Left Inferior Lateral Ablation of Typical AVNRT (Left sided AVNRT)

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Clinical Presentation

- Forty nine year old female presented with recurrent palpitations for 10 years duration.
- ECG during palpitation suggestive of AVNRT with baseline ECG without any preexcitation.
- Echo showed structurally and functionally normal heart.
- EP Study done which confirmed AVNRT after excluding other mechanism of SVT.
- Tried to ablate inferior –posterior right septum but failed to ablate and so patient was put on Metoprolol 50 mg BD but after few months AVNRT recurred even on beta-blocker. Therefore taken up for repeat procedure and 3D Mapping Navix was used.
EGM in Sinus Rhythm
Induction of Tachycardia with 1:2 response
V-Pacing during Tachycardia with entrainment and VA Capture
Spontaneous VPC during His refractory failed to preexcite atria
V Extra during His Refractory
JT on the Right side of Septum
Mapping Slow pathway potentials on Left side of Inferolateral Mitral annulus

Slow Pathway Potentials
Frequent JT on Start of RF
Summary and Conclusion

- The left sided variety of Typical Slow –Fast AVNRT is very rare.
- This is first case for me where I did RF ablation from left inferolateral part of Mitral annulus when failed to ablate from right side at two attempt with frequent junctional beats.
- Over more than one year of follow up there is on recurrence of tachycardia.
ORIGINAL ARTICLE

Slow/Fast Atrioventricular Nodal Reentrant Tachycardia Using the Inferolateral Left Atrial Slow Pathway

Role of the Resetting Response to Select the Ablation Target

Stavros Stavrakis, MD, PhD Warren M. Jackman, MD Deborah Lockwood, MD Hiroshi Nakagawa, MD, PhD Karen Beckman, MD Khaled Elkholey, MD Zulu Wang, MD Sunny S. Po, MD, PhD
BACKGROUND: We describe a technique to localize the ablation target in patients with an unusual variant of slow/fast atrioventricular nodal reentrant tachycardia (AVNRT) using a slow pathway connecting to the basal inferolateral left atrium.

METHODS: Consecutive patients with slow/fast AVNRT were included. During stable slow/fast AVNRT, a single late atrial extrastimulus (AES) was delivered at the inferolateral left atrium near the mitral annulus. Advancing the next His bundle potential by $\geq 5$ ms, followed by resetting of the tachycardia cycle length, indicated that the AES engaged the anterograde slow pathway. The latest AES resetting AVNRT was considered to be in close proximity to the atrial end of the anterograde slow pathway and was selected as the ablation target.

RESULTS: In 10 of 843 (1.2%) patients, ablation at the inferolateral left atrium was required. All patients had had failed ablation at the inferior triangle of Koch and roof of the coronary sinus. In all 10 patients, a late AES advanced the His bundle potential by $\geq 10$ ms and reset the tachycardia. Ablation at that site eliminated slow pathway conduction and terminated the tachycardia. Ablation was successful at the site of the latest AES, delivered 49±12 ms after the onset of the His bundle potential. No recurrent tachycardia was noted at 1 year of follow-up.

CONCLUSIONS: The inferolateral left atrium slow pathway is used in a small subset of patients with slow/fast AVNRT. Accurate localization of the ablation target can be achieved by delivering late AES during AVNRT (resetting response).
In all 10 patients, a late atrial extrastimulus delivered near the inferolateral mitral annulus advanced the HB potential by \( \geq 10\) ms and reset the tachycardia. Ablation at that site eliminated slow pathway conduction and terminated the tachycardia.
Figure 1. Radiographs in the right anterior oblique (RAO; A) and left anterior oblique (LAO; B) projections show the mapping catheter positioned at the basal inferolateral left atrium, close to mitral annulus (arrow, inferolat LA), at the site of resetting with the latest extrastimulus and successful ablation of the IL-LA slow pathway. Other catheters are positioned at the right atrial appendage (RAA), His bundle region (HB), anterobasal right ventricle (RV), and coronary sinus (CS). Modified from Lockwood et al® with permission. Copyright © 2009, Elsevier.
Late Extrastimulus at Inferior Triangle of Koch
Late Extrastimulus at Inferior Triangle of Koch

Atrial Activation in CS is Advanced
Late Extrastimulus at Inferior Triangle of Koch

Ensure Fast Pathway was Not Penetrated
Late Extrastimulus at Inferior Triangle of Koch

No Advance in $A_{HB}$
Late Extrastimulus at Inferior Triangle of Koch

No Advance in A_{HB} – Retro FP Activ is On Time

S_2 Sufficiently Late
Late Extrastimulus at Inferior Triangle of Koch

No Advance in H₂ – No Advance in A₂
Late Extrastimulus at Inferior Triangle of Koch

No Advance in $H_2$ – No Resetting of the Circuit
Later Extrastimulus at Roof of Proximal CS
Slightly Later Extrastimulus at Roof of Prox CS

H₂ is Advanced by 25 ms – A₂ is Advanced by 25 ms
Slightly Later Extrastimulus at Roof of Prox CS

LIE is Antegrade Limb of Circuit

H₂ is Advanced by 25 ms – Tachycardia is Reset
Ablation of “Leftward Inferior Extension” at Roof of Proximal CS

RAO Projection

LAO Projection

- RAA
- RV
- HB
- CS Floor
- CS Roof
Ablation of Leftward Inferior Extension

Resetting Site
Roof of CS

Ablation LA
Near Inferior MA

LAO Projection

Ablation in LA
Required for 25% of LIE
Resetting Slow/Fast AVNRT by Late Extrastimulus at the *Inferolateral Mitral Annulus*
Resetting Slow/Fast AVNRT at the Inferolateral Mitral Annulus

$H_2$ is Advanced by 10 ms
$A_2$ is Advanced by 10 ms
Resetting Slow/Fast AVNRT at the Inferolateral Mitral Annulus

Inferolateral Left Atrial Slow Pathway is the Antegrade Limb

Positive Resetting Response
Ablation at Inferolateral Mitral Annulus

RAO Projection

LAO Projection

RAA
RV
HB
CS

Inferolateral Mitral Annulus
During Ablation at the IL-LA

RF Power: 20 Watts

Junctional Automaticity with Retrograde Fast Pathway Conduction

Heating (Injury) “IL-LA” Slow Pathway
Figure 3. Schematic representation of the location of the successful resetting and ablation sites in the 10 patients (pts) with slow/fast atrioventricular nodal reentrant tachycardia requiring left atrial ablation adjacent to the inferolateral mitral annulus, as seen in the left anterior oblique projection.
Figure 5. Retrograde conduction over the inferolateral left atrial (IL-LA) slow pathway in a patient with fast/slow atrioventricular nodal reentrant tachycardia (AVNRT) using the IL-LA slow pathway for the retrograde limb of the reentrant circuit.
WHAT IS KNOWN?

• Anatomic slow pathway ablation at the inferior triangle of Koch fails to eliminate slow/fast atrioventricular nodal reentrant tachycardia in ≈5% of patients. • In these patients, targeting the leftward inferior extension of the atrioventricular node at the roof of the coronary sinus or the left inferior septal region is most often successful in eliminating the tachycardia.

WHAT THE STUDY ADDS?

• In this study, we describe an even rarer form of slow/ fast atrioventricular nodal reentrant tachycardia, in which the anterograde limb is formed by a slow pathway with the atrial end located at the basal inferolateral left atrium, near the mitral annulus.  
• We describe a technique to select the ablation target for anterograde inferolateral left atrial slow pathway conduction during slow/fast atrioventricular nodal reentrant tachycardia using the resetting response to late atrial extrastimuli delivered at the basal inferolateral left atrium. The site where the latest extra-stimulus advances the next His bundle potential and resets the tachycardia identifies the approximate location of the atrial end of the slow pathway participating in this rare form of slow/fast atrioventricular nodal reentrant tachycardia.
Left Septal Slow Pathway Ablation for Atrioventricular Nodal Reentrant Tachycardia

BACKGROUND: Immunohistochemistry studies suggest that the anatomic substrate of the slow pathway in atrioventricular nodal reentrant tachycardia (AVNRT) is the left inferior nodal extension. We hypothesized that slow pathway ablation from the left septum is an effective alternative to right-sided ablation.

METHODS AND RESULTS: We analyzed our databases of AVNRT in search of cases that had used slow pathway ablation from the left septum because of failure of right septal ablation, and then prospectively subjected consenting patients to a left septal-only procedure. Of 1342 patients subjected to right septal slow pathway ablation for AVNRT, 15 patients, 11 with typical and 4 with atypical AVNRT, had a left septal approach after unsuccessful right-sided ablation (R+L group). Eleven patients were subjected to a left septal-only approach for slow pathway ablation without a previous right septal attempt (L group). Fluoroscopy times in the R+L and L groups were 30.5 (21.0–44.0) and 20.0 (17.0–25.0) minutes, respectively (P=0.061), and radiofrequency current delivery times were 11.3 (5.0–19.1) and 10.0 (7.0–12.0) minutes, respectively (P=0.897). There was no need for additional ablation lesions at other anatomic sites in either group, and no cases of atrioventricular block were encountered. Recurrence rates of the arrhythmia block were encountered. Recurrence rates of the arrhythmia block were encountered. Recurrence rates of the arrhythmia block were encountered. Recurrence rates of the arrhythmia block were encountered. Recurrence rates of the arrhythmia block were encountered. Recurrence rates of the arrhythmia block were encountered. Recurrence rates of the arrhythmia block were encountered. Recurrence rates of the arrhythmia block were encountered. Recurrence rates of the arrhythmia block were encountered. Recurrence rates of the arrhythmia block were encountered. Recurrence rates of the arrhythmia block were encountered. Recurrence rates of the arrhythmia block were encountered. Recurrence rates of the arrhythmia block were encountered. Recurrence rates of the arrhythmia block were encountered. Recurrence rates of the arrhythmia block were encountered. Recurrence rates of the arrhythmia block were encountered. Recurrence rates of the arrhythmia block were encountered. Recurrence rates of the arrhythmia block were encountered. Recurrence rates of the arrhythmia block were encountered. Recurrence rates of the arrhythmia block were encountered. Recurrence rates of the arrhythmia block were encountered. Recurrence rates of the arrhythmia block were encountered. Recurrence rates of the arrhythmia block were encountered. Recurrence rates of the arrhythmia block were encountered. Recurrence rates of the arrhythmia block were encountered. Recurrence rates of the arrhythmia block were encountered. Recurrence rates of the arrhythmia block were encountered. Recurrence rates of the arrhythmia block were encountered. Recurrence rates of the arrhythmia block were encountered. Recurrence rates of the arrhythmia block were encountered. Recurrence rates of the arrhythmia block were encountered. Recurrence rates of the arrhythmia block were encountered. Recurrence rates of the arrhythmia block were encountered. Recurrence rates of the arrhythmia block were encountered. Recurrence rates of the arrhythmia block were encountered. Recurrence rates of the arrhythmia block were encountered. Recurrence rates of the arrhythmia block were encountered. Recurrence rates of the arrhythmia block were encountered. Recurrence rates of the arrhythmia block were encountered. Recurrence rates of the arrhythmia block were encountered. Recurrence rates of the arrhythmia block were encountered. Recurrence rates of the arrhythmia block were encountered. Recurrence rates of the arrhythmia block were encountered. Recurrence rates of the arrhythmia block were encountered. Recurrence rates of the arrhythmia block were encountered. Recurrence rates of the arrhythmia block were encountered. Recurrence rates of the arrhythmia block were encountered. Recurrence rates of the arrhythmia block were encountered. Recurrence rates of the arrhythmia block were encountered. Recurrence rates of the arrhythmia block were encountered. Recurrence rates of the arrhythmia block were encountered. Recurrence rates of the arrhythmia block were encountered. Recurrence rates of the arrhythmia block were encountered. Recurrence rates of the arrhythmia block were encountered. Recurrence rates of the arrhythmia block were encountered. Recurrence rates of the arrhythmia block were encountered. Recurrence rates of the arrhythmia block were encountered. Recurrence rates of the arrhythmia block were encountered. Recurrence rates of the arrhythmia block were encountered. Recurrence rates of the arrhythmia block were遇到了。
Figure 2. Position of the left septal ablating electrode. The ablating electrode, L(ts) abl, has been placed transseptally on the left septum and advanced below the coronary sinus electrode. This is the anatomic area of the left inferior nodal extension. CS indicates coronary sinus; HRA, high right atrium; L(ta) His, transaortic, left septal, His recording electrode; L(ts) abl, transseptal, left septal, ablating electrode; R His, right septal His recording electrode; and RV, right ventricle.
Figure 3. Correct atrial electrogram recorded by the ablating electrode.
Left: Initial attempts for left-sided atrial pathway ablation. Note that the atrial signal recorded by the ablating electrode
appears normal.
Figure 4. Anatomically left-sided septal slow pathway ablation in dextrocardia and situs inversus totalis.
<table>
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<tr>
<th>Authors</th>
<th>Year</th>
<th>AVNRT Type</th>
<th>N</th>
<th>Approach</th>
<th>Anatomic Site</th>
<th>A:V Ratio</th>
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<td>Hwang et al(^3)</td>
<td>1997</td>
<td>11 SS, 9 FS</td>
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<td>Jais et al(^2)</td>
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<td>Yamabe et al(^14)</td>
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<td>4 FS</td>
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AVNRT = AV nodal reentrant tachycardia; CS = coronary sinus; endo = endocardial; LA = left atrial; RF = radiofrequency; RT = retrograde; TS = transseptal.
Thank You
Is it Left Sided Circuit in AVNRT?

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Clinical Presentation

• Thirty one year old female presented with recurrent paroxysmal palpitations.
• ECG during tachycardia showed regular narrow QRS tachycardia with CL 260 msec.
• ECG in Sinus rhythm showed no preexcitation.
• Referred for EPS and RF ablation.
Induction of Tachycardia by Atrial premature beat due atrial Extrastimuli may be reentry beat with eccentric retrograde atrial activation
EP Study: Intracardiac Electrogram during Tachycardia with CL 260 msec with earliest A at distal CS.
Differential Diagnosis of Regular narrow QRS tachycardia with earliest A at distal CS:

• Left Lateral concealed AP mediated circus movement ORT.
• Atrial Tachycardia from lateral Mitral Annulus.
• Left sided circuit in AVNRT fast – slow type.
Burst Pacing of RV septum with concentric retrograde conduction
Electrophysiological Maneuvers to distinguish these three tachycardia: Pacing LV with concentric conduction.
Pacing of LV lateral wall during tachycardia with VAVA response on stopping Pacing excludes left mitral annular Atrial Tachycardia
LV pacing during tachycardia in the beginning: Termination of tachycardia with fusion beat proves to be AP mediated tachycardia.
A on V tachycardia was frequently inducible with VA interval <70 msec indicates Slow-Fast AVNRT.
Now the differential diagnosis

- AVNRT slow-fast type
- Junctional Tachycardia
- Nodo-fascicular or Nodo-ventricular mediated ORT.
- Atrial tachycardia from triangle of Koch’s with A near the previous QRS.
RF ablation

• Successful slow pathway ablation done by Electrogram and anatomical guided near the upper lip of CS with frequent junctional beats.
• Transeptal Puncture was done but on LV pacing there was no conduction through AP (no eccentric atrial activation) therefore not ablated.
• No tachycardia was inducible by any means.
• May be pathway got bumped by catheter.
• Resetting from three slow pathway region by giving delayed atrial extramuli during tachycardia and demonstrating His preexcitation (resetting) confirms part of circuit and ablation should be done there.
• **This type of manifestation may be due to Left sided concealed Nodoventricular bypass tract.**
Concealed Nodofascicular Pathway

Animation by Criley S, Blaufuss Medical Multimedia, Palo Alto, Calif
Conclusion

• This narrow QRS tachycardia with Eccentric and Concentric atrial conduction could be due to left sided (Fast-Slow type) and right sided (Slow-Fast type) circuit of AVNRT but fusion beat terminates tachycardia proves AP mediated ORT.

• Although episodic bypass conduction can cause orthodromic circus movement tachycardia.

• Over five years of follow up no recurrence of any tachycardia.
Atypical Atrioventricular Node Reciprocating Tachycardia Masquerading as Tachycardia Using a Left-Sided Accessory Pathway

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Los Angeles, California and Provo, Utah

Objectives. The study was performed to document that atrioventricular node reciprocating tachycardia (AVNRT) can be associated with eccentric retrograde left-sided activation, masquerading as tachycardia using a left accessory pathway.

Background. The eccentric retrograde left-sided activation during tachycardia is thought to be diagnostic of the presence of a left free wall accessory pathway. However, it is not known whether AVNRT can occur with eccentric retrograde left-sided activation.

Methods. We studied 356 patients with AVNRT who underwent catheter ablation. Retrograde atrial activation during tachycardia and ventricular pacing were determined by intracardiac recordings, including the use of a decapolar coronary sinus catheter.

Results. The retrograde atrial activation was eccentric in 20 patients (6%). Eight of these patients had the earliest retrograde atrial activation recorded in the lateral coronary sinus leads, and 12 had the earliest retrograde atrial activation recorded in the posterior coronary sinus leads, with the most proximal coronary sinus electrode pair straddling the coronary sinus orifice. These tachycardias were either the fast-slow or the slow-slow form of AVNRT. The slow-fast form of AVNRT was also inducible in 17 of the 20 patients. Successful ablation of the slow pathway in the right atrial septum near the coronary sinus ostium prevented the induction and clinical recurrence of reciprocating tachycardia in all patients.

Conclusions. Atypical AVNRT with eccentric retrograde left-sided activation was demonstrated in 6% of all patients with AVNRT masquerading as tachycardia using a left-sided accessory pathway. Ablation of the slow pathway at the posterior aspects of the right atrial septum resulted in a cure in these patients. (J Am Coll Cardiol 1997;30:218–25)

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B, Retrograde atrial activation sequences during left ventricular pacing with a cycle length of 500 ms, obtained after successful SP ablation.
Figure 2. Resetting technique for localizing the atrial end of the inferolateral left atrial slow pathway forming the anterograde limb of the slow/fast reentrant circuit.