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Differentiating Slow Fast Atrioventricular Nodal Reentry Tachycardia From Atrioventrcular Reentry Tachycardia With Concealed Septal Bypass Tracts By Various Pacing Maneuvers

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Abstract:
Aim: *Differentiation of Atrioventricular nodal reentry tachycardia (AVNRT) from atrioventricular orthodromic reciprocating tachycardias (AVRT) mediated by the concealed septal accessory pathway requires some electrophysiological workup. In this study we have studied the usefulness of various pacing maneuvers in differentiating the two.*
Results: *Among the 42 patients included in our study 32 patients were finally diagnosed to have typical slow fast AVNRT and 10 patients were diagnosed to have AVRT. Sinus Cycle length, Basal AH, HV interval, tachycardia cycle length, HV interval during tachcycardia were not significantly different between the two groups. AH interval during the Tachycardia was significantly higher during AVNRT. Mean VA interval during tachycardia was significantly higher during AVRT. None of the patients with AVNRT had significant advancement of atrial activity during His refractory ventricular pacing. All patients with AVRT had significant advancement of atrial activity during his refractory ventricular pacing. During Assessment of ΔVA (VA (Entrainment)–VA (tachycardia)), Mean ΔVA in patients with AVNRT was 117 +/- 27 msec. Mean ΔVA in patients with AVRT was 29.8+/-13 msec (P <0.0001). In three patients with AVNRT the difference was < 85 msec and none of the patient with AVRT had the difference of more than 74 msec. During assesment of Post Pacing Interval (PPI) - Tachycardia cycle length (TCL), Among 28 patients with AVNRT, 24 patients (85 %) had PPI-TCL of more than 115 msec, in 4 patients the difference was less than 115 msec. Among 7 patients with AVRT, 6 patients (85 %) had PPI-TCL of less than 115 msec, in one the difference was more than 115 msec. During differential RV pacing, Among 32 patients with AVNRT, in 24 patients the Ventriculo atrial interval during basal pacing (VA base) was at least 10 msec more than the VA apex. In eight patients with AVNRT the difference was < 10 msec but more than 0 msec. Among 10 patients with AVRT, in patients VA apex was more than VA interval during base pacing by at least 10 msec. In two patients with AVRT, VA apex was less than VA base. During Parahisian pacing among the 26 patients with AVNRT 25 had the difference between stimulus to atrial interval (SA) during His non capture was at least 10 msec more than SA during His capture but in one the difference was less than 10 msec. All the patients with AVRT, difference between SA during His noncapture and His capture was less than 10 ms.*
Conclusion: *His refractory ventricular pacing has the maximum sensitivity and specificity to differentiate slow fast AVNRT from AVRT with concealed septal bypass tracts. PPI – TCL (Post pacing interval – Tachycardia cycle length) has a lower sensitivity in diagnosing slow fast AVNRT. ΔVA (VA entrainment – VA tachycardia), a cut off of 70 ms has a better differentiating value in differentiating AVRT and AVNRT. Differential RV pacing and para hisian pacing may not be useful in differentiating slow fast AVNRT and anteroseptal bypass tracts.*

I. Introduction

Retrograde atrial activation during supraventricular tachycardia in patients with atrioventricular nodal reentry tachycardia as well as atrioventricular orthodromic reciprocating tachycardias mediated by the septal accessory pathway is concentric. The diagnosis of a concealed atrioventricular accessory pathway frequently requires some electrophysiological workup, since the electrocardiographic signs of preexcitation during sinus rhythm are lacking and the ability of the standard surface ECG to recognize its presence during tachycardia is limited. There are many studies done previously assessing the usefulness of various pacing maneuvers individually in differentiating AVNRT from AVRT using septal bypass tracts. But there are only very few studies available which are comparing maneuvers with each other.

Aim: To assess the usefulness of the various pacing maneuvers in differentiating slow fast Atrio ventricular Nodal Reentry tachycardia (AVNRT) from Atrio ventricular Reentry tachycardia (AVRT) with septal bypass tracts

II. Materials and Methods

Study design: Prospective observational study

Sample size: 42 patients with supraventricular tachycardia

Inclusion criteria: Patients who presented with symptoms suggestive of paroxysmal supraventricular tachycardia (SVT) or documented tachycardia and had inducible sustained SVT during electrophysiology procedure with concentric retrograde atrial conduction (earliest retrograde atrial activation at His or coronary sinus proximal location) during ventricular pacing or during tachycardia were included.

Exclusion criteria:
Patients with documented pre excitation in the baseline ECG, patients with no inducible tachycardia during study were excluded.

Electrophysiological study:
As a part of the protocol, Quadripolar catheters were placed in right ventricular apex, Right atrium and His bundle through the femoral vein approach. Decapolar catheter was placed in the coronary sinus through a right internal jugular access and a deflectable radio frequency ablation (RF) catheter of various curves was (C to F curve) used to pace the RV base and the parahisian region. Catheter positioning was done under fluoroscopy guidance using standard technique. BARD EP system was used. Pacing was done with Micropace system. Baseline parameters during sinus rhythm and during tachycardia (Sinus cycle length, AH, HV interval during sinus rhythm, tachycardia cycle length, AH, HV, VA intervals and earliest 'A' location) were noted. Following electrophysiological maneuvers were performed.

1. His refractory ventricular pacing: Ventricular premature complex was delivered by RV apex pacing during tachycardia less than 50 ms before the expected His deflection and advancement of the atrial activity during premature stimulation was assessed. If there is advancement of the atrial activity in proportion to the prematurity of the stimulus delivered, it was diagnosed as AVRT and if there is no advancement it was diagnosed as AVNRT.

2. Calculation of □ VA interval (VA entrainment –VA tachycardia): Entrainment of tachycardia was done by pacing at RV apex at a cycle length 10 to 20 msec shorter than tachycardia cycle length. Entrainment was confirmed when the atrial cycle length accelerated to pacing cycle length, without a change in the atrial activation sequence, and tachycardia resumed after pacing was discontinued. The longest paced cycle length clearly resulting in entrainment was used for analysis. The VA interval (V-High right atrium interval) was measured in the cycle immediately before pacing. Difference between VA interval during entrainment and VA interval during tachycardia was calculated. AVNRT was considered as a diagnosis if the difference is more than 85 msec, and if less than 85 msec AVRT was considered as the diagnosis.

3. Post-pacing interval (PPI) - tachycardia cycle length (TCL): Entrainment of tachycardia was done by pacing at RV apex at a cycle length 10 to 20 msec shorter than TCL. The TCL was measured in the cycle immediately before pacing. The PPI was measured from the last RV pacing stimulus to RV electrogram in the first return beat. Difference between the PPI and TCL was calculated. PPI was not calculated if tachycardia is terminated at the end of ventricular entrainment. If the difference was more than 115 msec it was diagnosed as AVNRT and if less than 115 msec it was diagnosed as AVRT.

4. Differential RV pacing: Ventricular pacing was performed at a rate 10 ms less than tachycardia cycle length, from an apical site and a posterobasal site under fluoroscopic guidance using a RF ablation catheter. VA interval is assessed during apical and basal pacing when pacing at the same interval. The apical catheter position was always confirmed on the right anterior oblique view. If VA interval during apical pacing is more than VA interval during basal pacing, it was diagnosed as AVRT. If VA interval during basal pacing is more than apical pacing it was diagnosed as AVNRT

5. Para-Hisian pacing: Ventricular pacing was performed with the RF catheter adjacent to the His bundle and proximal right bundle branch (HB-RB). Ablation catheter was positioned at the anterobasal right ventricular septum 1 to 2 cm anterior and apical to the His bundle catheter. Bipolar ventricular pacing was performed at a high output (10 mA). During pacing, the catheter was slowly withdrawn toward the pair of electrodes on the His bundle catheter, until the width of the paced QRS complex shortened, indicating direct HB pacing. The pacing output then decreased until the paced QRS complex lengthened, which was associated with a delay in the timing of the retrograde His bundle potential, indicating loss of HB capture. The pacing output was increased and decreased to gain and lose HB-RB capture, respectively, while local ventricular capture was maintained. The SA interval (stimulus to earliest atrial electrogram interval) was recorded in both during his capture and his noncapture. If the SA interval during His non capture is more than the SA interval during His capture by atleast 10 msec, it was diagnosed as AVNRT. If the difference between SA interval during His non capture and His capture is less than 10 msec, it was diagnosed as AVRT.

Final diagnosis of the Slow fast AVNRT was made with the following criteria:
1. Dual AV nodal physiology with initiation of a tachycardia with an AH jump at a critical AH interval.
2. Earliest retrograde atrial activation during tachycardia at His or CS proximal region.
3. VA interval during tachycardia <70 msec.
4. No inducible tachycardia after slow pathway ablation.

Final diagnosis of the AVRT due to septal bypass tract was done with the following criteria:
1. VA interval during the tachycardia of more than 70 ms
2. Earliest atrial activity at His or CS proximal region
3. Local VA fusion during the mapping of accessory pathway during tachycardia or ventricular pacing
4. Non inducibility of the tachycardia after the accessory pathway ablation.

Study end points

To assess the sensitivity, specificity, positive predictive value, negative predictive value of the above mentioned maneuvers in differentiating slow fast AVNRT from AVRT using septal bypass tracts.

III. Statistical Analysis

Statistical analysis was done with SPSS 15th edition. Continuous variables are reported as mean +/- standard deviation. Significance of difference in mean was calculated with one way ANOVA test. A p value of less than 0.05 was considered significant.

IV. Results

Among 42 patients included in our study 32 were finally diagnosed to have typical slow fast AVNRT and 10 were diagnosed to have AVRT. Among the patients with AVRT, 6 had right posteroseptal bypass trac,2 had anteroseptal bypass tract and two patients had mid septal bypass tract. All patients diagnosed as slow fast AVNRT underwent successful slow pathway ablation. Among the patients with AVRT, patients diagnosed to have right posteroseptal bypass tracts and mid septal bypass tracts underwent successful accessory pathway ablation. Patients diagnosed to have anteroseptal bypass tracts did not undergo ablation in view of the anticipated high risk of heart block during the procedure.

Demographic profile:

Mean age of the patients in this study was 42 yrs. Mean age of the patients with AVNRT was 44.8 yrs +/-13 and was significantly higher than that of AVRT (34.7 yrs +/-13) (P 0.05) (Table 1) . Among the patients with AVNRT 60 % (19) were females and 40% (13) were males. Patients with AVRT, the sex ratio was 1:1 (F:M). None of the patients had any structural heart disease.

Baseline electrophysiological parameters:

Sinus Cycle length, Basal AH, HV interval were not significantly different between the two groups. (Table 2). The mean Tachycardia Cycle length was 331.6 msec and was not significantly different between the two groups (Table 2). AH interval during the Tachycardia was significantly different between the two groups. Mean AH interval during AVNRT was 264 +/- 35 msec and during AVRT was 160 msec (P <0.0001) (Table 2). Mean HV interval during the tachycardia was 41 msec and was not significantly different between the two forms of the tachycardia. VA interval during the tachycardia was significantly different between the forms of the tachycardia (P <0.0001). Mean VA interval during AVNRT was 36.7 +/-SD 39 msec and during AVRT was 134.3 msec (Table 2). Earliest "A" during tachycardia was at "His" in 91% of patients with slow fast AVNRT (29 out of 32 patients). Three (9 %) patients with AVNRT had the earliest atrial activation at CS proximal lead**.** Among 10 patients with AVRT 8 had their earliest A at CS proximal lead. Two patients had their earliest activation at "His", and were finally diagnosed to have anteroseptal concealed bypass tract.

Diagnostic pacing maneuver 1 (Ventricular pacing during the His refractoriness):

His refractory ventricular pacing was done in all patients. Atrial advancement with his refractory ventricular pacing was significantly different between the two forms of the tachycardia. (P value < 0.0001) (Table 3). None of the patients with AVNRT had significant advancement of atrial activity during His refractory ventricular pacing. All patients with AVRT had significant advancement of atrial activity during his refractory ventricular pacing (Table 3).

Diagnostic pacing maneuver 2 (Assessment of ΔVA : VA (Entrainment) – VA (tachycardia))

This diagnostic maneuver was performed in all patients. Mean VA during RV entrainment in patients with AVNRT was 162+/-48 msec, in patients with AVRT it was 163 +/-23 msec and was not significantly different between the two forms of the tachycardia (Table 4). ΔVA was significantly different between the two groups. Mean ΔVA in patients with AVNRT was 117 +/- 27 msec. Mean ΔVA in patients with AVRT was 29.8+/-13 msec (P <0.0001) (Table 4). In three patient with AVNRT the difference was < 85 msec (74 msec in two patients and 75 msec in one patient) and none of the patient with AVRT had the difference of more than 74 msec (Table 3 and Fig 1).

Diagnostic pacing maneuver 3 Assesment of Post Pacing Interval (PPI) - Tachycardia cycle length (TCL):

Post pacing Interval could be calculated in 35 (83 %) patients only. In 7 (16 %) patients tachycardia was terminated at the end of the ventricular pacing. So PPI could not be calculated. Mean PPI during ventricular pacing in patients with AVNRT is 485 msec, in patients with AVRT it was 412 msec, and was significantly different between the two forms of the tachycardia (P 0.014). Mean TCL in Patients with AVNRT is 334 msec , in patients with AVRT is 334 msec . Mean TCL was not significantly different between the groups (Table 5). Mean PPI - TCL in patients with AVNRT is 145 +/- 35 msec , in patients with AVRT is 97 +/- 12msec and was significantly different between the two forms of the tachycardia groups. (P 0.001) (Table 5). Among 28 patients with AVNRT, 24 patients (85 %) had PPI-TCL of more than 115 msec , in 4 patients the difference was less than 115 msec. Among 7 patients with AVRT, 6 patients (85 %) had PPI-TCL of less than 115 msec, in one the difference was more than 115 msec (Table 3 and Fig 2).

Diagnostic pacing maneuver 4 Differential RV pacing (VA apex – VA base):

Differential RV pacing was done in all the patients. Mean VA interval during RV apex pacing (VA apex) during sinus rhythm in patients with AVNRT was 160 msec +/-32.1, during base (VA base) pacing (VA base) 180 msec+/-32.4. Mean VA apex in patients with AVRT is 157 msec +/- 27, mean VA base in patients with AVRT is 125 msec +/- 51 (Table 6). Mean VA apex was not significantly different between the two groups. VA base was significantly higher in patients with AVNRT than in patients with AVRT (P 0.003) (Table 8). Mean VA base – VA apex in patients with AVNRT was 24 msec +/- 10.9 and with the patient with AVRT was –31 msec (SD 40) and was significantly different between the two forms of the tachycardia .(P<0.0001) (Table 6). Among the 32 patients with AVNRT, in 24 patients the VA base was at least 10 msec more than the VA apex . In eight patients with AVNRT the difference was < 10 msec but more than 0 msec . Among the 10 patients with AVRT, in 8 patients the VA apex was more than VA interval during base pacing by atleast 10 msec . In two patients with AVRT the VA apex was less than VA base (Table 3).

Diagnostic pacing maneuver 5 (Para - Hisian pacing):

Among 42 patients in this study, Para -Hisian pacing was performed in 30 (71%) patients. It was not done in 11 patients due to inadequate capture and was not interpretable in one patient due to baseline RBBB. Mean SA interval during His capture in patients with AVNRT was 99 +/- 34 msec and during His non capture was 153 +/- 55msec. Mean SA interval during His capture in patients with AVRT was 135 msec (SD 37) and during His non capture was 138 msec +/- 35msec (Table 7). Mean difference in SA during His non capture and His capture in patients with AVNRT 55 msec and in patients with AVRT 3.75 msec and was significantly different between the two forms of the tachycardia (P 0.001) (Table 7). Among the 26 patients with AVNRT 25 had the difference between SA during His non capture was at least 10 msec more than SA during His capture but in one the difference was less than 10 msec but more than 0 msec . All the patients with AVRT, difference between SA during His noncapture and His capture was less than 10 ms (Table 3).

Table 8 shows the sensitivity, specificity, positive predictive value and negative predictive value in diagnosing slow fast AVNRT, of all the maneuvers done in this study. Among all the five maneuvers studied ,His refractory ventricular pacing is the only method which has 100 % sensitivity , specificity , negative predictive value and positive predictive value in diagnosing slow fast AVNRT. PPI – TCL has the minimum sensitivity, specificity and positive predictive value in diagnosing AVNRT. All the other three maneuvers has 100% specificity and positive predictive value in diagnosing AVNRT.

V. Discussion

Retrograde atrial activation during supraventricular tachycardia in patients with atrioventricular nodal reentry tachycardia as well as atrioventricular orthodromic reciprocating tachycardias mediated by the septal accessory pathway is concentric. The diagnosis of a concealed atrioventricular accessory pathway frequently requires some electrophysiological workup, since the electrocardiographic signs of preexcitation during sinus rhythm are lacking and the ability of the standard surface ECG to recognize its presence during tachycardia is limited. There are many studies done previously assessing the usefulness of various pacing maneuvers individually in differentiating AVNRT from AVRT using septal bypass tracts. But there are only very few studies available which are comparing maneuvers with each other.

In this study we have assessed the usefulness of some of the baseline electrophysiological parameters in sinus rhythm (Sinus cycle length, AH, HV interval), during tachycardia (Tachycardia cycle length, AH, HV, VA interval , Earliest 'A' during tachycardia) and following five pacing maneuvers .

1. His refractory ventricular pacing and assessing the advancement of atrial electrogram.
2. Difference between the VA interval during entrainment of the tachycardia by from RV apical pacing and VA interval during tachycardia
3. Difference between the post pacing interval after ventricular pacing and tachycardia cycle length.
4. Differential RV pacing and assessing the difference between VA interval during base and apex pacing.
5. Para-Hisian pacing and assessing the difference between stimulus to atrium interval during His non capture and His capture.

In our study no baseline parameters during sinus rhythm (SCL, AH, HV, VA) were significantly different between slow fast AVNRT and AVRT using septal bypass tracts. HV interval was not different between the two forms of the tachycardia because patients with manifest preecxcitation were excluded from the study. In a study by Bradley et al, (3) ventricular preexcitation had a positive predictive value of 86% in diagnosing AVRT. Ten percent of patients with preexcitation had AV nodal reentry. So presence of preexcitation does not always mean that AVRT is the mechanism of the tachycardia.

Tachycardia cycle length was not significantly different between the two forms of the tachycardia. This is in concordance with the study by Bradley et al (3) where the TCL was not significantly different between AVRT and AVNRT but in contrast with the study by Josephson M et al (26) where TCL during AVRT was significantly higher than that of AVNRT.

AH interval during the tachycardia was significantly different between the two groups. Mean AH interval during AVNRT was 264 msec and during AVRT 160 ms. In a study by Gonzalez et al (25), patients with slow fast AVNRT had the mean AH interval of more than 180 msec and in patients with fast slow variant the mean AH interval was less than 180 msec.

VA interval in patients with AVNRT was always less than 70 msec and none of the patients with AVRT had VA interval of less than 70 msec. This is in concordance with a study by Benidict DG et al (23), where the patients with the AVNRT had minimum VA interval during tachycardia was less than 61 msec and V-HRA interval was always less than 95 msec. In a study by Bradley et al (3) the only characteristic that was diagnostic of AV nodal reentry was a septal VA time of $\leq$ 70 msec, none of the patients with AVRT had VA interval of less than 70 msec.

In all but 3 patients with AVNRT had their earliest retrograde atrial activation during tachycardia at 'His '. Three patients had earliest activation at CS proximal. In a report by Hwang et al (17), 6% of patients with AVNRT the atrial activation may be eccentric, earliest in mid to distal CS and may mimic left sided bypass tracts. Except two all patients with AVRT had their earliest retrograde atrial activation at His during tachycardia and were finally diagnosed to have posteroseptal bypass tract or midseptal bypass tract. Two patients with the final diagnosis of anteroseptal bypass tract had their earliest activation at 'His'.

Ventricular pacing during the His refractoriness

None of the patients with AVNRT had advancement of atrial activity during His refractory ventricular pacing. All patients with AVRT had advancement of atrial activity during His refractory ventricular pacing. This maneuver has the maximum sensitivity, specificity, positive predictive value, negative predictive value in diagnosing AVNRT. Requirement of sustained tachycardia during the maneuver is required and may terminate the tachycardia occasionally, which is a disadvantage of this maneuver (24).

□ VA interval (VA entrainment – VA tachycardia)

During entrainment of the tachycardia by pacing at right ventricle apex, VA interval during entrainment was not significantly different between the two groups. ΔVA was significantly different between the two forms of the tachycardia. In a study by Michaud et al (30) , patients with atypical AVNRT and ORT using a septal accessory pathway, all the patients with atypical AVNRT and none of the patients with ORT using a septal accessory pathway had an ΔVA interval >85 ms . By applying the same criteria (85 msec) in our study, all but three patients with AVNRT had ΔVA interval of more than 85 msec , three patients had their ΔVA interval 70 to 85 msec. In all patients with AVRT with septal bypass tract, the ΔVA was < 70 msec. So 70 msec may be a better cut off value in differentiating between AVNRT and AVRT using septal bypass tract (Table 8). In a study by Miller et al (27) His to atrial (HA) intervals were measured during SVT as well as ventricular pacing at the same rate. The delta HA interval (HA pace-HA SVT) was found to accurately distinguish AV nodal SVT (delta HA greater than 0 ms) from orthodromic SVT (delta HA less than -27 ms). An intermediate value of delta HA = -10 ms was chosen which had a 100% sensitivity, specificity and predictive accuracy in differentiating the 2 forms of SVT. A clear retrograde His potential during ventricular pacing, which is essential for application of this criterion, was present in 93% cases. In the same study they have assessed the other criteria incorporating the VA interval during the pacing to assess the ability to differentiate between the two forms of the tachycardia. The ΔVA (VA entrainment – VA tachycardia) was assessed. ΔVA was significantly different between the two forms of tachycardia, but there was some overlap between the two forms of the tachycardia and was not as precise as the ΔHA criterion in distinguishing the mechanism of SVT. This is probably because the right ventricular pacing site is remote from SVT circuit in either patient group and thus a portion of the paced VA interval is composed of the time required for the paced wave front to arrive at a portion of the ventricle near or within the SVT circuit.

Post pacing Interval – Tachycardia cycle length (PPI-TCL)

Mean PPI and Mean PPI-TCL was significantly different between the two forms of the tachycardia groups. In the same study by Michaud et al, patients with atypical AVNRT and patients with ORT using a septal accessory pathway, post-pacing interval (PPI) at the right ventricular apex were measured on cessation of ventricular pacing. All patients with atypical AVNRT and none of the patients with ORT using a septal accessory pathway had PPI–TCL more than 115 ms. Applying the same cut off value in our study , among the patients with AVNRT , 85 % had PPI-TCL of > 115 msec , in 15 % patients the difference was < 115 msec .Among the patients with AVRT 6 patients (85 %) had PPI-TCL of < 115 msec , In one patient the difference was > 115 msec . Post pacing Interval could be calculated in 83 % of the patients only. In the rest tachycardia was terminated at the end of ventricular pacing. So this maneuver has limited usefulness in differentiating Slow fast AVNRT and AVRT due to septal bypass tracts.

Differential RV pacing (VA base – VA apex)

In all patients with AVNRT VA base was more than VA apex .In three patients with AVNRT the difference was < 10 msec but more than 0 msec. This low difference could be due to variation in catheter positioning during RV base pacing. Individual differences in the distribution of the purkinje network could account for these individual differences in the conduction patterns. These results suggest that in the majority of patients the retrograde conduction times (comparing apical with posterobasal endocardial sites) follow qualitatively the antegrade conduction times (comparing apical with posterobasal endocardial sites). Among the 10 patients with AVRT, two patients with AVRT the VA interval during Apex pacing was less than VA interval during base pacing by 5 msec. These patients finally were diagnosed to have right anteroseptal bypass tract. Since the anteroseptal bypass tract is located far from the pacing site (posterobasal), it could have contributed to the above mentioned finding. In a study by Martinez-Alday et al (5), during posterobasal pacing, patients with posteroseptal bypass tracts had significantly shorter ventriculoatrial intervals than AVNRT patients. VA apex – VA base discriminated between the two groups without overlapping: It was positive in all patients with posteroseptal bypass tracts and negative in all except two patients with AVNRT.

Para-Hisian pacing

Among the 26 patients with AVNRT 25 had the SA interval during His noncapture was more than SA during His capture by atleast 10 msec , and in one the difference was less than 10 msec but more than 0 msec . All patients with AVRT had the difference between SA during His noncapture and His capture less than 10 ms .In one patient it was not interpretable in view of baseline RBBB. Para-Hisian pacing is technically more difficult to perform when compared to other maneuvers. One advantage of Para-Hisian pacing is it is being done during sinus rhythm. So it can be performed even if sustained tachycardia is not inducible in contrast with the other maneuver like His refractory ventricular pacing which require sustained tachycardia for the assessment. It is useful in bypass tracts located in all locations like posteroseptal , mid septal and anteroseptal areas, in contrast to the differential RV pacing, which is useful in differentiating only posteroseptal bypass tracts .

In a study by Kenzo Hirao et al (7), Para-Hisian pacing correctly identified retrograde AP conduction in 132 of 147 AP patients, including all septal and right free wall APs. Para-Hisian pacing correctly excluded AP conduction in all 53 patients with AVNRT. In 2 patients with very proximal right bundle branch block, right bundle branch capture failed to produce early retrograde activation of the His bundle, limiting the use of para-Hisian pacing in these patients. This suggests that HB-RB capture actually represents capture of the proximal right bundle branch and not His bundle capture. Importantly, para-Hisian pacing was performed successfully in many patients with more distal right bundle branch block, ie, distal to the para-Hisian pacing site.

VI. Study Limitations

Number of patients presented with concealed bypass tracts were small when compared to the patients with slow fast AVNRT. All the maneuvers were not done in all patients, which resulted in limited usefulness of this study in assessing the efficacy of various maneuvers. All the patients with AVNRT finally diagnosed to have slow fast AVNRT. So the same results may not be applicable to the patients with fast slow AVNRT.

VII. Conclusion

His refractory ventricular pacing is easy to perform and has the maximum sensitivity and specificity to differentiate slow fast AVNRT from AVRT. PPI - TCL has a lower sensitivity in diagnosing slow fast AVNRT and has limited usefulness in differentiating AVNRT from septal concealed bypass tracts. ΔVA (VA entrainment – VA tachycardia) , a cut off of 70 ms has a better differentiating value in differentiating AVRT and AVNRT . Differential RV pacing may not be useful in differentiating slow fast AVNRT and anteroseptal bypass tracts . The ventriculoatrial index for this type of accessory pathway should be obtained with stimulation from the septal aspect of the right ventricular infundibulum. Para-Hisian pacing is difficult to perform and is not useful in differentiating AVNRT and AVRT in patients with baseline RBBB.

References

[1]. TM Munger, DL Packer, A population study of the natural history of Wolff-Parkinson- White syndrome in Olmsted County, Minnesota, 1953-1989 . Circulation 1993;87;866-873
[2]. CR Kerr, JJ Gallagher and LD German Changes in ventriculoatrial intervals with bundle branch block aberration during reciprocating tachycardia in patients with accessory atrioventricular pathways . Circulation 1982;66;196-201
[3]. Bradley P. Knight, MD, FACC, Matthew Ebinger Diagnostic Value of Tachycardia Features and Pacing Maneuvers During Paroxysmal Supraventricular Tachycardia , Journal of the American College of Cardiology Vol. 36, No. 2, 2000
[4]. WILLIAM M. MILES, M.D., RAYMOND YEE, The preexcitation index: an aid in determining the mechanism of supraventricular tachycardia and localizing accessory pathways . Circulation 1986;74;493-500.
[5]. esus D. Martinez-Alday, MD; Jesus Almendral, Identification of Concealed Posteroseptal Kent Pathways by Comparison of Ventriculoatrial Intervals From Apical and Posterobasal Right Ventricular Sites . Circulation 1994;89;1060-1067
[6]. Goyal R, Zivin A, Souza J, Atrioventricular nodal reentrant tachycardia and accessory pathway-mediated tachycardia different ages of tachycardia onset
[7]. Am Heart J. 1996 Oct;132(4):765-7
[8]. Kenzo Hirao, MD; Kenichiro Otomo, MD;A New Method for Differentiating Retrograde Conduction Over an Accessory AV Pathway From Conduction Over the AV Node . Circulation. 1996;94:1027-1035.
[9]. Denes P Wu D , Demonstration of dual AV nodal pathways in patients with PSVT . Circulation 48;549-555,1973.
[10]. Rosen KM ,Mehta A Demostration of dual Atrioventruicular nodal pathways in man . Am J Cardiol 33:291-94,1974
[11]. Paes De carvalho AF , spread of activity through the atrioventricular node .
[12]. Circulation Res 8:801-09,1960
[13]. Anderson RH , A combined morphological and electrophysiological study of the atrioventricular node of the rabbit heart . Circulation Res 35:909-22,1974
[14]. Van Capelle FJL Spread of excitation in the atrioventricular node of isolated rabbit heart studied by multiple micro-electrode recording. Circulation Res 31:602-616 , 1972
[15]. Janse MJ influence of the direction wave front on AV nodal in isolated heart of rabbit Circulation Res 25:439-49,1969
[16]. Hirao K Electrophysiology of the AV nodal inputs and exits in the normal dog heart . J Cardiovasc electrophysiol 8;904-915,1997
[17]. Young C Demosnstration of a posterior atrial input to the atrioventricular node during sustained anterograde slow pathway conduction. Am Coll Caddiol 31:1615-21 ,1998
[18]. Fujimuar O Operative therapy of atrioventricular node reentry and results of anatomically guided procdure. Am J cardiol 64:1327-32:1989
[19]. Gonzalez MD Demonstrtion of left atrial input to the AV node in humans Circulation 106:2930-34 : 2002
[20]. Wu J , Mechanisms underlying the reentrant circuit of the AVNRT in isolated canine AV nodal preparation using optical mapping . Circulation Res 88:1189-95 :2001
[21]. Miller JM AVNRT studies on upper and lower common pathways. Circulation 75:930-40:1987
[22]. Wellens HJ Second degree block during reciprocal AVNRT. Circulation 53:595-99:1976
[23]. Bauernfeind RA retrograde block during dual pathway AVNRT. Am J Cardiol 42:499-505:1978
[24]. Gregory F. Michaud, MD Differentiation of atypical atrioventricular node re-entrant tachycardia from orthodromic reciprocating tachycardia using a septal accessory pathway by the response to ventricular pacing J Am Coll Cardiol, 2001; 38:1163-1167
[25]. Benedict DG VA intervals : diagnostic usefulness in differential diagnosis of supraventricular tachycardia. Ann Int med 91:161,1979
[26]. Zipes DP Unusual properties of accessory pathways Circulation 1974;49:1200-1211
[27]. Catheter ablation of cardiac arrhythmias 1st edition by Shoei K Steohen Huang MD
[28]. Josephson M Differential diagnosis of supraventricular tachycardias Cardiol clinics Vol 8 No 3 August 1990
[29]. Miller JM Usefullness of ΔHA and ΔVA interval to distinguish AVNRT from septal bypass tracts Am J Cardiol 1991;68:1037-44
[30]. Clinical cardiac electrophysiology 3rd edition Mark E.Josephson MD
[31]. Mines. On circulating relation to the heart muscle and its relations to the tachycardia and its relation to the fibrillation Trans R Soc Can 1914;8:43
[32]. Wellens HJ Value of programmed stimulation of the heart in a patient with WPW syndrome,In Josephnson Eds Tachycardia mechanisms and management, Lea& febiger, 1962-199
[33]. Benidict. spectrum of tachycardia with wide QRS in patients with accessory pathways Am J Cardiol 1978;42:826
[34]. Munger TM A population study of the natural history of WPW syndrome in Olmstead country, Minnasota 1953-89 Circ 1993;87; 866-873
[35]. Chen SA Longitudinal clinical and electrophysiological assessment of patients wit WPW syndrome, Circ 1996;93:2023-2032

Table 1 Mean age of patients presented with AVNRT and AVRT

Diagnosis	Mean Age (in yrs)	N	Std. Deviation
AVNRT	44.8438	32	13.31046
AVRT	34.7000	10	13.76832
P value	**0.05**		

Table 2 Basal electrophysiological parameters during sinus rhythm and during tachcyardia

Diag		**SCL** (In msec)	**AH** (In msec)	**HV** (In msec)	**TCL** (In msec)	**AH** (In msec)	**HV** (In msec)	**VA** (In msec)
AVNRT	Mean	737.43	85.31	42.37	333.25	264.53	39.93	36.71
	SD	189.12	35.02	4.95	52.74	58.55	8.68	39.36
	Min	353.00	50.00	30.00	256.00	110.00	20.00	-24.00
	Max	1288.00	258.00	55.00	490.00	418.00	55.00	192.00
AVRT	Mean	661.60	92.30	41.20	326.70	158.90	40.90	134.30
	S D	147.30	12.52	4.63	29.14	21.86	5.42	23.25
	Min	470.00	72.00	36.00	278.00	108.00	28.00	82.00
	Max	880.00	110.00	50.00	384.00	184.00	48.00	164.00
P value		**.253**	**.543**	**.511**	**.711**	**.0001**	**.744**	**.0001**

Table : 3 Usefulness of various maneuvers in diagnosing AVNRT and AVRT

		Final Diagnosis		**Total**
Maneuver	**Result**	**AVNRT**	**AVRT**	
His refractory V Pace	No adv of A	32	0	32
	Adv of A	0	10	10
VA ent –VA tachy	> 85 msec	29	0	29
	< 85 msec	3	10	13
PPI-TCl	> 115 msec	24	1	25
	< 115 msec	4	6	10
VA base —VA apex	> 0 msec	32	0	32
	< 0 msec	2	8	10
SA his Non capture – his capture	> 10 msec	25	0	25
	< 10 msec	1	4	5

Table 4 Mean VA interval during entrainment and tachycardia during two forms of the tachycardia

Diag		**VA Entrainment** (In msec)	SD	**VA tachycardia** (In msec)	SD	**VA (ent) – VA (tachy)** (In msec)	SD
AVNRT	Mean	163.5000	48.84	46.3125	39.36	117.7813	27.00745
AVRT	Mean	162.2000	23.86	132.4000	23.25	29.8000	13.99047
P value		**.936**	**43.92**	**.0001**	**55.31**	**.0001**	45.08794

Table 5 Mean Post pacing interval , Tachycardia cycle length in two forms of the tachycardia

Diagnosis		**PPI** (In msec)	**TCL** (in msec)	**PPI-TCL** (In msec)	SD
AVNRT	Mean	485.4286	334.0000	145.7143	35.1
AVRT	Mean	411.5714	314.0000	97.5714	12.2
P value		**0.014**	**0.340**	**0.001**	

Table : 6 Mean VA intervals during apical and base pacing during

Diagnosis		**VA apex**	**VA base**	**VA base - VA apex**
AVNRT	Mean	159.7500	180.4583	24.0417
AVRT	Mean	157.0000	125.3333	-31.6667
P value		**.849**	**.003**	**.000**

Table 7 Para-Hisian pacing - parameters

Diagnosis		SA his capture	SD	SA his non capture	SD	SA his non capture – his capture	SD
AVNRT	Mean	98.53	34.39	153.15	41.14	55.00	28.5
AVRT	Mean	135.00	37.14	138.75	35.35	3.75	6.23
P value		.060		.514		.001	

Diagnostic pacing maneuvers	Sens	Spc	PPV	NPV
His refractory Ventricular pacing	100	100	100	100
VA ent – VA tachy (cut off 85msec)	90	100	100	77
VA ent – VA tachy (cut off 70 msec)	100	100	100	100
PPI-TCL	85	85	96	60
Differential RV pacing	94	100	100	80
Para-Hisian pacing	96	100	100	80

Figure 1:Distribution of VA intervals according to the diagnosis. All but 3 patients with AVNRT had ΔVA interval of > 85 msec , in 3 patients it was <85 msec but > 70 msec . All patients with AVRT had ΔVA interval of <70 msec

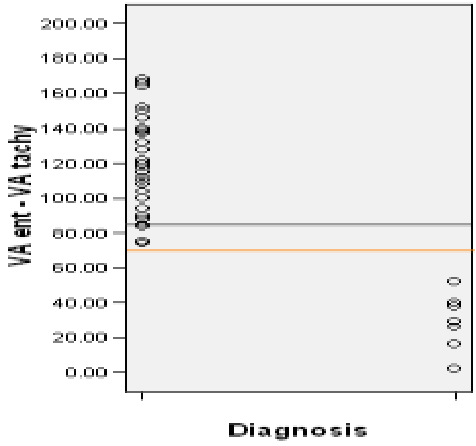

Table 8 : Sensitivity , specificity , positive predictive value and negative predictive value of the five diagnostic maneuvers .

Sens : Sensitivity , Spc : Specificity ,PPV :Positive predictive value ,NPV : Negative predictive value

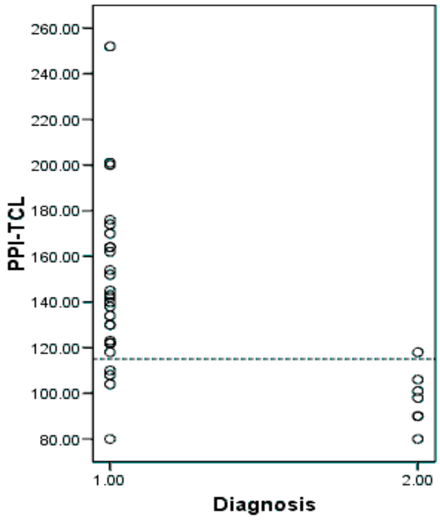

Figure : 2 Shows the distribution of patients according to the PPI- TCL and final diagnosis. In 4 patients with AVNRT PPI – TCL was < 115 msec and one patient with AVRT PI-TCL was > 115 msec