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St Thomas’ Hospital, London UK
AVNRT: The Most Common Regular SVT

SVT

Prevalence: 2.25/1,000 persons
Incidence: 35/100,000 person-years (MESA study)

Thus, there are approximately 89,000 new cases/year and 570,000 persons with SVT in the United States.

Mechanisms of SVT

AVNRT: The Most Common Regular SVT
1756 pts undergoing ablation
Porter et al. HeartRhythm 2004;1:393-6
AVNRT: The Most Common Regular SVT
AVNRT: The Most Common Regular SVT
AVRT: The 2\textsuperscript{nd} Most Common Regular SVT
AVNRT: Fast-slow form
AVNRT: Slow-slow form
AVNRT: Fast-slow form
AVNRT: The Most Common Regular SVT

- 1913 Mines: circus movement in AV node a mechanism for SVT
- 1956 Moe: evidence of a dual AV conduction system in dogs
- 1973 Denes: demonstration of dual AV nodal pathways
AVNRT
The Human AV node
AV NODAL REENTRANT TACHYCARDIA
UNRESOLVED ISSUES

1. Does the Atrium Participate in the Circuit?

2. Is There An Upper Common Pathway?

3. Are These Pathways Confined to the AV Node?

4. Are There Only Two Pathways?

5. Is There Only One Circuit?

6. Is AV Nodal Duality a Functional Phenomenon?
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Does the Atrium Participate in the Circuit?
Chen and Josephson. JCE 2000
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Retrograde atrial activation during AVNRT has been found heterogeneous in the majority of patients thus arguing against the concept of an anatomically discrete upper pathway.

Katritsis PACE 2007;30:1305-1308

Broad early atrial activation at more than one separate locations (LRA, HBE, Cs os)
Upper and Lower Common Pathways in Atrioventricular Nodal Reentrant Tachycardia: Refutation of a Legend?

DEMOSTHENES G. KATRITSIS, M.D., PH.D., F.R.C.P.
From the Department of Cardiology, Athens Euroclinic, Athens, Greece

The concepts of upper and lower common pathways represent long-standing controversies of atrioventricular nodal reentrant tachycardia (AVNRT). Over the last years there has been considerable evidence against the presence of a lower and, especially, an upper common pathway as distinct entities that can be identified in most patients with atrioventricular reentrant tachycardia. The mechanism and relevance of these concepts remain speculative. (PACE 2007; 30:1305–1308)
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AV NODAL REENTRANT TACHYCARDIA
Are These Pathways Confined to the AV Node?

Fast pathway "all or none" conduction
and pharmacological response have been described

Gomes et al. Am J Cardiol 1979; 43: 687
Wu et al. Circulation 1981; 64: 823
Kay et al. Circulation 1992; 85: 1675
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AV NODAL REENTRANT TACHYCARDIA
Are There Only Two Pathways?

AVNRT Utilizing Multiple Retrograde Fibers
Katritsis et al. Clin Cardiol 1993

Anterior s-f AVNRT

Posterior s-f AVNRT
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AV NODAL REENTRANT TACHYCARDIA
Is There Only One Circuit?

Jackman and colleagues
AV reentry occurs in a complex network of nodal and transitional cells and in the rim of surrounding atrial cells. Loh et al. Circulation 2003
AV NODAL REENTRANT TACHYCARDIA
UNRESOLVED ISSUES

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Is AV Nodal Duality a Functional Phenomenon?
Anatomic and functional dual pathways including and excluding the atrium.

*Spach and Josephson*
Is AV Nodal Duality a Functional Phenomenon?
The AV junction anatomical structure contains the conditions for the existence of functional pathways. A deep central portion is surrounded by successive layers of myocardium that gradually merge with atrial myocardium.

High resolution, 3-D, fluorescent imaging.

_Efimov and Mazgalev. Circulation 1998_
AV NODAL REENTRANT TACHYCARDIA

Can the anisotropic model explain the typical electrophysiologic behaviour of AV nodal duality?

Anisotropy in the superficial layers of the triangle of Koch

A study of multichannel mapping in isolated animal hearts. Despite the large increase in the AH interval, delay between earliest and latest endocardial activation within the recording area increased by only 4 ms

Hocini et al. JACC 1998
AV NODAL REENTRANT TACHYCARDIA
Anisotropy in the triangle of Koch

A study on the superfused canine AV junction failed to demonstrate a role for fiber orientation determining decremental conduction and block in transitional cell AV nodal approaches. 
Patterson and Scherlag. J Interv Card Electrophysiol 2002
AVNRT: The Most Common Regular SVT

Right and Left Septal Mapping During LIPS Pacing: Retrograde Slow pathway Conduction
14 pts with s-f AVNRT
AVNRT ΔSt-H at max decrement: R>L
ΔSt-H is 96 msec (220-124) on right His recordings, and 90 msec (218-128) on left His recordings.
AVNRT

ΔSt-H at max decrement: R>L
Microscopic section, taken perpendicular through the atroventricular septal junction, of a heart of a 5-year-old child. The left hand panel shows the right (Rt) and leftward (Lt) extensions in topographic relationship with the atrial septum, clearly revealing at this level the right (RA) and left atrial components, the crest of the ventricular septum (VS) and the mitral (MV) and tricuspid valves (TV). The boxed area is shown in higher magnification in the right hand panel. Rt and Lt in contact with right and left atrial myocardium, respectively.

AVNRT: The Most Common Regular SVT

Inoue and Becker. Circulation 1998
The Human AV Node
AVNRT

19 pts with s-f AVNRT: R, TA, and TS His

AVNRT

19 pts with s-f AVNRT: Shift of retro A activation from R to L with max decrement

ΔSt-H is 244 msec (324-80) on right His recordings, and 234 msec (320-86) on left His recordings
10 pts with s-f AVNRT
Katritsis et al. Am J Cardiol. 2006;97(6):860
Resetting of AVNRT by left inferoparaseptal extrastimuli. The His bundle electrogram is advanced by 10 msec 10 pts with s-f AVNRT Katritsis et al. Am J Cardiol. 2006;97:860
The last tachycardia beat is not conducted to the atrium, revealing the actual components of the A electrogram

22 pts with s-f AVNRT. Katritsis et al. *HeartRhythm* 2006;3:993
First extra captures V without disturbing the AVNRT circuit. Second extra captures both V and A and separates the two electrograms revealing that the small component seen during AVNRT is the A electrogram.

Katritsis et al. *HeartRhythm* 2006;3:993
Extrastimulus captures V without resetting the AVNRT circuit, as judged by constant A-A intervals, results in separation of V and A electrograms, and allows identification of the beginning of the A on left His.

Katritsis et al. *HeartRhythm* 2006;3:99 22 pts with s-f AVNRT
AV NODAL REENTRANT TACHYCARDIA
Where is the fast pathway?

Animal studies have demonstrated evidence of multiple atrial inputs to the AV node
Antz et al. JCE 1998

AV junctional cells have been identified around both the tricuspid and mitral annulus
AV NODAL REENTRANT TACHYCARDIA

Atrial Extensions of the AV Node.
The Missing Link?

1906 Tawara

1976 Becker and Anderson

1998 Inoue and Becker

2007 Katritsis and Becker

Histological evidence of both rightward and leftward inferior extensions and speculated that these extensions may be involved in slow pathway conduction.
AVNRT Circuit(s): A Proposal
Katritsis and Becker 2007

HRA pace

Bb

MV

TV

LIPS pace

CS

ri

rs

li

ls

AVN

**Slow-fast AVNRT**

Fast-slow AVNRT

Slow-slow AVNRT
### CLASSIFICATION OF AVNRT
Katritsis DG, Camm AJ. *Circulation*. 2010;122:831-40

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<th>AH/HA</th>
<th>VA (His)</th>
<th>Usual ERAA</th>
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<td>&gt;1</td>
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- **Typical AVNRT**
- **Atypical AVNRT**

Traditionally, right septal only mapping has been performed.
RV apex entrainment

StimA=592 ms
VA=134 ms
Pp AH=224 ms
AH=172 ms
PPI=447 ms
TCL=322 ms

RV base entrainment

StimA=524 ms
VA=134 ms
Pp AH=222 ms
AH=172 ms
PPI=407 ms
TCL=322 ms
AVNRT vs AVRT: Differential Entrainment
Tachycardia Interruption (atypical AVNRT)
## CLASSIFICATION OF AVNRT


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Traditionally, right septal only mapping has been performed.
AVNRT
The Circuit
Katritsis and Becker. *HeartRythm* 2007
AVNRT
Slow pathway ablation: away from the His, towards the CSos
AVNRT
Slow pathway ablation: away from the His, towards the CSos
AVNRT
Giazitzoglou E, et al. Slow-pathway ablation for atrioventricular nodal re-entrant tachycardia with no risk of atrioventricular block.

227 pts with s-f AVNRT
In 4 pts (1.8%) a left-sided ablation was necessary
0 AV block
Katritsis et al. An approach to left septal slow pathway ablation.

AVNRT: Left septal ablation
AVNRT: Left septal ablation

100 mm/sec
Position of catheters in RAO and LAO projections.
The site of successful slow pathway ablation (L Abl) is at the posterior, anatomically left septum towards the ostium of the coronary sinus.

A. Despite recording of suitable signals and appropriate anatomic position of the anatomically right (R Abl) ablation catheter on the left side of the septum, no nodal beats or rhythm could be obtained.

B. Recording of a His by the anatomically left (L Abl) ablation catheter on the right side of the septum.

C. By advancing the anatomically left ablation catheter on the right side of the septum posteriorly and towards the CS ostium, the anatomic area of the left posterior extension of the AV node is negotiated. At this point, nodal rhythm was immediately obtained RF, and the AVNRT was no longer inducible.
1. Η AVNRT είναι η πλεον συχνή κανονική ταχυκαρδία.
2. Πιθανότερο υποβαθρό του κυκλώματος οι επεκτασεις του κομβού.
3. Η ακολουθία παλινδρομής ενεργοποίησης του κολπού μπορεί να προσομοιάζει αυτή ενός παραπληρωματικού δεματίου.
4. Η ορθή διαγνώση είναι απαραίτητη για ανεπιπλέκτο ablation.
5. To ablation πρέπει πάντοτε να εχει ως στόχο την περιοχή του αργού δεματίου: προς το στομίο του CS και μακραν του His.
6. Σε περιπτώσεις αποτυχιας, αριστερή προσπελάση (δια της αορτής) ενδείκνυται.

Θεραπεία μπορεί πλέον να επιτευχθεί με αμελήτεο κινδύνο AV block.