DIFFERENTIATION OF REGULAR, NARROW-QRS COMPLEX TACHYCARDIA TYPES BY UTILIZING THE STANDARD 12-LEAD ELECTROCARDIOGRAM

Mohammad A. Shaikhani [a], Hemin Sadeeq Mohammed [b], and Ammar Al-Hamdi [a]

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ABSTRACT

Background

Supraventricular tachycardia comprises 80% of regular tachycardia that present to the emergency rooms and cardiology clinics. It is of many mechanisms and electrocardiography features. In a high percentage of cases, it occurs in the structurally-normal heart. Epidemiologically it has been discovered that it is more widespread in females than in males.

Objectives

Electrocardiography (ECG) criteria help differentiate the types of Supraventricular tachycardia (SVT) and predict the underlying mechanism. For example, the patient with short R.P. and long P.R. types is more suggestive of atrioventricular nodal reentrant tachycardia (AVNRT), where ablation therapy is more successful than in atrial tachycardia and atrioventricular reentrant tachycardia (AVRT)

Differentiating between AVNRT, AVRT, and atrial tachycardia is extremely significant regarding the acute termination by medications; Adenosine and Calcium-channel blockers (CCBs) are found more effective in atrioventricular reentrant tachycardia, CCBs should be avoided in long R.P. and short P.R.

Patients and Methods

A retrospective cross-sectional study was conducted between December 2016 and February 2018. This study included patients who visited the emergency room with a narrow-QRS-complex tachycardia.

Results

Eighty-five patients with regular narrow-QRS-complex tachycardia were included. The mean ± S.D. of the participants-age was 46.29 years ±12.71, 56 cases (65.9%) were females, and 29 (34.1%) were males. The mean ± S.D. of the disease duration of the condition was 5.07±5.52 years, and a frequency of 3.8 attacks per 6 months, and a mean duration of each episode was approximately 80 minutes for each episode. Regarding the symptomatology of tachycardia, almost all patients had symptoms of palpitation, 11.8% had presyncope, and 4.7% had syncope.

Conclusion

Atrioventricular nodal reentries tachycardia (slow/fast) are the most common in our study. AVRNT was found more prevalent in females than males. Atrioventricular reentry tachycardia was found in males more than females in our study.

Keywords: *Supraventricular tachycardia; PR interval; electrocardiograph record; Gender.*

[a] College of Medicine, University of Sulaimani, Kurdistan Region, Iraq.
[b] Directorate of Health, Ministry of Health, Kurdistan Region, Iraq.
Correspondence: heminsadiq1@gmail.com

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INTRODUCTION

History of arrhythmias

The diagnosis of cardiac arrhythmias & the elucidation of their mechanisms depends on the recording of the electrical activity of the heart. The study of the disorder of the rhythmic activity of the heart started around the fifth century B.C. in China and in Egypt around 3000 B.C. with the examination of the peripheral pulses [(1)] . In 1887, Waller was the first who record an electrocardiogram from the body surface of a dog and a man. He took advantage of the principles of electrocapillarity, using Gabriel Lippmann's then-recent invention, the capillary electrometer, which was a tubular instrument, with a thick end and a thin end (resembling a capillary), in which a column of mercury borders on a weak, diluted solution of sulfuric acid in a narrow glass capillary [(1)].

Supraventricular tachycardia (SVT)

SVT is an umbrella term used to denote tachyarrhythmias (atrial and ventricular rates above 100 beats per minute, at rest) that originate from above the ventricles (the bundle of His and above it). These SVTs include inappropriate sinus tachycardia, AT (including focal and multifocal AT), macro-reentrant AT (including typical atrial flutter), junctional tachycardia, AVNRT, and various sorts of accessory pathway-mediated reentrant tachycardia [(2)].

Atrioventricular Nodal Reentry Tachycardia (AVNRT)

It is considered to be the most prevalent type. The majority of cases having AVNRT do not suffer from any structural heart problems, most commonly inflicting otherwise-healthy, young females [(3)]. It is important to note that in a minority of cases, heart diseases have been found to be the culprit, such as pericarditis, previous myocardial infarction, or mitral valve prolapse [(4)]. The source of reentrant tachyarrhythmias' aberrant substrate is the presence of both slow and fast fibres in the A.V. node [(5)]. A reentrant tachycardia that involves the two functionally-distinct pathways are described as "fast" and "slow" pathways.

Most commonly, the fast fibre is located near the apex of Koch's triangle, and the slow pathway infers posterior to the compact A.V. node tissue. There have been some variant pathways reported that allow for "slow-slow" AVNRT [(5)].

Atrioventricular reentrant tachycardia (AVRT)

A reentrant tachycardia, the electrical pathway of which requires an accessory pathway, the atrium, atrioventricular node (or second accessory pathway), and ventricle [(6)].

Diagnosis of arrhythmias

a) History and physical examination

Symptoms of supraventricular tachycardia (SVT) depend on some factors, including patient age, whether comorbidities are present or not, and duration of SVT episodes. It is not uncommon for the patient to be completely symptom-free. Taking a detailed history is valuable as it can reveal the likely cause of tachycardia. It should always be remembered to consider sinus tachycardia. There have been various instances where Episodic SVT has been misdiagnosed as a panic attack or anxiety[(7)]. This is especially true if the case has had a history of psychiatric ailment(s). A high index of suspicion is required, as it has been shown that certain types of cardiomyopathy can be caused by persistent and prolonged tachycardia [(8)]. Physical examination is typically standard, apart from tachycardia.

b) Electrocardiography (ECG)

A 12-lead Electrocardiography (ECG) should be performed in patients who are hemodynamically stable, with particular attention to rhythm and rate, P.R. interval (A.V. conduction), R.P. interval, hypertrophy, presence of pathologic Q waves, prolongation of the Q.T. interval, and any evidence of pre-excitation. Most SVTs have narrow QRS complexes. Patients should be immediately taken to a cardiologist if they experience shortness of breath, syncope [(9,10)].

Situations in Which Referral to a Cardiologist or Electrophysiologist Is Warranted

Medications are not controlling symptoms, The patient cannot tolerate medications or no longer wishes to use them. The patient has worsening symptoms or is becoming hemodynamically unstable. The physician is uncomfortable with or uncertain about management or initial diagnosis. Syncopal episodes accompany the SVT. Pre-excitation showed on electrocardiography or if atrioventricular reciprocating tachycardia is suspected.

PATIENTS AND METHODS

The retrospective study was conducted after approval by the scientific and ethical committee of the Iraqi Board for medical specialization in internal medicine. The patient collection started from 1st December 2016 to 1st January 2018. Eighty-five patients of both genders were referred to the emergency department of Sulaimania Teaching Hospital for Heart Diseases with symptoms of palpitations, chest pain, chest tightness, dizziness, and dizzy spells.

Inclusion Criteria

Patients with regular narrow-QRS complex tachycardia were referred to the emergency department of Sulaimania Teaching Hospital for Heart Diseases.

Exclusion Criteria

Patients below 15 years of age, patients with irregular narrow-QRS complex tachycardia, patients with wide QRS complex tachycardia.

According to electrocardiography for supraventricular tachycardia Made Easy, ACC/AHA/HRS ECG criteria most common types of Supraventricular Tachycardia:

1) AVNRT

Rate: 118 to 264 b/m

Rhythm: regular, narrow-QRS complex (<120 msec); regular, wide QRS complex (= 120 msec);

May not see any P-wave activity in either type (atypical or typical).

Typical AVNRT: R.P. interval < P.R. interval; pseudo R wave in lead V1 with tachycardia, not with normal sinus rhythm; Pseudo S wave in leads I, II, and aVF.

Atypical AVNRT: R.P. interval > P.R. interval; P waves negative in leads III and aVF.

2) AVRT

Rate: 124 to 256 b/m

Rhythm: regular, narrow-QRS complex common (orthodromic); regular wide QRS complex uncommon (orthodromic or antidromic) if bundle branch block or aberrancy present

Orthodromic AVRT: R.P. interval < P.R. interval or R.P. interval > P.R. interval with a slowly conducting accessory pathway; retrograde P waves (leads I, II, III, aVF, V1); delta wave seen with normal sinus rhythm, not with tachycardia.

Antidromic AVRT: short R.P. interval (< 100 msec); regular, wide QRS complex (= 120 msec); delta waves are seen with normal sinus rhythm and tachycardia; concealed accessory pathways do not show delta waves.

3) AT

Rate: 100 to 250 b/m (atrial); ventricular varies

Rhythm: regular, narrow QRS complex usually; irregular (ectopic foci) may have wide QRS complex if aberrancy present.

Focal AT: long R.P. interval most common; P-wave shape/polarity variable.

Multifocal AT: three different P-wave morphologies present unrelated to each other; R.R. interval irregular.

After taking a detailed history, the device GE MAC 1200 DIGITAL, 12-LEAD ECG system has been used. Patients were asked to document symptoms, and the ECG record was done during arrhythmia and sinus rhythm. Cardiologists analyzed the ECG for arrhythmias.

Palpitation is defined as an unpleasant awareness of a forceful or rapid heartbeat. Dizziness and syncope are defined as transient loss of consciousness, which is associated with loss of postural tone and spontaneous recovery without neurological deficit.

Statistical Analysis

All patients' data were entered using computerized statistical software; a statistical package for social sciences (SPSS) version 17 was used.

Descriptive statistics are presented as (mean± standard deviation) and frequencies as percentages. Multiple contingency tables were conducted, and appropriate statistical tests were performed; the Chi-square test was used for categorical variables. Independence t-test was used to compare between means. In all statistical analyses, the level of significance (P-value) is set at = 0.05, and the results are presented as tables and /or graphs.

RESULTS

In This study, 85 patients with regular narrow-complex tachycardia were included, the mean ± S.D. of participants-age was 46.29 ± 12.71 years, 56 cases (65.9%) were females, and 29 (34.1%) were males. The mean duration of the disease was 5.07±5.5year, with a frequency of 3.8 episodes per six months and a mean duration of the episode was approximately 80 minutes for each episode, Table1. As for their symptoms, almost all of them had symptoms of palpitation, 11.8% had presyncope, and 4.7% had syncope. These symptoms and the prevalence of co-existing medical and structural heart diseases, Table 2.

Significant ECG findings during episodes of tachycardia and after reverting to sinus rhythm, Table 3.

Distribution of cases according to differentiating ECG profile of presence of discernible pseudo-r-wave (V1, aVr) and Pseudo S-wave (II, III, aVF) or RP-PR interval (short R.P. long P.R. versus long R.P. short P.R.) during tachycardia episode are shown in Table (4). Comparison of ECG findings did not show significant differences in terms of Age and Gender, Table (5).

The most common drugs used in managing cases of supraventricular tachycardia in the emergency room of Sulaimania Teaching Hospital for Heart Diseases are adenosine (n=70, 82.3%), verapamil (n=13, 15.2%). In contrast, ten patients (11.8%) were on more than one medication used (Table 6).

Table 1. Basic Patient Characteristics.

Variable	Mean	Standard deviation
Gender: N (%)		
Male	29(34.1%)	
Female	56(65.9%)	
Age	46.29	12.719
Duration	5.07	5.522
Frequency/ 6months	3.80	3.105
Duration/Attack	79.28	46.247
CCU visit/Year	3.80	3.788

Table 2. Common Presenting Symptoms and Possible Associated Medical History.

Variable		Percent
Palpitation	85	100%
Presyncope	10	11.8%
Syncope		4.7%
Hypertension	29	34.1%
Diabetes mellitus	10	11.8%
Ischemic heart diseases	13	15.3
Structural heart diseases	1	12
Smoking	14	16.5%
Alcohol	1	1.2
Family history	6	7.1%
Thyroid disorders	6	7.1%

Table 3. ECG findings during episodes of tachycardia and sinus rhythm.

ECG	Mean	Std Deviation
QRS	85	9
TCL- SVT(msec)	356	46
HR-SVT/bpm	168.53	21.73
TCL-Sinus(msec)	660	110
HR-Sinus/bpm	90.77	9.09

Table 4. EGC Profile According To Presence or Absence of Psudo r-Wave or Psudo S -Wave and Relation of RP-PR Interval .

ECG Finding	N.(%)
Pseudo r- wave	71(83.5%)
Pseudo -s - wave	58(68.2%)
Either Pseudo r or s wave	75(88.2%)
No Pseudo r or s wave	10 (11.8%)
Short RP – Long PR	76(89.4%)
Long RP – Long PR	9(10.6%)

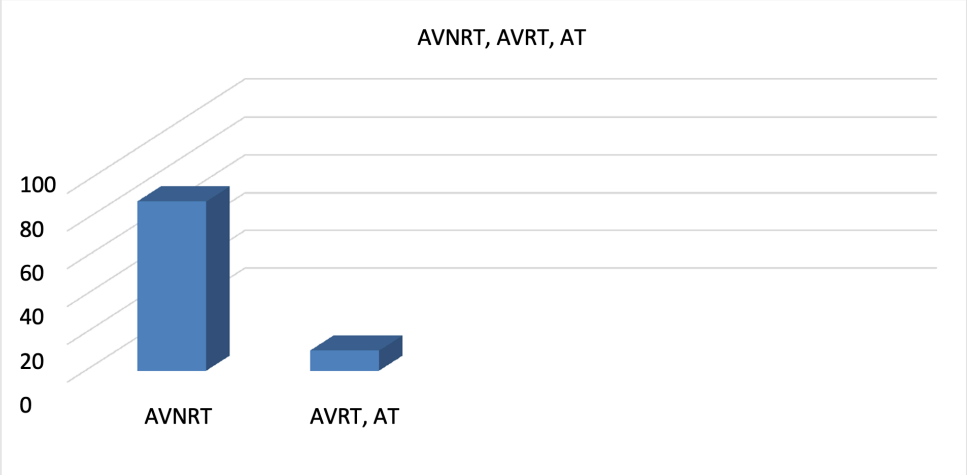

Figure 1. Shows typical slow/fast AVNRT (short RP-long PR) and AVRT, AT.

Table 5. ECG Finding as Compared for Gender and Age .

ECG Findings	Gender		P-Value
	Male	Female	
Pseudo r or Pseudo s Wave	23	52	0.08
No Pseudo r or s wave	6	4	
Short RP-Long PR	24	52	0.26
Long RP-Short PR	5	4	

ECG Findings	Age (Mean±SD)	P-Value
Pseudo r or Pseudo s wave	45.56±12.82	0.146
No Pseudo r or s wave	51.80±10.97	
Short RP-Long PR	46.43±12.92	0.77
Long RP-Short PR	45.11±11.49	

Table 6. Drugs used in the management of supraventricular tachycardia.

Drugs	Number	Percentage
Adenosine (i.v.)	70	82.3%
Verapamil (i.v.)	13	15.2%
Amiodarone (i.v.)	1	1.2%
Direct current cardioversion	1	1.2%

DISCUSSION

Supraventricular tachycardia is a common dysrhythmia that occurs in all age groups, and treatment can be challenging [11-14]. Therefore, we studied and analyzed a series of narrow-QRS complex tachycardia to ascertain the utility of the various ECG criteria in diagnosing the specific mechanism (s) of causing the paroxysmal SVT.

In this study, the distribution of patients according to differentiating ECG profile of presence of discernible pseudo-r-wave (V1, Avr) and pseudo-S-wave (inferior lead) were 88.2% or RP-PR interval (short R.P. long PR 89.4% versus long R.P. short PR 10.6%) during tachycardia episode this means common types AVNRT more than AVRT. This finding agreed with another study done by Izzet Erdinler et al. [15], who studied 120 patients presented with narrow-QRS complex tachycardia (QRS < or = 0.11 msec. and rate > 120 beats/min) and found 40 patients had atrioventricular reentrant tachycardia; 70 patients had atrioventricular nodal reentrant tachycardia, and ten patients had atrial tachycardia defined with electrophysiological study (EPS) [15]. In This study, 85 patients with regular narrow-complex tachycardia were included; the mean±SD age of participants was 46.29± 12.71 years, 56 cases (65.9%) were females, and 29 (34.1%) were males. Again, this is similar to other studies.

Michael porter found that AVNRT is more common in young and female patients. The mean age was 45 ± 19 years (range 5–96), and the majority were, indeed, women (62%). Overall, AVNRT was the predominant mechanism (n = 1,042 [56%]), followed by AVRT (n = 500 [27%]) and AT (n = 315 [17%]) [16]. Regarding the treatment schedule that used the emergency department at our hospital, if the hemodynamic status of the patient is stable, adenosine, at a dosage of 6mg, was administered intravenously.

When rhythm did not return to the normal sinus rhythm within 5 minutes, the second dose of adenosine (12mg i.v. bolus) was administered. If the rhythm still did not return to normal sinus rhythm within 5 minutes, verapamil (5mg, i.v. bolus) was administered. When rhythm was not converted to the normal sinus rhythm, two to three doses were repeated every 5 minutes. One case needed amiodarone 150 mg in 100ml D5W

(i.v. bolus dose); another case was hemodynamically unstable converted by synchronized cardioversion 50 Joules. Adenosine is recommended as the first-line treatment option for stable narrow-QRS complex SVT in a study carried by Neumar et al. [17], who found that a 6 mg first dose of adenosine can correct the rhythm to sinus rhythm in 60% of patients.

While with the second dose following a 12-mg dose of bolus adenosine, the rate rose to 90% [17]. In two other randomized clinical studies carried by Cheng et al. and Brandy et al., they found that in stable SVT patients, adenosine and diltiazem had similar rates of reversion to sinus rhythm [18-19, 20].

The patient with short R.P. and long P.R. types are more suggestive of AVNRT, where ablation therapy is more successful than AVRT and AT. Differentiation AVNRT from AVRT and AT is significant regarding the acute termination by drugs where adenosine and CCBs are more effective in AVNRT. However, CCBs should be avoided in long R.P. short P.R. where AVRT are more common as they may cause accelerated conduction through the accessory pathway and may result in severe ventricular arrhythmia.

In conclusion; atrioventricular nodal reentry tachycardia (short RP-long PR) (slow/fast) types are common in our study. AVNRT was found in females more than males in our study. AVRT was found in males more than females in our study.

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