SVT: Diagnosis and Treatment

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ABIM

Medical-Content Category	Relative Percentage
Cardiovascular Disease	14%
Gastroenterology	9%
Pulmonary Disease	10%
Infectious Disease	9%
Rheumatology/Orthopedics	8%
Endocrinology, Diabetes and Metabolism	8%
Medical Oncology	7%
Hematology	6%
Nephrology/Urology	6%
Allergy/Immunology	3%
Psychiatry	4%
Neurology	4%
Dermatology	4%
Obstetrics/Gynecology	3%
Ophthalmology	2%
Otorhinolaryngology	2%
Miscellaneous	3%
Total	100%

ABIM

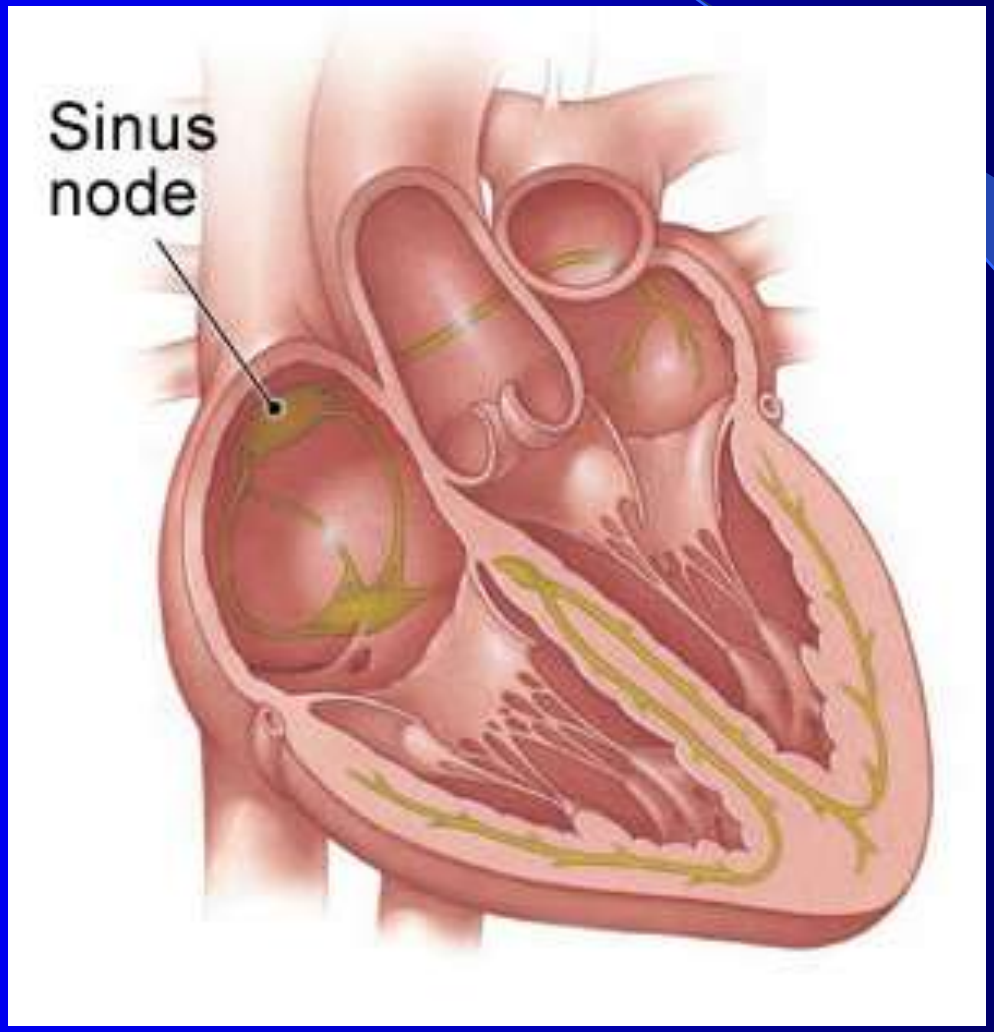
Cardiovascular Disease (14%)	30–32 as follows
Hypertension	2–4
Pericardial disease	1–4
Ischemic heart disease	8–11
Arrhythmias	2–5
Congenital heart disease	0–1
Valvular heart disease	2–5
Myocardial disease	1–4
Cardiac tumors	0–1
Endocarditis and other cardiovascular infections	0–1
Vascular disease	0–2
Noncardiogenic syncope	0–1
Preoperative consultation	2–3
Miscellaneous cardiovascular disease	1–3

Presentation Objectives

After completion of this presentation, the participant should be able to:

- **Understand the mechanisms of SVT**
- **Diagnose SVT/Interpret the response to adenosine**
- **Understand various therapeutic options for SVT**

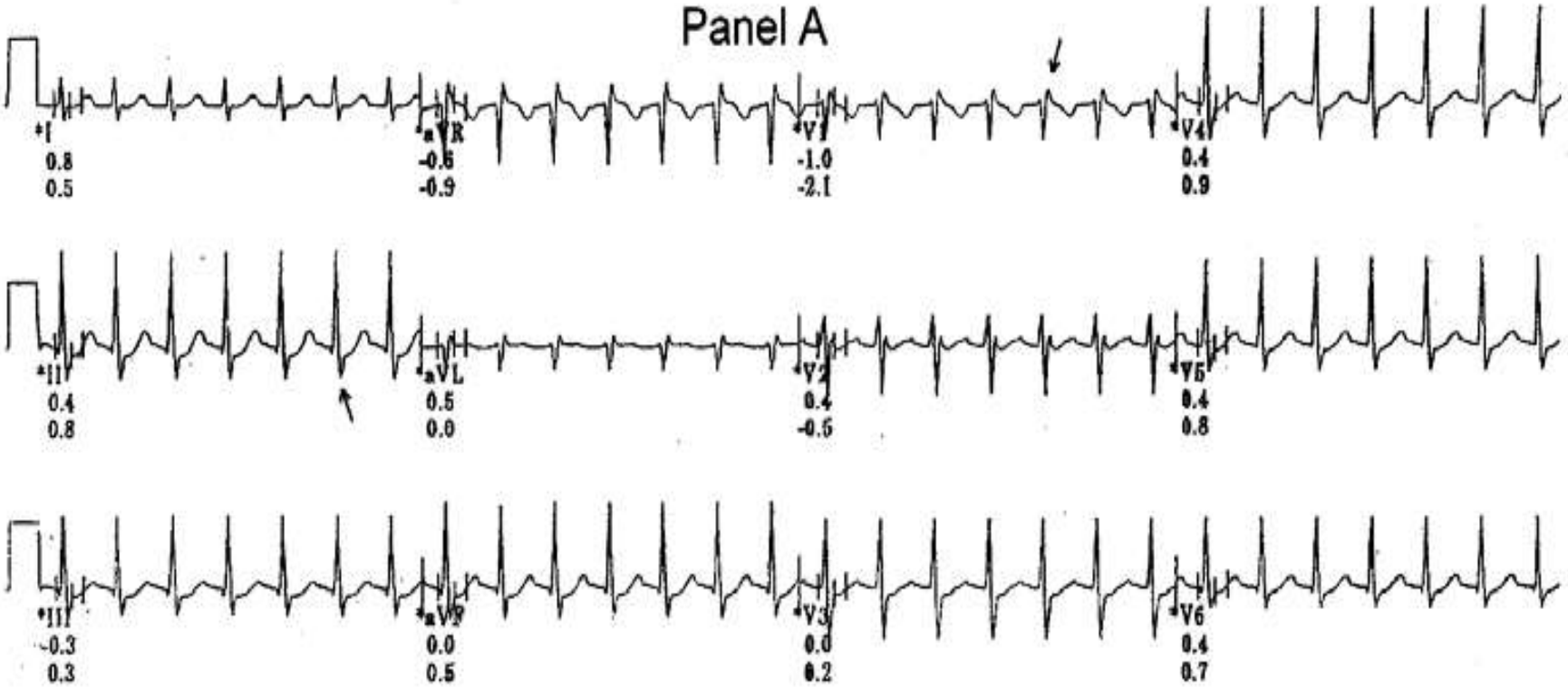
Conduction System



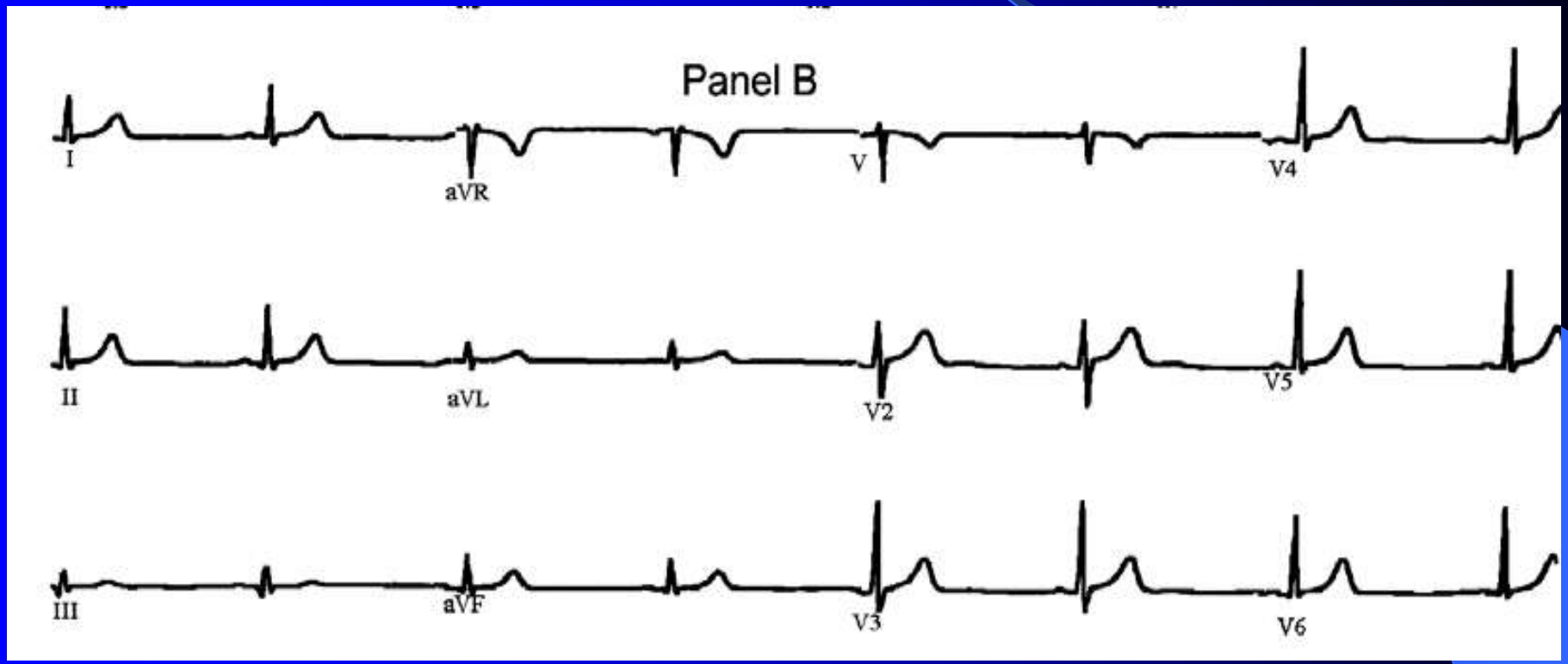
Classification of Narrow QRS Complex Tachycardias by Structures Required for Initiation and Maintenance

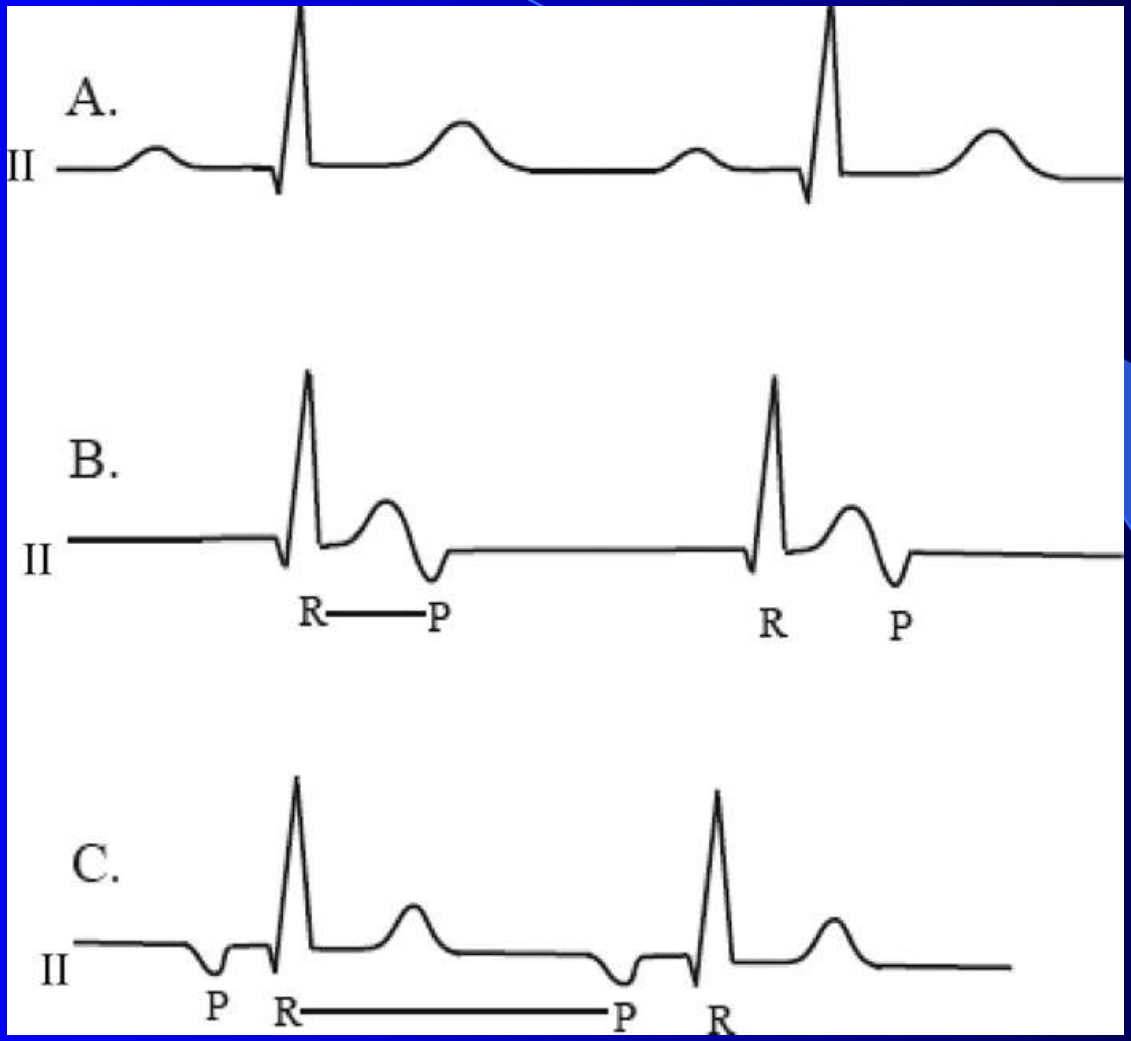
Atrial tissue only	AV junction
Sinus tachycardia	AV nodal reentrant tachycardia
Inappropriate sinus tachycardia	Atrioventricular reentrant tachycardia
Sinus nodal reentrant tachycardia	Junctional tachycardia
Atrial tachycardia	Junctional ectopic tachycardia in children
Multifocal atrial tachycardia	Nonparoxysmal junctional tachycardia in adults
Atrial fibrillation	
Atrial flutter	

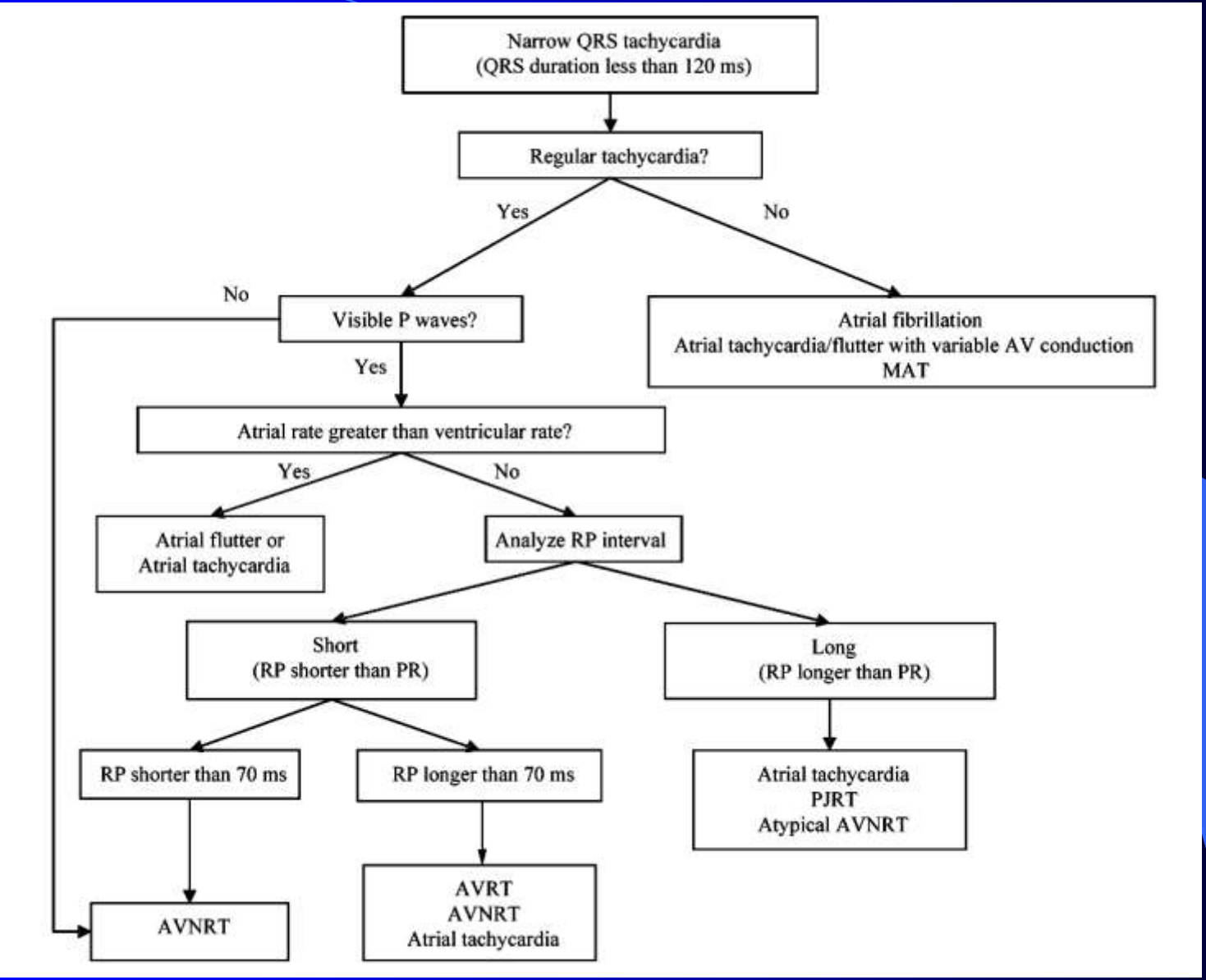
23 year-old female with sudden onset palpitations while watching TV?



ECG in SR




A.
II
B.
II
R
P
R
P
C.
II
P
R
P
R


Narrow QRS tachycardia
(QRS duration less than 120 ms)
Regular tachycardia?
Yes
No
No
Visible P waves?
Yes
Atrial fibrillation
Atrial tachycardia/flutter with variable AV conduction
MAT
Atrial rate greater than ventricular rate?
Yes
No
Atrial flutter or
Atrial tachycardia
Analyze RP interval
Short
(RP shorter than PR)
Long
(RP longer than PR)
RP shorter than 70 ms
RP longer than 70 ms
Atrial tachycardia
PJRT
Atypical AVNRT
AVNRT
AVRT
AVNRT
Atrial tachycardia

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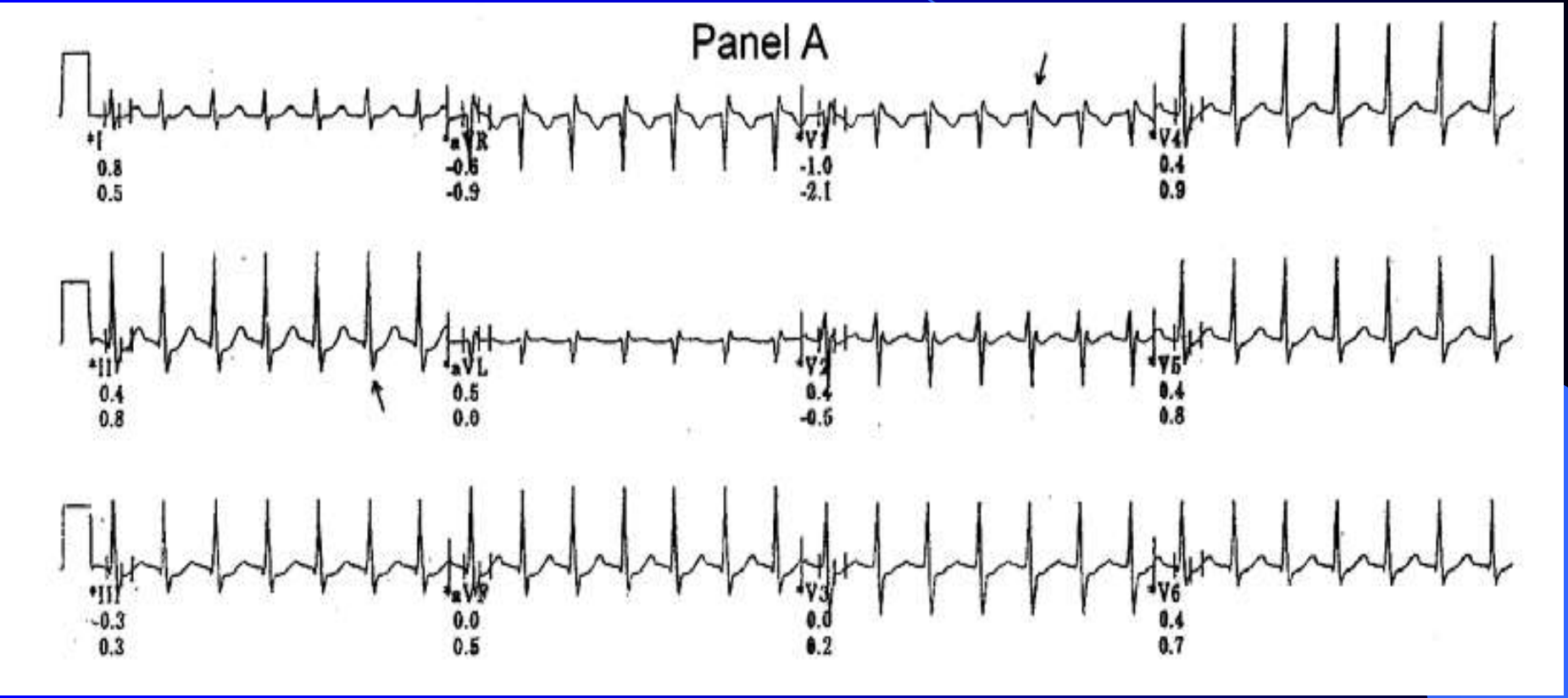
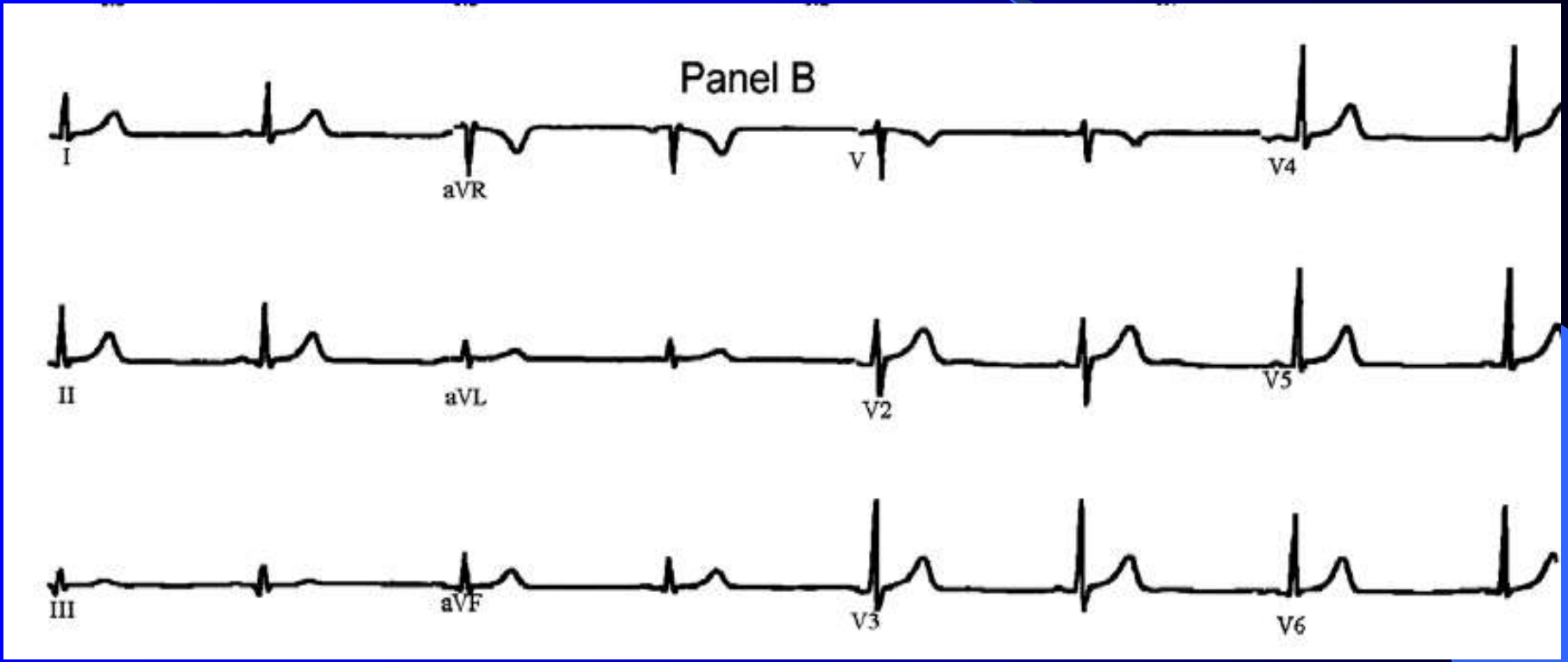
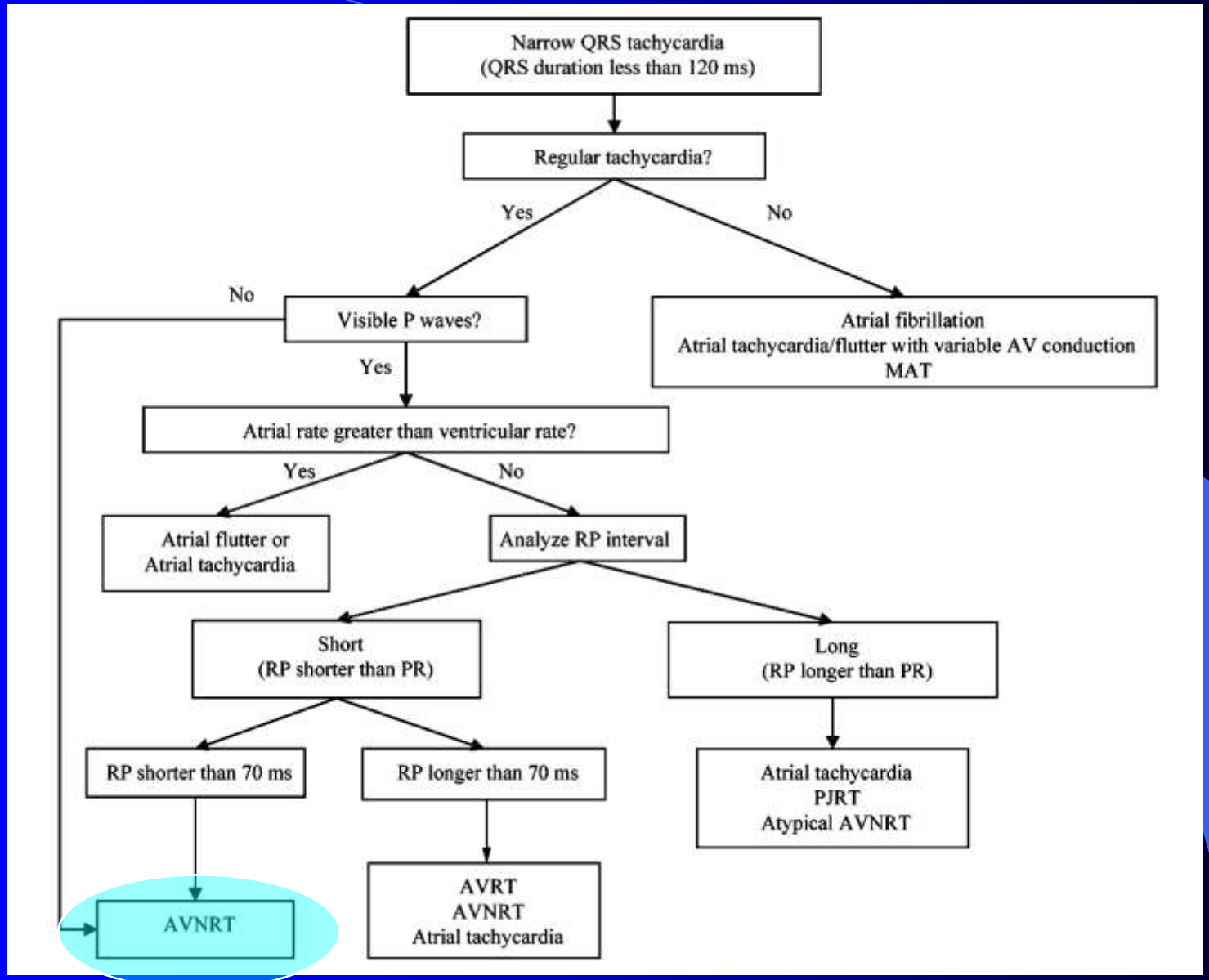


ECG in SR

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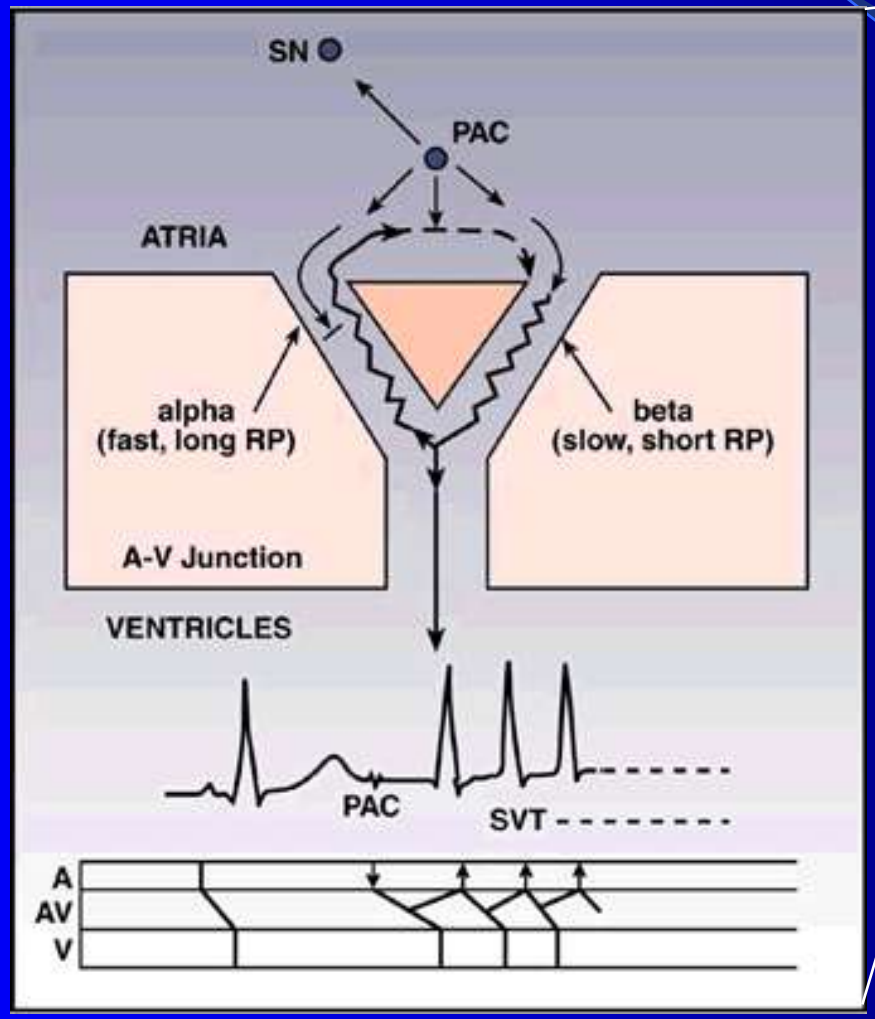
Atrial rate greater than ventricular rate?
Yes
No
Atrial flutter or
Atrial tachycardia
Analyze RP interval
Short
(RP shorter than PR)
Long
(RP longer than PR)
RP shorter than 70 ms
RP longer than 70 ms
Atrial tachycardia
PJRT
Atypical AVNRT
AVNRT
AVRT
AVNRT
Atrial tachycardia

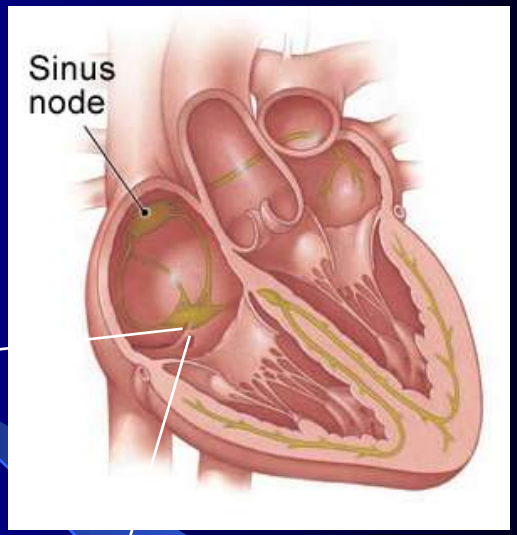
AV Nodal Reentry

- Common form of recurrent, paroxysmal SVT
- 60-65% of PSVTs
- ECG
  - Discrete P waves not visible
  - A&V depolarize simultaneously
- Symptoms
  - Palpitations
  - Lightheadedness
  - Chest discomfort
  - Anxiety

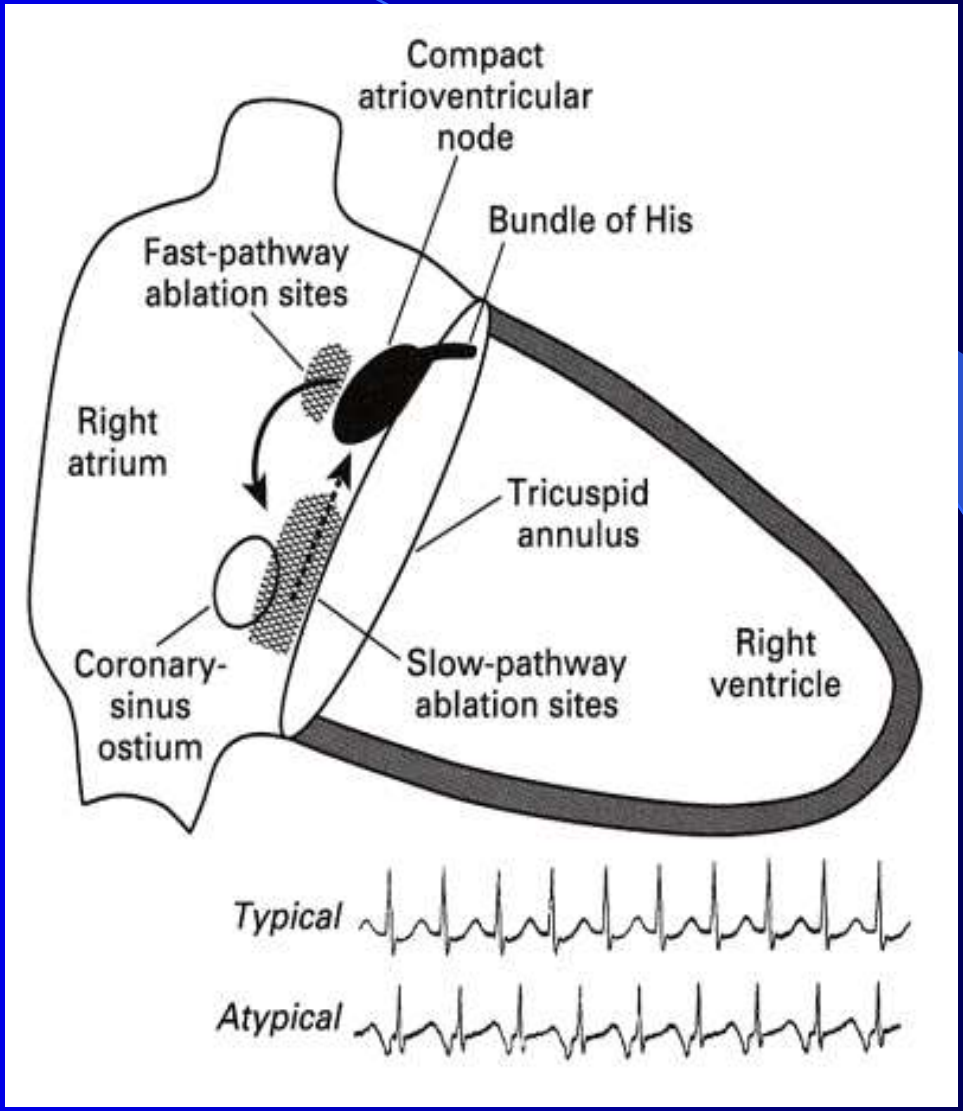
Kay GN. Am J Med. 1996;100:344-356.

Mechanism


SN
PAC
ATRIA
alpha
(fast, long RP)
beta
(slow, short RP)
A-V Junction
VENTRICLES
PAC
SVT
A
AV
V

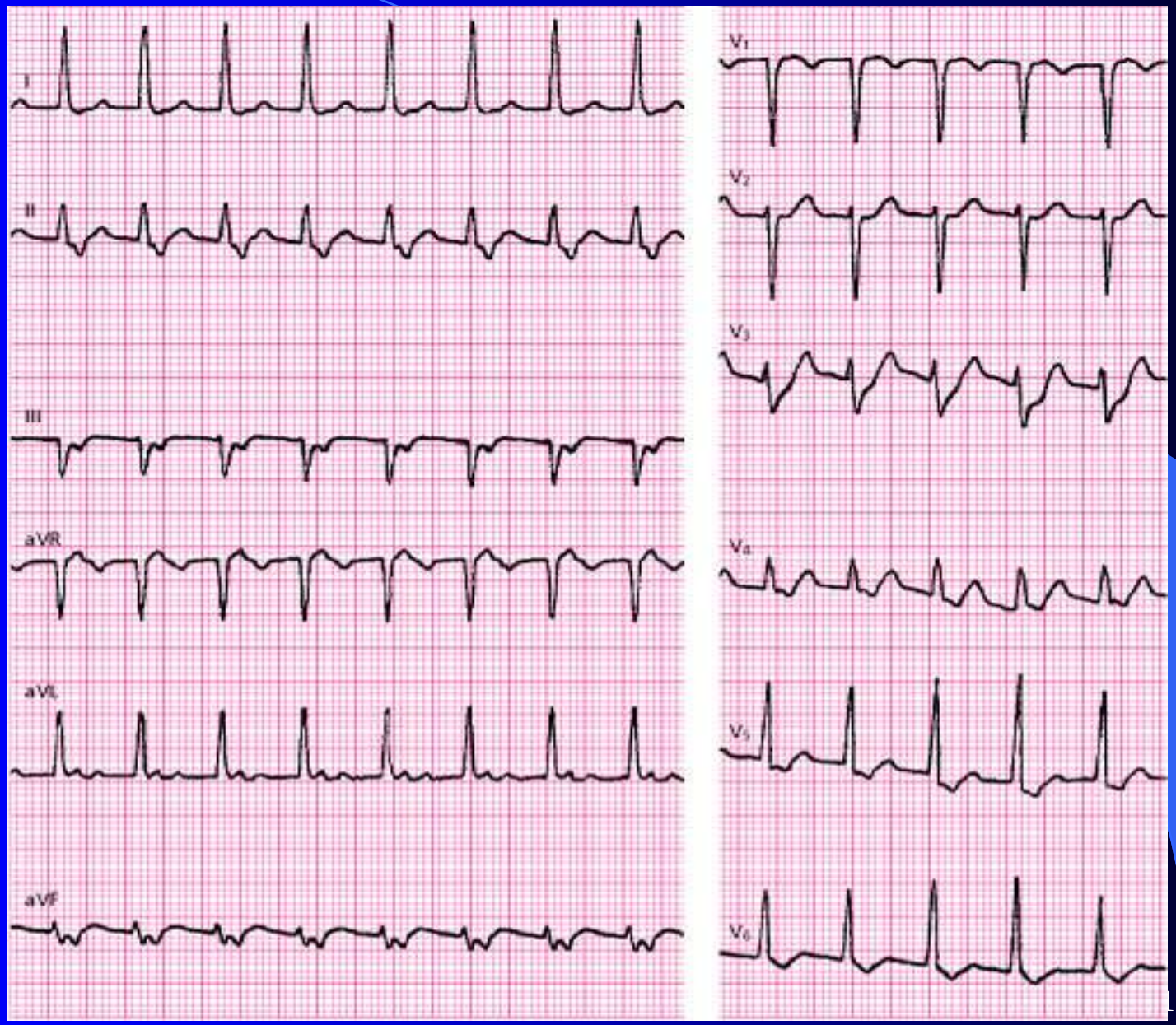

Sinus
node

AVNRT

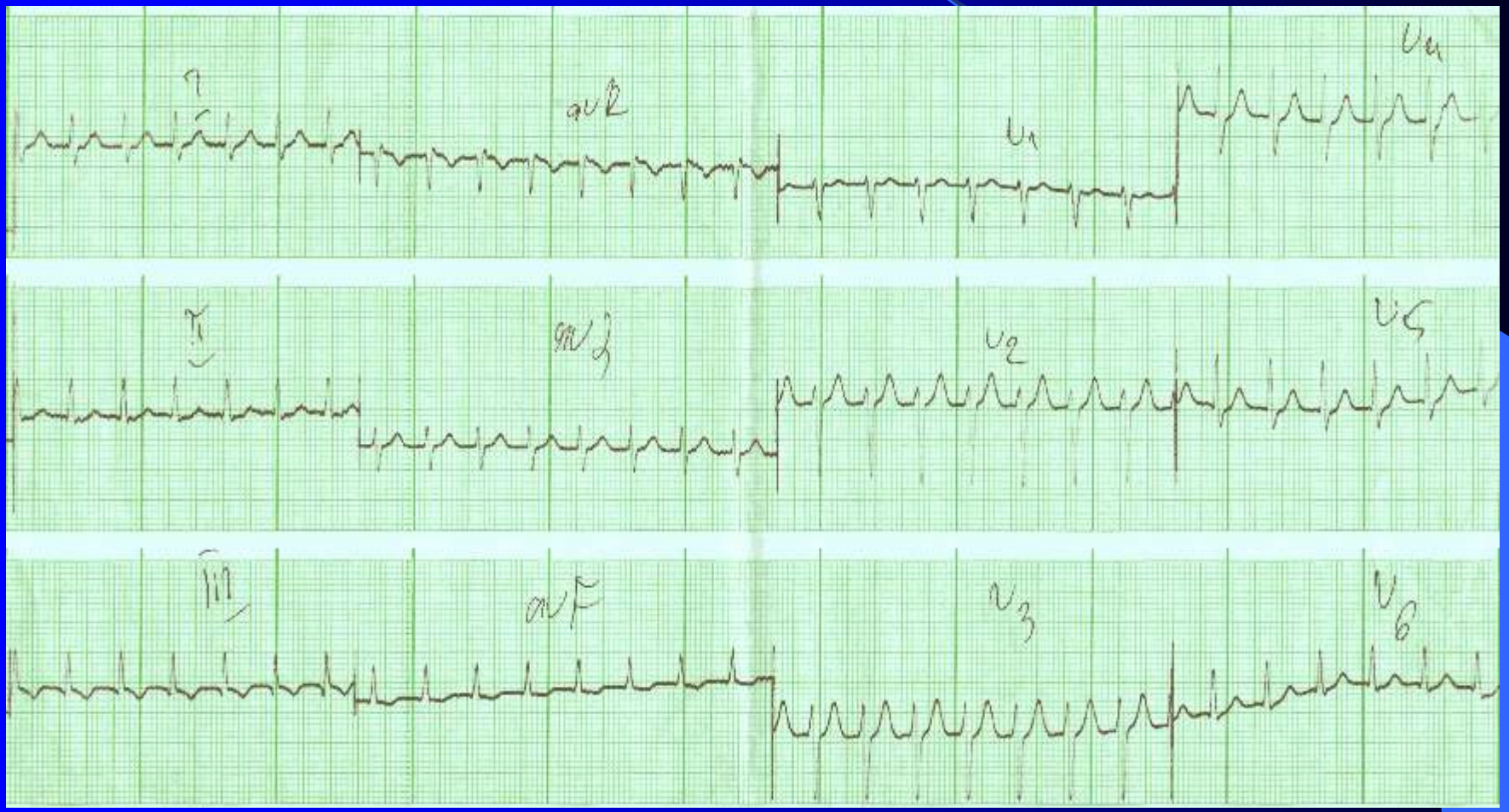


Morady F. N Engl J of Med. 1999;340:534-544.

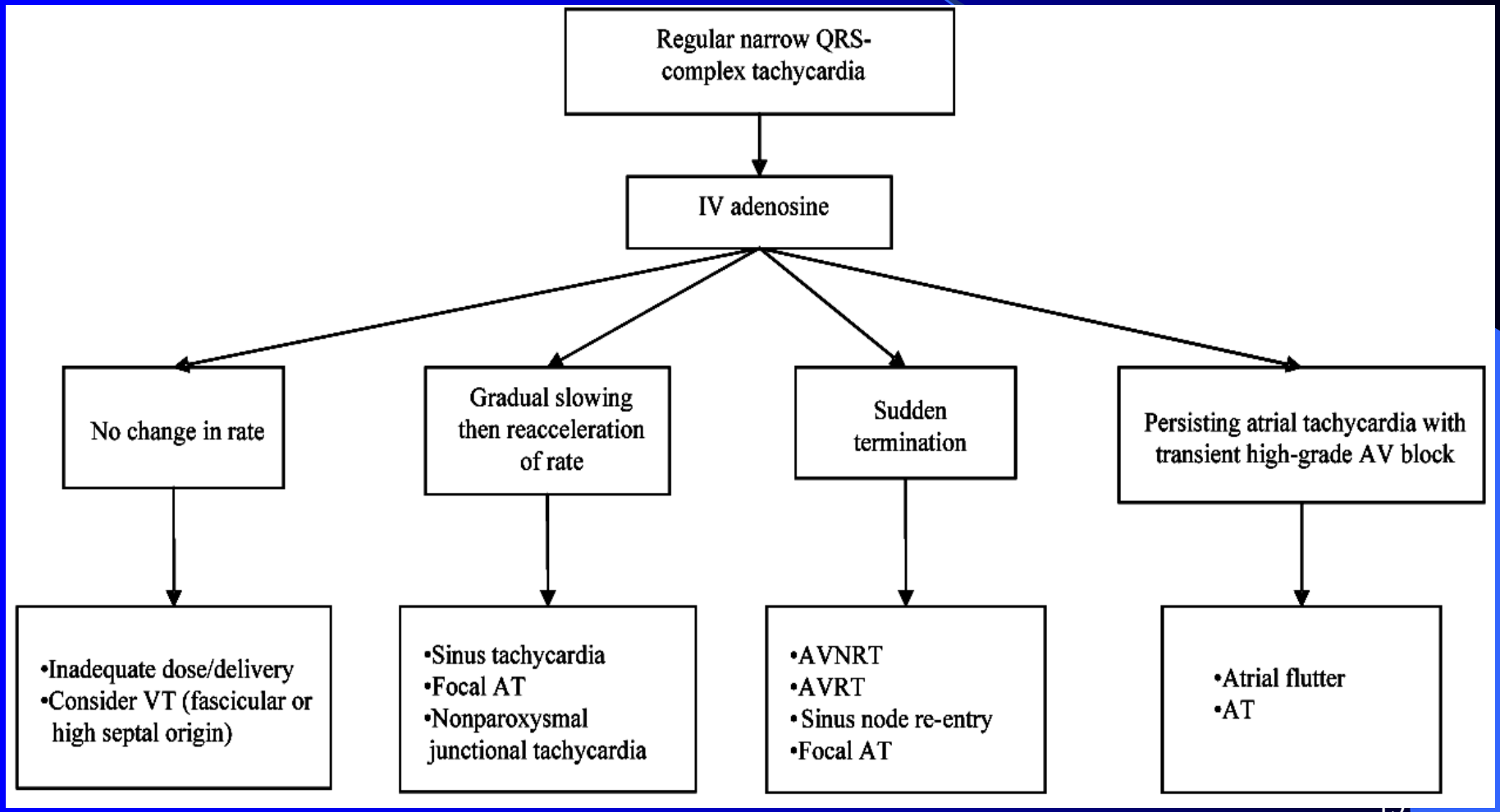
AVNRT



AVNRT



Response to Adenosine



ACC/AHA Guidelines for long term treatment of AVNRT

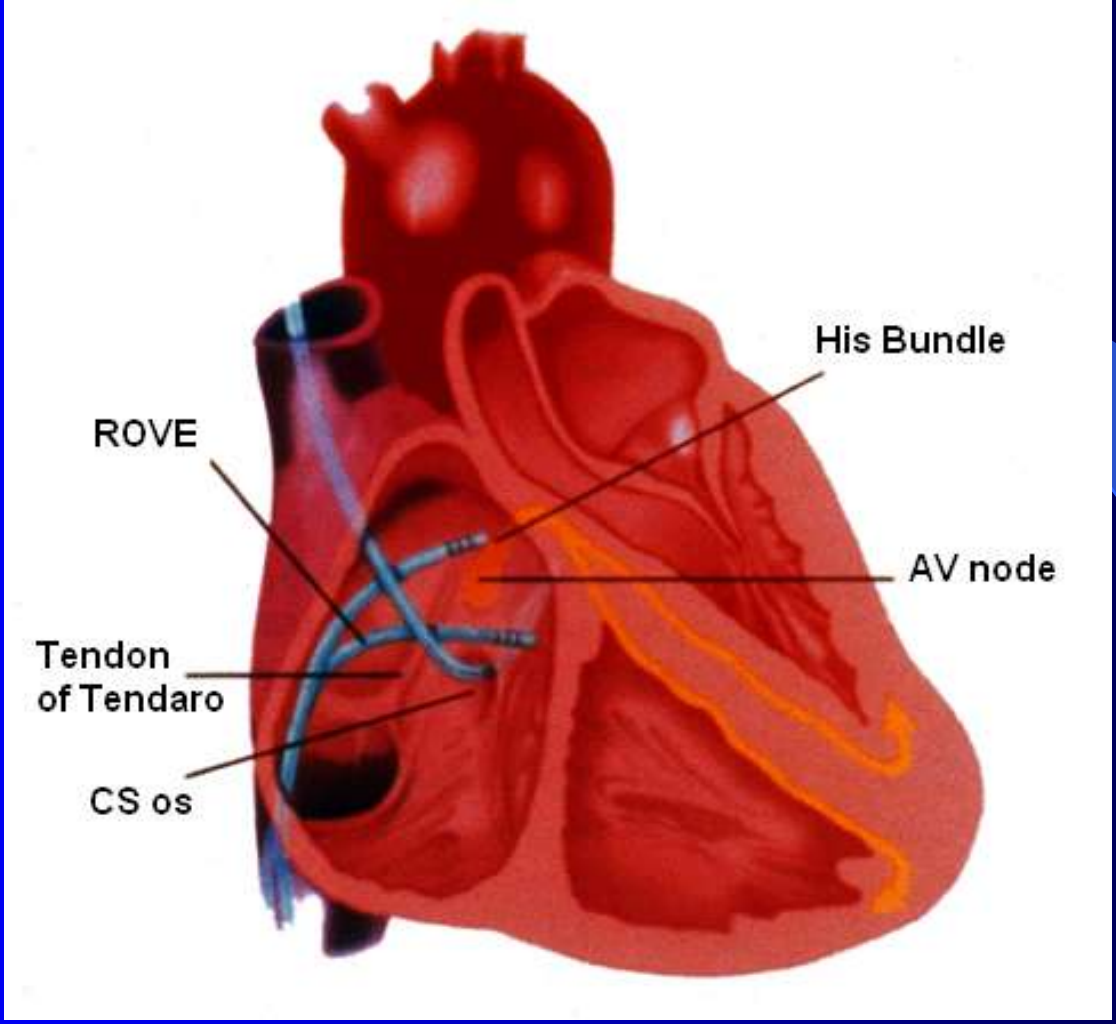
Clinical Presentation	Recommendation	Class	Level of Evidence
Poorly tolerated AVNRT with hemodynamic intolerance	Catheter ablation	I	B
	Verapamil, diltiazem, beta blockers, sotalol, amiodarone	IIa	C
	Flecainide,* propafenone*	IIa	C
Recurrent symptomatic AVNRT	Catheter ablation	I	B
	Verapamil	I	B
	Diltiazem, beta blockers	I	C
	Digoxin†	IIb	C
Recurrent AVNRT unresponsive to beta blockade or calcium-channel blocker and patient not desiring RF ablation	Flecainide,* propafenone,* sotalol	IIa	B
	Amiodarone	IIb	C
AVNRT with infrequent or single episode in patients who desire complete control of arrhythmia	Catheter ablation	I	B
Documented PSVT with only dual AV-nodal pathways or single echo beats demonstrated during electrophysiological study and no other identified cause of arrhythmia	Verapamil, diltiazem, beta blockers, flecainide,* propafenone*	I	C
	Catheter ablation‡	I	B
Infrequent, well-tolerated AVNRT	No therapy	I	C
	Vagal maneuvers	I	B
	Pill-in-the-pocket	I	B
	Verapamil, diltiazem, beta blockers	I	B
	Catheter ablation	I	B

AV Nodal Reentry: Ablation

Ablation	Slow pathway - antegrade AV nodal
Site	Inferior to CS ostium
Efficacy	99%
Complications	AV block <1.0% Recurrence 5%

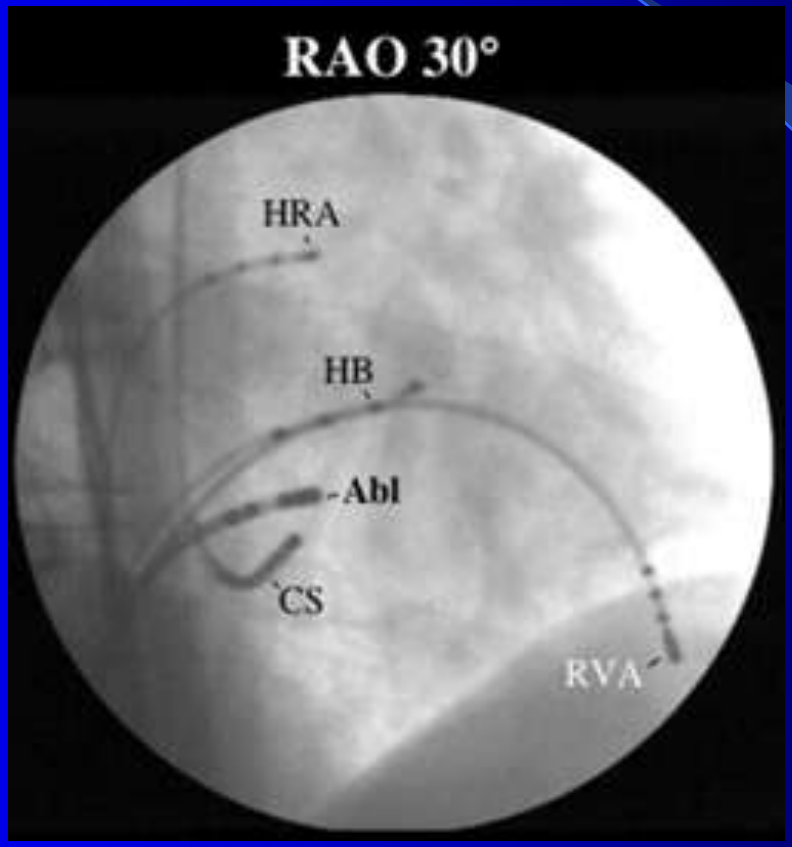
Kay GN. Am J Med. 1996;100:344-356.
Morady F. N Engl J Med. 1999;340:534-544.

Site of Slow Pathway Ablation

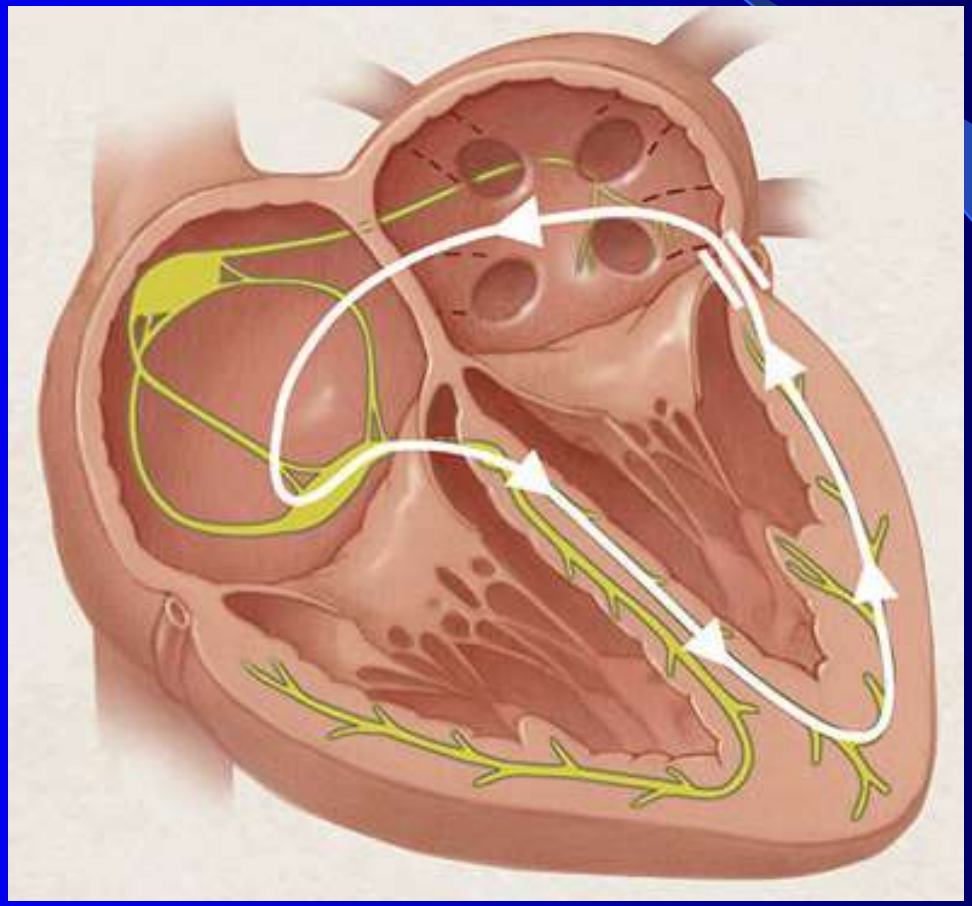


Source: Scheinman, M.M. Emerging Technologies in Antiarrhythmic Therapy; Creative Medical Communications, Inc., NY 1992: 1-33.

AVNRT Ablation



Accessory Pathways



Accessory AV Pathways

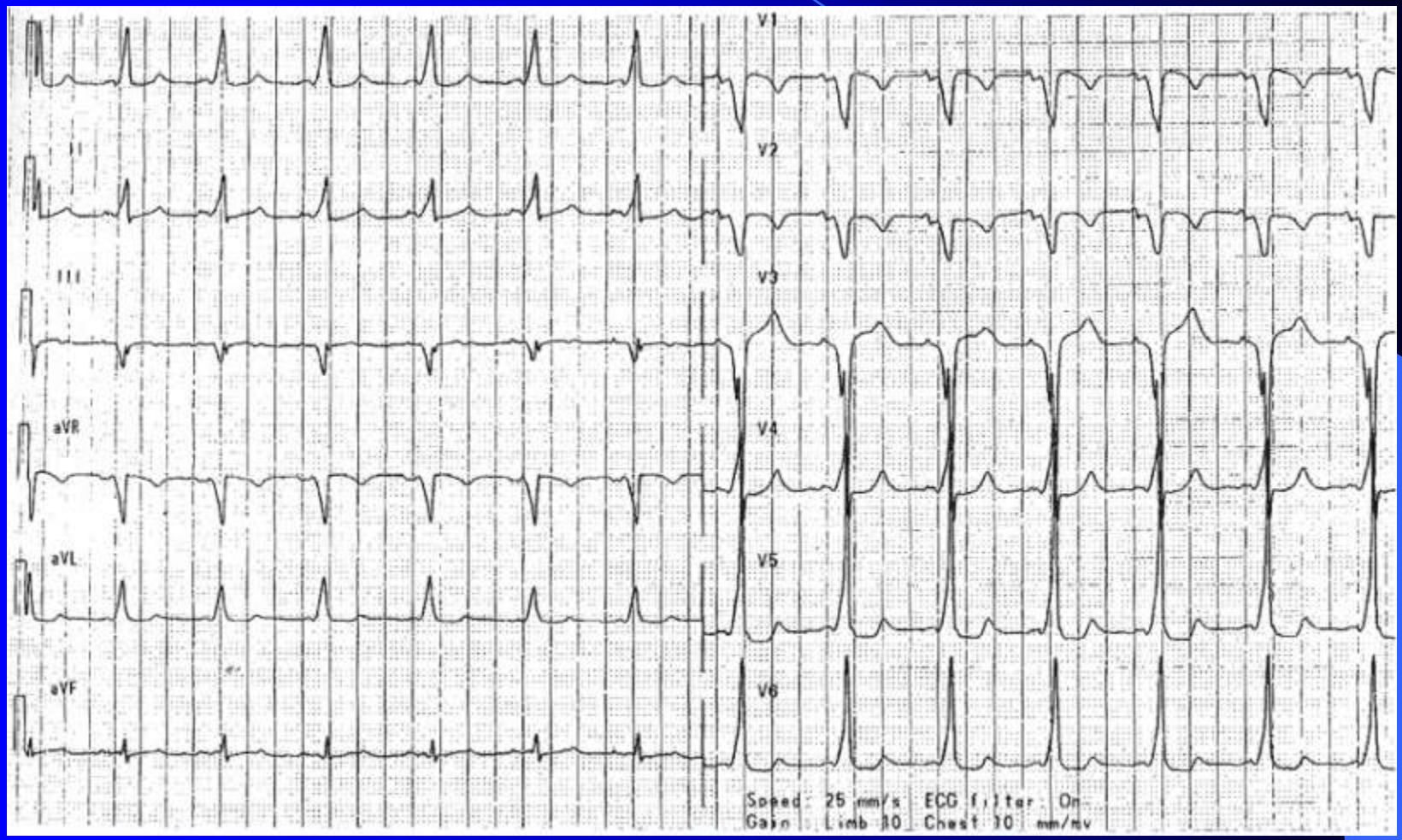
- Asymptomatic to sudden cardiac death
- Conduction: Antegrade and/or retrograde
- SVT may be frequent or recurrent

Kay GN. Am J Med. 1996;100:344-345.

Wolff-Parkinson-White Syndrome

- Delta wave
- Accessory pathway without delta wave
- If accessory pathway capable of rapid antegrade conduction
  - VF from rapid conduction of AF

Pre-excitation



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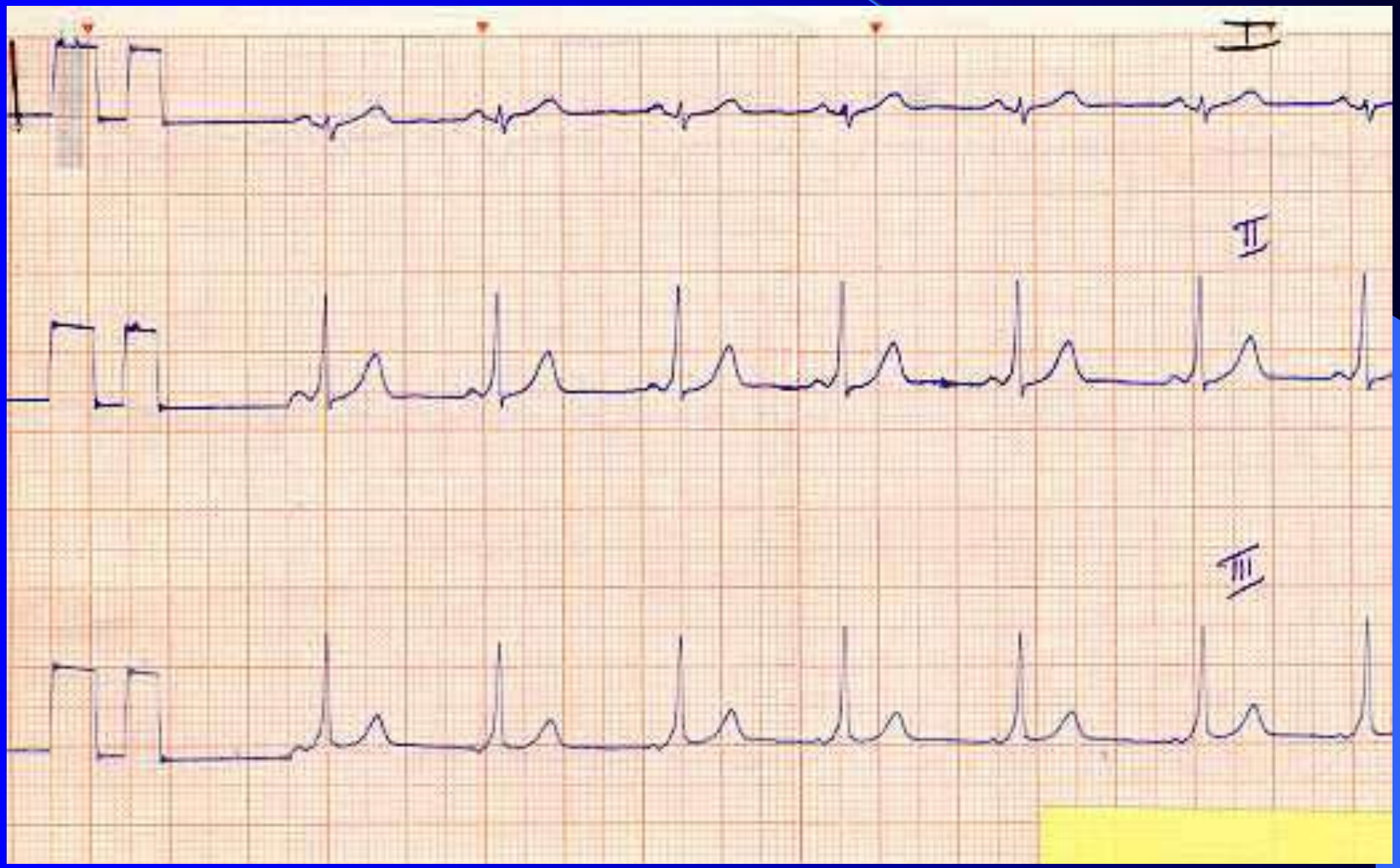
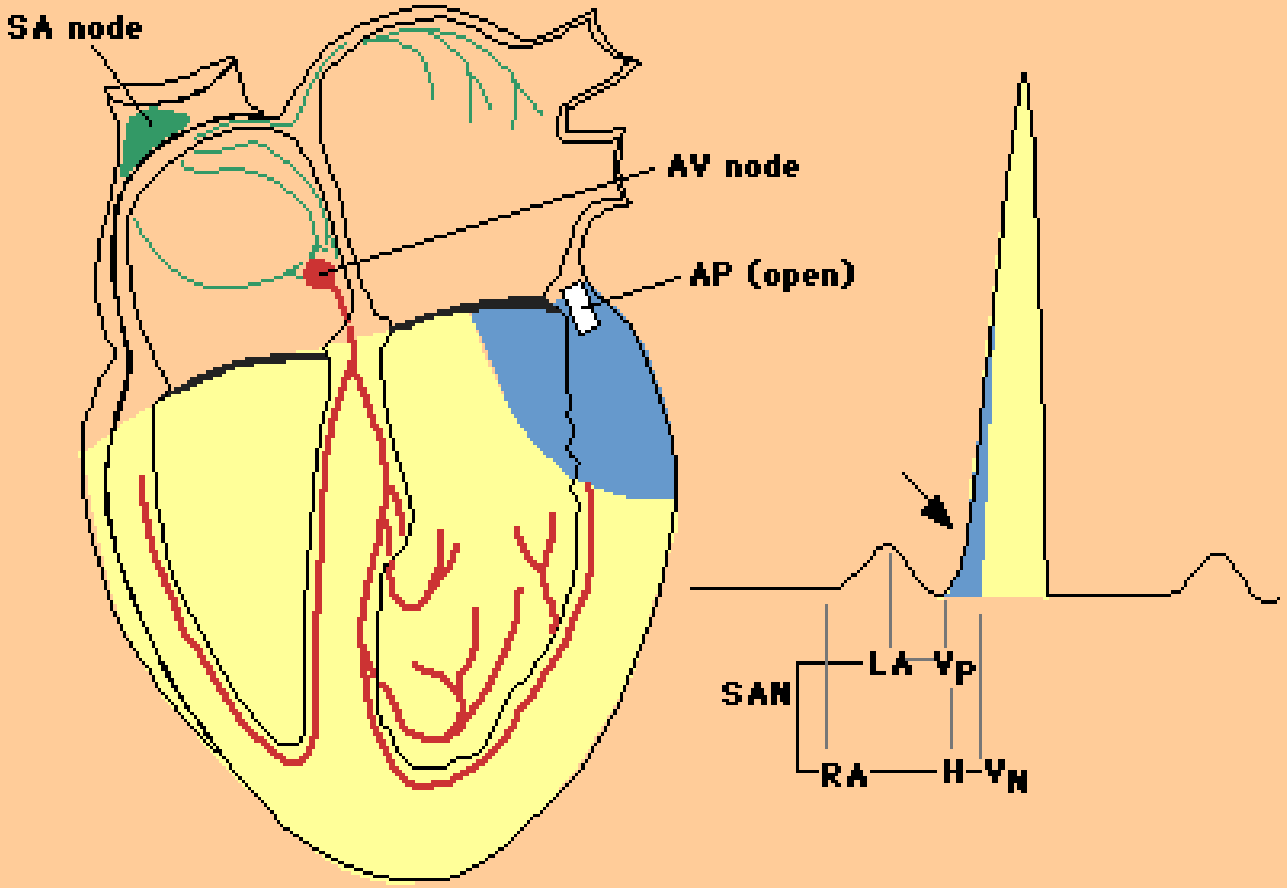
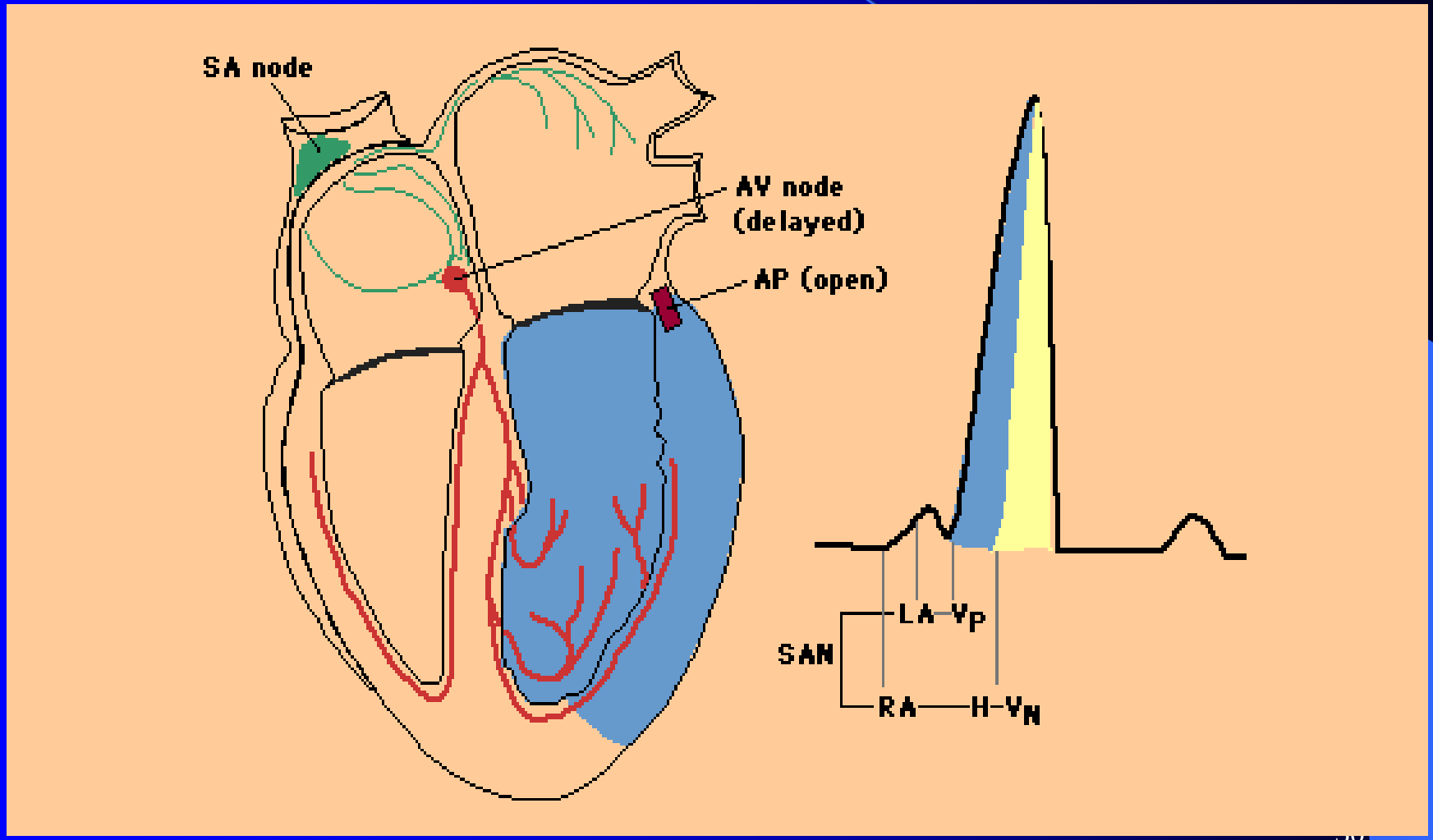
Preexcitation



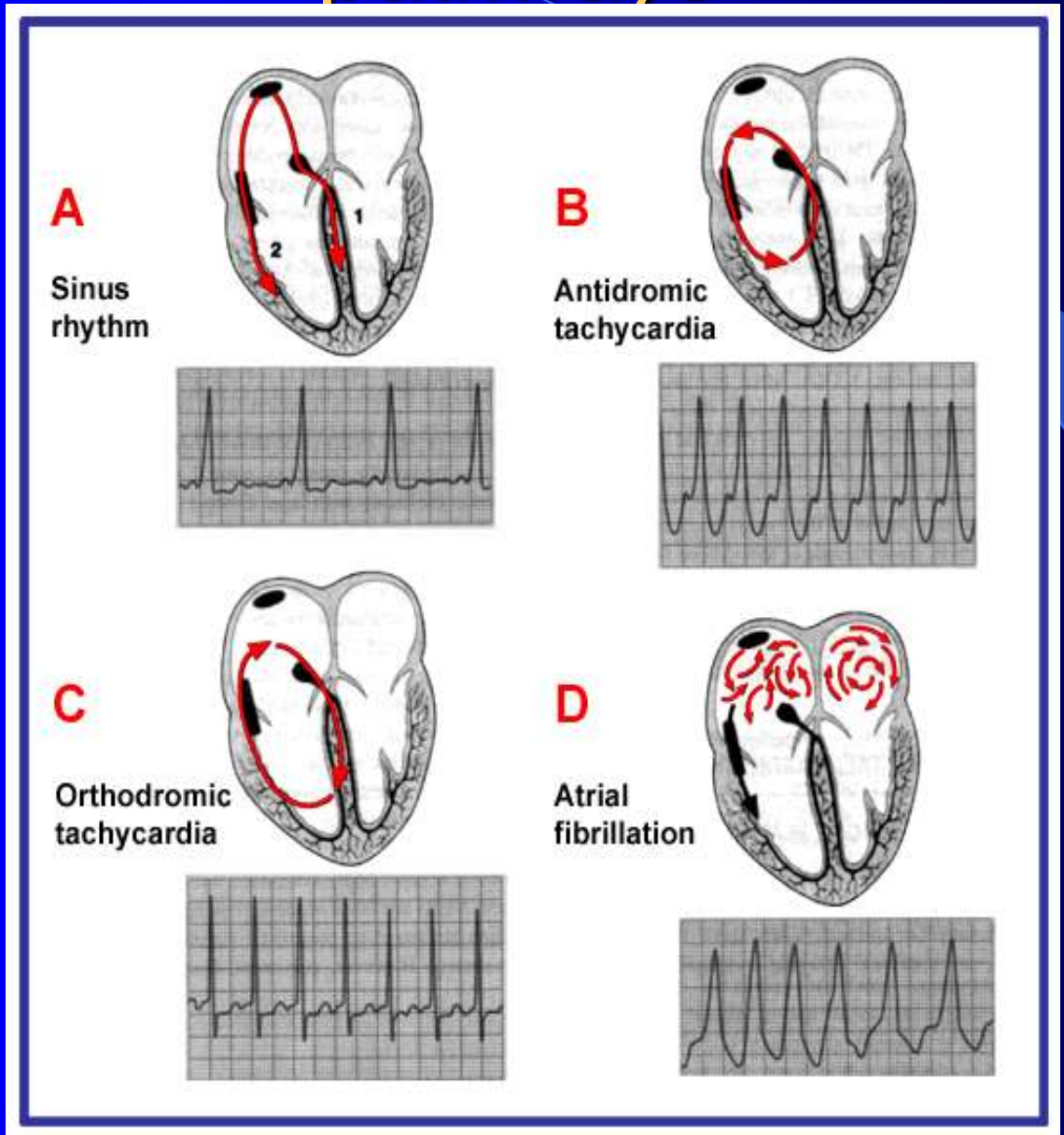
Delta wave



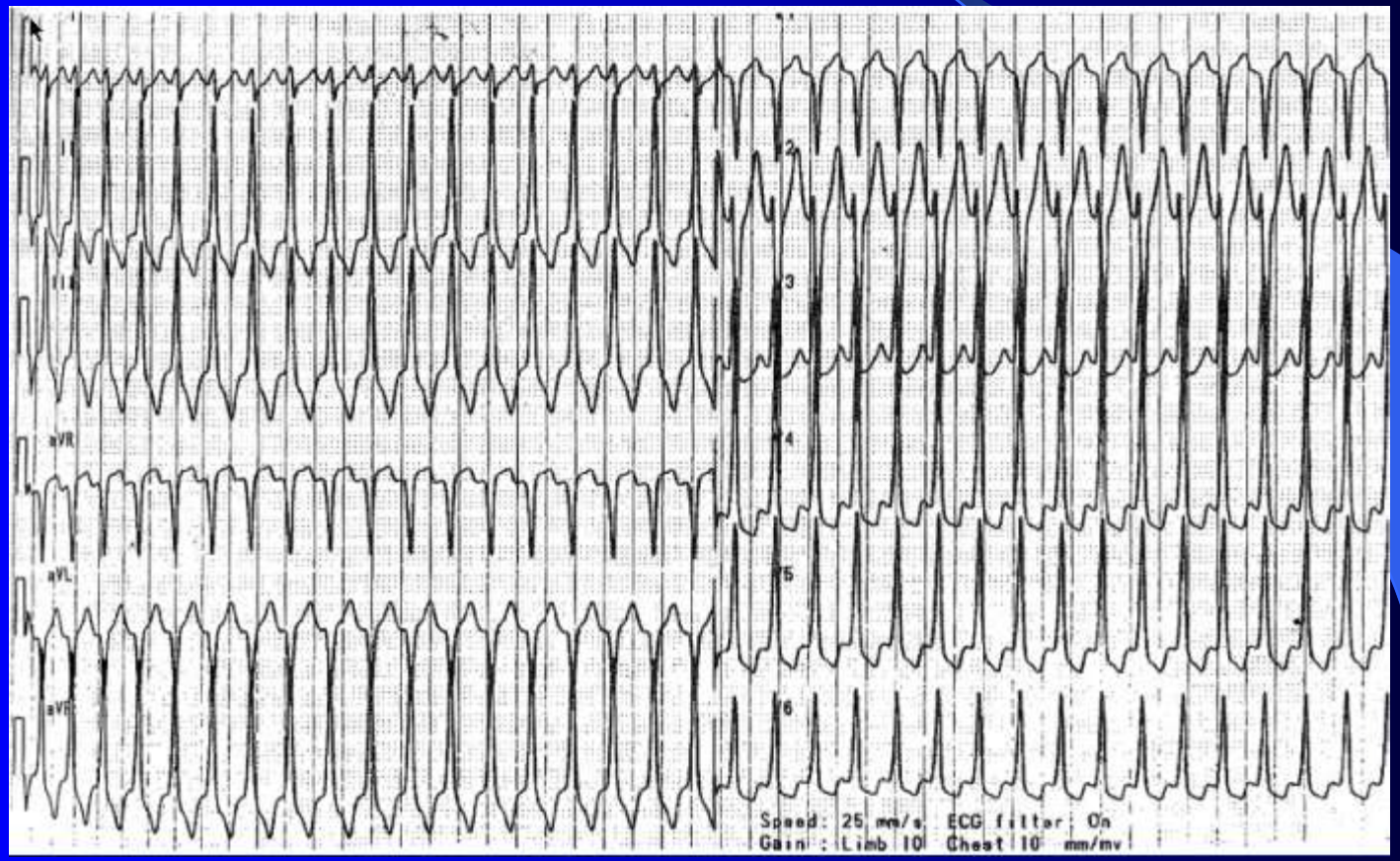
Delta wave



Tachycardia with Accessory pathways



Orthodromic Reciprocating Tachycardia



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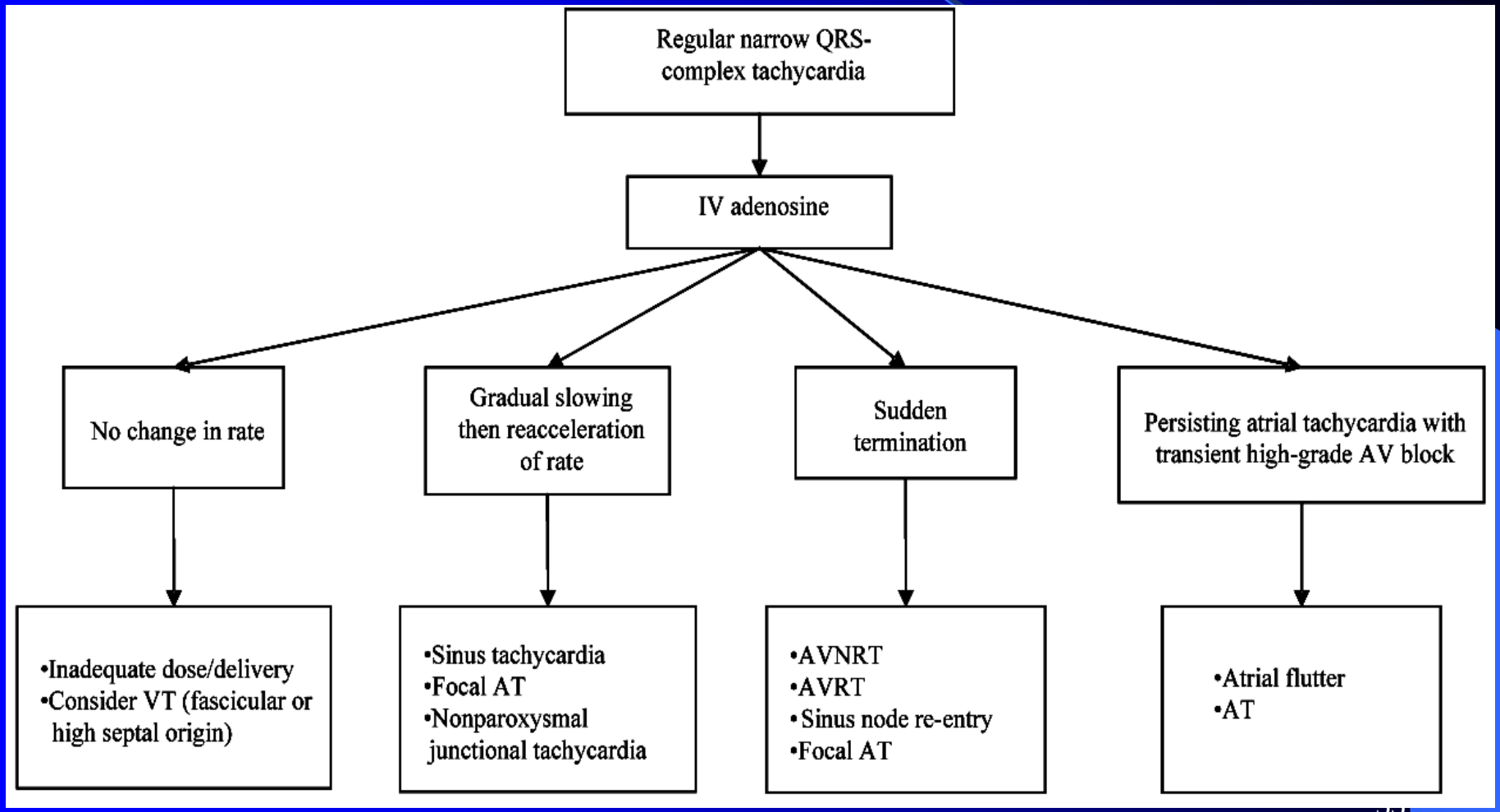
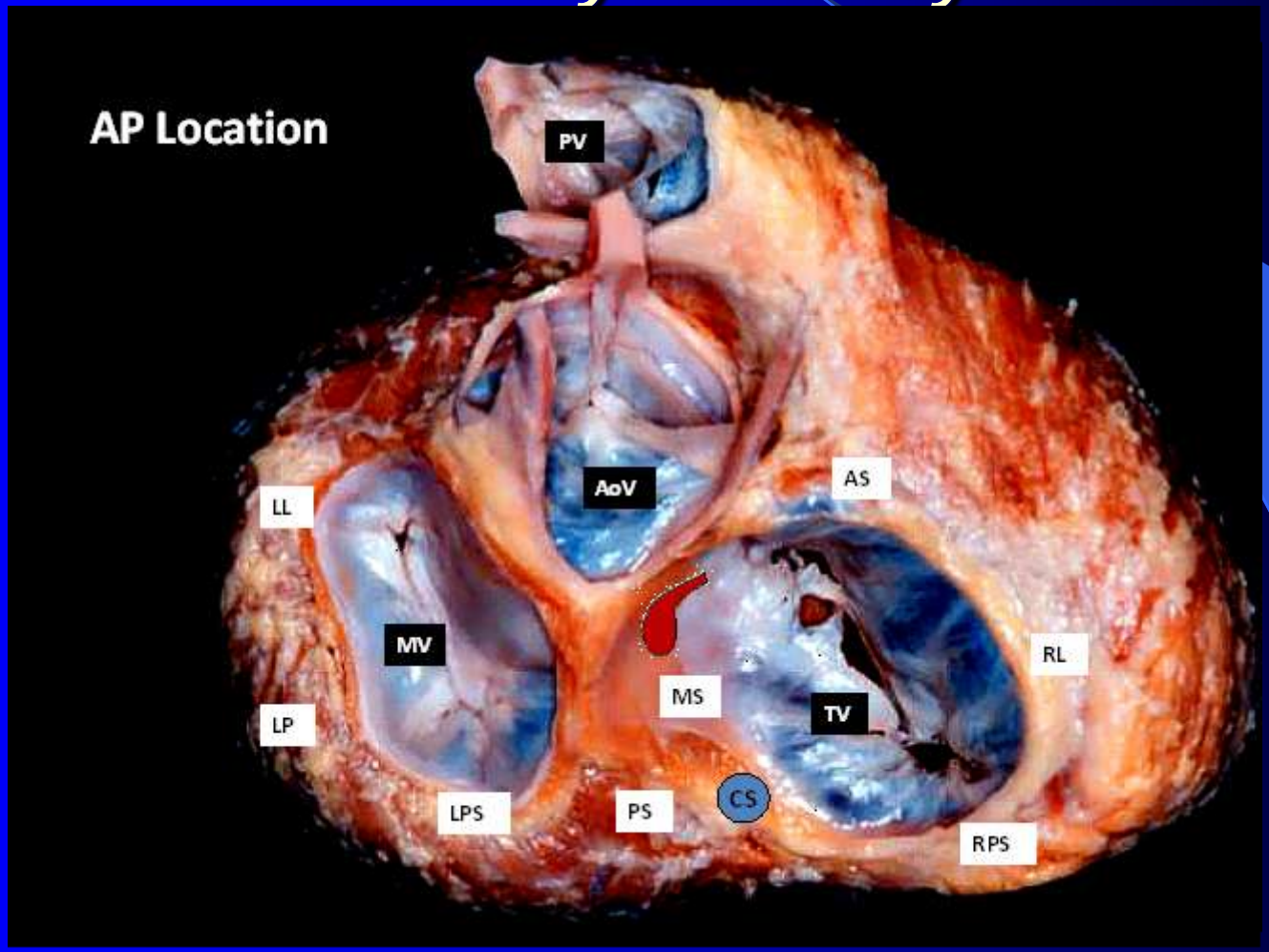
Response to Adenosine



Anatomic Locations

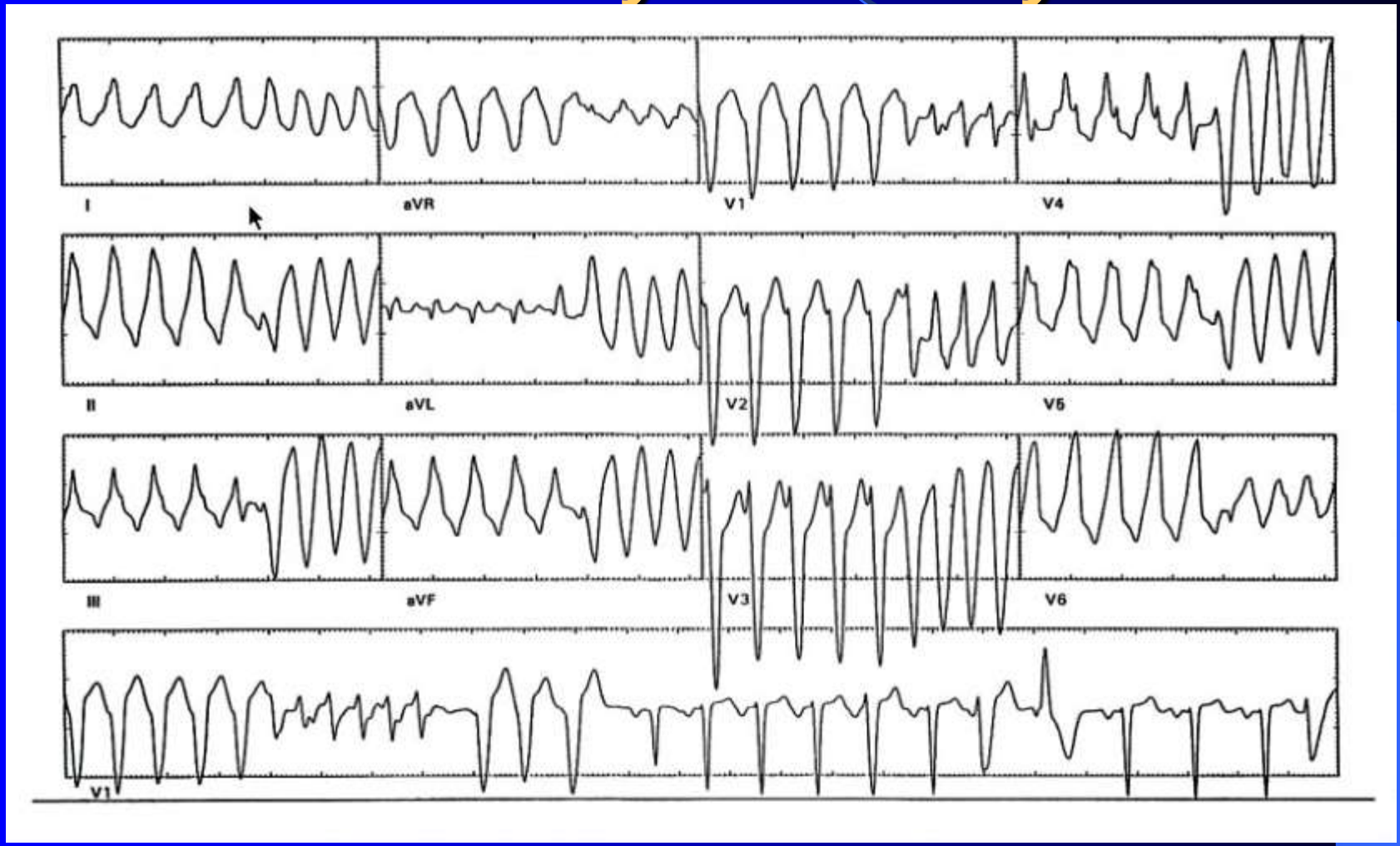
Accessory Pathways



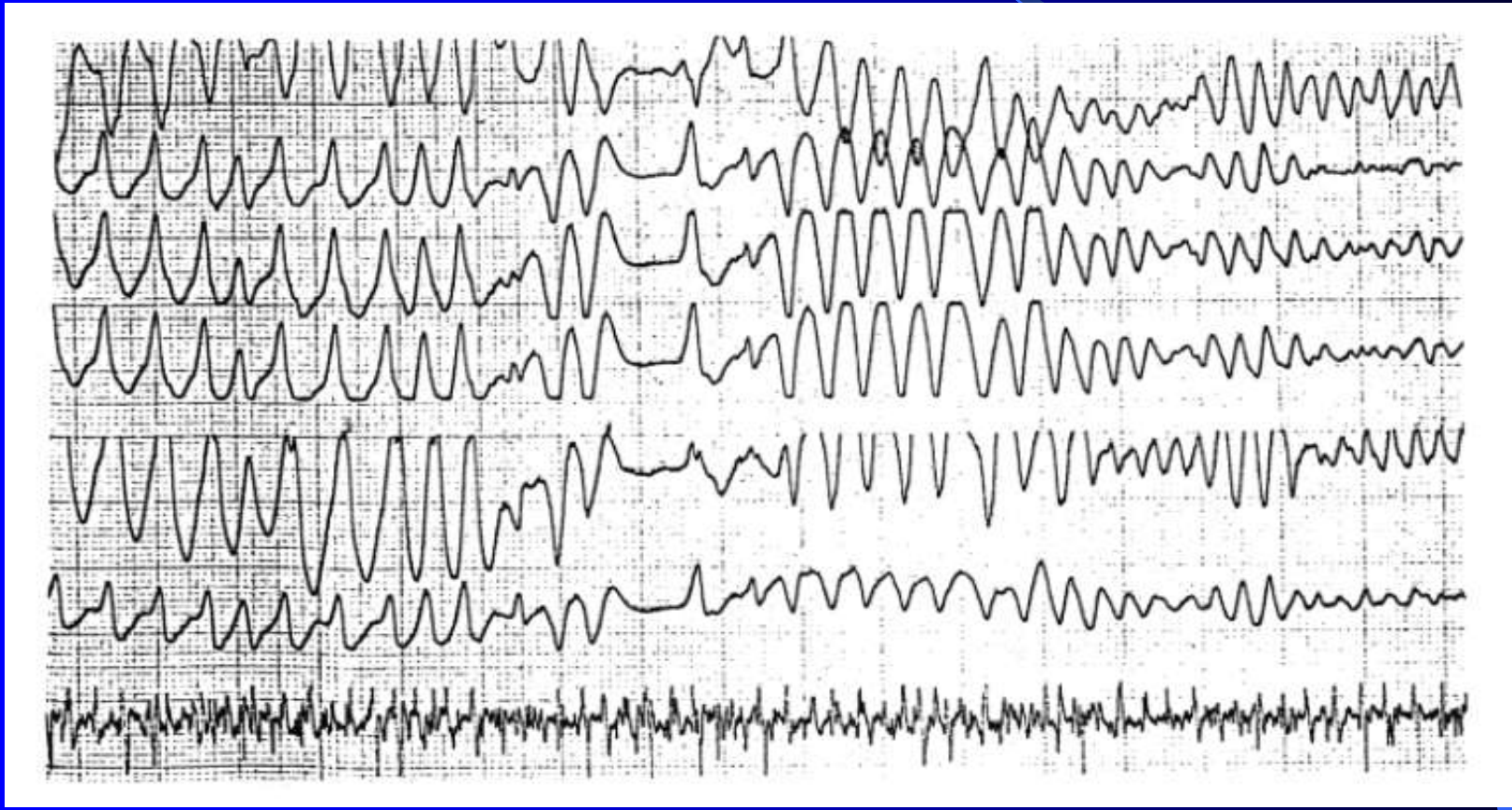
WPW: Case Study

- 18 year old male basketball player
- Presented to ER with:
  - Multiple episodes of near-syncope
- Adenosine 12 mg accelerated the heart rate
- Emergency cardioversion performed

AF with Multiple Accessory Pathways

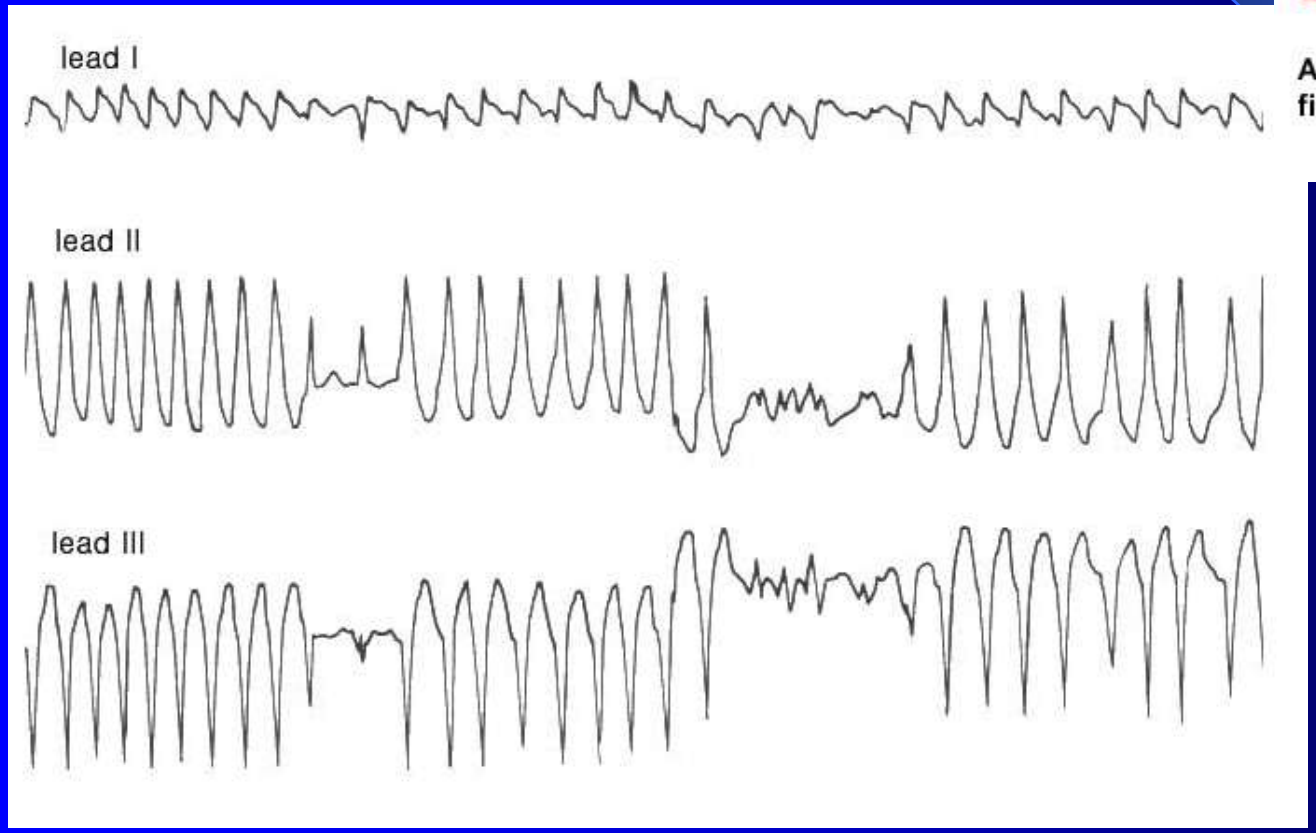


AF → VF



Courtesy of Dr. Brian Olshansky.

What happens in A Fib?



Management

- Acute: Maneuvers
- AV blockers
- Cardioversion

- Chronic: Predictors of high vs low risk
- Special groups
- Antiarrhythmics: Class Ic

Morady F. N Engl J of Med. 1999;340:534-544.

Acute Management of SVT

TABLE 1. Recommendations for Acute Management of Hemodynamically Stable and Regular Tachycardia

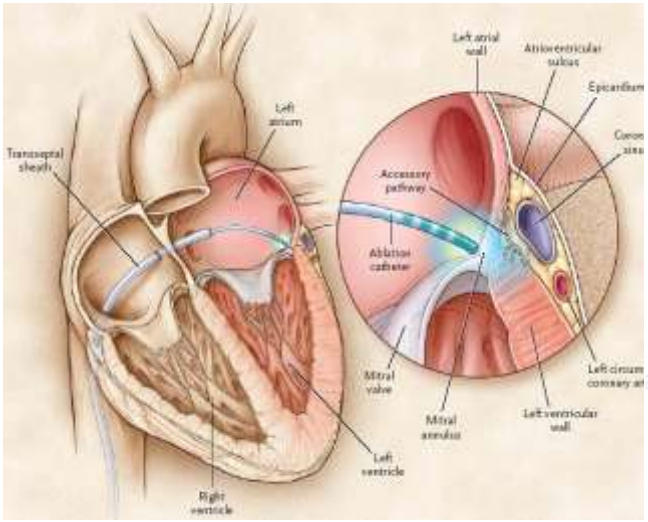
ECG	Recommendation*	Classification	Level of Evidence	References
Narrow QRS-complex tachycardia (SVT)	Vagal maneuvers	I	B	
	Adenosine	I	A	15,17,18
	Verapamil, diltiazem	I	A	19
	Beta blockers	IIb	C	20,21
	Amiodarone	IIb	C	22
	Digoxin	IIb	C	

ACC/AHA Recommendation with AP mediated arrhythmias

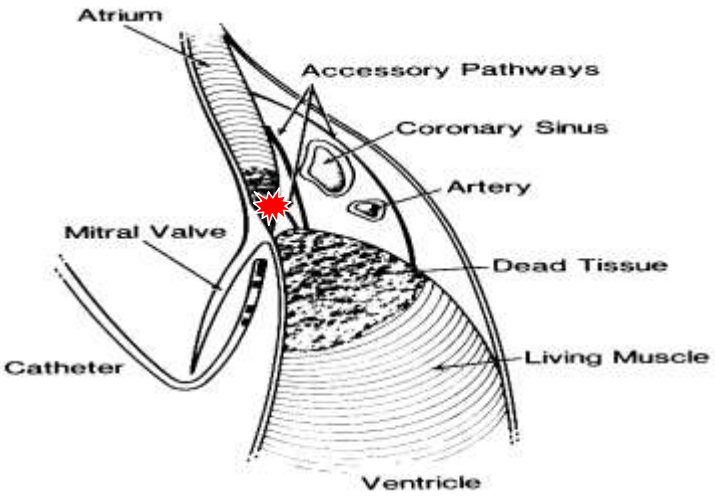
Arrhythmia	Recommendation	Classification	Level of Evidence
WPW syndrome (pre-excitation and symptomatic arrhythmias), well tolerated	Catheter ablation	I	B
	Flecainide, propafenone	IIa	C
	Sotalol, amiodarone, beta blockers	IIa	C
	Verapamil, diltiazem, digoxin	III	C
WPW syndrome (with AF and rapid-conduction or poorly tolerated AVRT)	Catheter ablation	I	B
AVRT, poorly tolerated (no pre-excitation)	Catheter ablation	I	B
	Flecainide, propafenone	IIa	C
	Sotalol, amiodarone	IIa	C
	Beta blockers	IIb	C
	Verapamil, diltiazem, digoxin	III	C
Single or infrequent AVRT episode(s) (no pre-excitation)	None	I	C
	Vagal maneuvers	I	B
	Pill-in-the-pocket— verapamil, diltiazem, beta blockers	I	B
	Catheter ablation	IIa	B
	Sotalol, amiodarone	IIb	B
	Flecainide, propafenone	IIb	C
	Digoxin	III	C
Pre-excitation, asymptomatic	None	I	C
	Catheter ablation	IIa	B

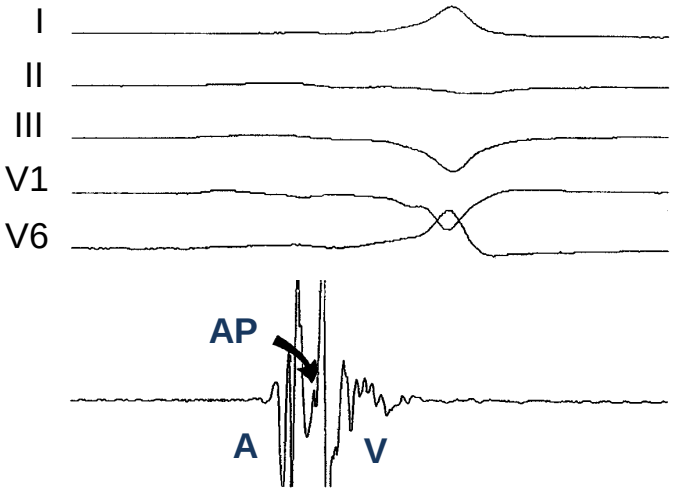
Catheter Ablation of WPW

Transeptal

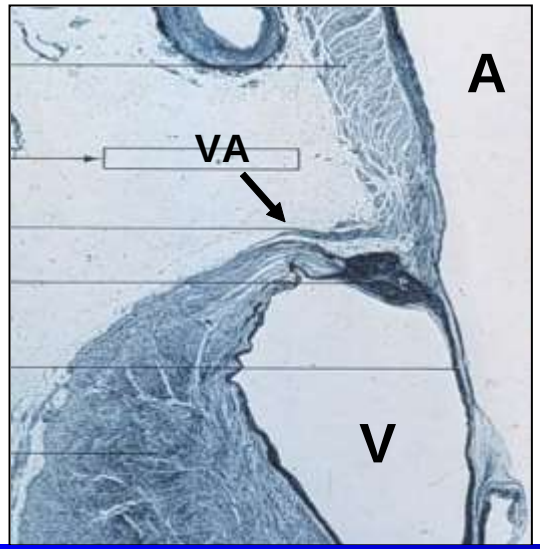


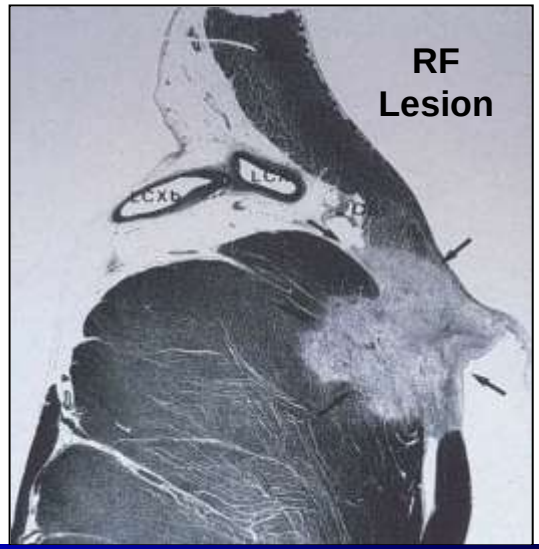
Retrograde




I
II
III
V1
V6
AP
A
V


RF

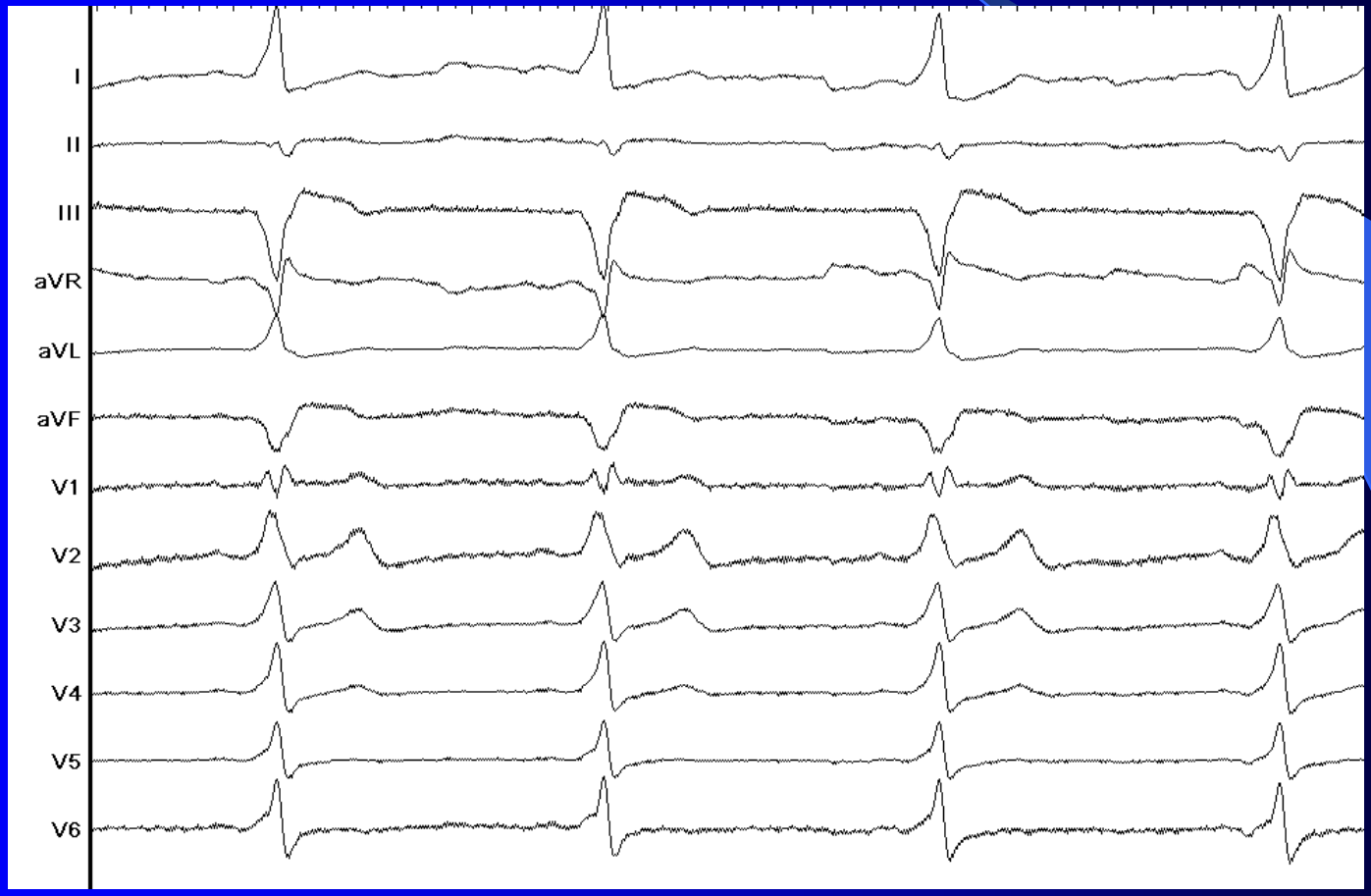

A
VA
V


RF
Lesion

Role of ablation

- Efficacy 89-99%
  - Highest left-sided pathways
  - Lower septal and right-sided
- Recurrence 3-9%

30 y/o male with palpitations



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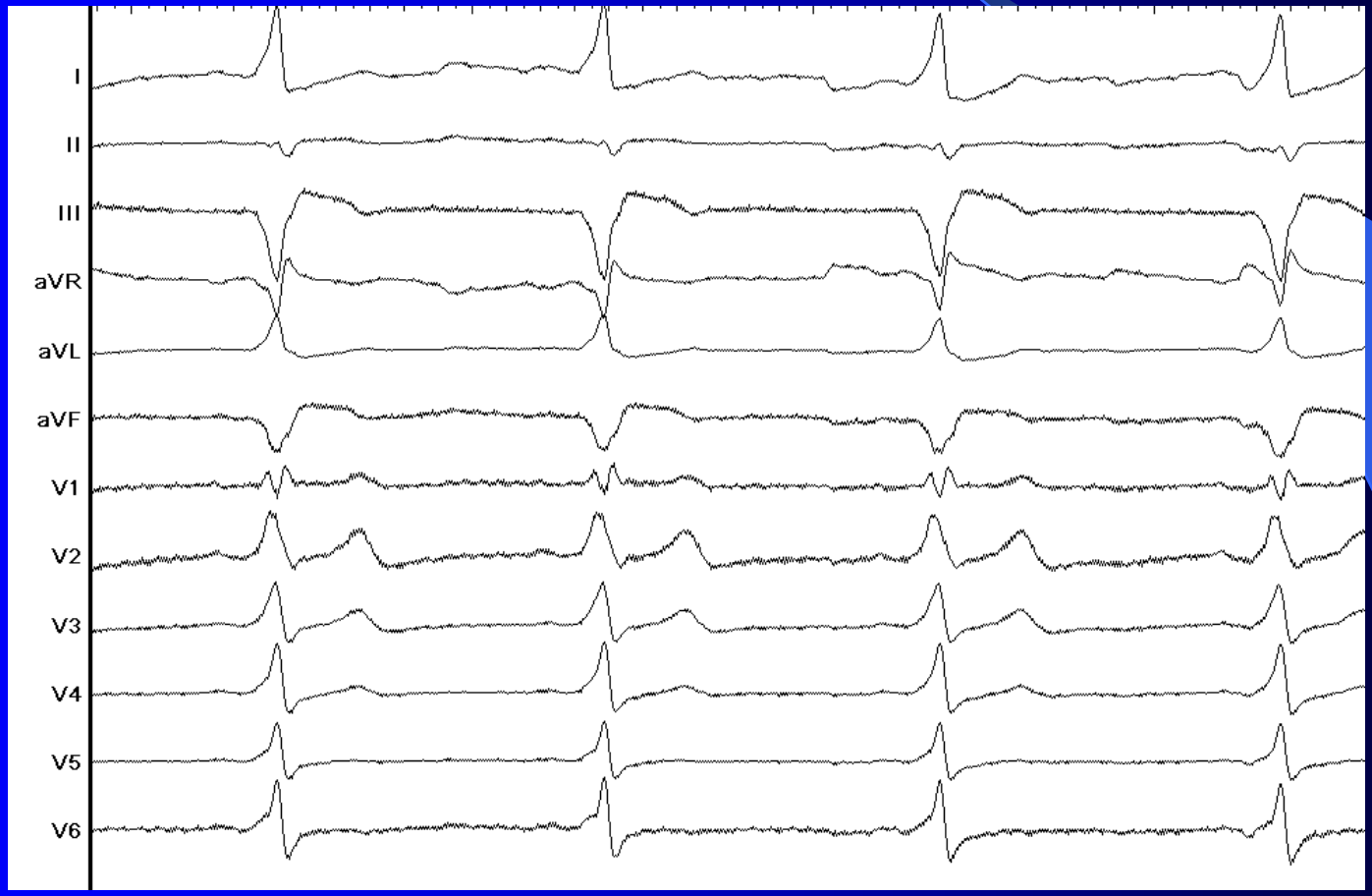
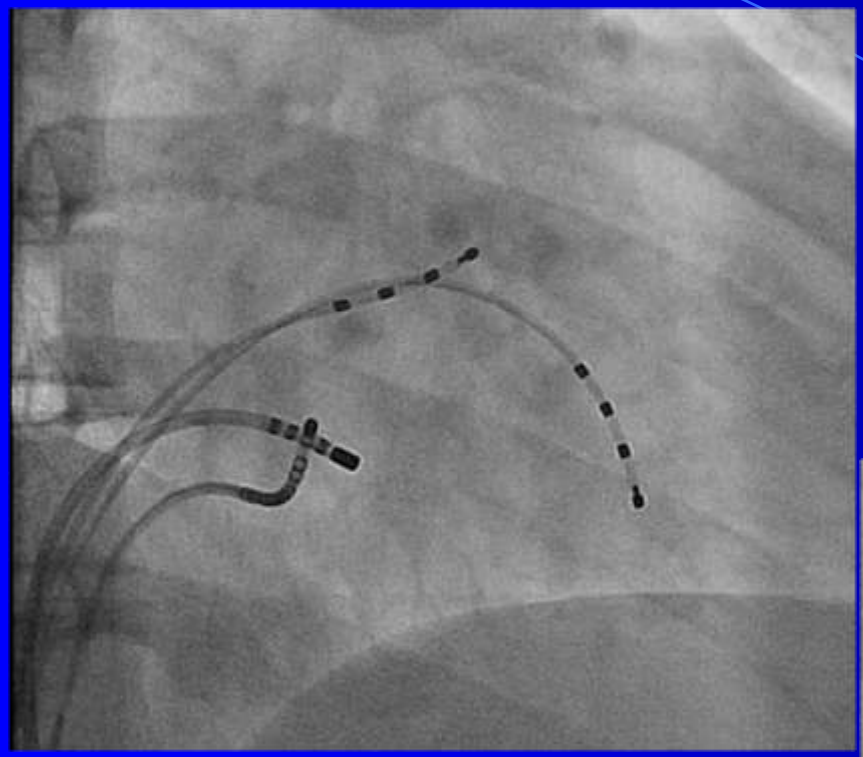
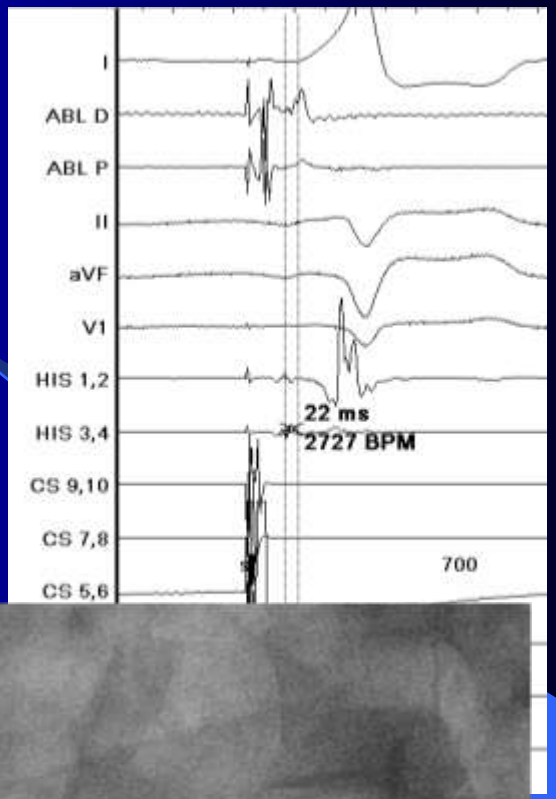
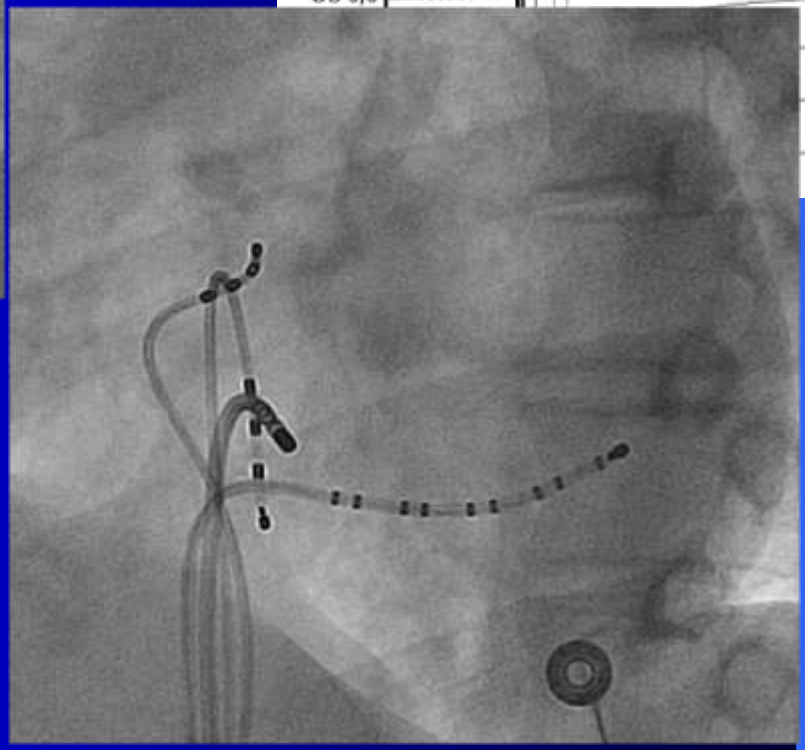
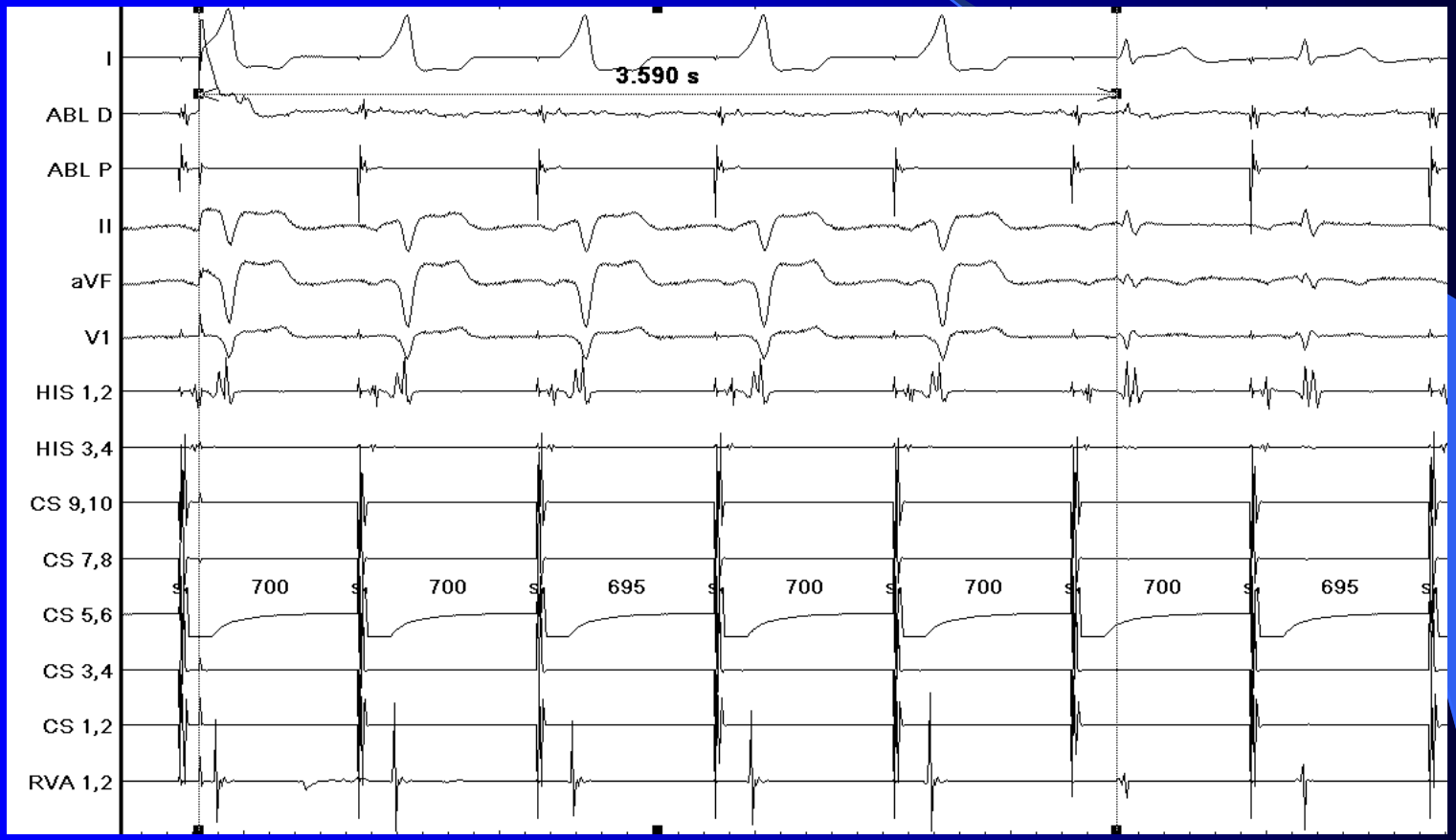




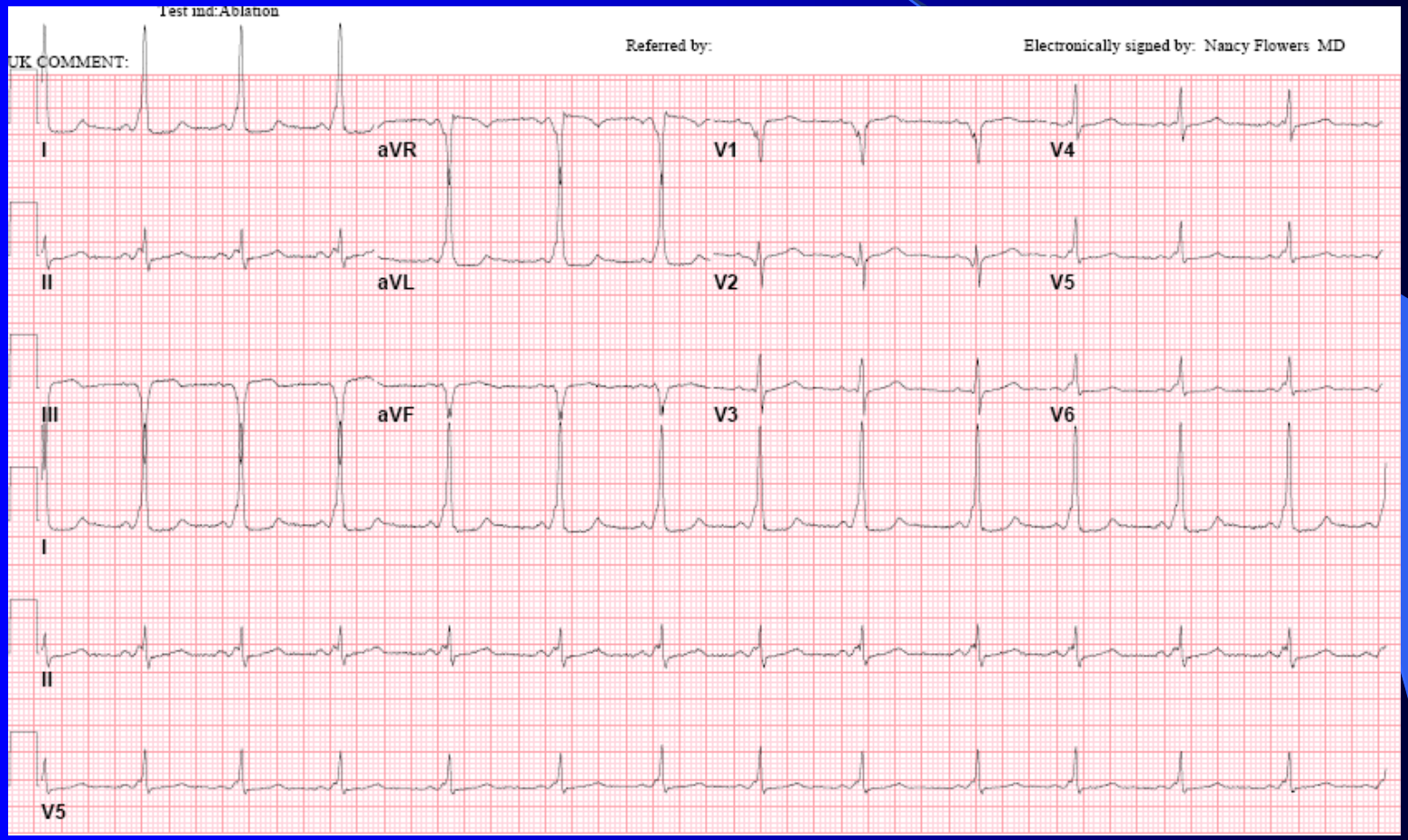

I
ABL D
ABL P
II
aVF
V1
HIS 1,2
HIS 3,4
CS 9,10
CS 7,8
CS 5,6
22 ms
2727 BPM
700

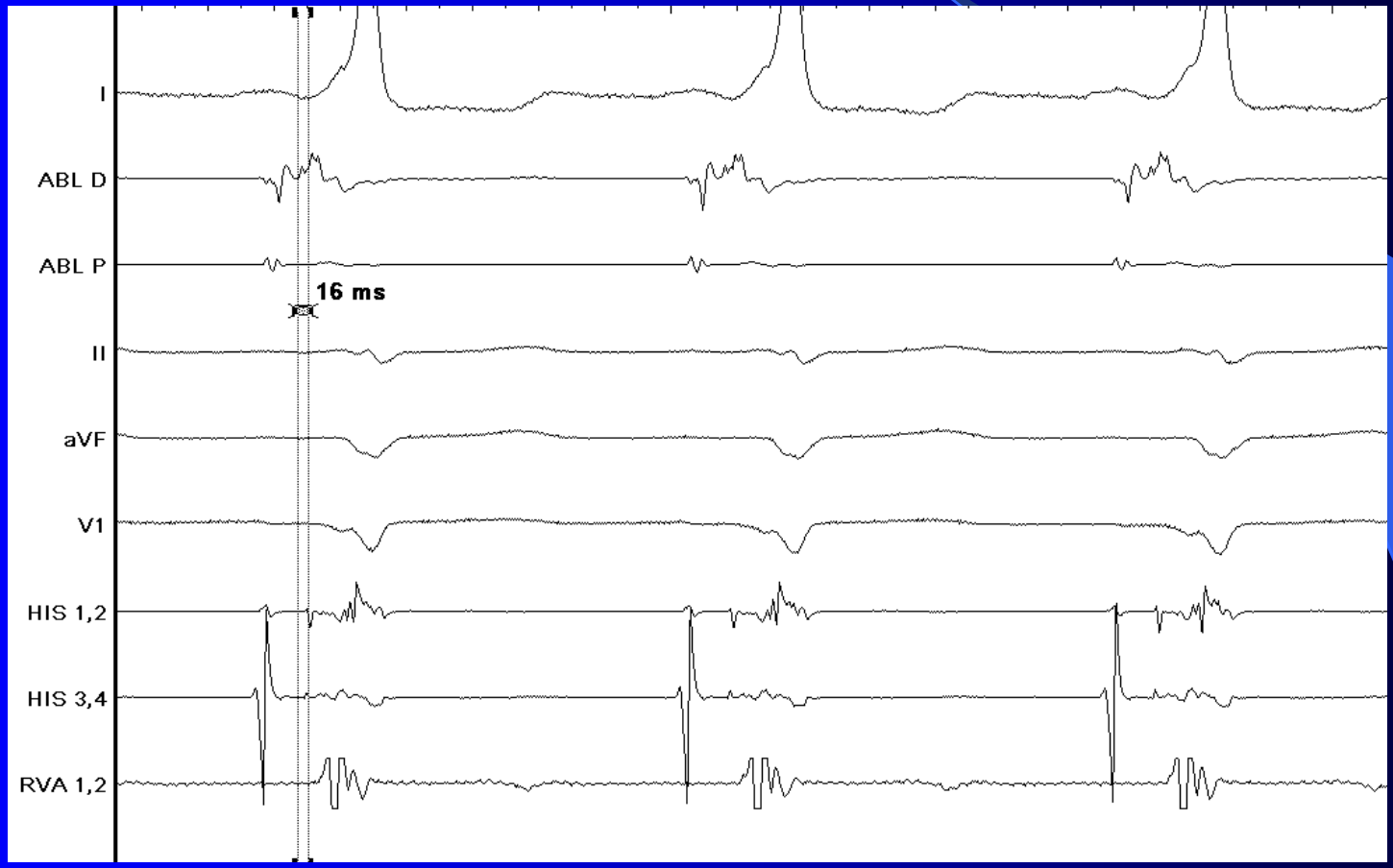


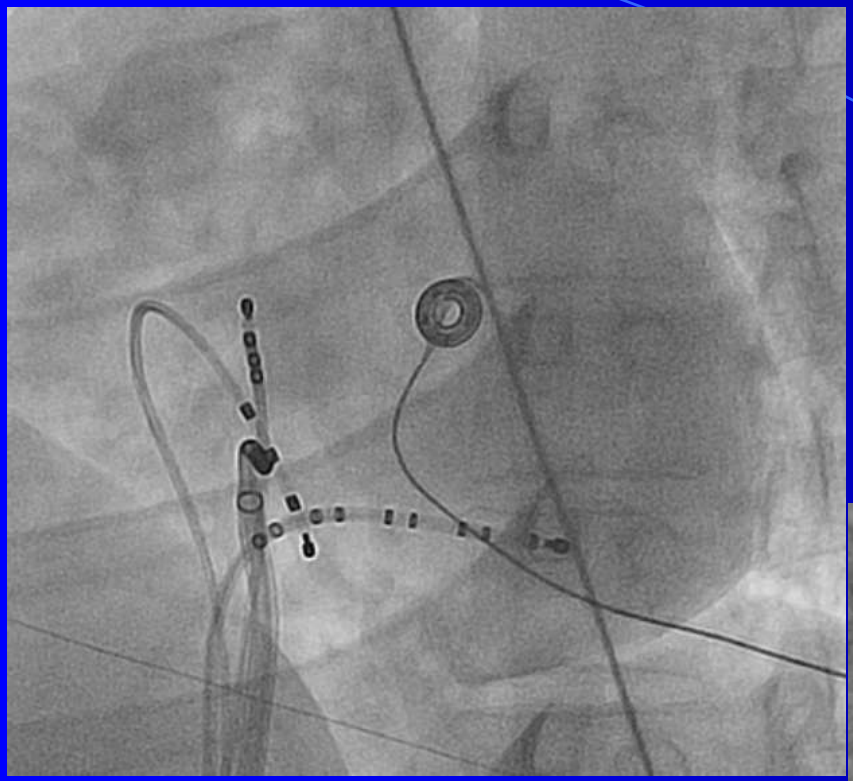
Ablation

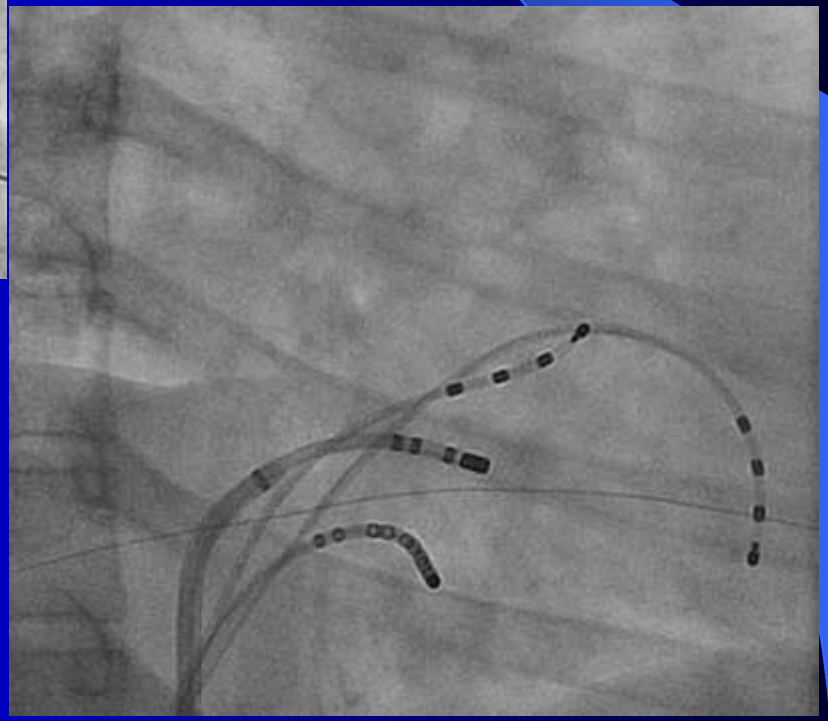

I
ABL D
ABL P
II
aVF
V1
HIS 1,2
HIS 3,4
CS 9,10
CS 7,8
CS 5,6
CS 3,4
CS 1,2
RVA 1,2
3.590 s
700
700
695
700
700
700
695

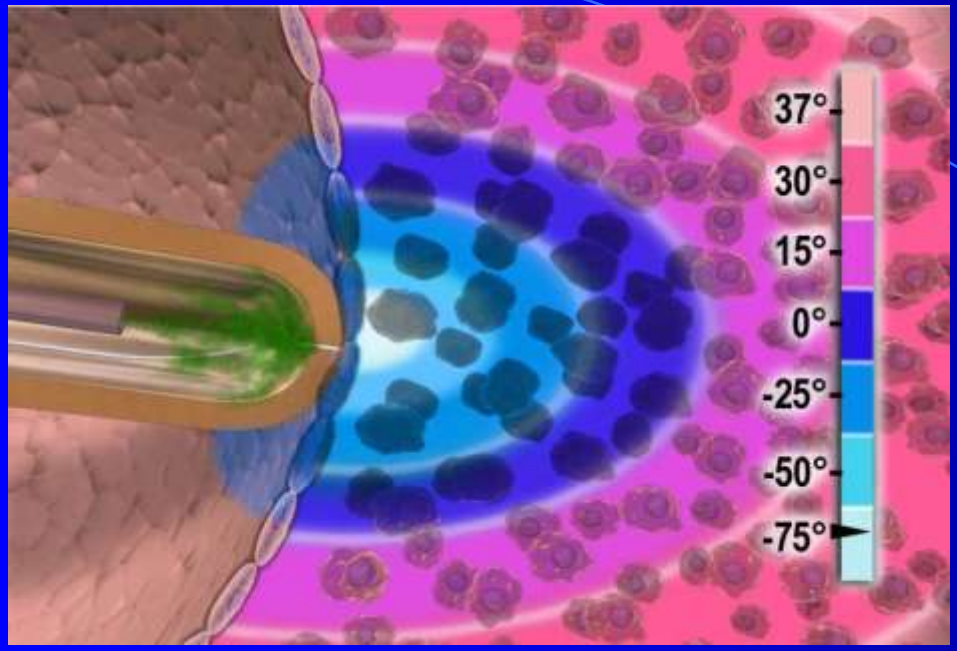
23 y/o female with palpitations




I
ABL D
ABL P
16 ms
II
aVF
V1
HIS 1,2
HIS 3,4
RVA 1,2

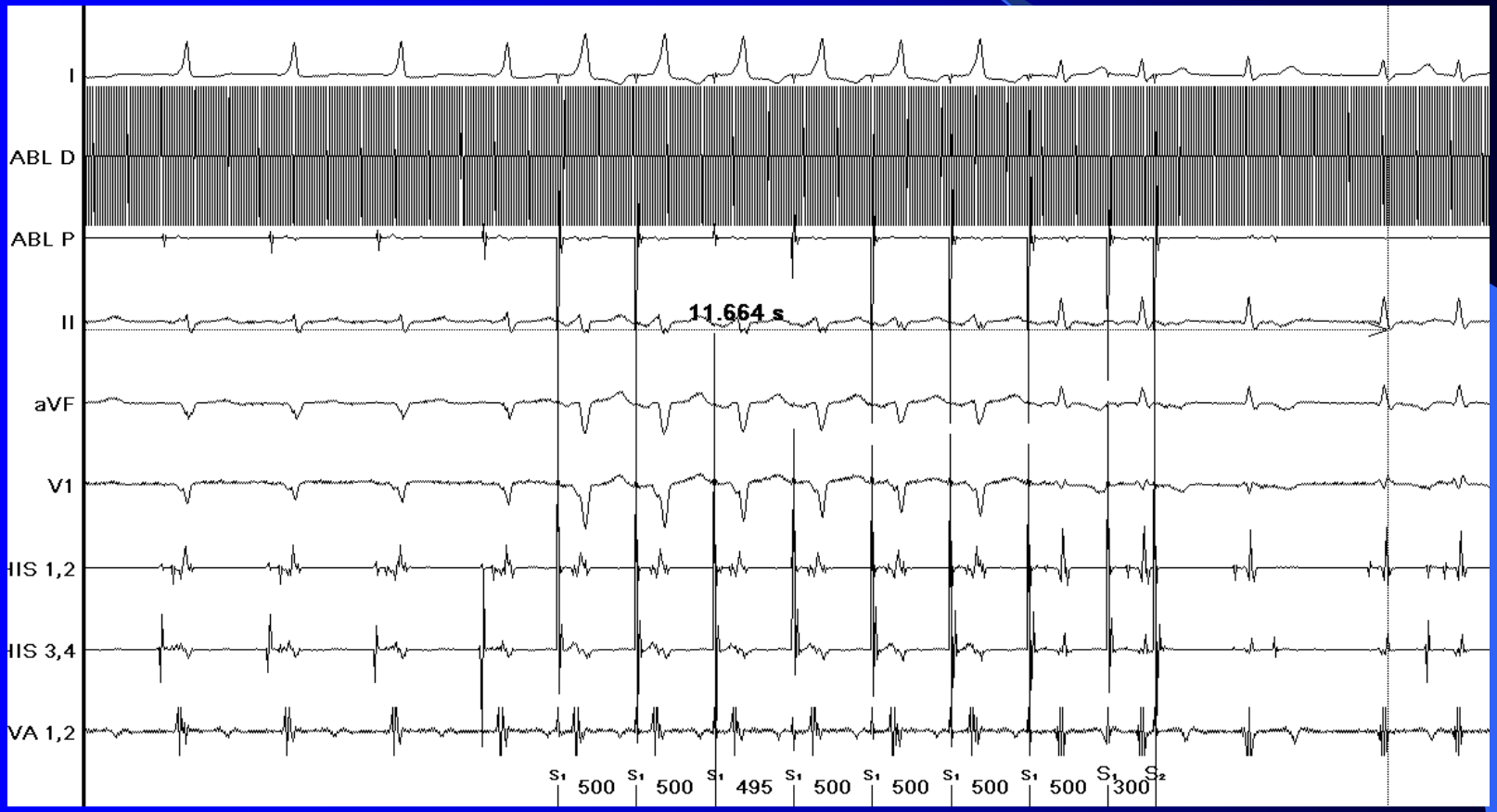




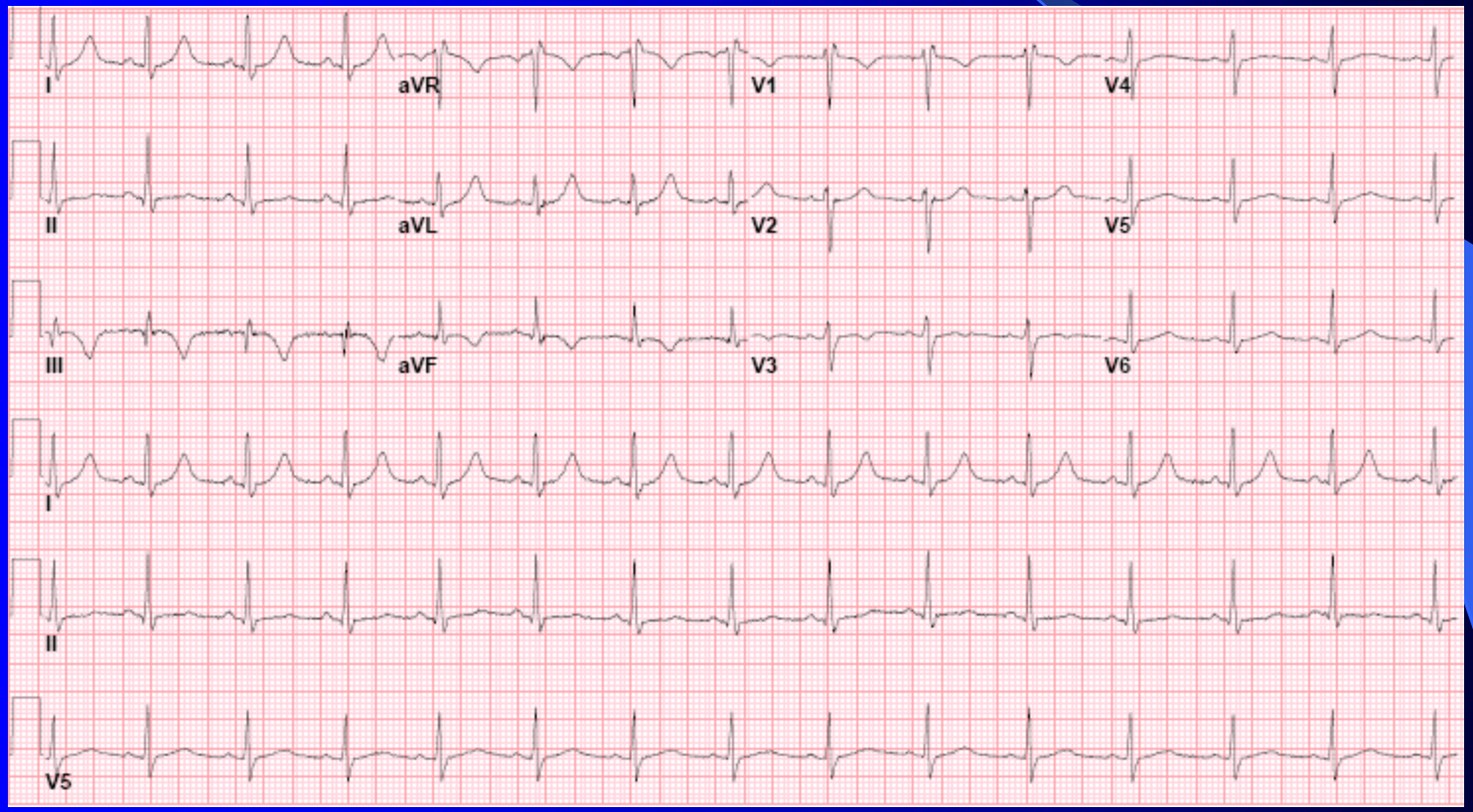

37°
30°
15°
0°
-25°
-50°
-75°


CryoCath

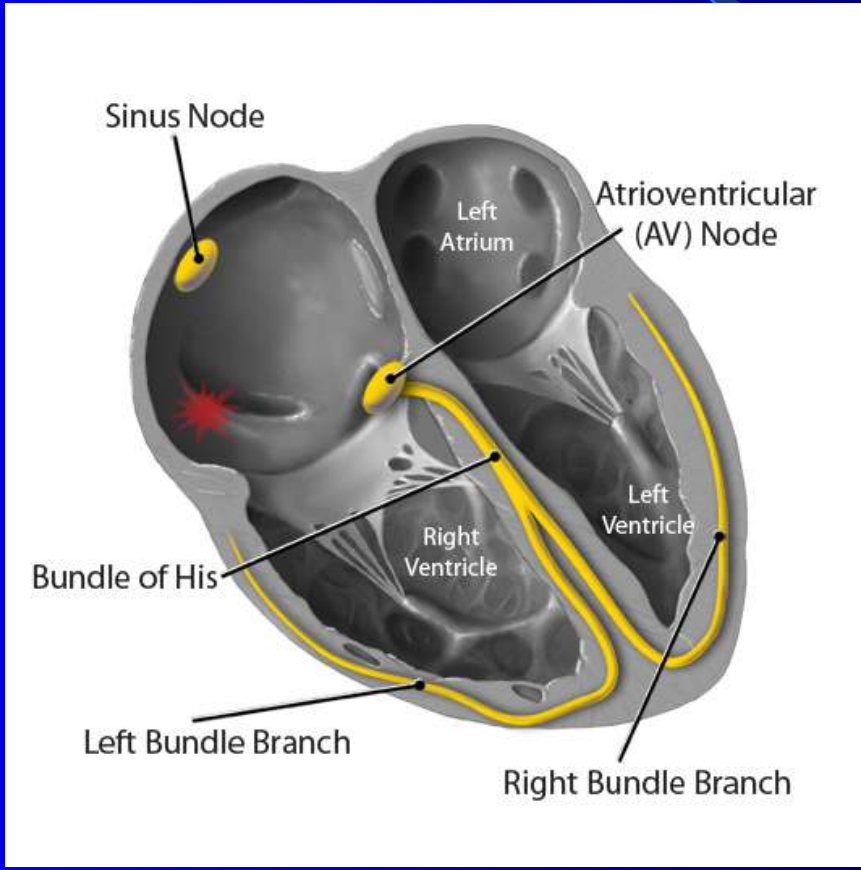
Cryoablation



Post Ablation ECG



Atrial Tachycardia

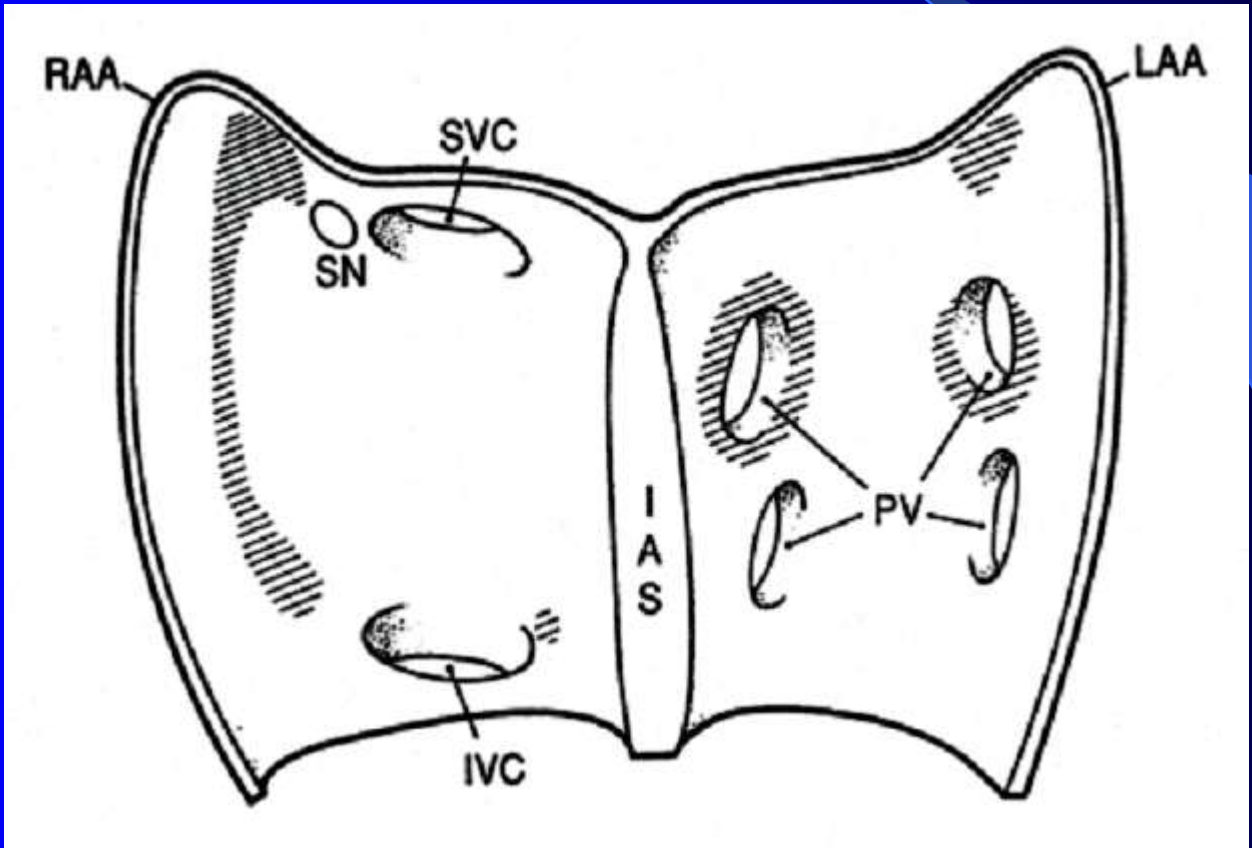


Atrial Tachycardia

- 5-15% of all SVT's
  - Higher in pediatric population
  - Normal hearts
  - S/P surgery for congenital lesions
- Paroxysmal or persistent
  - Persistent atrial tachycardia can cause tachycardia induced cardiomyopathy

Tracy C. Cardiology Clinics. 1997;15:607-621.

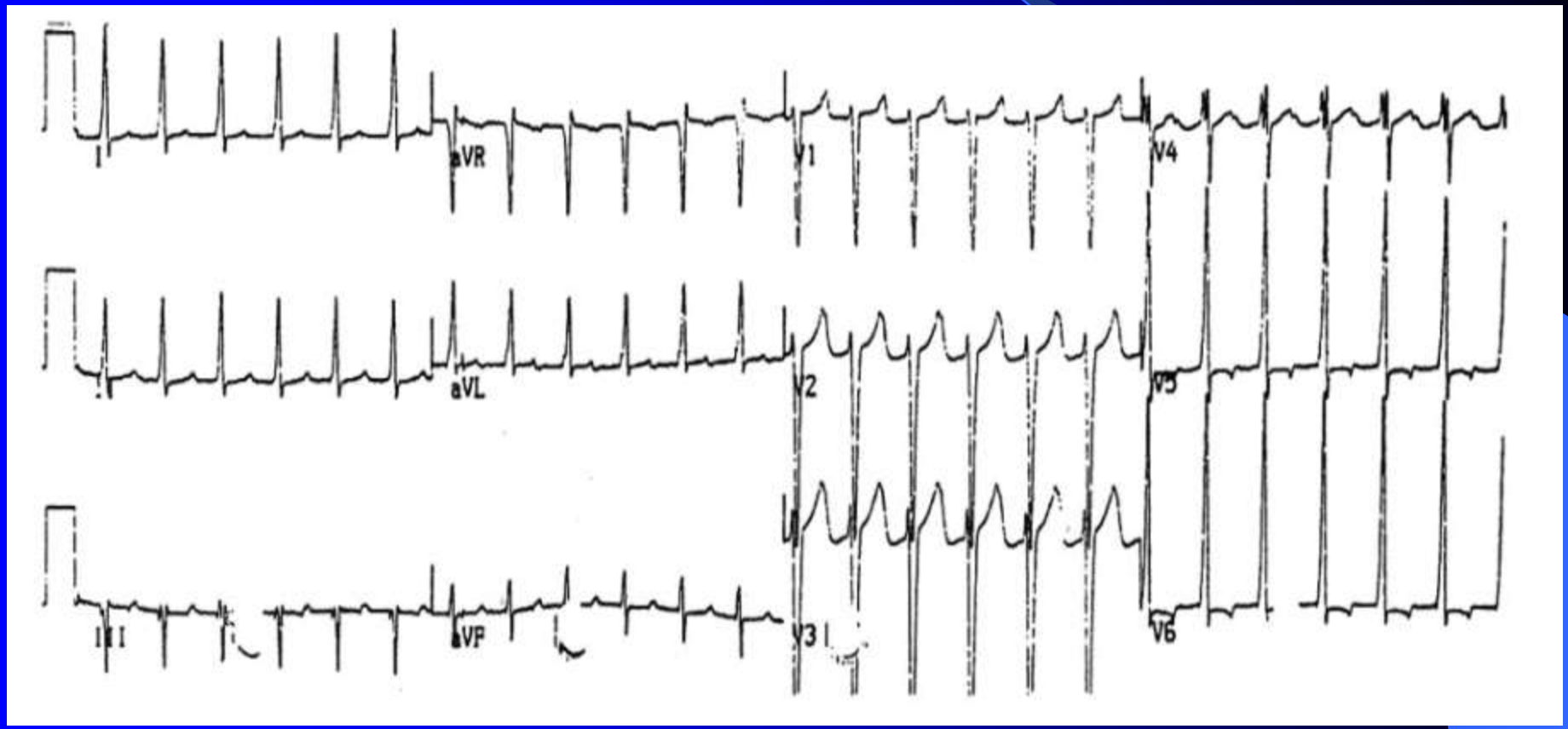
Location of Atrial Tachycardias



Tracy C. Cardiology Clinics. 1997;15:607-621.

Atrial Tachycardia

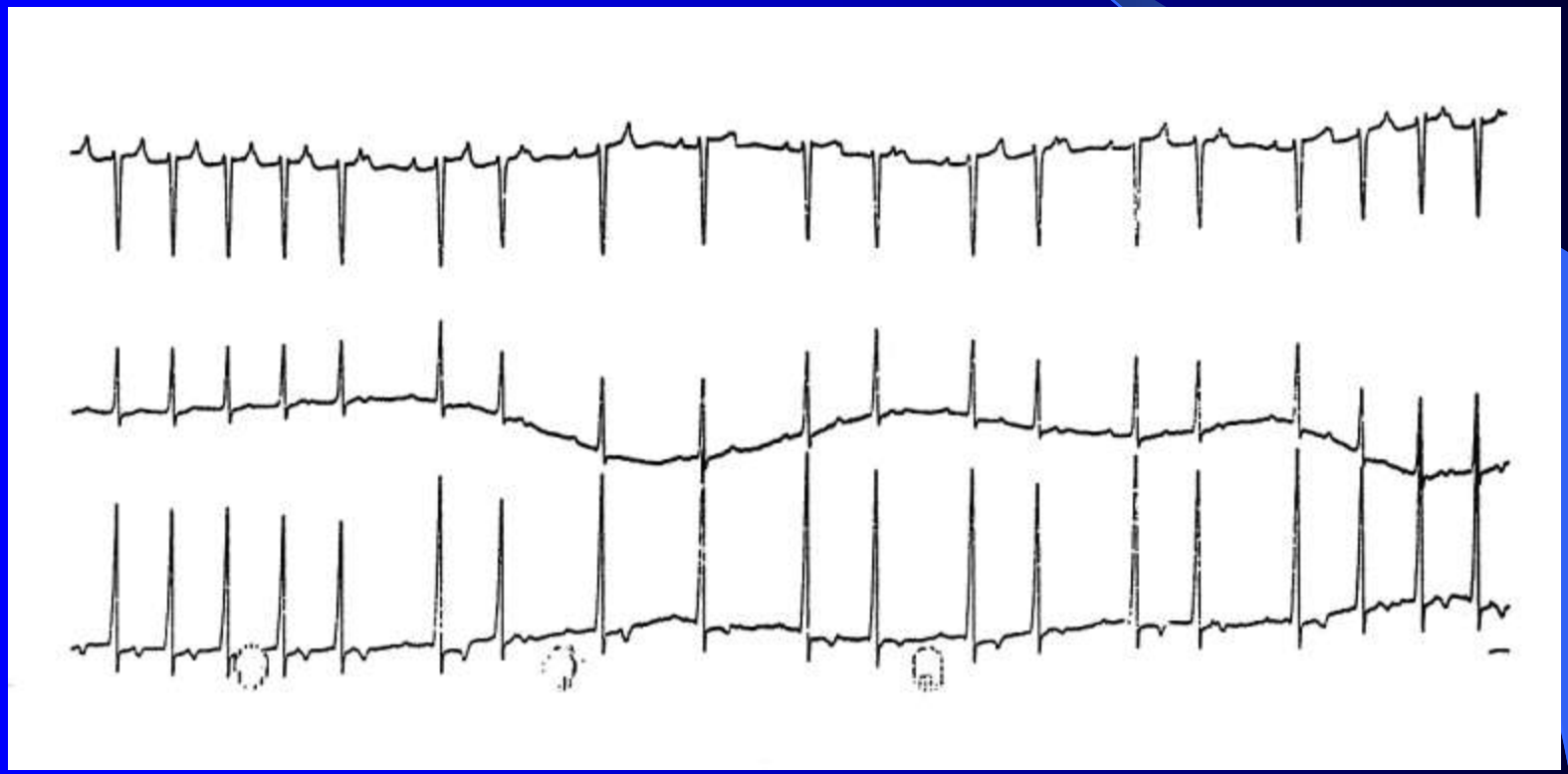
Baseline ECG



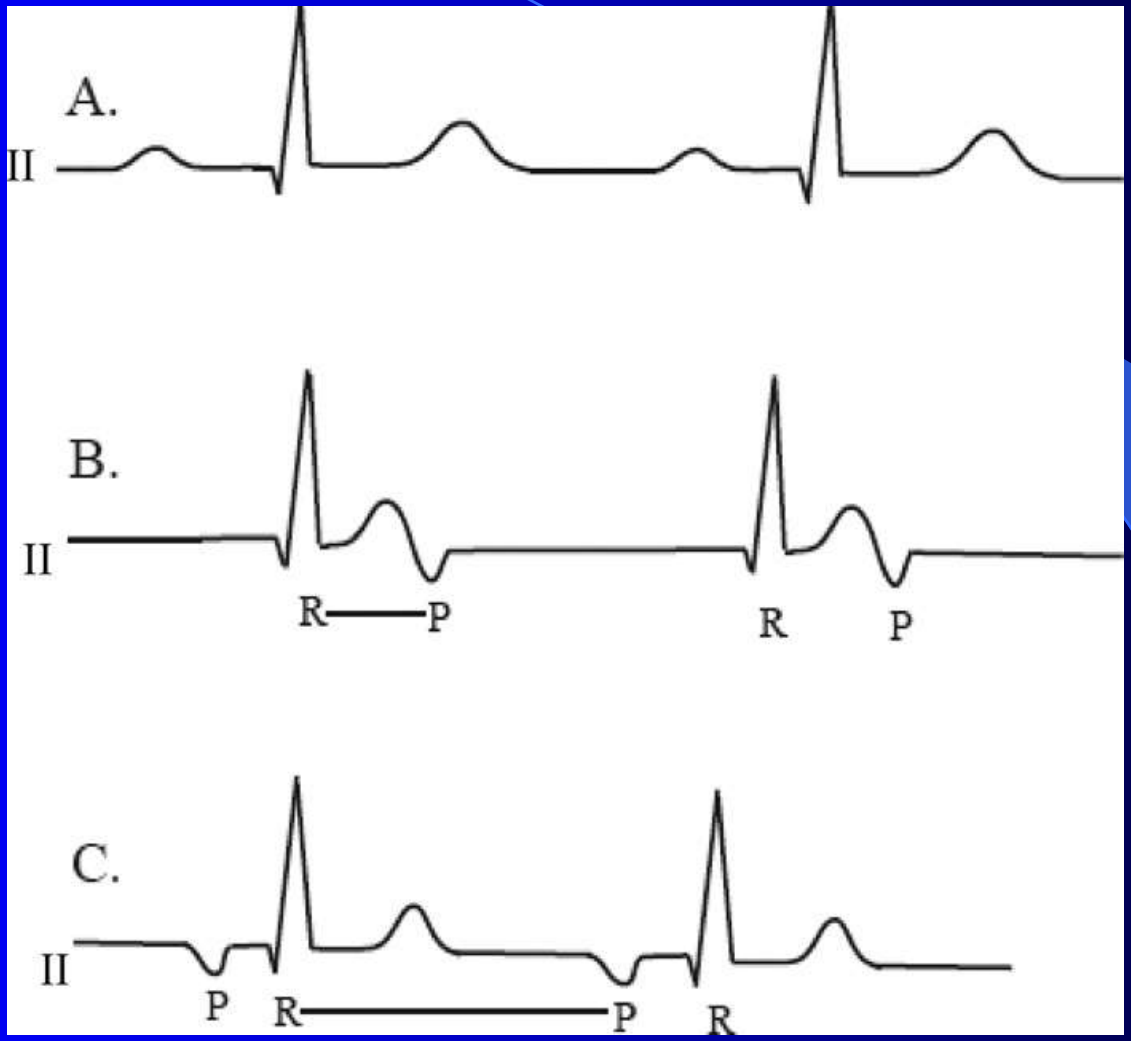
Tracy C. Cardiology Clinics. 1997;15:607-621.

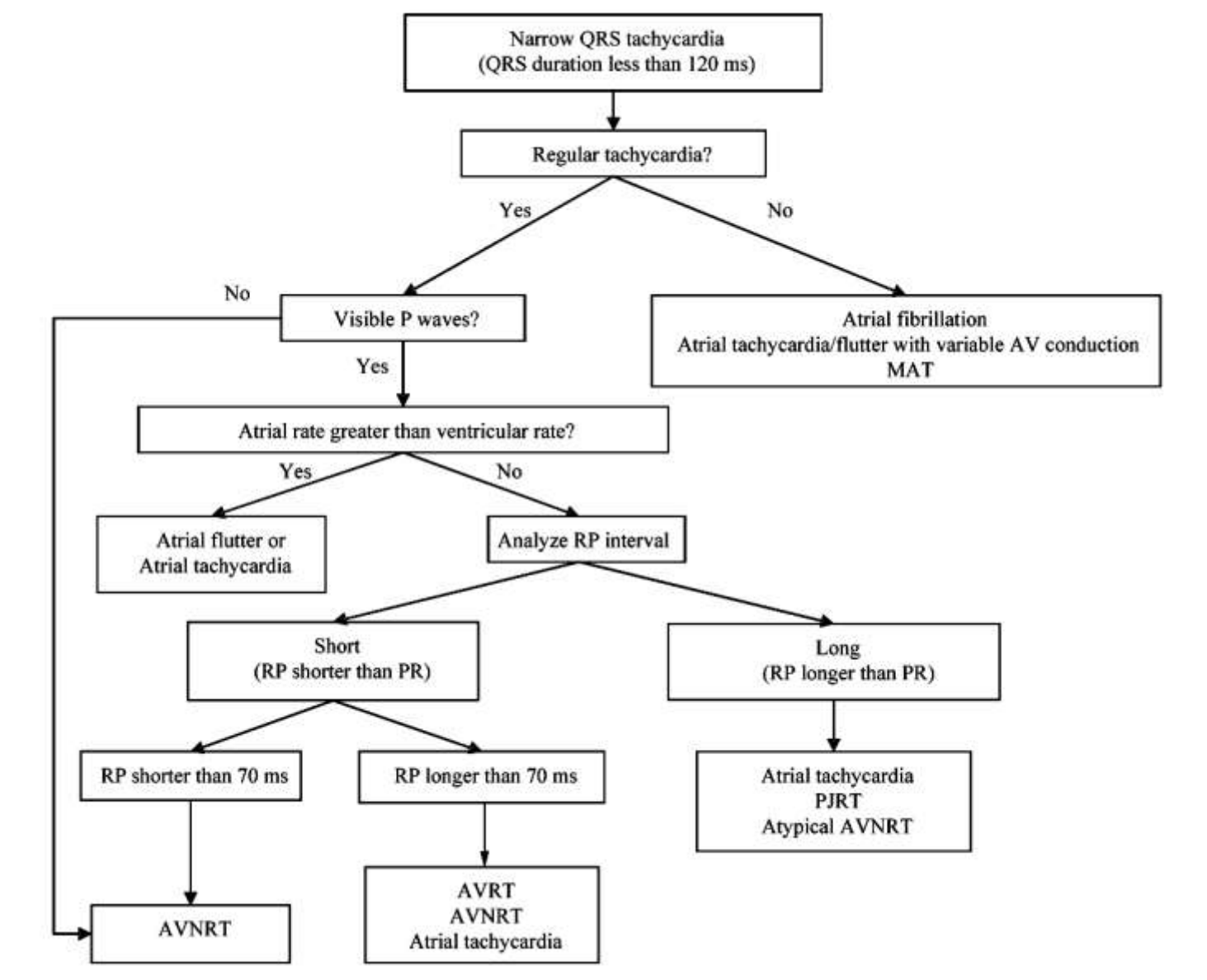
Atrial Tachycardia

Transient AV Block After 12 mg IV Adenosine

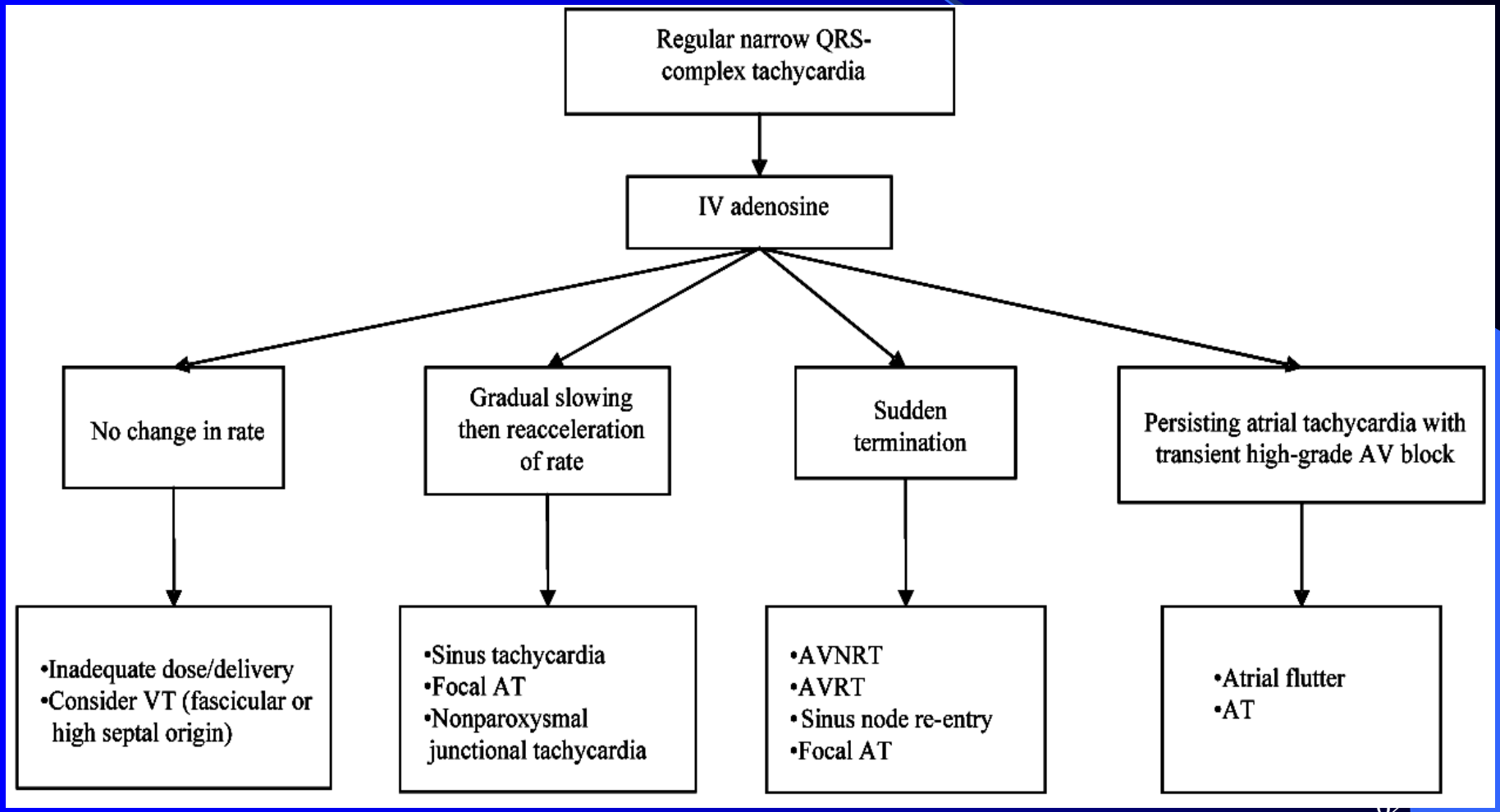


Tracy C. Cardiology Clinics. 1997;15:607-621.

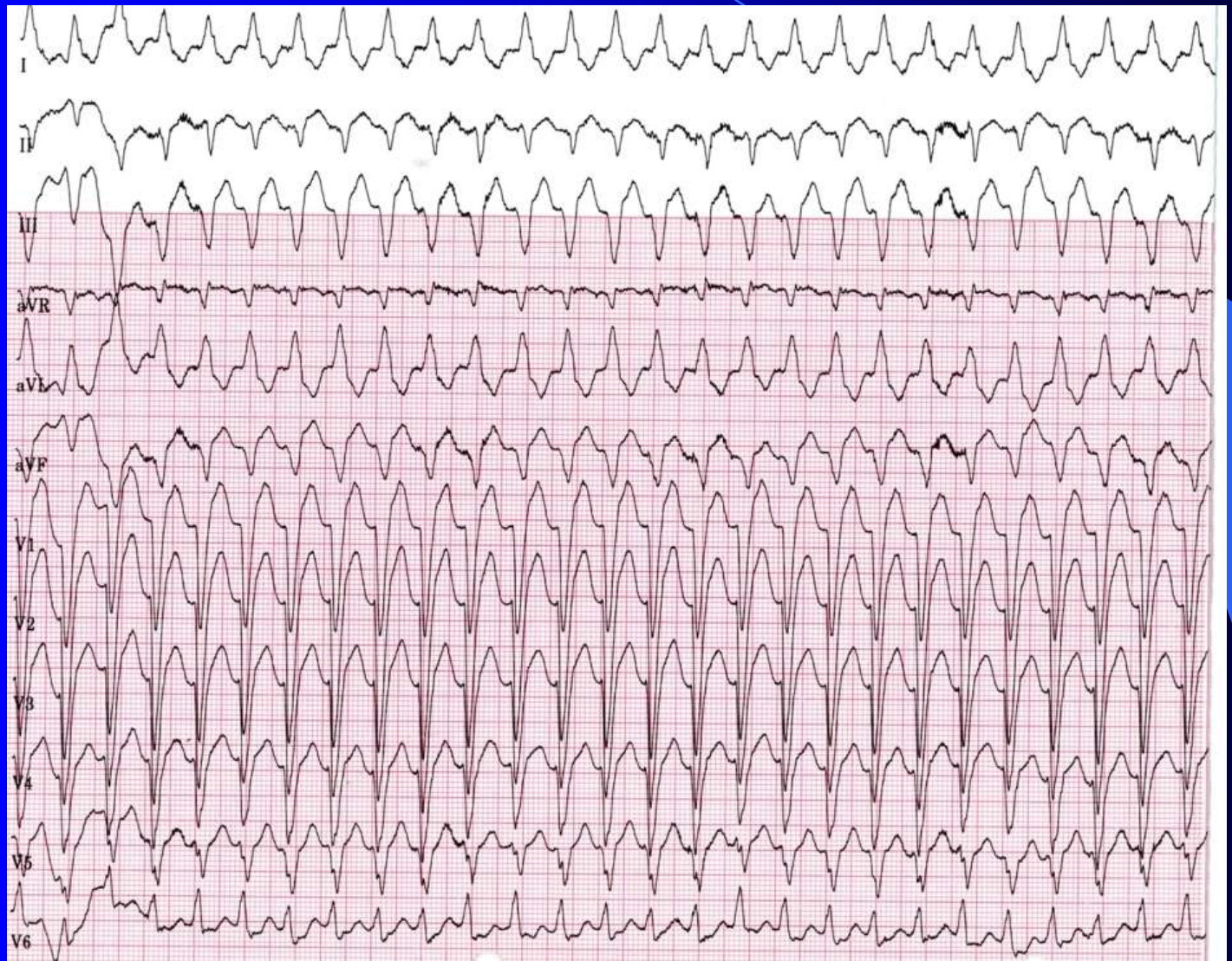

A.
II
B.
II
R
P
R
P
C.
II
P
R
P
R


Narrow QRS tachycardia
(QRS duration less than 120 ms)
Regular tachycardia?
Yes
No
No
Visible P waves?
Yes
Atrial fibrillation
Atrial tachycardia/flutter with variable AV conduction
MAT
Atrial rate greater than ventricular rate?
Yes
No
Atrial flutter or
Atrial tachycardia
Analyze RP interval
Short
(RP shorter than PR)
Long
(RP longer than PR)
RP shorter than 70 ms
RP longer than 70 ms
Atrial tachycardia
PJRT
Atypical AVNRT
AVNRT
AVRT
AVNRT
Atrial tachycardia

Response to Adenosine

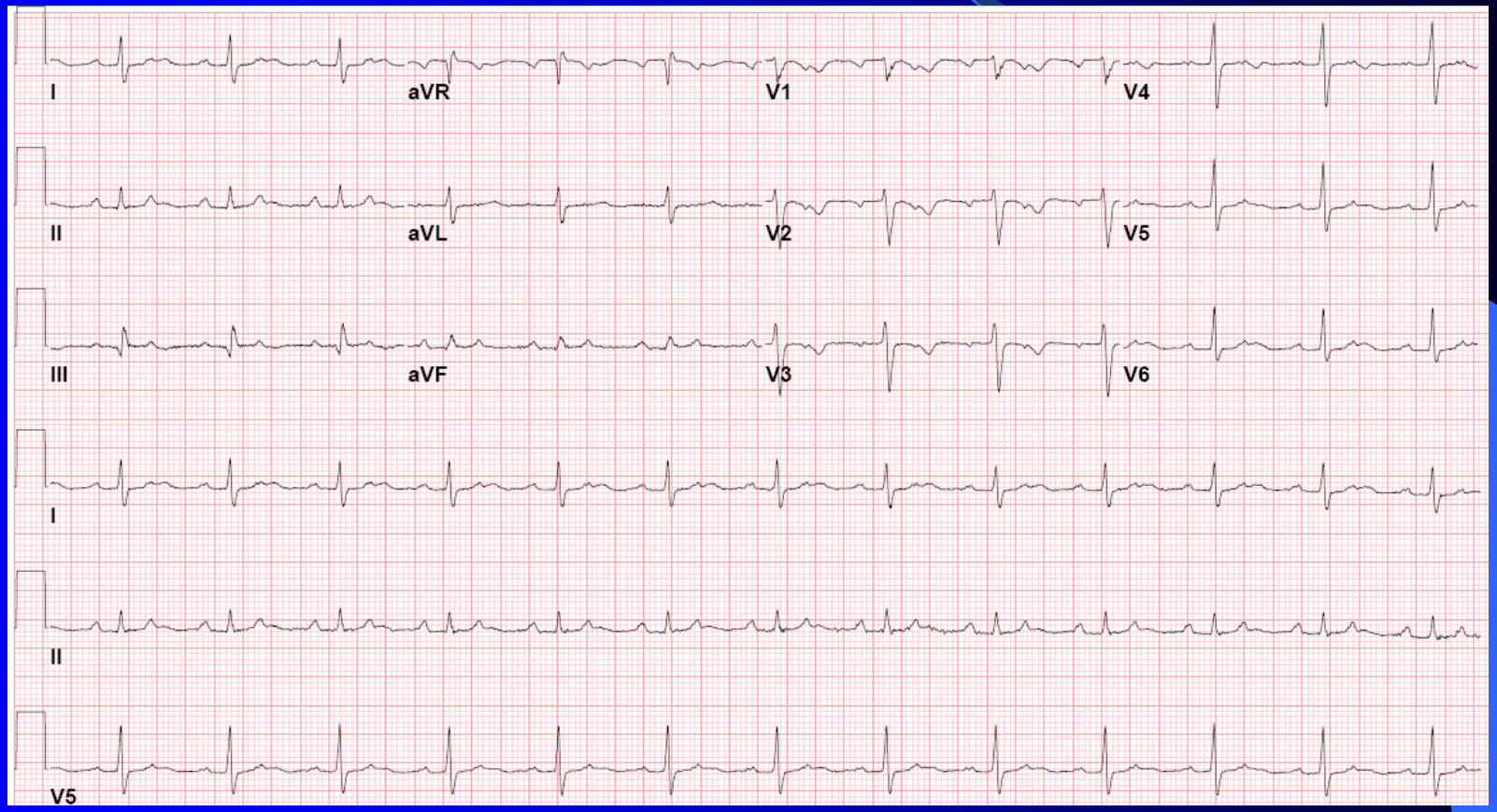


60 y/o female with palpitations

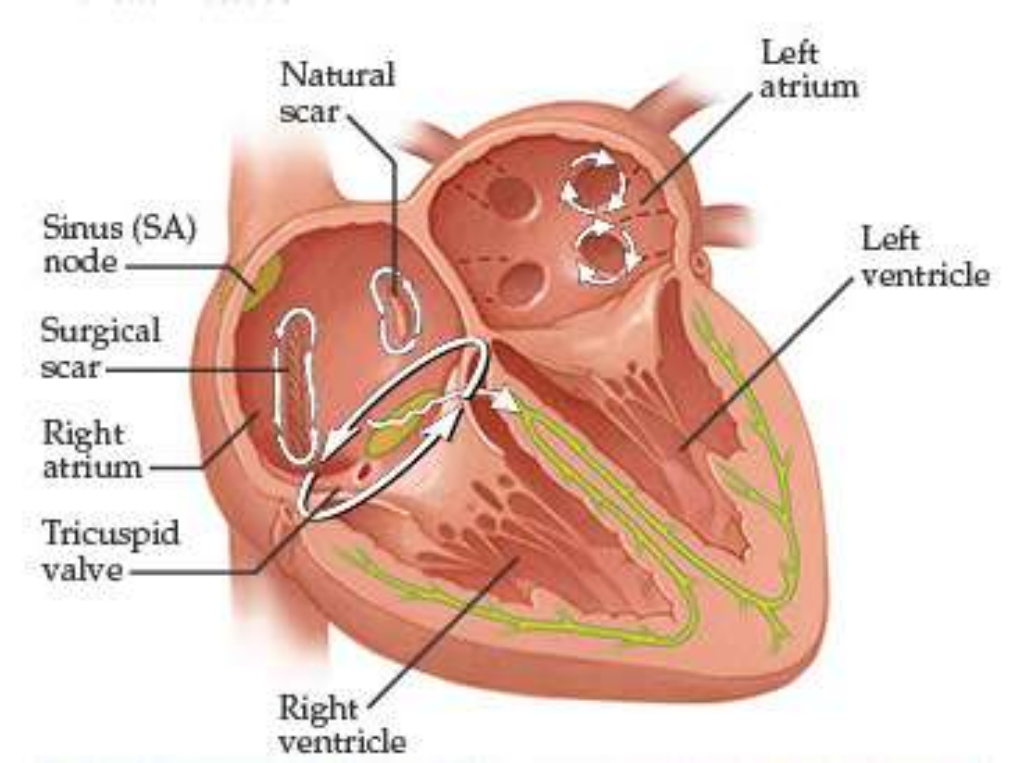


Adenosine 6 mg IV

50 y/o male post CABG



Atrial Flutter



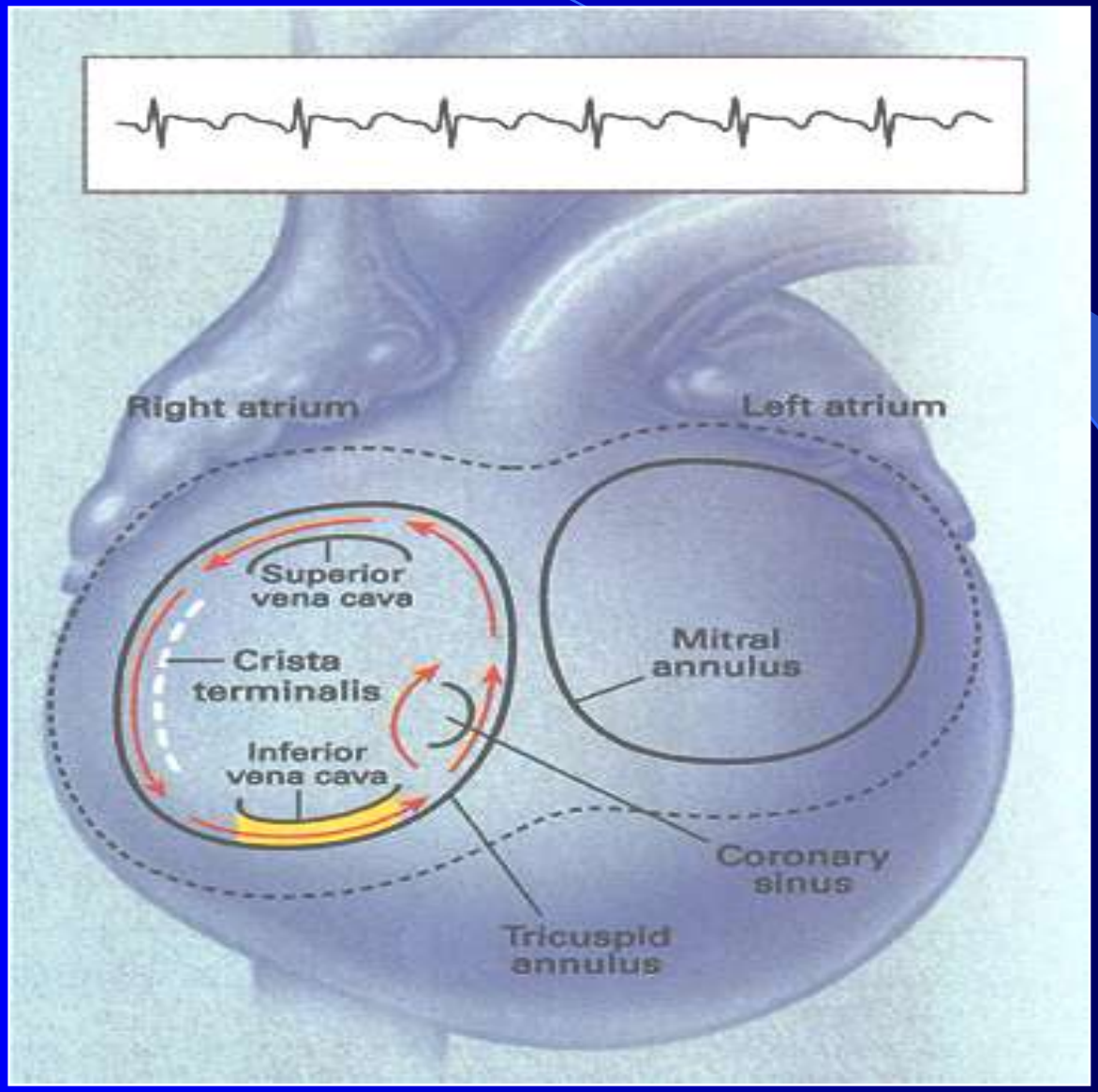
65 y/o male with palpitations

Common Atrial Flutter

- ECG: "Sawtooth" pattern in leads II, III, aVF
- Counterclockwise macro-reentry in RA
- Ablate an "isthmus" between TV and IVC
- Efficacy >90%
- Recurrence <10%
- Complications rare

Morady F. N Engl J of Med. 1999;340:534-544.

Reentry Circuit



Morady F. N Engl J of Med. 1999;340:534-544.

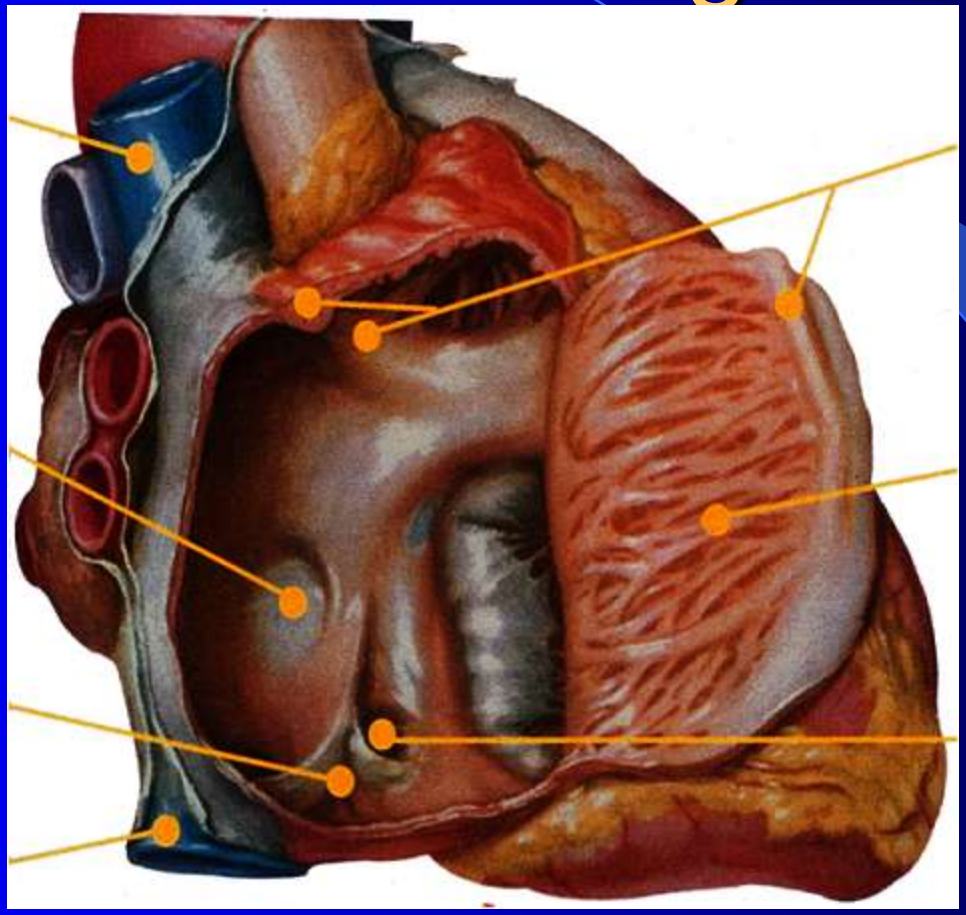
Oblique View of Right Atrium

Superior Vena Cava

Fossa Ovalis

Eustachian Ridge

Inferior Vena Cava



Crista Terminalis

Pectinate Muscle

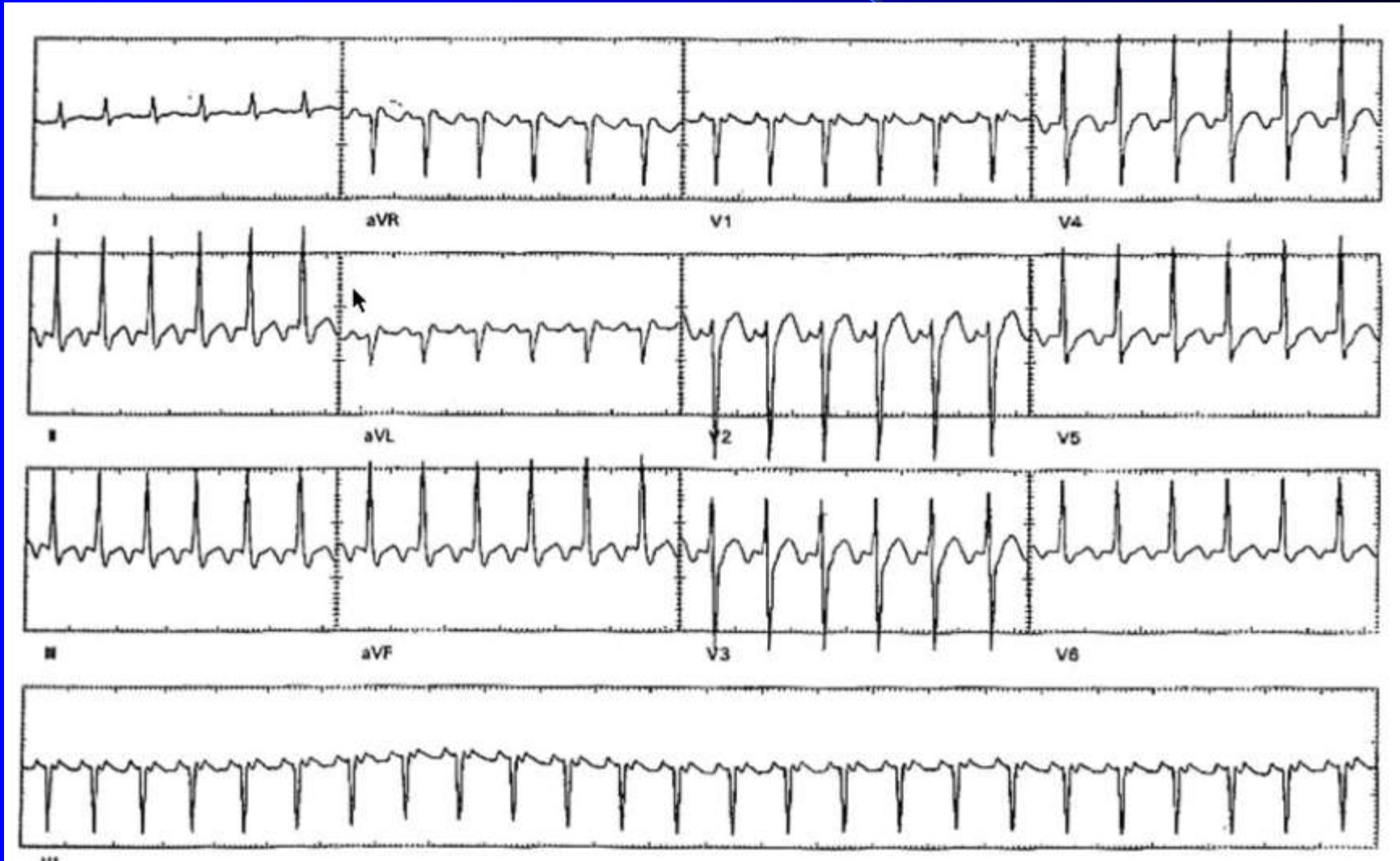
Orifice of Coronary Sinus

Netter F. Atlas of Human Anatomy. 1989;Plate 208.

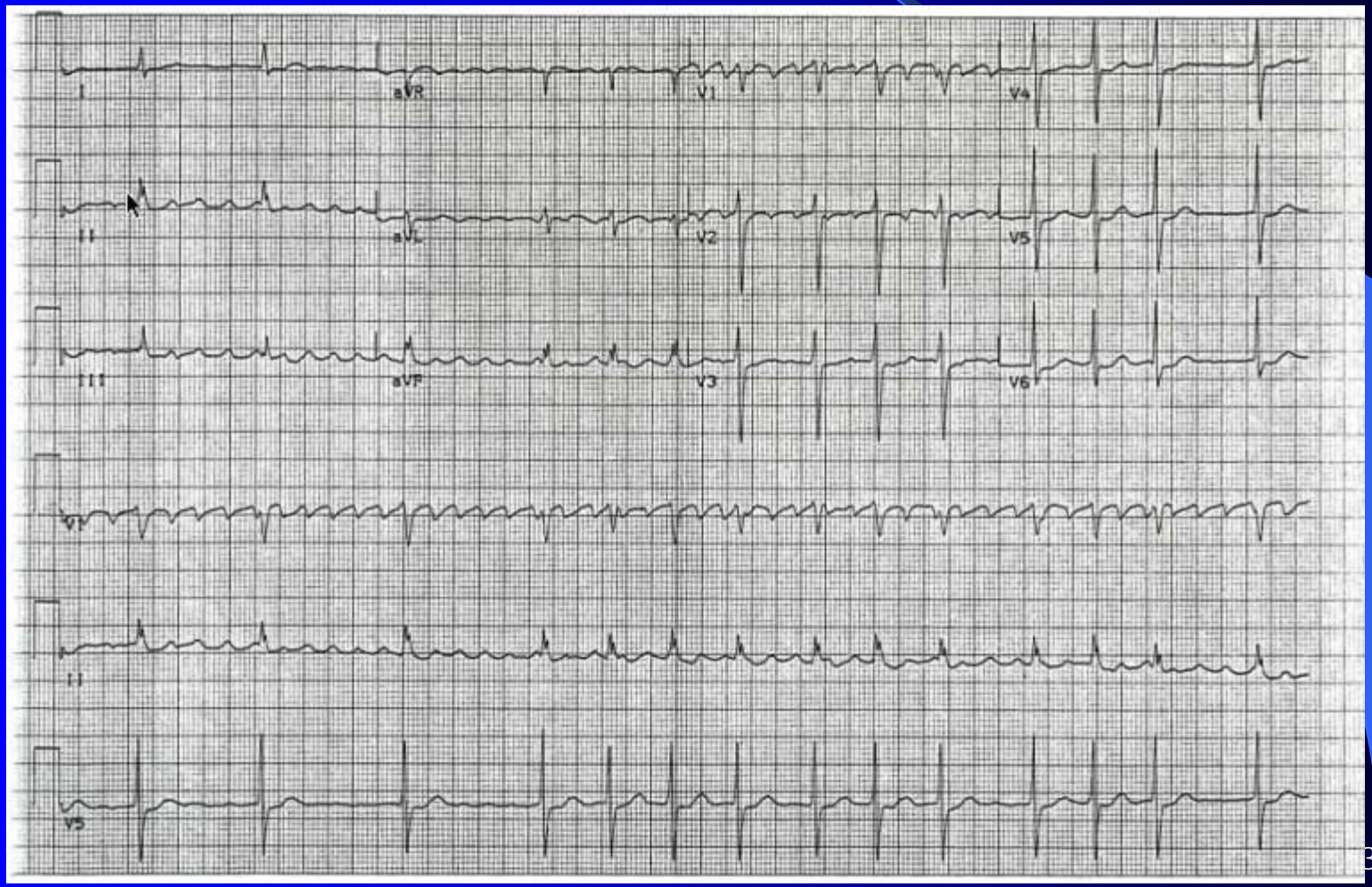
Counterclockwise Atrial Flutter

Courtesy of Dr. Brian Olshansky.

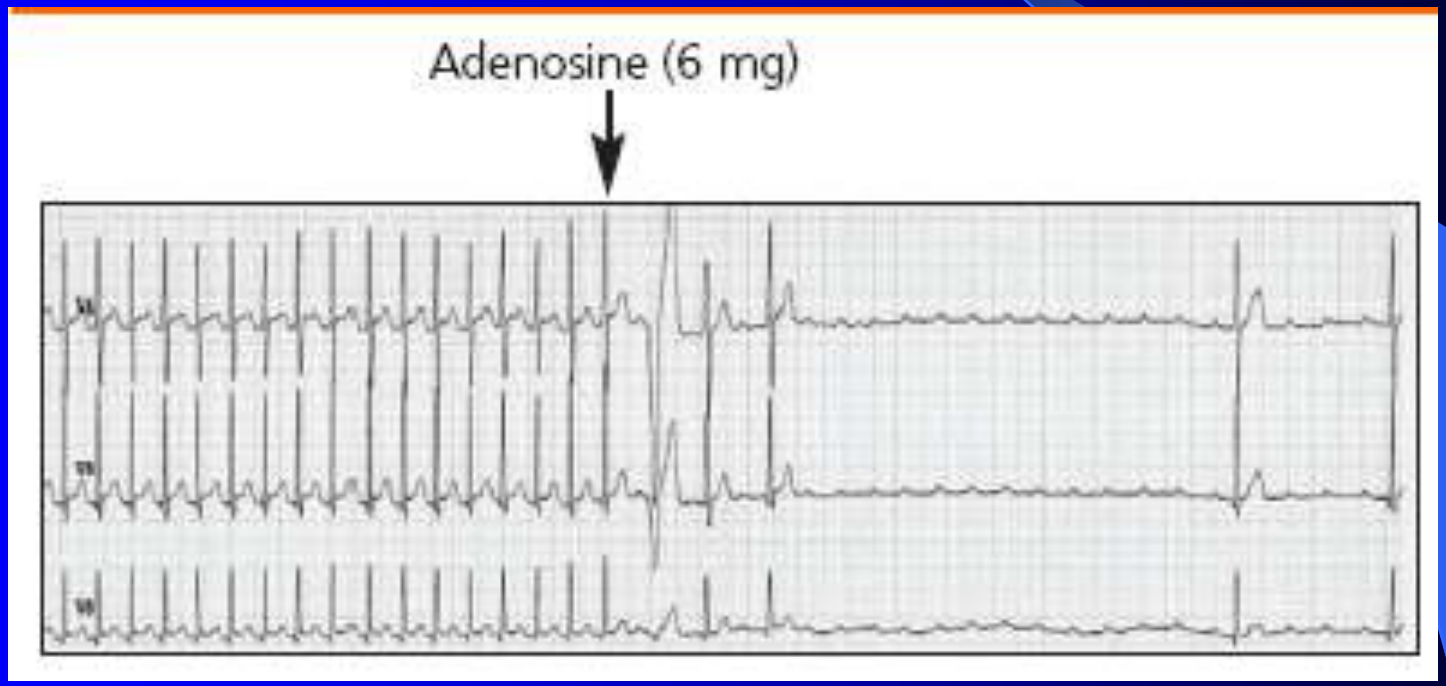
Typical Atrial Flutter



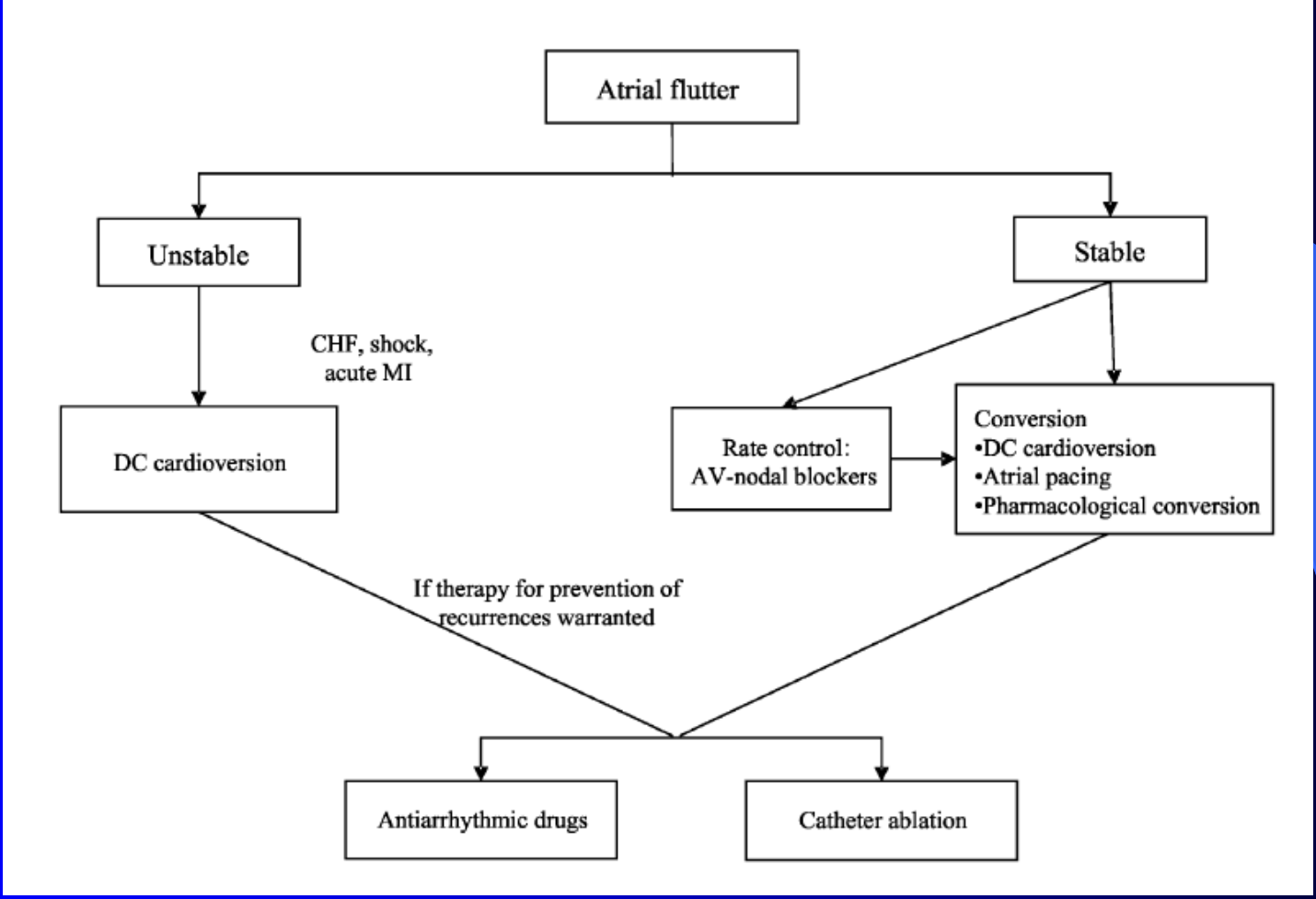
Clockwise Atrial Flutter



Adenosine and Atrial Flutter



ACC/AHA Guidelines



Therapeutic options

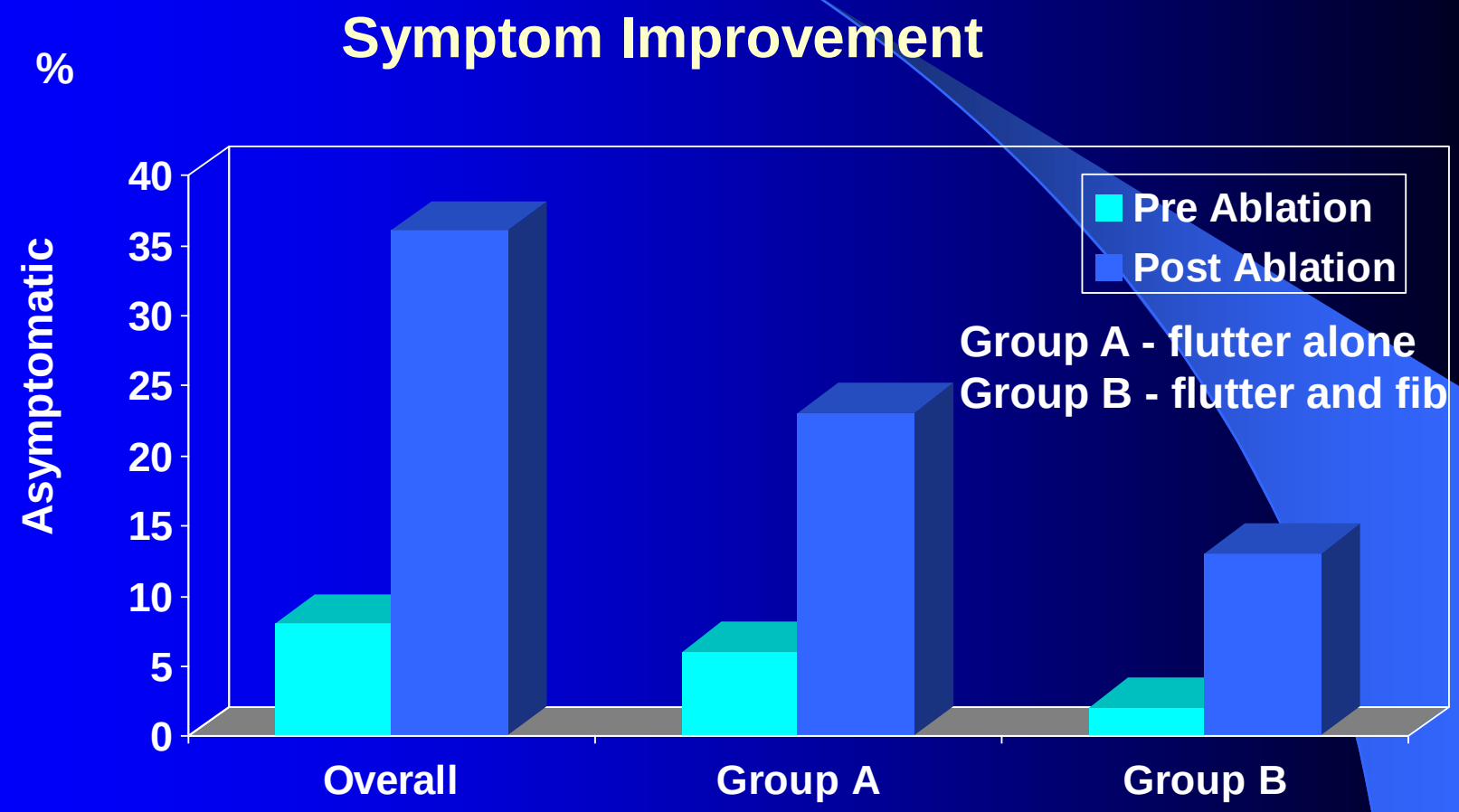
- Rate control: AV blocking agents
- Anticoagulation
- Rhythm control: Class Ia
  - Class Ic
  - Class III

RF Ablation Atrial Flutter
Optimal Candidates

- Patient preference as primary therapy
- Drug refractory or significant side-effects
- Symptomatic patients
- Chronic and sustained
- Hybrid therapy for AF

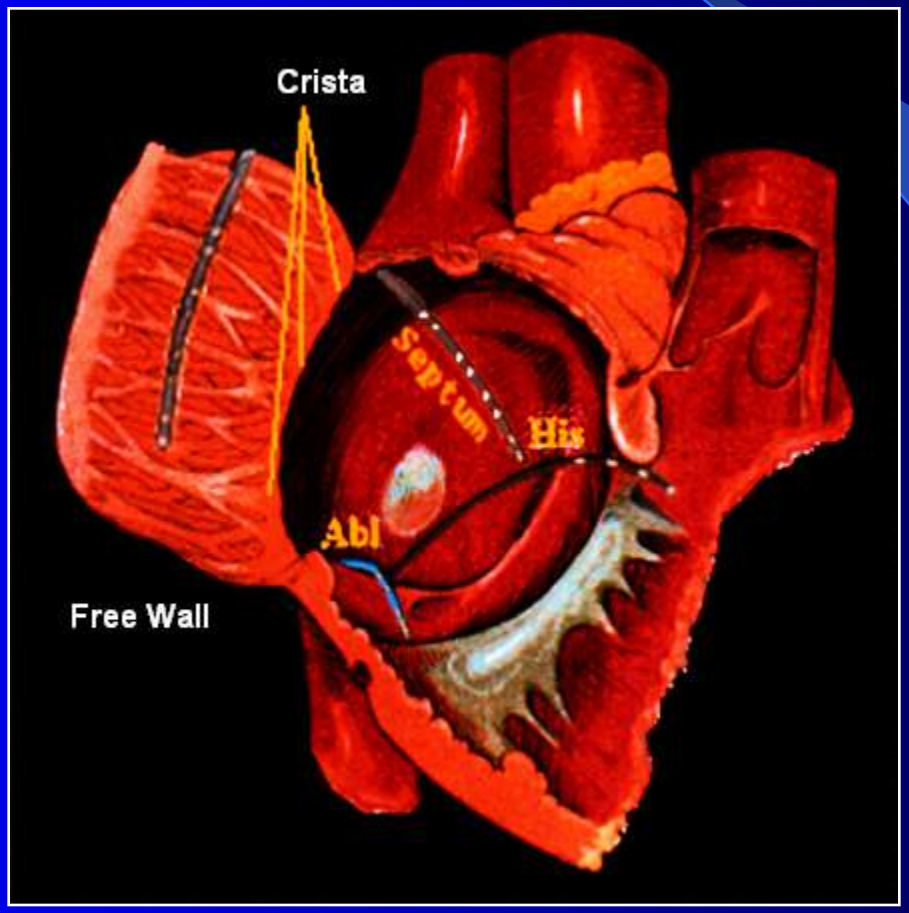
Morady F. N Engl J of Med. 1999;340:534-544.

Ablation of Atrial Flutter



Anselme F, et al. Circulation 1999;99:534-40.

Catheters in Flutter Ablation



AF after atrial Flutter Ablation

- 25% experience AF after atrial flutter ablation
- Easier to manage AF
- Flutter initiates AF in some patients

Radiofrequency (RF) Ablation

- EPS + RFA has replaced drug therapy for many arrhythmias
- Safe and effective
- Percutaneous catheters via veins
- Pacing, and recording in the heart
- Discrete RF lesions eliminates critical part of circuits of SVT

Clinical Indications for Ablation

- Paroxysmal supraventricular tachycardia (SVT)
  - AV nodal reentry
  - Accessory AV pathway
  - Atrial flutter
- Focal atrial tachycardia
- Drug refractory arrhythmias
  - AF (ventricular rate control)
  - Monomorphic VT in structural heart disease
  - Bundle branch reentry
  - Idiopathic (RVOT and apical-septal LV VT)

Adapted from Morady F. N Engl J Med. 1999;340:534-544.

RF Ablation Lesion

Morady F. N Engl. J Med. 1999;340:534-544..

Success Rates

Type of Arrhythmia	Success Rate (%)
WPW or SVT (concealed bypass tract)	85-95
AV Node Reentry	95+
Atrial Fibrillation	60-80
Typical Atrial Flutter	90
Atrial Tachycardia	70-80
Ventricular Tachycardia (Normal Heart)	90
Ventricular Tachycardia (Structural Heart Disease)	60

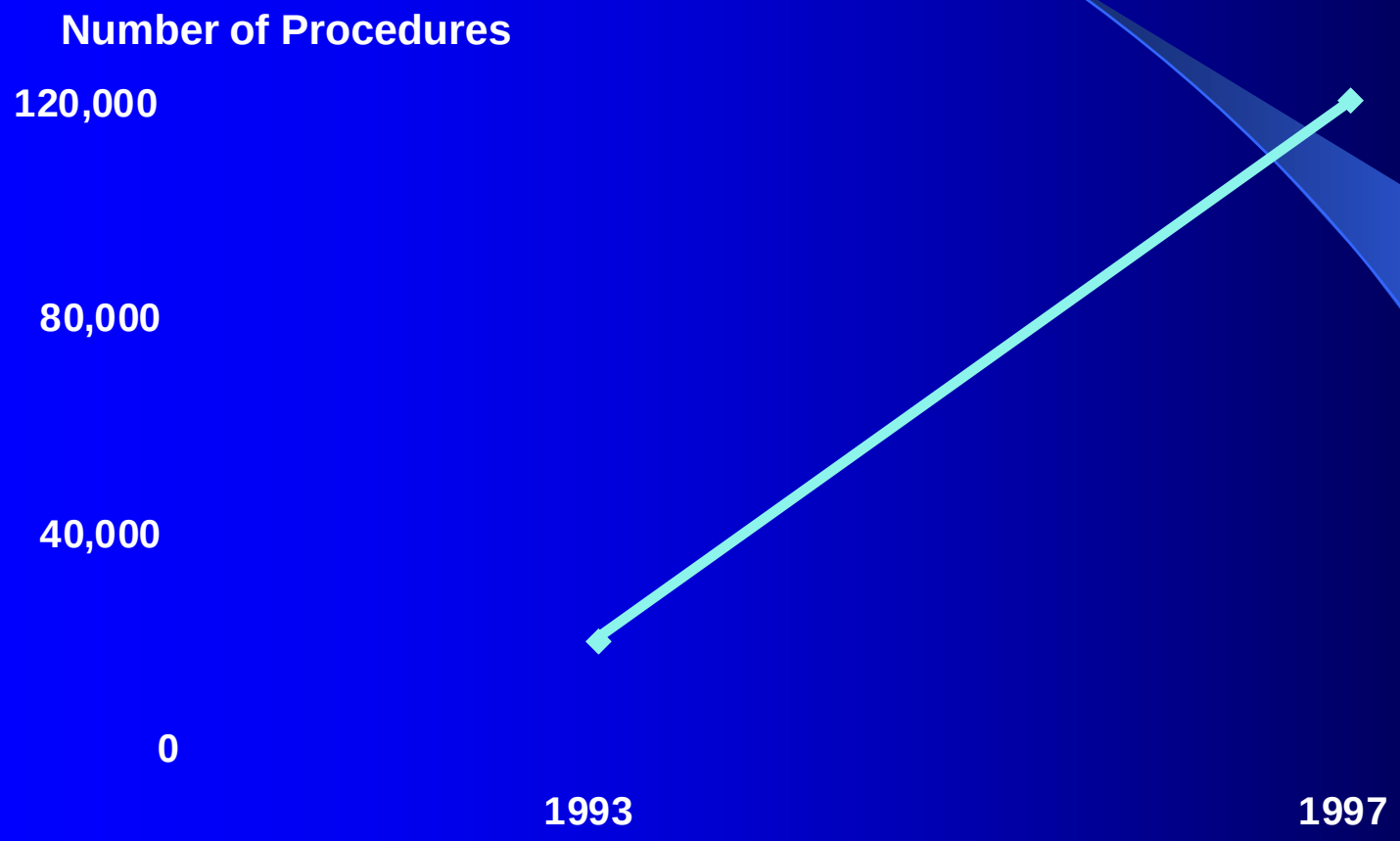
Adapted from Gallik DM. Radio-frequency Catheter Ablation for the Treatment of Cardiac Arrhythmias. Cardiology Special Edition. 1997;59-61.

RF Ablation Complications

Complication	Prevalence (%)
Death	**0.1**
Non-fatal complications:	
Tamponade	**0.5**
AV block	**0.5**
Pericarditis	**0.1**
Femoral artery complications:	
Thrombolic occlusion	**0.2**
Hematoma	**0.2**
AV fistula	**0.1**

ACC/AHA Circ. 1995;92:673-691.
Morady F. N Engl J Med. 1999;340:534-544.

RF Ablation Utilization (US)



Medical Data International, Market and Technology Reports, RP-481284;1;1999:5-15.

Conclusion

- AVNRT is the most common SVT
- The ECG is crucial to make a presumptive diagnosis
- Response to adenosine is helpful in treatment and diagnosis of SVT
- Catheter ablation is an attractive option for patients with symptomatic SVT

Question 1

Which one is the most common form of narrow complex, regular tachycardia?

a) Atrial tachycardia
b) Accessory pathway mediated tachycardia
c) AV node reentrant tachycardia
d) Atrial fibrillation

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Question 2

What effect adenosine has in patients with atrial flutter with rapid ventricular response?

a) No effect on ventricular rate
b) Transient AV block allowing us to see flutter waves
c) Termination of atrial flutter
d) All of the above

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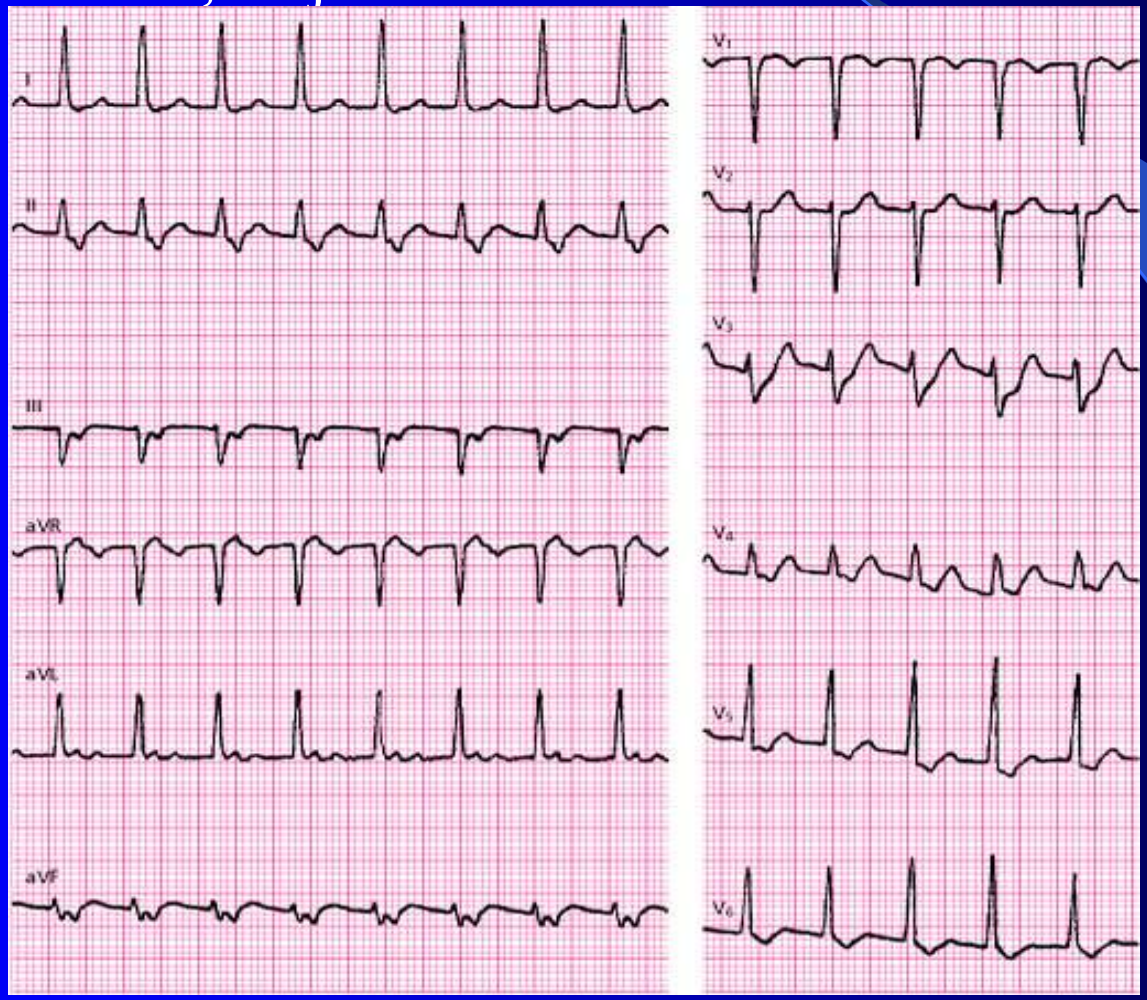
Question 3

A 26 year-old male admitted in the hospital for appendicitis, develops palpitations in the floor, the ecg is show. Patient vitals is stable, he just feels anxious.



Question 3

Which is the acute best treatment for his condition?

a) Electrical cardioversion
b) Verapamil 5 mg IV
c) Procainamide 1 gram IV
d) Amiodarone 150 mg IV
e) Adenosine 6 to 12 mg IV

Question 3

Which is the acute best treatment for his condition?

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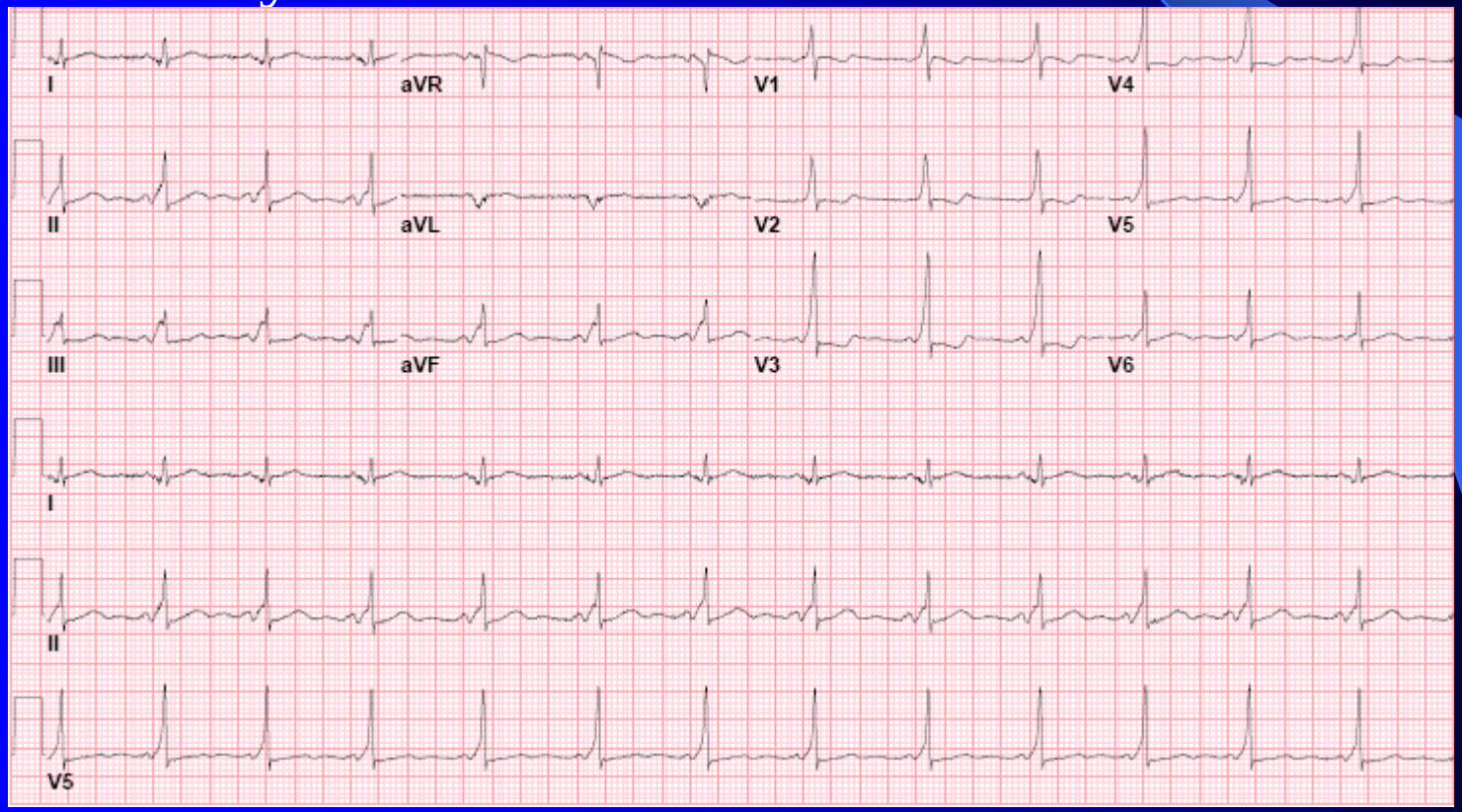
Question 4

A 45 y/o female has been in the ER 3 times with palpitations, despite been on beta blockers. His ECG in your office is shown.



Question 4

Which is the best next step in his management?

a) Stop beta blocker, start flecainide 100 mg TID
b) Add digoxin 0.125 mg PO daily
c) Refer for EPS/Ablation
d) Reassure patient that he will not die with this condition

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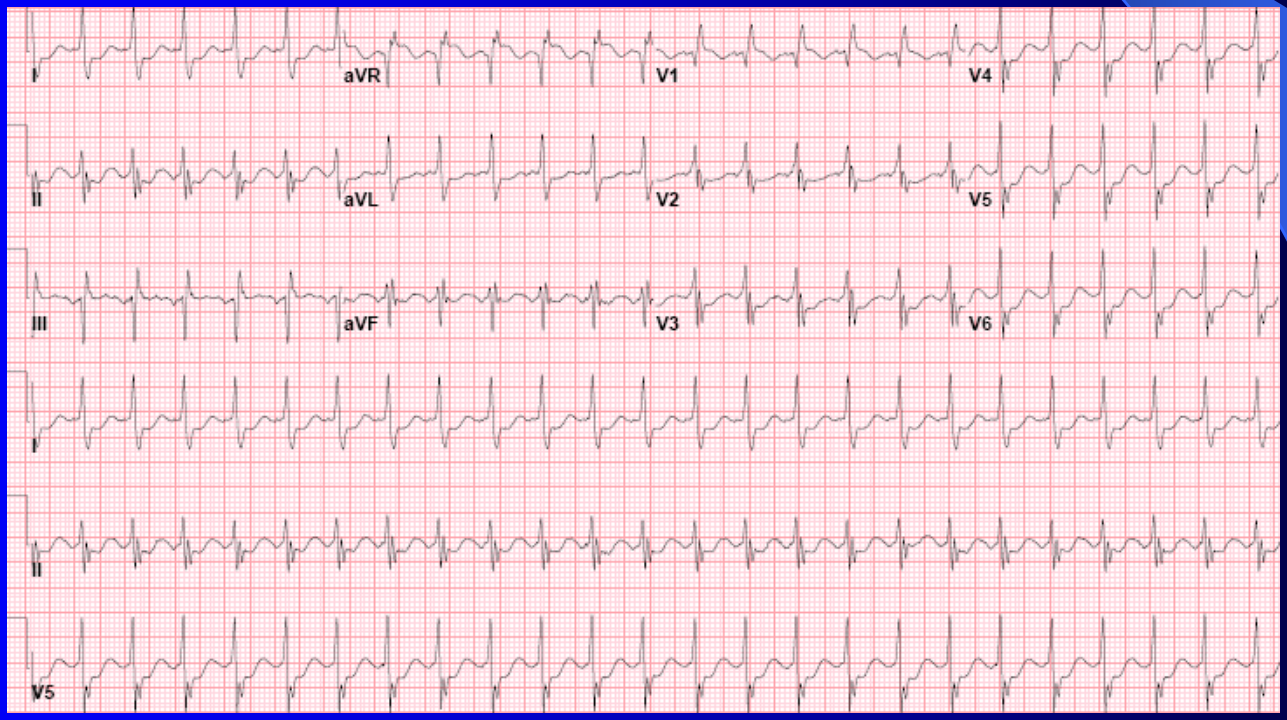
Question 5

You administer adenosine to the following arrhythmia and immediately terminates converting to sinus rhythm.



Question 5

Which of the following statements about this rhythm is correct?

a) This rhythm cannot be atrial tachycardia
b) If the baseline ECG in sinus rhythm has a delta wave, I should not have given adenosine as he could go into VF
c) The rhythm is atrial flutter
d) The AV node is most likely part of the arrhythmia circuit

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THANKS