ORIGINAL ARTICLE

Supraventricular tachycardia of the sick: A unique entity

Hasta supraventriküler taşikardisi: Özgün bir tanı

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ABSTRACT

Objective: This study explored a unique form of atrioventricular nodal reentrant tachycardia (AVNRT) in which certain acutely ill patients have a first episode of supraventricular tachycardia (SVT) with a short RP interval.

Methods: A retrospective chart review was conducted of patients at a single institution who developed SVT with short RP and yielded 19 patients.

Results: None of the 19 patients had a prior history of AVNRT or any other arrhythmia. The mean age was 58 years, the majority of patients were male (13/19), and there was a presence of hypertension (10/19), diabetes mellitus (5/19), hyperlipidemia (7/19), congestive heart failure (2/19), coronary artery disease (3/19), obstructive sleep apnea (2/19), and active cancer (8/19). The reasons for admission were planned surgery (8/19), sepsis (8/19), drug abuse (2/19), and neurological disorder (2/19). The AVNRT either terminated spontaneously or following the administration of adenosine. The patients were treated with amiodarone (12/19), metoprolol (6/19), or diltiazem (1/19). Follow-up (mean: 370 days) details revealed that patients were on amiodarone (3/19), metoprolol (6/19), were not taking any cardiac medication (5/19), or had passed away (5/19). Only 1 patient had a recurrence of AVNRT, and none of the patients required ablation therapy.

Conclusion: "AVNRT of the sick" has not been previously described in the medical literature, to our knowledge. It can be successfully treated with medications and the chance of recurrence after resolution of the acute illness is small.

ÖZET

Amaç: Bazı akut hastalarda yaşamlarında ilk kez, kısa RP aralığıyla karakterize bir supraventriküler taşikardi (SVT) atağı gelişmektedir. Çalışmamızda, bu özgün atriyoventriküler nodal re-entran taşikardi (AVNRT) tipi araştırılmıştır.

Yöntemler: Merkezimizde, kısa RP aralığı ile karakterize SVT gelişen hastaların kayıtları geriye dönük olarak taranmış ve 19 hasta saptanmıştır.

Bulgular: On dokuz hastanın hiçbirinde AVNRT veya başka bir aritmi öyküsü yoktu. Hastaların ortalama yaşı 58 olup çoğu erkekti (13/19). Hastalarda hipertansiyon (10/19), diabetes mellitus (5/19), hiperlipidemi (7/19), konjestif kalp yetersizliği (2/19), koroner arter hastalığı (3/19), obstrüktif uyku apnesi (2/19) ve aktif kanser (8/19) saptandı. Hasta kabul nedenleri cerrahi girişimin planlanmış olması (8/19), sepsis (8/19) ilaç kötüye kullanımı (2/19) ve nörolojik bozukluk (2/19) idi. AVNRT ya kendiliğinden sonlandı veya adenozin kullanıldı. Hastalar amiodaron (12/19), metoprolol (6/19) veya diltiazem (1/19) ile tedavi edildi. İzlem süresince (ortalama 370 gün), hastalar amiodaron (3/19), metoprolol (6/19) tedavisi altındaydı veya herhangi bir kalp ilacı (5/19) almamaktaydı. Beş (5/19) hasta hayatını kaybetti. Yalnızca bir hastada AVNRT tekrar etti ve hiçbir hastada ablasyon tedavisi gerekmedi.

Sonuç: "Hasta AVNRT'si" tıp literatüründe daha önce tanımlanmamıştır. İlaçlarla başarıyla tedavi edilebilir ve akut hastalık iyileştikten sonra yinelenme olasılığı düşüktür.

Atrioventricular nodal reentrant tachycardia (AVNRT) is the most frequently seen form of regular paroxysmal supraventricular tachycardia (SVT). It is more likely to occur in young adults, but may also occur in the elderly.[1] Symptoms can be exertional or occur at rest, and may include episodic palpitations, chest pain, shortness of breath, dizziness, and syncope. AVNRT can be controlled using atrioventricular (AV) nodal blocking agents, such as beta-blockers or calcium-channel blockers, or with anti-arrhythmic medications.[2] Ablation procedures are also offered as first-line therapy to patients, with success rates of

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>95%.[2,3] A unique form of AVNRT is described in this report: It was observed that certain acutely sick patients develop SVT with a short RP interval for the first time in their life. It is thought that this tachycardia is due to the acute illness and will not recur once the patient recovers from that illness.

Abbreviations:

AV	*Atrioventricular*
AVNRT	*Atrioventricular nodal reentrant tachycardia*
ECG	*Electrocardiogram*
EP	*Electrophysiology*
SVT	*Supraventricular tachycardia*

This is an account of 19 patients who were admitted to a single center with acute illness and developed SVT with a short RP interval between January 2014 and January 2018.

METHODS

A retrospective chart review of patients who developed SVT with a short RP interval in the setting of acute illness between January 2014 and January 2018 was conducted and yielded a total of 19 patients. All of the patients were seen by the inpatient electrophysiology (EP) consult team who reviewed the electrocardiogram (ECG) and telemetry strip tracings. An ECG diagnosis of typical slow-fast AVNRT was made with a visible retrograde P wave and a short RP interval of 80 milliseconds or less on a 12-lead ECG (<2 small boxes). The cutoff used as a criterion was lower than that previously published in the literature (<90 milliseconds[1]), as it is easier to determine 80 milliseconds on the ECG paper. Since our cutoff was lower, all of our patients met the 90-millisecond criterion mentioned in the previous reference. Figure 1 illustrates the ECG results for 2 different patients while in AVNRT. All of the patients were treated as inpatients and followed up in the EP clinic.

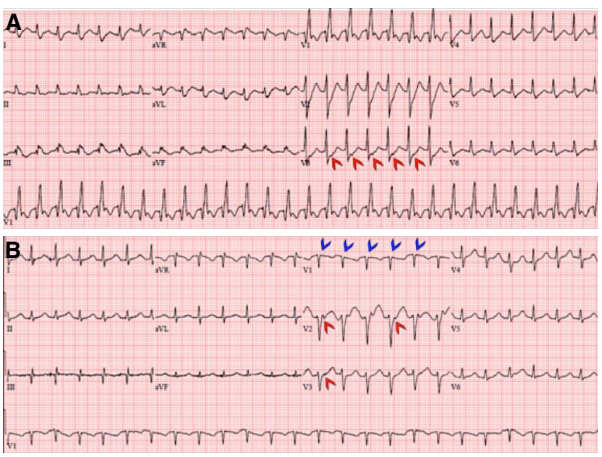

Figure 1. (A) Supraventricular tachycardia with right bundle branch block (RBBB); **(B)** Supraventricular tachycardia with pseudo-RBBB. The red arrowheads indicate retrograde P waves within 80 milliseconds of the R waves. The blue arrowheads indicate pseudo-RBBB.

RESULTS

None of the 19 patients had a prior history of AVNRT or any other arrhythmia. The mean age was 58 years (±19 SD) and 79% (15/19) of the patients were over 50 years of age. Interestingly, 68% (13/19) were male, 53% (10/19) had hypertension, 26% (5/19) had diabetes mellitus, 37% (7/19) had hyperlipidemia, 11% (2/19) had congestive heart failure, 15% (3/19) had coronary artery disease, 11% (2/19) had obstructive sleep apnea, and 42% (8/19) had active cancer (Table 1). The reasons for admission were planned surgery in 42% (8/19), sepsis in 42% (8/19), drug abuse in 11% (2/19), and neurological disorder in 11% (2/19). Of the 8 patients who underwent surgery, 3 were cases of surgical cancer resection and 5 were non-cancer-related procedures. The results of the laboratory testing at admission were a mean white blood cell count of 13.3 K cells/mL, a hemoglobin level of 10.7 g/dL, and mildly elevated liver enzymes, with an aspartate aminotransferase value of 64 U/L and an alanine aminotransferase value of 52 U/L (Table 2).

Table 1. Demographic data

Category	n	%	Mean
Number of patients	19		
Mean age (years)	58		
Age >50 years (%)	15	79.0	
Male	13	68.4	
Caucasian	13	68.4	
Mean weight (lbs)			198.6
Mean body mass index			27.0
Body mass index >35 kg/m^2	3	15.8	
Smoking history	4	21.1	
Hypertension	10	52.6	
Diabetes	5	26.3	
Hyperlipidemia	7	36.8	
Congestive heart failure	2	10.5	
Coronary artery disease	3	15.8	
Obstructive sleep apnea	2	10.5	
Active tumor	8	42.1	

All of the patients developed symptomatic AVNRT during hospitalization; however, none were sufficiently hemodynamically unstable to warrant electrical cardioversion. Symptoms during the episodes included palpitations, shortness of breath, and chest pain. ECG findings of SVT with a short RP interval of less than 80 milliseconds were used for diagnosis. The tachycardia either stopped spontaneously or terminated with a dose of 6 or 12 mg of intravenous adenosine. Thereafter, patients were treated with amiodarone (63%, 12/19), metoprolol (32%, 6/19), or diltiazem (5%, 1/19). Amiodarone was administered for short-term use (4 weeks or until resolution of acute illness). The first physician attending to the patient (not necessarily a cardiologist or electrophysiologist) made the choice of initial therapy.

The mean left ventricular ejection fraction for the group was 55% (±10% SD) and transthoracic echocardiography revealed diastolic dysfunction in 8/19 (42%) patients. In all, 3/19 patients died while an inpatient during the same admission; however, the cause of death was not related to AVNRT. At hospital discharge, 37% (7/19) of patients were on amiodarone, 26% (5/19) were on metoprolol, 5% (1/19) were on diltiazem, and 11% (2/19) were not on any medication for arrhythmias. Approximately half of the patients (9/16) who survived the admission were seen after discharge in the EP clinic, and their medications were reevaluated and optimized. For patients treated with amiodarone, the medication was terminated at 1 month of follow-up in 9/12 cases. The medication was maintained in the other 3 patients because the risk of recurrence of AVNRT was high due to ongoing chemotherapy and it was assessed that amiodarone would be the best option to prevent recurrence.

Only 1 chemotherapy patient had a recurrence of AVNRT, which occurred 14 months after the initial AVNRT episode. This patient was taking amiodarone 200 mg/day and was in chemotherapy treatment. The mean duration of follow-up for the group was 370 days. The most recent patient visit records in the electronic medical record system indicated that 16% (3/19) were on amiodarone, 32% (6/19) were on metoprolol, 26% (5/19) were not taking any cardiac medication, and 26% (5/19) had passed away (Table 3).

Table 2. Results of laboratory tests at admission

Labs	Mean	STDEV
WBC (1000/mL)	13.3	7.0
Hemoglobin (g/dL)	10.7	2.5
Platelets (1000/mL)	272.4	240.9
Sodium (mEq/L)	137.2	5.0
Potassium (mEq/L)	4.1	0.5
Creatinine (mg/dL)	1.1	0.5
AST (U/L)	64.3	104.3
ALT (U/L)	52.4	94.8
TSH (mU/L)	2.3	2.4
Neutrophil to lymphocyte ratio	28.99	68.5

White blood cells; AST: Aspartate aminotransferase; ALT: Alanine aminotransferase; TSH: Thyroid-stimulating hormone.

DISCUSSION

AVNRT is the most frequent form of SVT seen in practice and occurs mainly in young to middle-aged adults.[1] Cases have, however, been described in children and the elderly.[4] AVNRT is seen in women twice as often as in men.[5,6] The reentrant circuit of AVNRT is located in the AV node within the triangle of Koch

Table 3. Medications initially administered, in use at the first cardiology follow-up visit, and medications in use at the last follow-up

	Initial treatment after conversion to sinus		First EP clinic follow up		Final medication	
Category	#	%	#	%	#	%
Amiodarone	12	63	7	37	3	16
Metoprolol	6	32	5	26	6	32
Diltiazem	1	5	1	5	0	0
No medications	0	0	2	11	5	26
Deceased	–	–	4	21	5	26

EP: Electrophysiology.

and the physiology behind the arrhythmia has been well described. Slow-fast AVNRT, in which the electrical impulse travels down the slow pathway reaching the His bundle and returns via the fast pathway to stimulate the atria, is the most common form (seen in around 85% of cases). Acute termination of AVNRT can be achieved with vagal maneuvers or AV nodal blocking drugs, such as adenosine. Other medications, like beta-blockers and calcium channel blockers, may also be considered. In the event of hemodynamic instability, emergent electrical cardioversion should be performed. Long-term treatment to prevent recurrence is tailored according to the patient's preference and the frequency of episodes, toleration of antiarrhythmic medications, and the severity of symptoms. The definitive treatment is ablation, which has a known success rate of more than 95%[7,8] and is a Class I recommendation of the 2015 American College of Cardiology/American Heart Association/Heart Rhythm Society guidelines.[2]

Patients who present with AVNRT are typically relatively healthy. Rare cases have been reported where AVNRT was provoked by swallowing solid food[9] or by an oversized catheter touching the tricuspid annulus.[10] Based on our data, we believe that acute illness, stress, inflammation, or infection may trigger reentrant supraventricular tachycardia. This may be due to an alteration in the conductivity of ion channels, increased adrenergic tone, and/or electrolyte abnormalities.

One study has shown that the neutrophil-to-lymphocyte ratio was significantly higher in the SVT group than the control group.[11] In that study, they excluded any patient with a current infection or active cancer. In our case series, most of the patients either had cancer and were undergoing chemotherapy or had an active infection. Unsurprisingly, the neutrophil numbers were significantly high and the ratio was greater than that reported in the previously mentioned study.

Limitations to our study include the small number of patients, variability in the initial management, and the method of diagnosis of AVNRT. The differential diagnosis of short RP tachycardia includes AVNRT, AV reentrant tachycardia, and atrial tachycardia. An EP study can confirm a definitive diagnosis. In our cases, EP studies were not performed, but we have strong evidence of AVNRT given that the RP interval was less than 90 milliseconds in all cases and that the arrhythmias were terminated with adenosine, rather than slowed. Our cutoff was 80 milliseconds rather than 90 milliseconds due to the nature of measuring such a small interval with ECG; it was more practical to use 80 milliseconds (2 small boxes). EP studies of a ventriculoatrial interval of less than 70 milliseconds would be diagnostic of AVNRT.[12] These criteria were recognized by the European Heart Rhythm Association in the latest consensus document released in 2017.[13]

None of our patients had any history of AVNRT and thus, ablation was not considered, especially given that their AVNRT episode was triggered by illness. We believe that once the acute illness in a patient with "AVNRT of the sick" has resolved, the chance of a recurrence of AVNRT is unlikely. In our cases, we implemented medical management successfully without the need for ablation therapy, thereby avoiding procedural complications and radiation exposure. Three patients remained on amiodarone for a longer period, patients who we believe were at greater risk of recurrence due to cancer, and those considerations likely outweighed the side effects of amiodarone. Amiodarone use in this population was a measure to prevent AVNRT recurrence, hospitalization, and complications. Finally, diltiazem may lower blood pressure, and hypertension is a common problem in cancer patients.

Conclusion

The entity we are describing as "AVNRT of the sick" has not been previously described in the medical literature. It can be successfully treated with amiodarone, metoprolol, or diltiazem. The chance of recurrence after resolution of the acute illness is very small. Increased ion channel conductivity, adrenergic tone, and electrolyte abnormalities during the acute illness are potential causes. Further research is needed to delineate the exact mechanism, and larger studies could optimize the best management strategies.

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Keywords: Atrioventricular nodal reentrant tachycardia; AVNRT of the sick; narrow-complex tachycardia; short RP tachycardia; sick; supraventricular tachycardia.

Anahtar sözcükler: Atriyoventriküler nodal re-entran taşikardi; hasta AVNRT'si; dar kompleks taşikardisi; kısa RP taşikardisi; hasta; supraventriküler taşikardi.