Validity of his refractory PVC in related to other electrophysiological maneuvers in differentiation between AVNRT and AVRT

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Abstract:

Background: Different maneuvers used to differentiate between AVNRT and AVRT underwent electrophysiological study, including PPI-TCL, VA tachy cardin Delta, VA, His refractory PVC, and this confirmed by ablation result. **Patients and Methods:** Patients with SVT, after gave four consent of patient, three or four catheters were into right ventricle, Coronary Sinus, His catheter, and ablator. After that four electrophysiological maneuvers done for him concentrating on his refractory PVC. 140 cases from Mach 2022 till August 2023. **Results:** Among 140 patients with SVT underwent electrophysiological study, four maneuvers done for him. His refractory PVC with 100% specificity and 91% specificity. Delta VA near theses result. While PPI-TCL 100% specificity and specificity and VA tachycardia near theses result. **Conclusion:** His refractory PVC one of important maneuvers in differentiation between AVNRT and AVRT.

Keywords : PVC , electrophysiological maneuvers ,AVNRT , AVRT.

Introduction

The term 'SVT' literally indicates tachycardia [atrial rates >100 beats. per minute (b.p.m.) at rest], the mechanism of which involves tissue from the his bundle or above [1,2]. Traditionally, SVT has been used to describe all kinds of tachycardias apart from ventricular tachycardias (VTs) and AF [1,2]. So the term 'narrow QRS tachycardia' indicates those with a QRS duration ≤120 ms. A wide QRS tachycardia refers to one with a QRS duration >120 ms. In clinical practice, SVT may present as narrow or wide QRS tachycardias, most of which, although not invariably, manifest as regular rhythm [3,4,5].

Epidemiological studies on the SVT population are limited. In the general population, the SVT prevalence is 2.25/1000 persons and the incidence is 35/100000 person-years. Women have a risk of developing SVT that is two times greater than that of men, and persons aged ≤65 years or have more than five times the risk of developing SVT than younger individuals. Patients with lone paroxysmal SVT vs. those with cardiovascular disease are younger, have a faster SVT rate, have an earlier onset of symptoms, and are more likely to have their condition first documented in the emergency department [6].
AVNRT is the most frequently treated substrate after AF, followed by atrial flutter and AVRT, in patients referred for catheter ablation [7,8].

Represents the most common mechanism generating cardiac arrhythmias. It results from abnormal impulse conduction. This mechanism requires two separate routes or pathways for conduction having different refractoriness and conduction velocity. The routes can be anatomically or functionally defined. Arrhythmias usually develop in response to a premature stimulus, although they may less commonly arise from spontaneous conduction slowing in one of the pathways. Reentry initiates when a premature stimulus blocks in one pathway and conducts slowly in the other [9].

A VES delivered when the HB is refractory (i.e., when the His potential is already manifest or within 35 to 55 milliseconds before the time of the expected His potential) that advances (accelerates, i.e., makes it activate earlier than expected) the next atrial activation is diagnostic of the presence of a retrogradely conducting BT. Such a VES has to conduct and advance atrial activation via a BT because the HPS-AVN is already refractory and

cannot mediate retrograde conduction of the VES to the atrium, Although such an observation excludes AVNRT, it does not exclude AT or prove orthodromic AVRT, and the pre excited atrial activation can reset or even terminate an AT, whereby the BT is an innocent bystander. However, if this VES advances atrial activation with an activation sequence identical to that during the SVT, this suggests that the SVT is orthodromic AVRT and the BT is participating in the SVT, although it does not exclude the rare case of an AT originating at a site close to the atrial insertion site of a bystander AV BT.

Furthermore, a VES delivered when the HB is refractory may not affect the next atrial activation if the ventricular stimulation site is far from the BT. Conduction from the ventricular stimulation site to the BT, local ventricular refractoriness, and the TCL all determine the ability of a VES to reach the reentrant circuit before ventricular activation over the normal AVN-HPS.

Aim of study: To evaluate the validity of his refractory PVC in the related to other maneuvers in differentiation between AVNRT and AVRT.

Patients and methods: An experimental prospective study presenting in the IBN ALBITAR center/ electrophysiological department for treatment of supraventricular tachycardia between March, 2022 and August 2023 were included in this study.

The electrophysiological testing was done to whom demonstrated sustained supraventricular tachycardia suggestive of AVNRT or AVRT.

Inclusion criteria in the study should met:- Documented diagnosis of AVNRT or AVRT depending on different electrophysiological testing ; Successful Radio frequency "RF" ablation for that diagnosis and Exclusions criteria for the study: Non- inducible arrhythmia; Non- successful ablation ; Those does not complete the electrophysiological maneuver required in the study and Left lateral accessory pathway.

Electrophysiological study: The patient gave informed consent ; Under local anesthesia; Right and left femoral approach; Three or four venous access; Three or four catheters; Quadripolar to right ventricle; Decapolar to coronary sinus; Quadripolar "Ablator"; Hexapolar to His.

- The surface ECG and intracardiac electrogram were continuously recorded on a digital recording system.
- Programmed ventricular stimulation during sinus rhythm "VA study" :
  - Decremental.
  - Non-decremental.
    - Atrial activation sequence. (Concentric, Eccentric)
- Programmed atrial stimulation during sinus rhythm "AV study" :
  - Dual AV node physiology.
    - AH jump.
    - Dual ventricular response to a single atrial beat "double Fire".
    - PR interval exceeding the RR interval during rapid atrial pacing.
    - Two distinct PR or AH internals during NSR or fixed-rate atrial pacing.
- Tachycardia features
  - TCL
  - VA interval (Cut of value <70 ms) exclude AVRT.
- Entertainment of SVT by ventricular pacing.

  ΔVA interval ($VA_{pacing} - VA_{svt}$) > 85 ms exclude orthrodromic AVRT
- PPI – TCL >115ms (or corrected PPI–TCL >110ms) exclude orthrodromic AVRT
- His refractory PVC (Reset , No reset)

VES delivered during SVT when the HB is refractory that reset (advance or delays) or terminates the SVT excludes AVNRT.

Results: Total number of patients 140, from those 116 (83%) diagnosed as AVNRT, where is 24 (17%) diagnosed as AVRT. Regarding the sex, female predominant in total SVT study (95 patients, 68%) while male (45 patients 32%). In AVNRT female predominant 87 (75%) while male 29 (25%). In AVNRT male predominant 16 (67%) while female 8 (33%).

Table (1): Characteristics of patient with SVT underwent EP study

Type of SVT	AVNRT	AVRT	Total Number
Number of patients %	116 (83%)	24 (17%)	140
Male %	29 (64.4%)	16 (35.6%)	45 (32%)
Female %	87 (91.5%)	8 (8.5%)	95 (68%)
Mean age for each group	46	29	

All 140 patients involved in the study, measurements of PPI - TCL during tachycardia. All patients with PPI - TCL >110[ms] have a diagnosis of AVNRT, and patients with PPI - TCL < 110ms have a diagnosis of AVRT (100%. sensitivity, 100% specificity, 100% PPV, 100% NPV).

Table (2): PPI - TCL in patients with SVT underwent EP study

Type of SVT No. of patients	AVNRT	AVRT	Total Number
PPI – TCL > 110 ms	116	0	116
PPI – TCL < 110 ms	0	24	24
Sensitivity	100%		
Specificity	100%		
PPV	100%		
NPV	100%		

All 140 patients involved in the study measurement of VA interval during tachycardia. VA interval <70 ms have a diagnosis of AVNRT While a patients with VA interval >70 ms diagnosed as AVRT (97% sensitivity, 100%. specificity, 100% PPV, 88% NPV).

Table (3): VA interval in patients with SVT underwent EP study

Type of SVT No.	AVNRT	AVRT	Total
VAt < 70 ms	113	0	113
VAt > 70 ms	3	24	27
Sensitivity	97%		
Specificity	100%		
PPV	100%		
NPV	88%		

Delta VA measurement done for all 140 patients involved in the study during tachycardia. ΔVA > 85 ms have a diagnosis of AVNRT while a patients with ΔVA < 85 ms diagnosed as AVRT (97% sensitivity, 91% specificity, 98% PPV, 88%. NPV).

Table (4): Delta VA in patients with SVT underwent EP study

Type of SVT No.	AVNRT	AVRT	Total
ΔVA > 85 ms	113	2	115
ΔVA < 85ms	3	22	25
Sensitivity	97%		
Specificity	91%		
PPV	98%		
NPV	88%		

His refractory PVC, performed for all Patients in the study during SVT. have no effect in all patient with AVNRT (No reset), and have obvious effect on patients with AVRT (Reset). (100% sensitivity, 91%. specificity, 98%. PPV, 100%. NPV).

Table (5): His refractory PVC, in patients with SVT underwent EP study

Type of SVT No. of patients	AVNRT	AVRT	Total
No Reset	116	2	118
Reset	0	22	22
No. of patients	116	24	140
Sensitivity	100%		
Specificity	91%		
PPV	98%		
NPV	100%		

Discussion: General characteristics as shows in table (1). In regarding to age found AVNRT older than AVRT patients (mean age for AVNRT 46 years and for AVRT 29 years) and this result in comparison with previous studies like Michael J, porter MD, joseph *etal.*, [10] found nearly the same result.

In regarding to gender female predominant in AVNRT (75%), male (25%), while in AVRT male predominant (67%), female (33%), and these result similar to previous studies like Michael J, porter MD, joseph *etal.*, [10] and S. Dung Chu, Minh Thi Tran, Khank Quoc Pham *etal.*, [11].

Regarding PPI-TCL in patients underwent Ep study and cut value of 110ms and found 100% sensitivity and specificity, and 100% PPV and NPV. In comparison to other studies like Gregory F, Michand, Hiroshi Tada *etal.*, [12], found the same result, while in F. Javir Garacia, Marta pachon et al found sensitivity (98%), specificity (98%) PPV 98%, NPV 98%.

Regarding tachycardia VA interval and Consider 70 ms as acut point for a diagnosis, <70 ms consider as AVNRT and >70 ms diagnosed as AVRT, and found (97% sensitivity 100% specificity, 100% PPV, and 88%. NPV). These results goes with the same result obtained in Shanmuga *etal.*, [13].so regarding to Delta VA (SA-VA) measurements and consider 85 ms as acut point in measurement. A value >85 ms diagnosed AVNRT while those <85ms diagnosed AVRT- and resulted in 97% sensitivity, 91% specificity, 98%. PPV and 88% NPV.

In comparison appear lower than previous studies Like F.J. Garcia et al. [18] which identified sensitivity 100%, specificity 98%, PPV 99%, and NPV 100% and appear higher than Ayman Mortada *etal.,* [15] which identified 100% sensitivity and 76% specificity.

In regarding his refractory PVC in our study found all patients with AVNRT there is no change in atrial activation sequence (no reset) while in AVRT 92% of patient respond (reset) either advance, delay or terminate.

Statistical analysis revel 100% - sensitivity, 91% specificity, 98 PPV and 100% NPV.

These result is slightly lower than Benzy *etal.,* whose found 100% specificity and sensitivity [16]. Among 73 patients 44 AVNRT (60%), 29 AVRT (40%).

Also our study lower than Ankur *etal.,* [17]. Whose found 100% specificity. Among 65 patients 43 AVNRT (66%) and 22 AVRT (34%). as well as Shanmuga *etal.,* [13] conclude his refractory ventricular pacing has the maximum sensitivity and specificity to differentiate slow fast AVNRT from AVRT with concealed septal by pass tract.

In clinical application that his refracting PVC could be considered an a routine basis or in cases where AVNRT and AVRT diagnosis cannot be established from tachycardia features and the standard maneuvers.

It is viral to collect data from multiple observation and maneuvers to verify the diagnosis before proceeding with ablation. Diagnostic maneuver used during the EP study have some pitfalls and maneuver of his refractory PVC with no exception, as it is a powerful maneuver but not 100% specific and sensitive. One should attempt multiple maneuvers and acknowledge various forms of tachycardia features rather than rely on one maneuver, and it is vital to establish the understanding of the tachycardia as all these maneuvers lack 100% sensitivity and specificity apart from PPI - TCL.

Conclusion: There are several maneuvers to differentiate between AVNRT and AVRT. This refractory PVC consider one of these maneuvers and significant result (sensitivity, specificity). Consider it as a routine work in differentiation between AVNRT and AVRT in electrophysiological study.

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