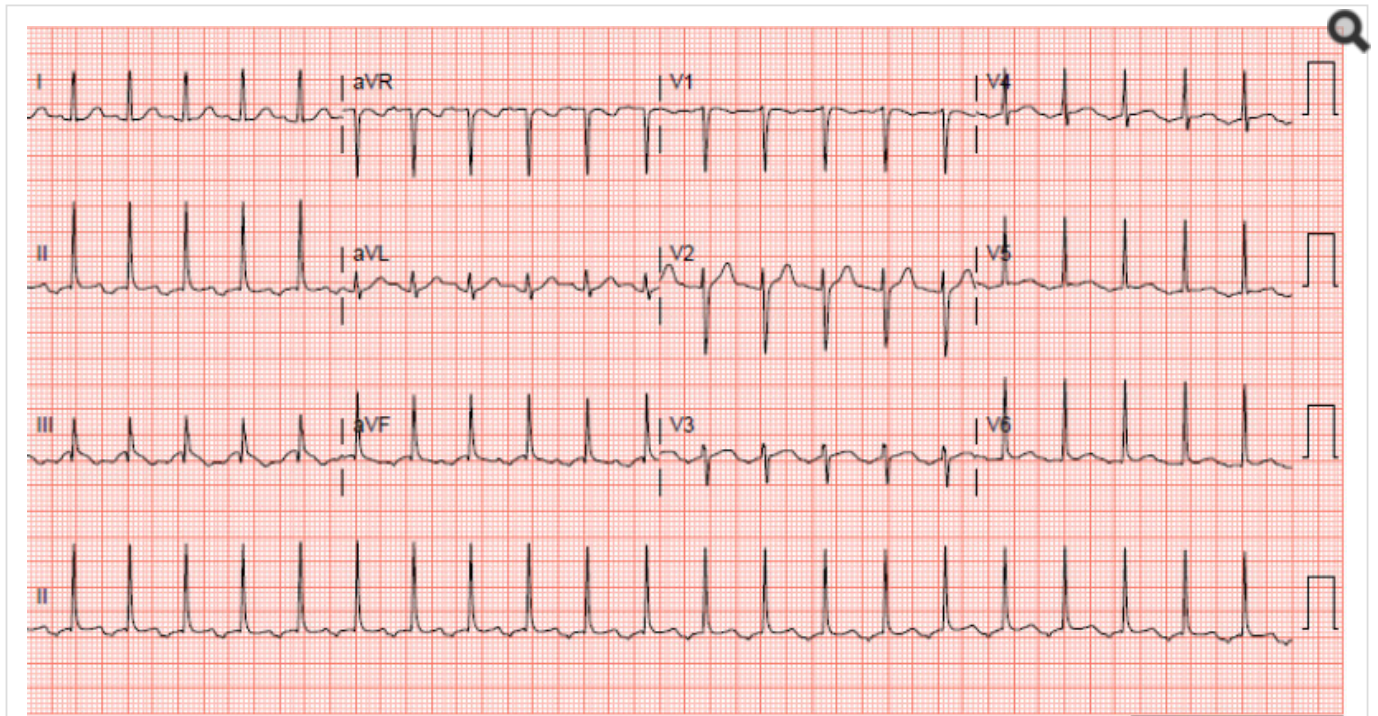
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Disclosure: Yamama Hafeez declares no relevant financial relationships with ineligible companies.

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Figures



This is a rhythm strip of uncommon AVNRT. Contributed by Dr. Yamama Hafeez DO

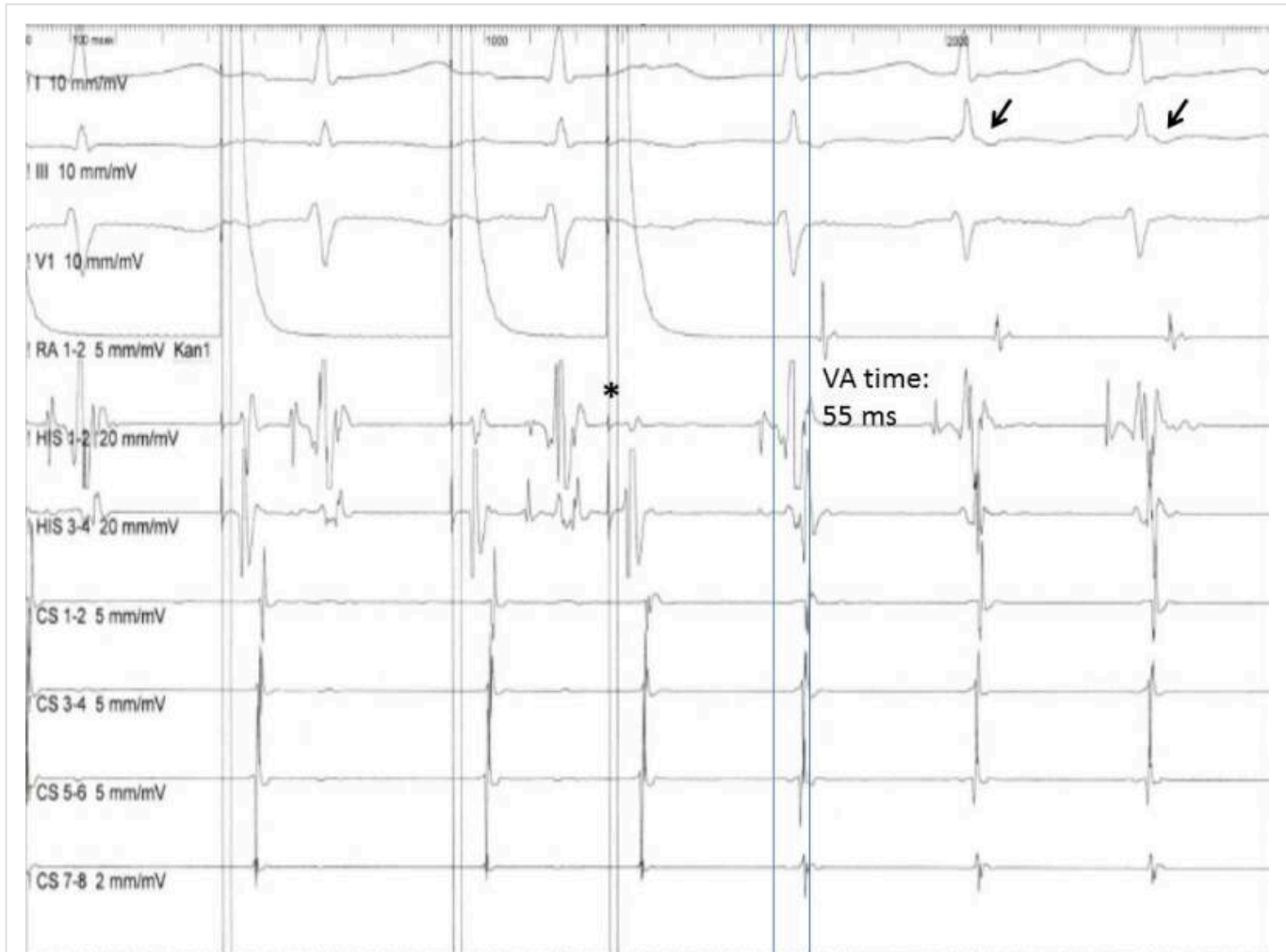


Figure 5. Induction of an atrioventricular nodal reentry tachycardia (AVNRT) with a premature atrial extra stimulus (asterisk). Note the short VA time (< 60 ms) in the His bundle recording and the retrograde P waves in the ECG leads (arrows) Contributed by Spyridon Koulouris, MD

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