Basics of arrhythmology

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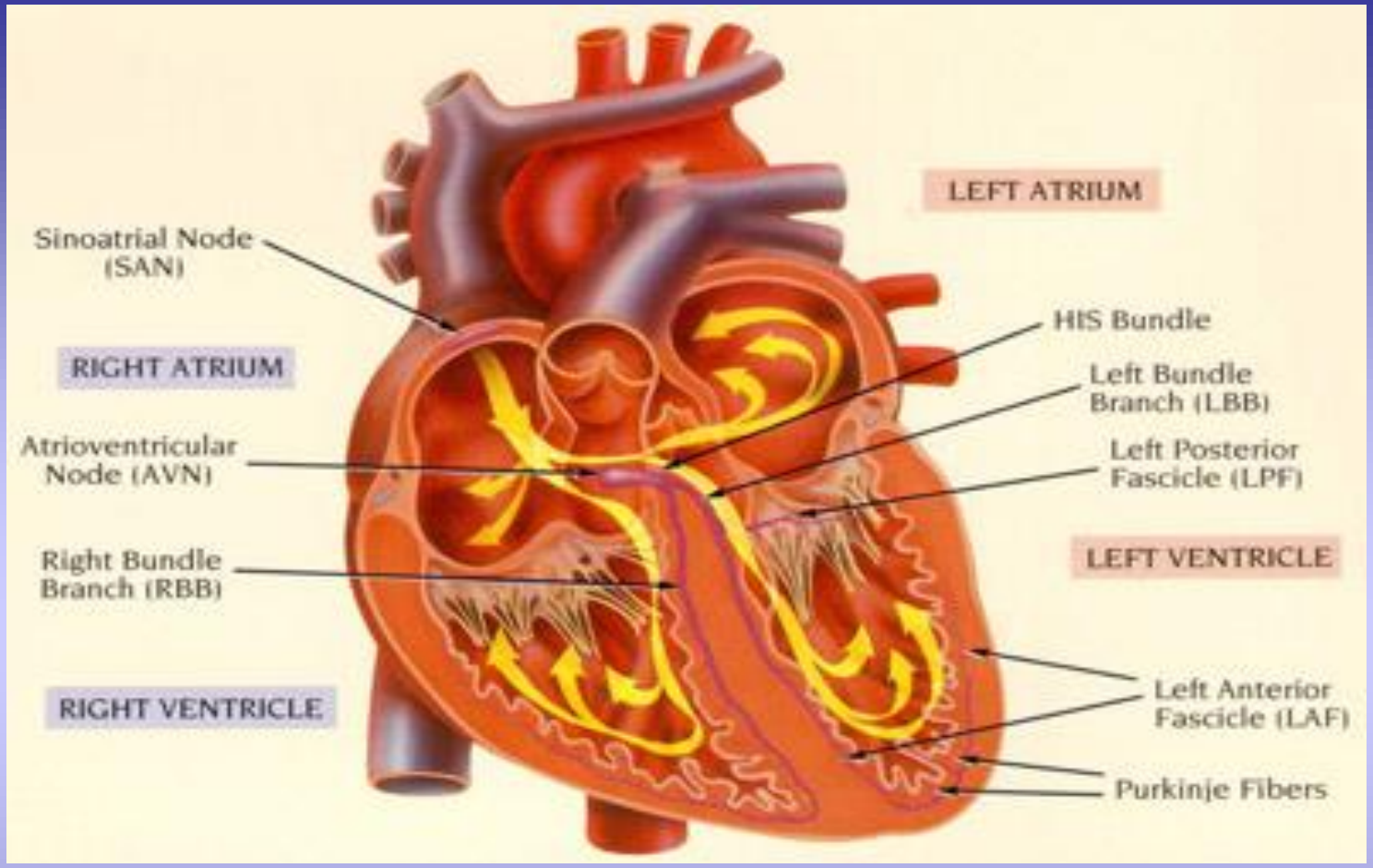
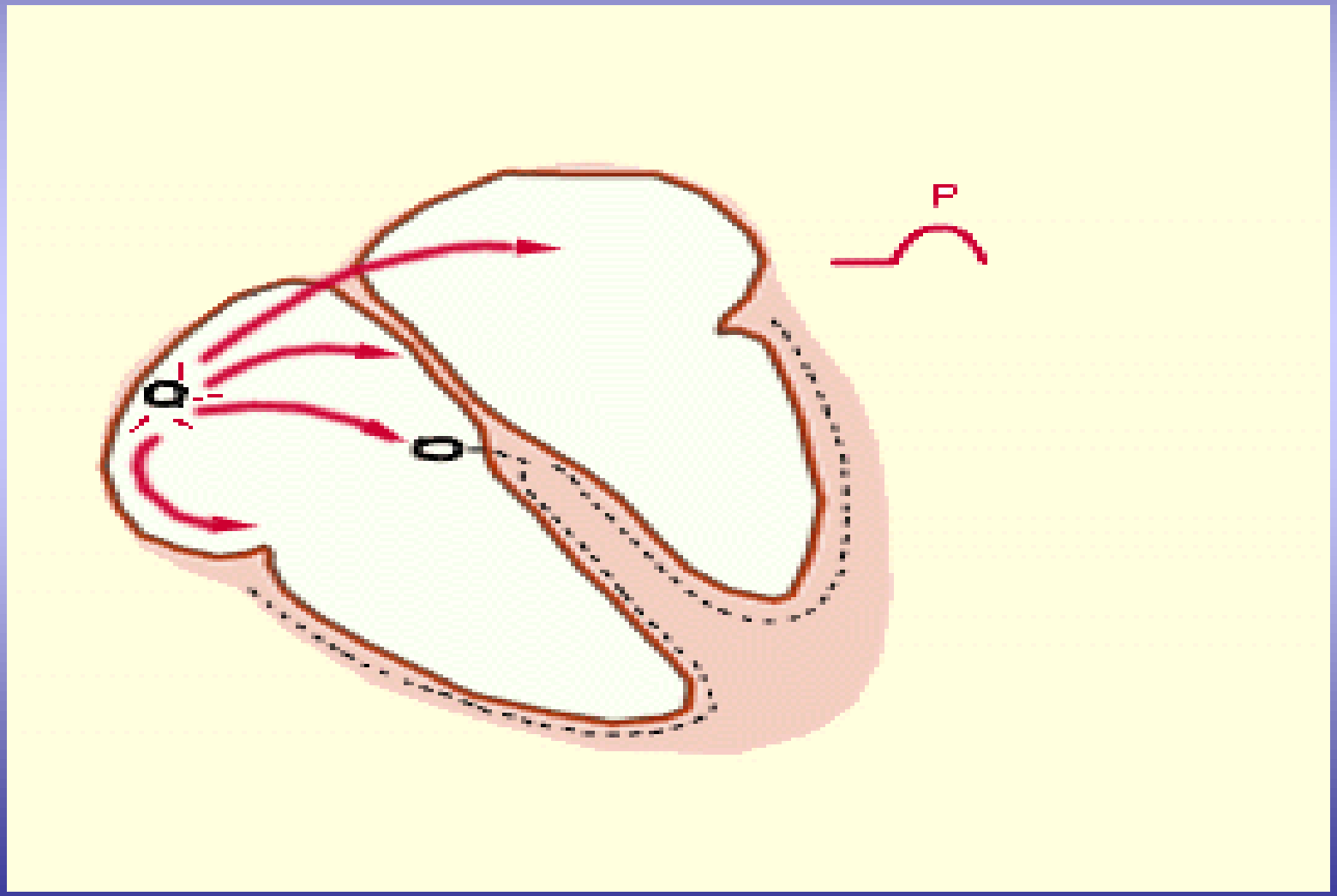


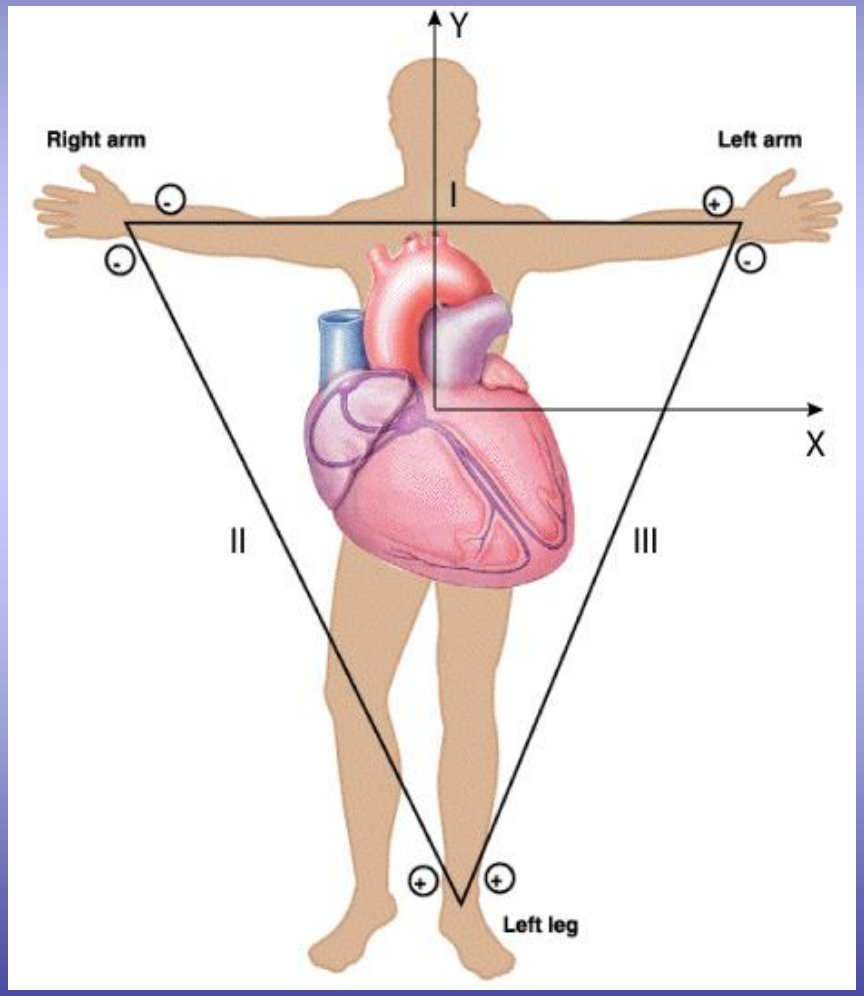
60 bpm,
3600 bph,
100.000 bpd,
36.000.000 bpy,
2.520.000.000 bpl

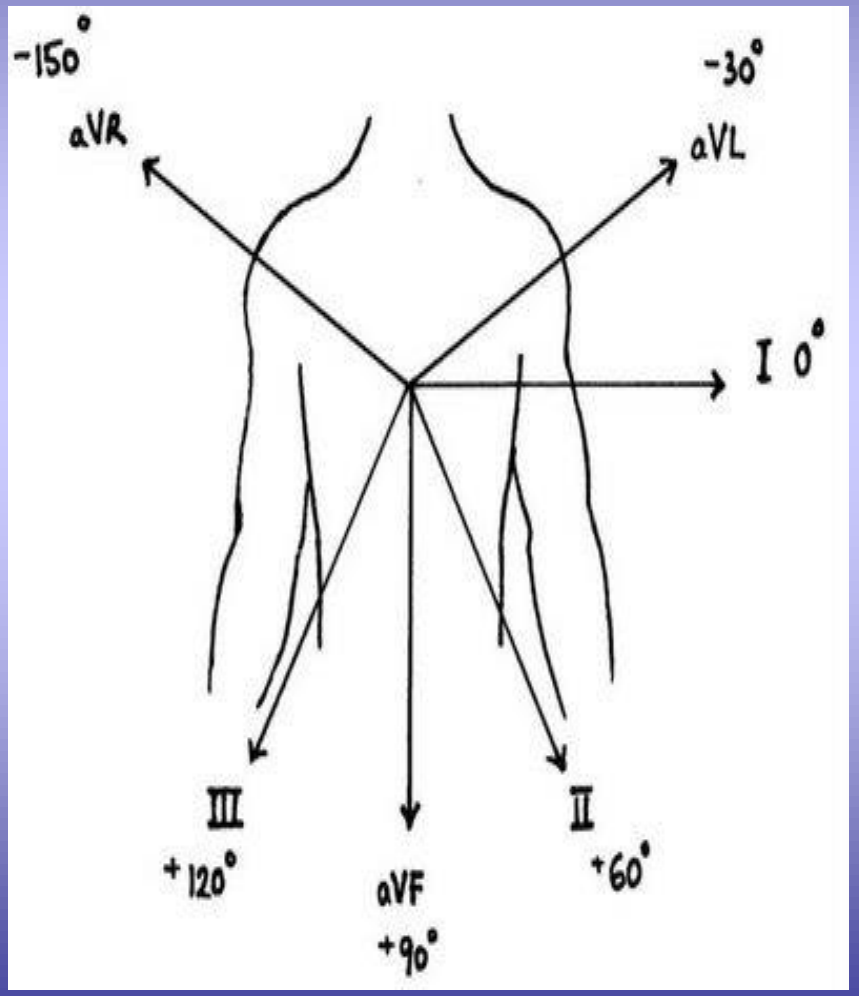
ECG – sinus rhythm

ECG (Willem Einthoven 1893)

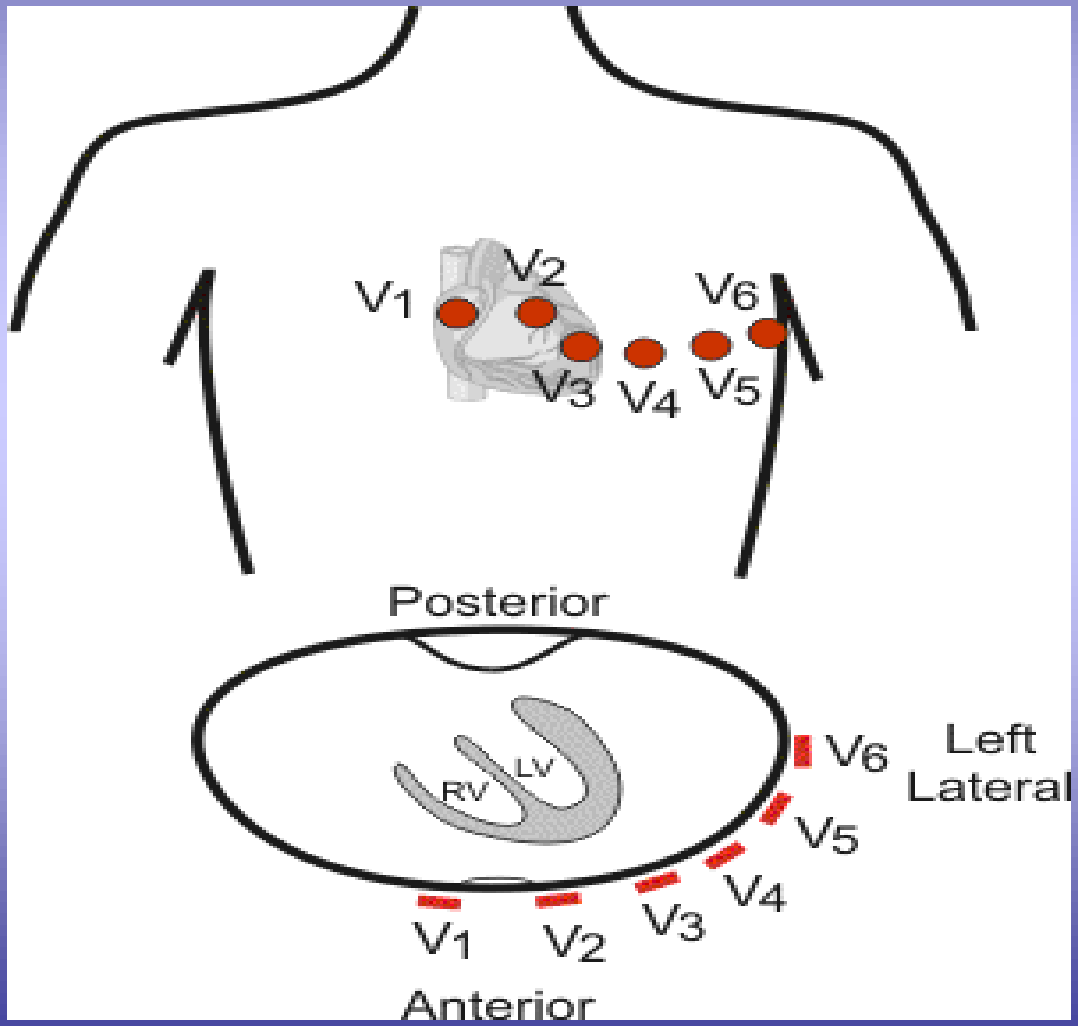


ECG – limb leads

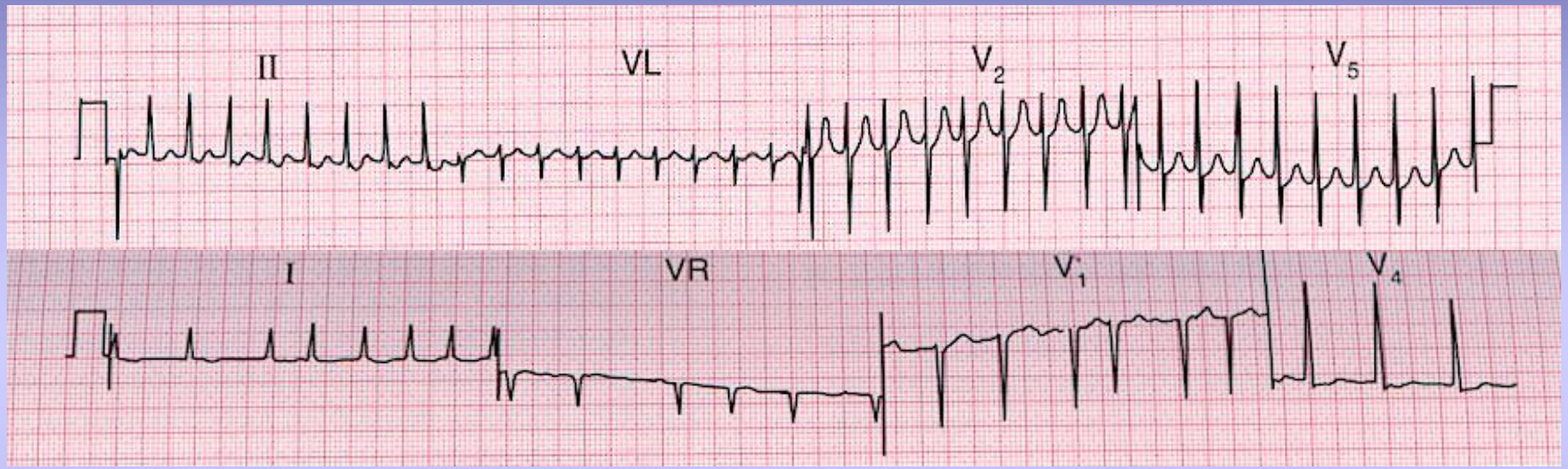




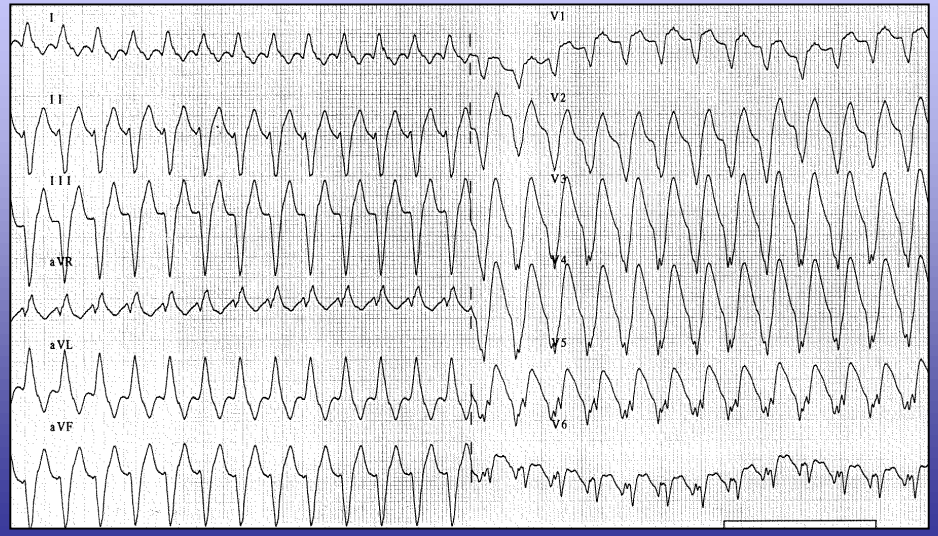
ECG- precordial leads



ECG


II
VL
V2
V5
I
VR
V1
V4

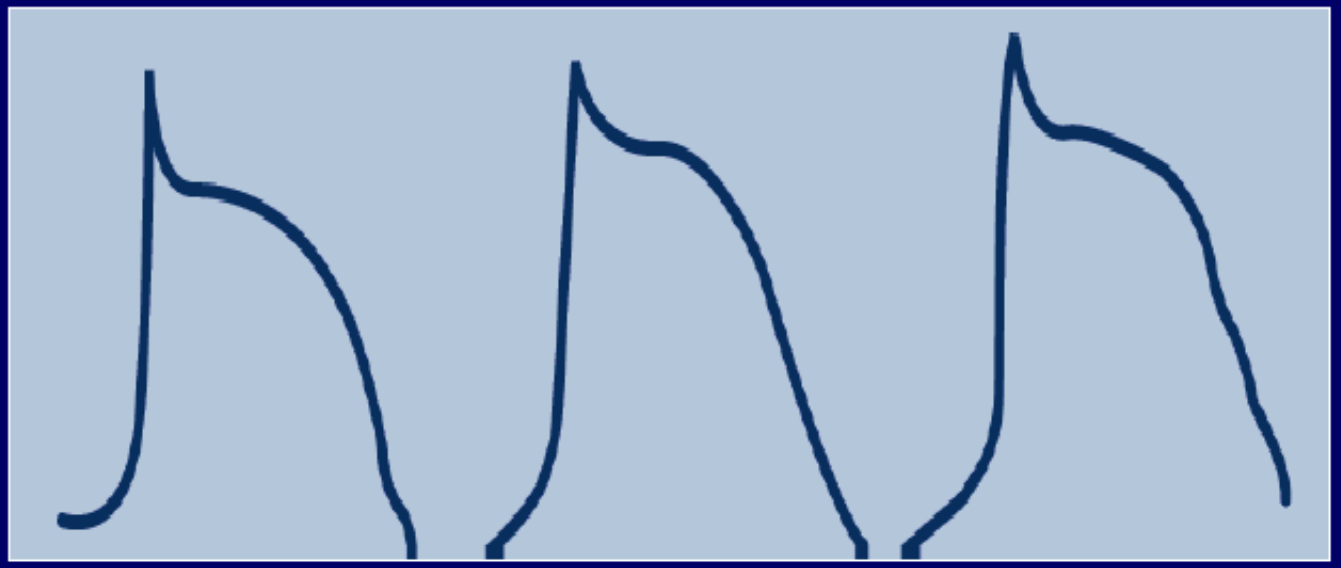

I
II
III
aVR
aVL
aVF
V1
V2
V3
V4
V5
V6


I
II
III
aVR
aVL
aVF
V1
V2
V3
V4
V5
V6

Arrhythmia development

- AUTOMATICITY
- TRIGGERED ACTIVITY
- REENTRY

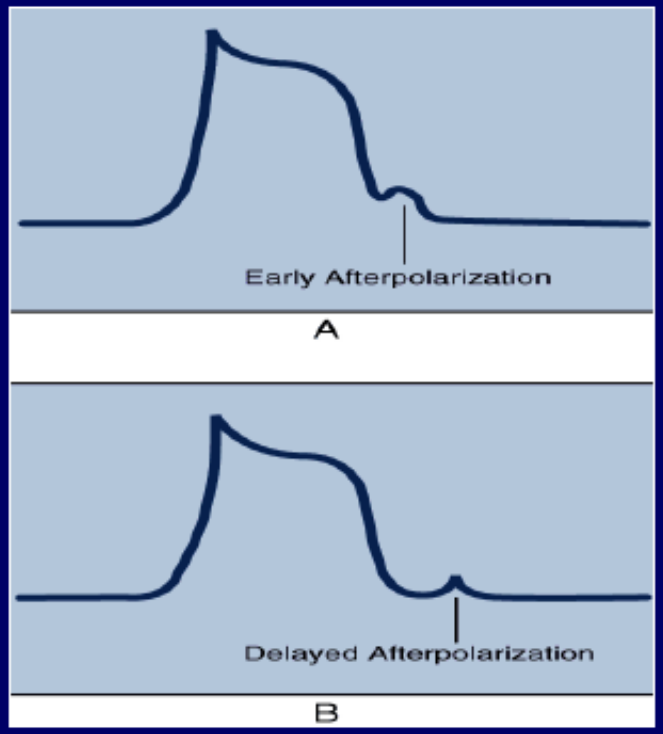
Automaticity



Abnormal Acceleration of Phase 4

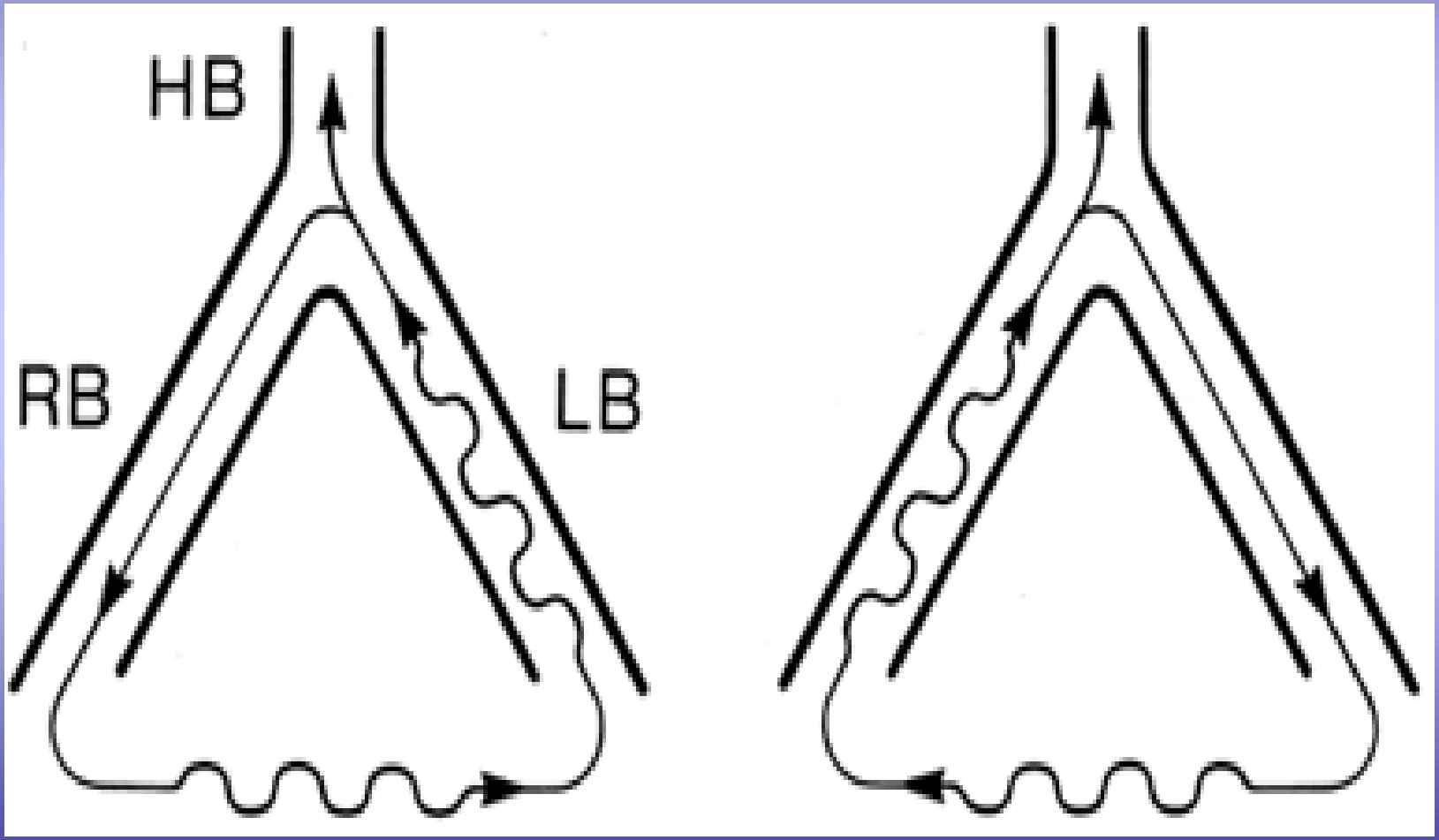
Fogoros: Electrophysiologic Testing. 3rd ed. Blackwell Scientific 1999; 16.

Triggered



Fogoros: Electrophysiologic Testing. 3rd ed. Blackwell Scientific 1999; 158.

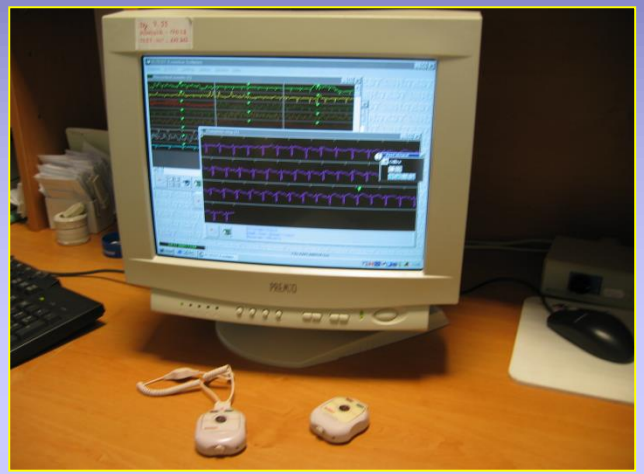
Basic principle of reentry

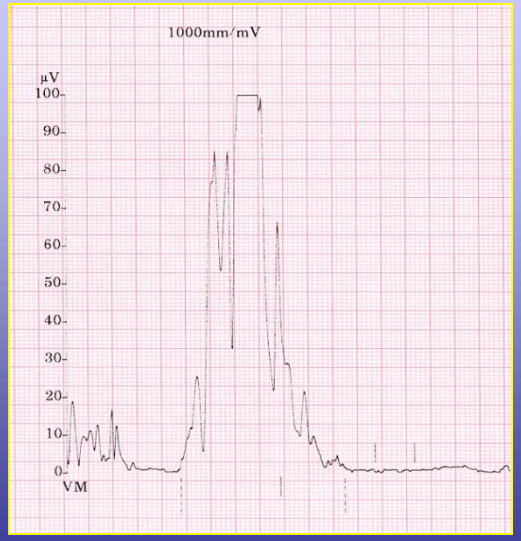


Noninvasive assessment of arrhythmias

- History
- ECG
- Holter monitoring
- Long FU ECG recorders (R – test. Rhythm card)
- ILR - REVEAL

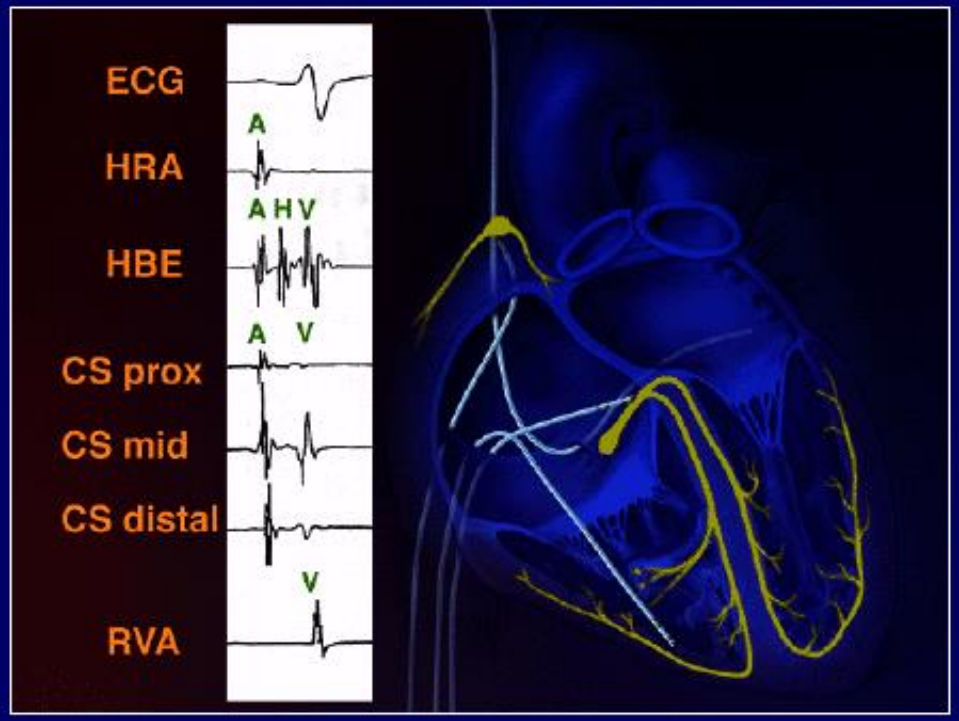
Noninvasive arrhythmia assessment





Invasive assessment of arrhythmias

Catheter Placement



ICEG

Treatment

- Medication
- Radiofrequency ablation
- Pacemaker
- Implantable Cardioverter Defibrillator

Tachyarrhythmias

- **SV - arrhythmias**

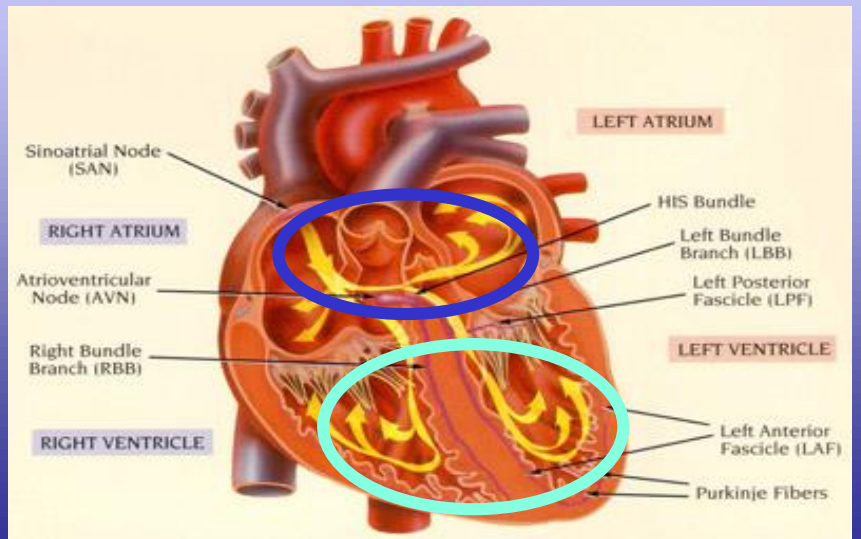
  A Fib., A Flu., Atr. Tach, AVNRT, AVRT

- **Ventricular arrhythmias**

  Ventricular tachycardia (120-230/min)

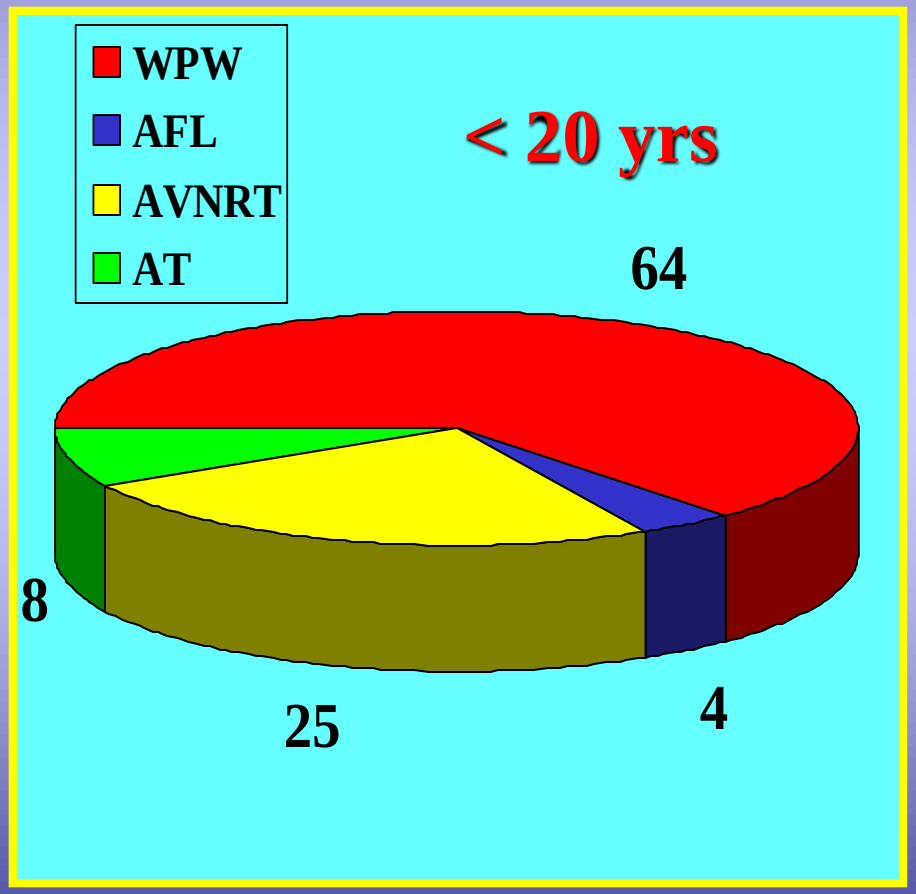
  Fast ventricular tachycardia (>230/min)

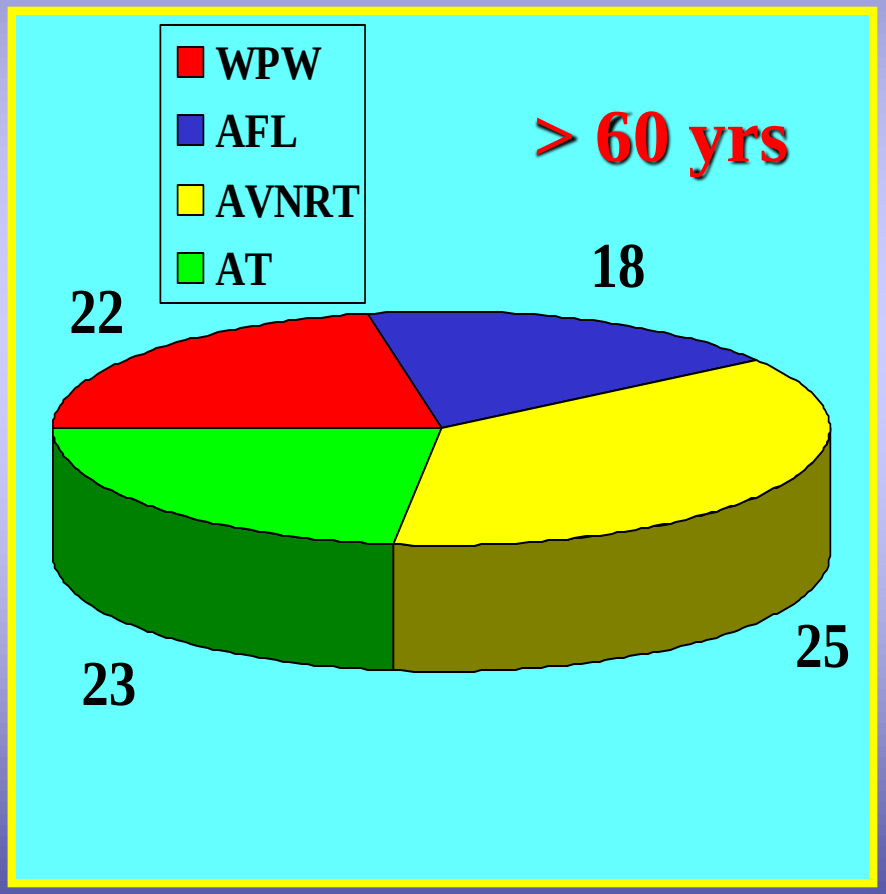
  Ventricular fibrillation



Supraventricular arrhythmias

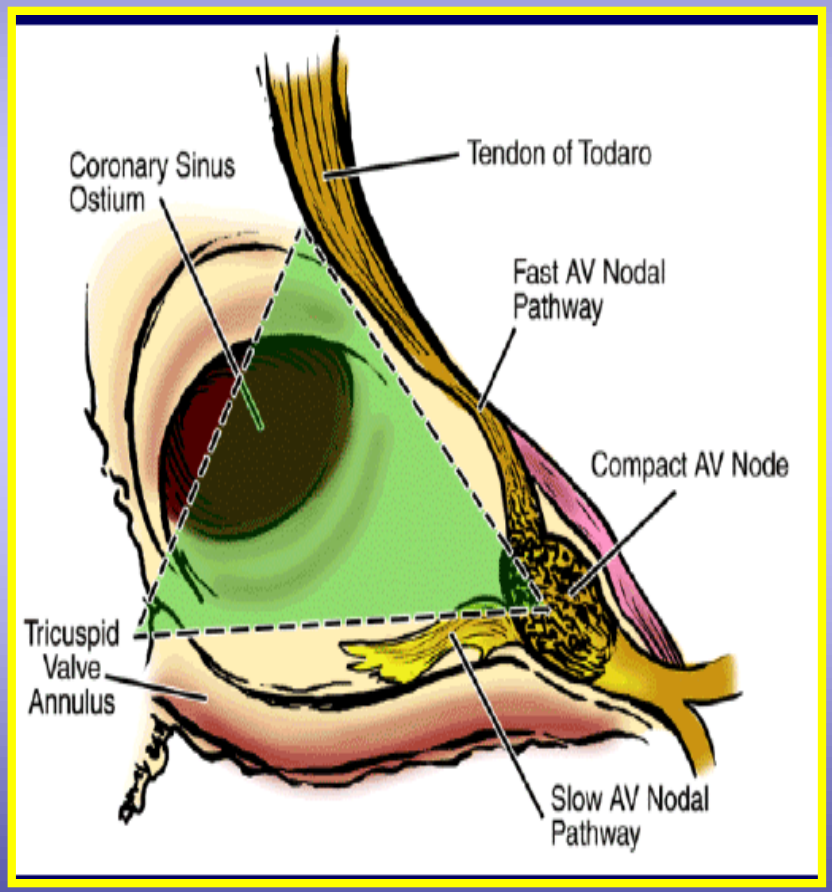
Occurrence depends on the age and cardiac disease





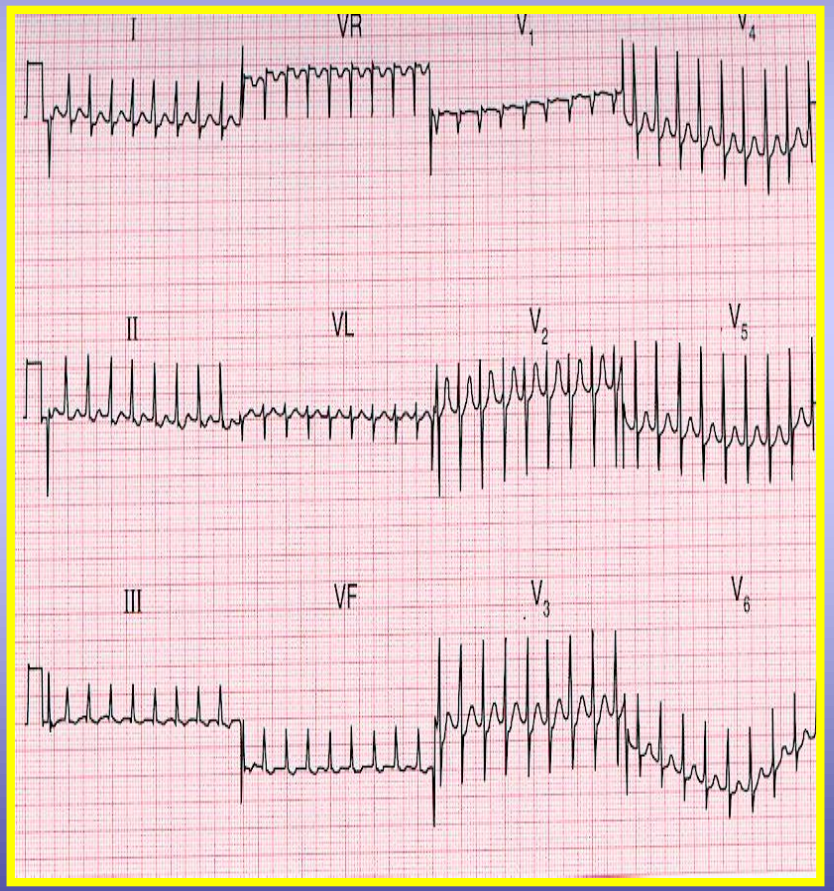
AVNRT

- History - childhood
- Abrupt start/stop
- F 120-220/min
- Vagal manouevres
- Female
- Frog sign



AVNRT

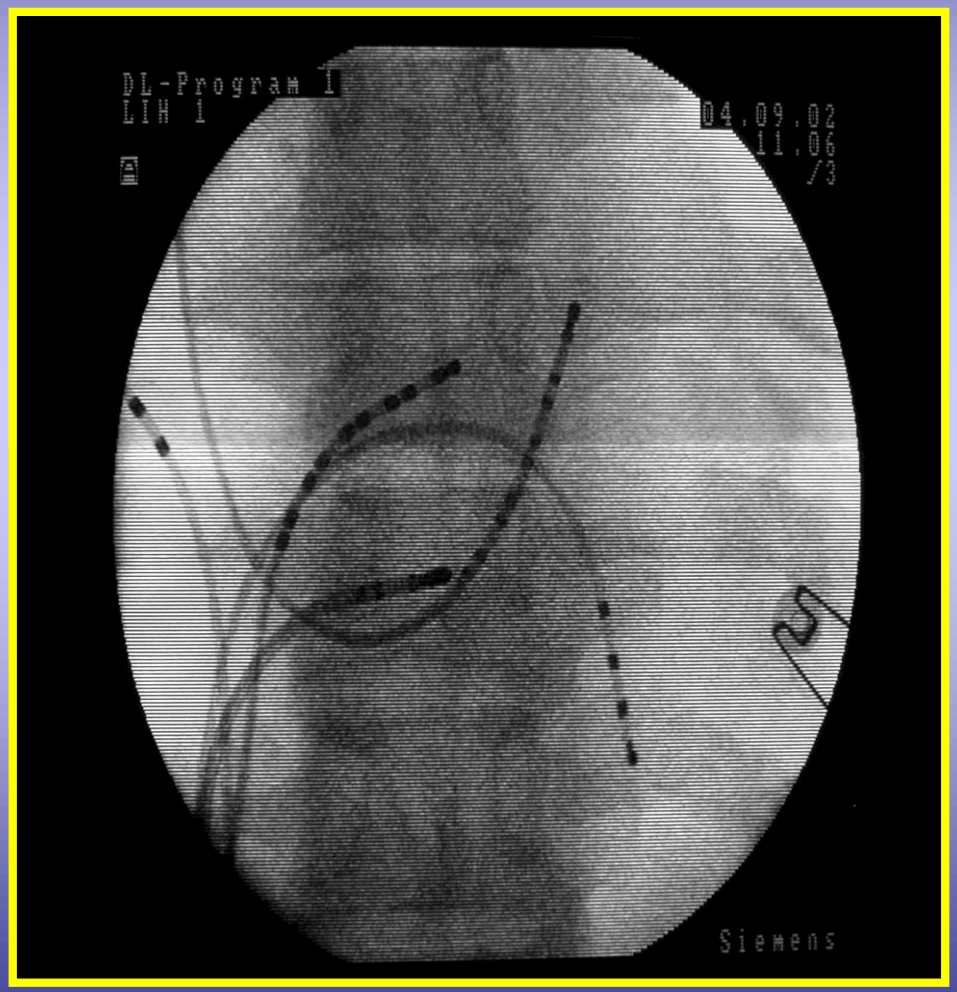
- Vagal man.
- Adenosin - 12-24mg i.v.
- Verapamil - 5-10mg i.v.
- Metoprolol - 5mg i.v.
- RFA of slow pathway
- Verapamil
- BB

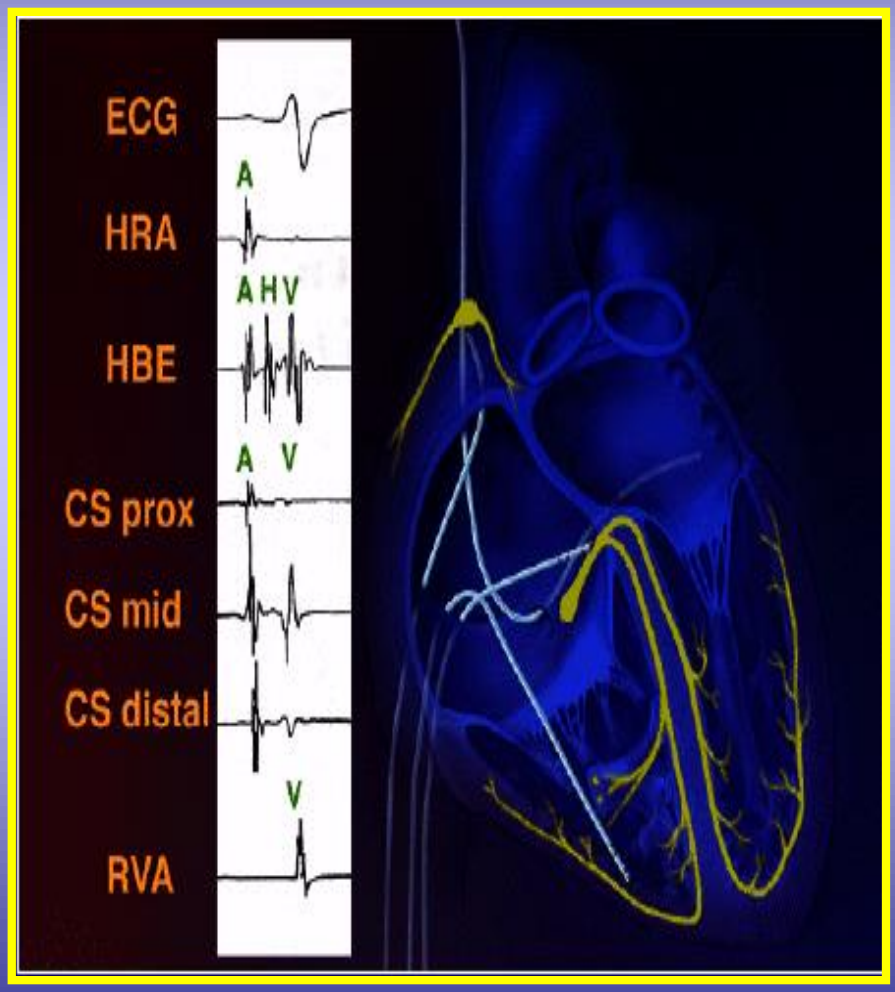


Radiofrequency ablation -RFA

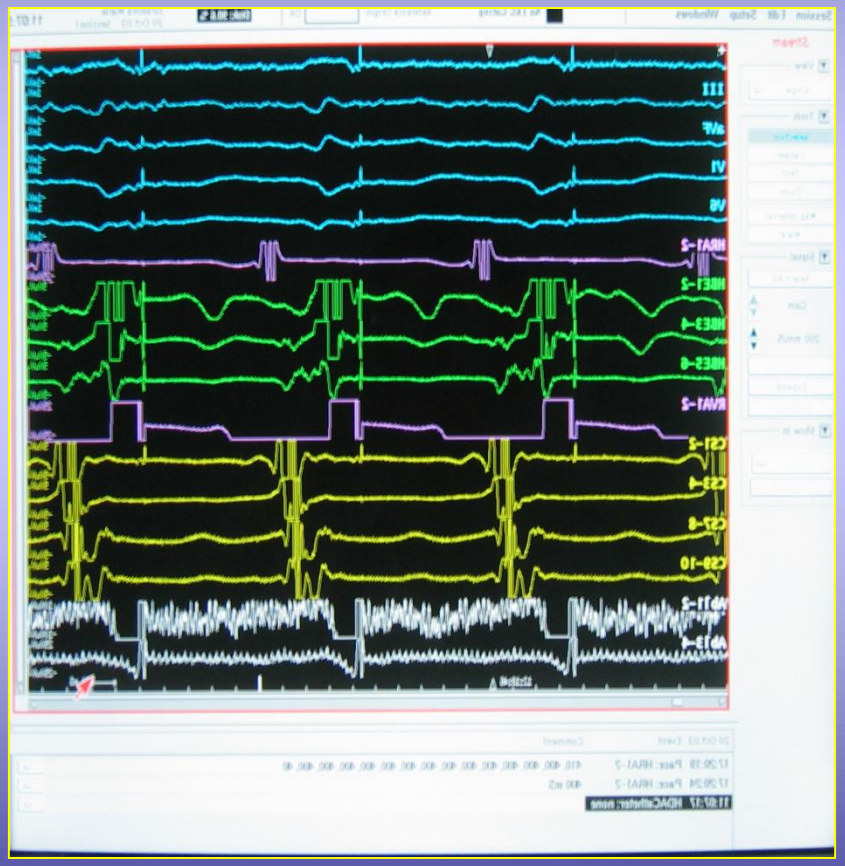
- Special catether creating endocardial tissue heating causing local necrosis and damage of contact place.
- Conatct place - arrhythmic focus, accessory pathway, arrhythmogenic substrate

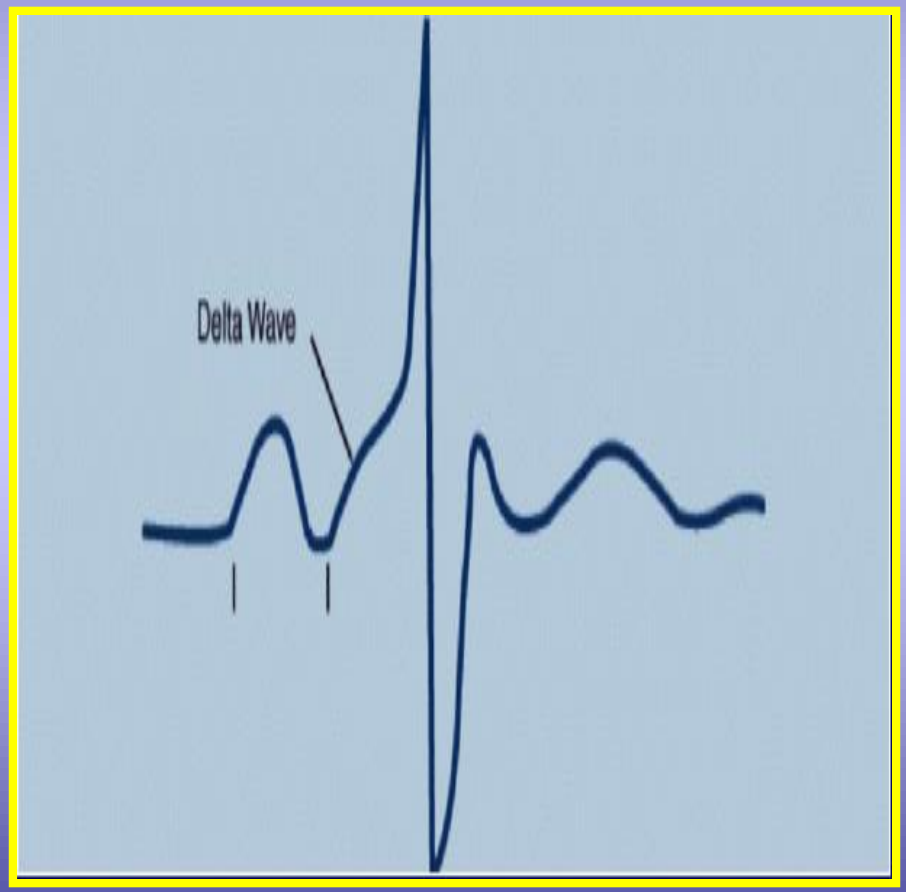
Cathether placement during AVNRT RFA



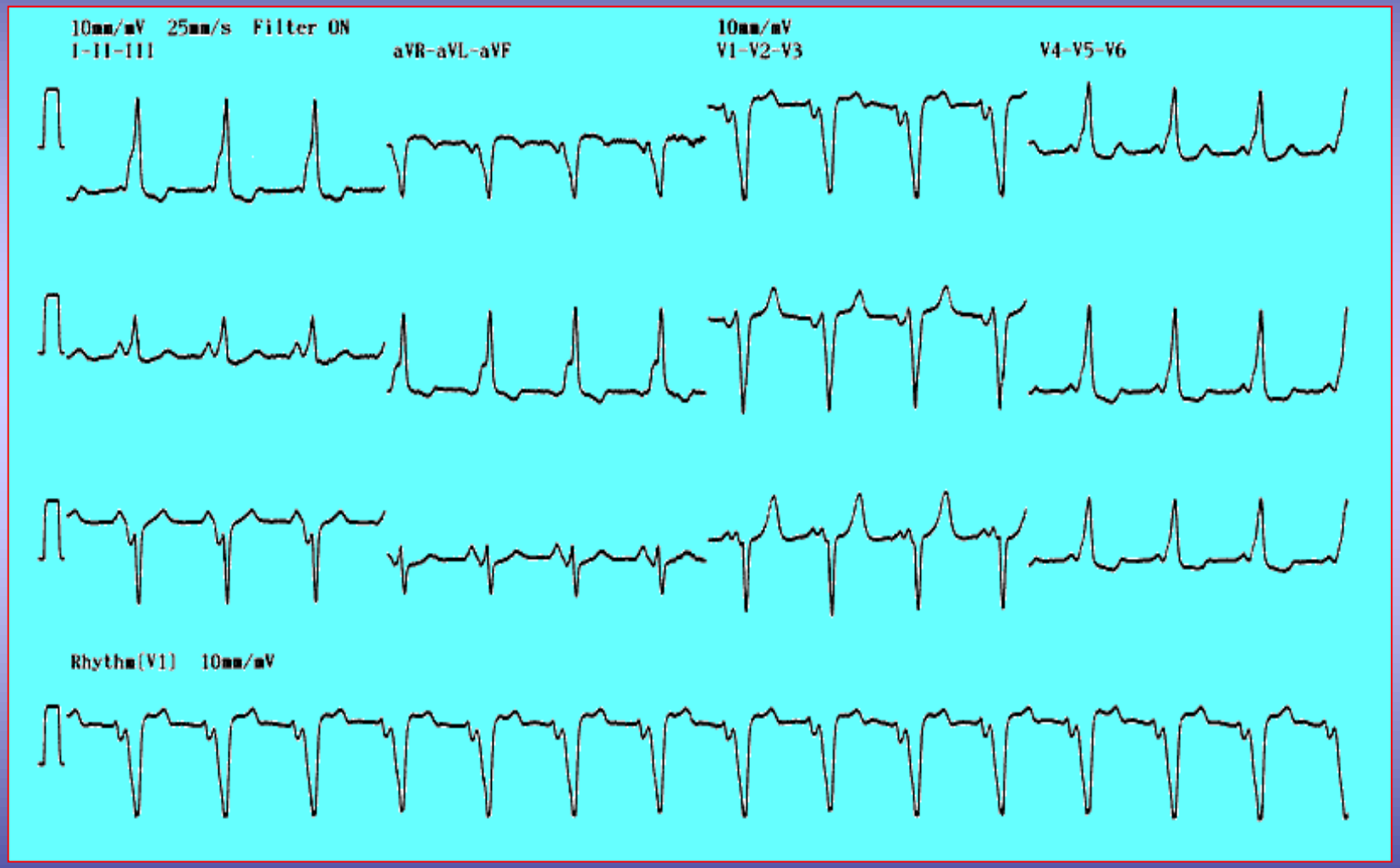


AVRT



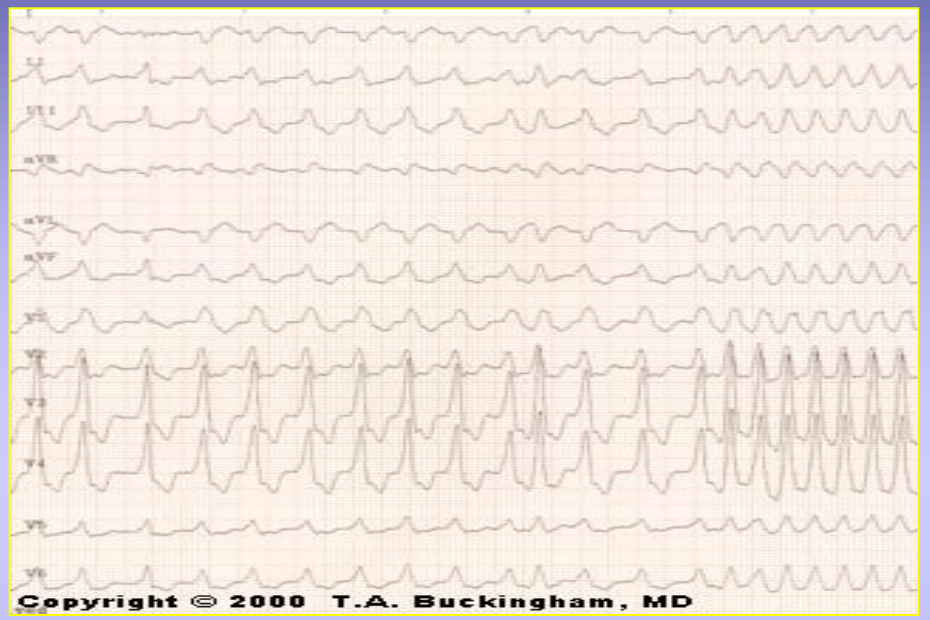


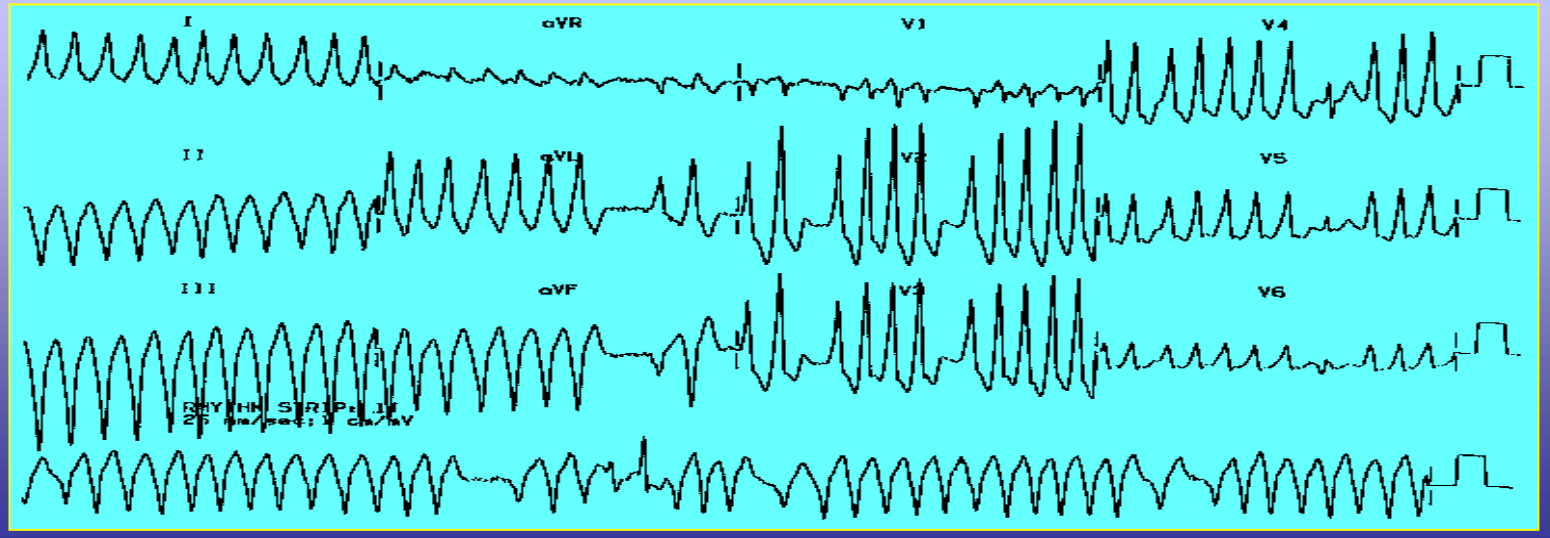
Delta wave in WPW syndrom



Preexcitation with risk of SCD

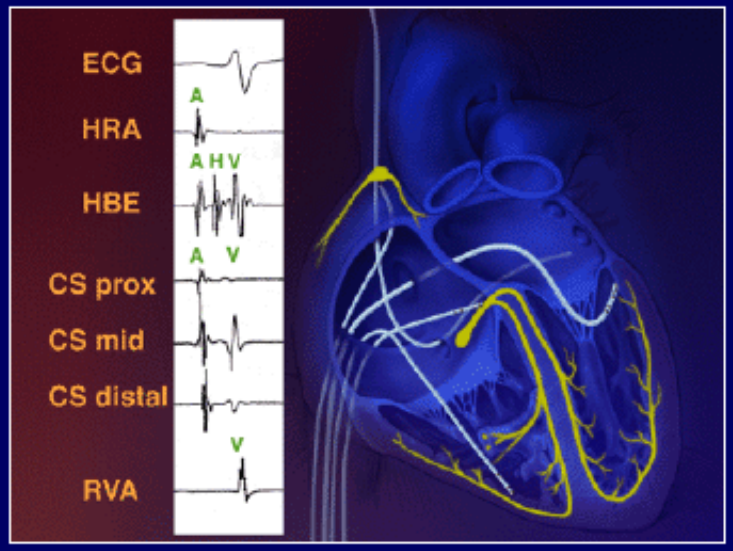
- In patients with AP fast conduction
- During Afl, or AFib



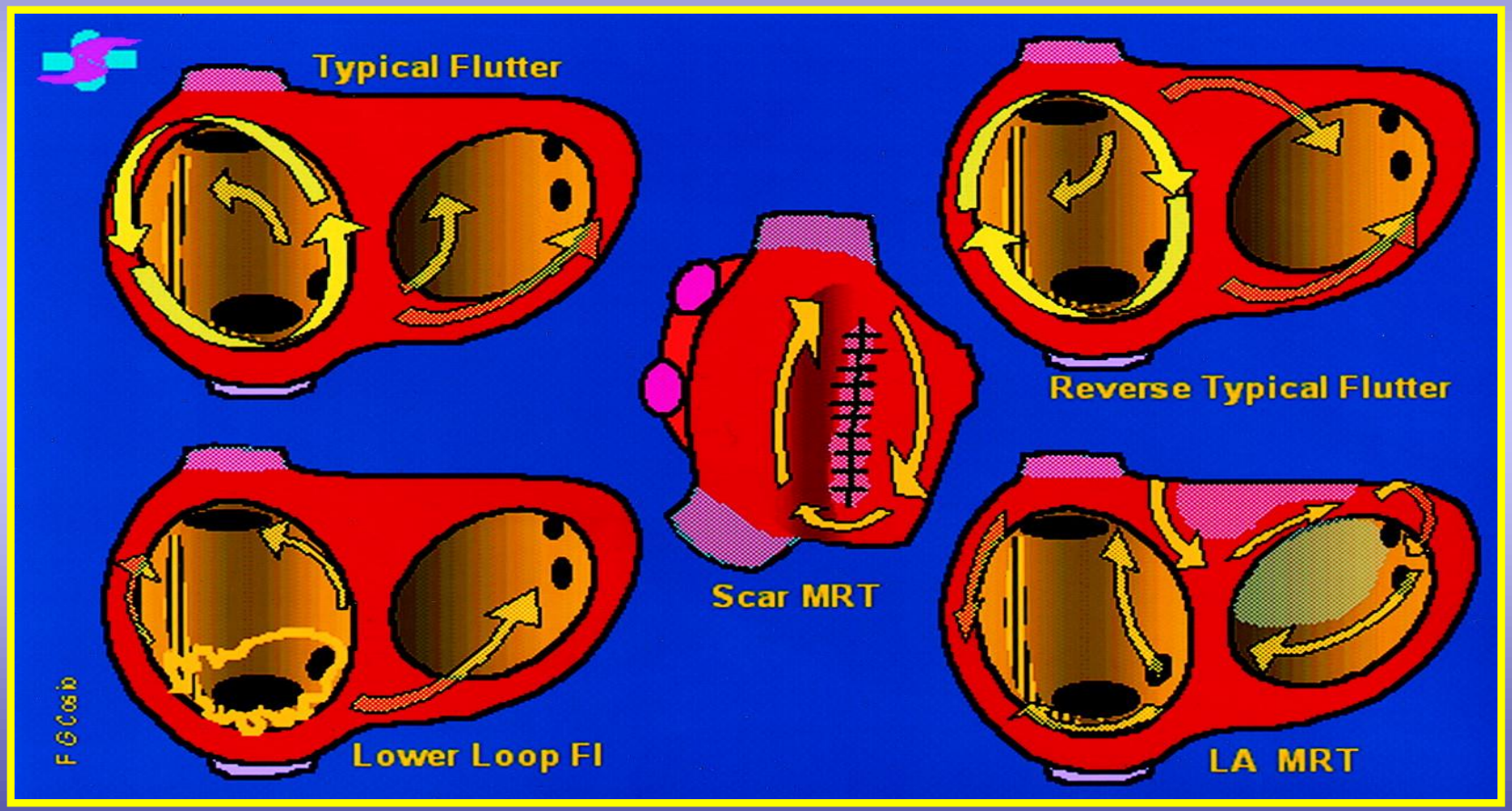


AVRT Left Free Wall

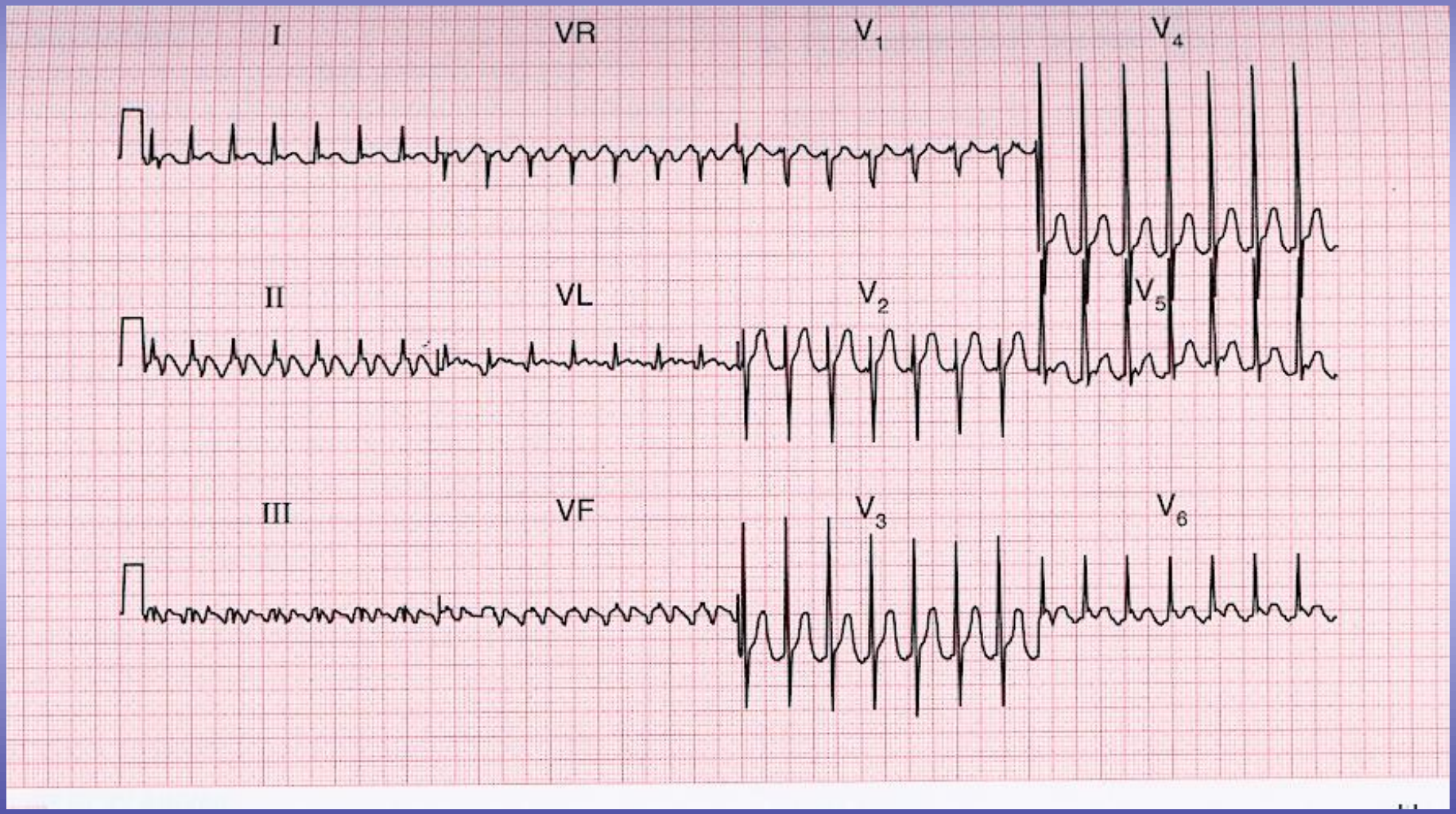
- Transseptal approach to LV
- Catheter positioned along rim of mitral annulus



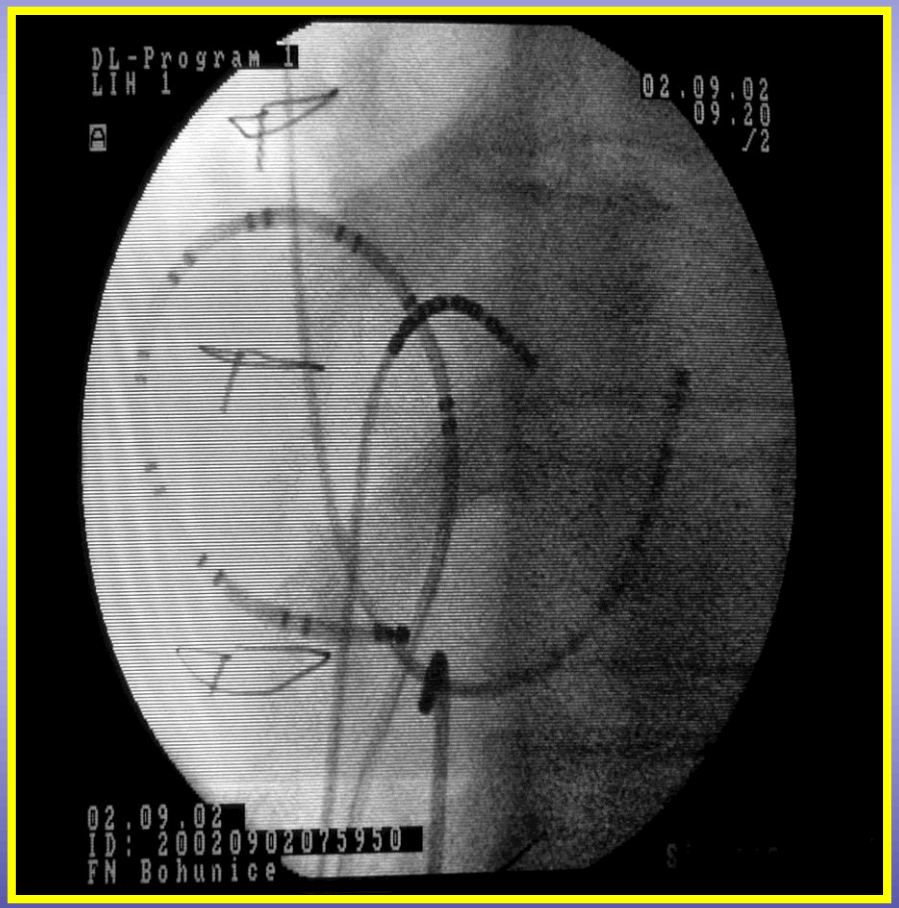
Atrial flutter

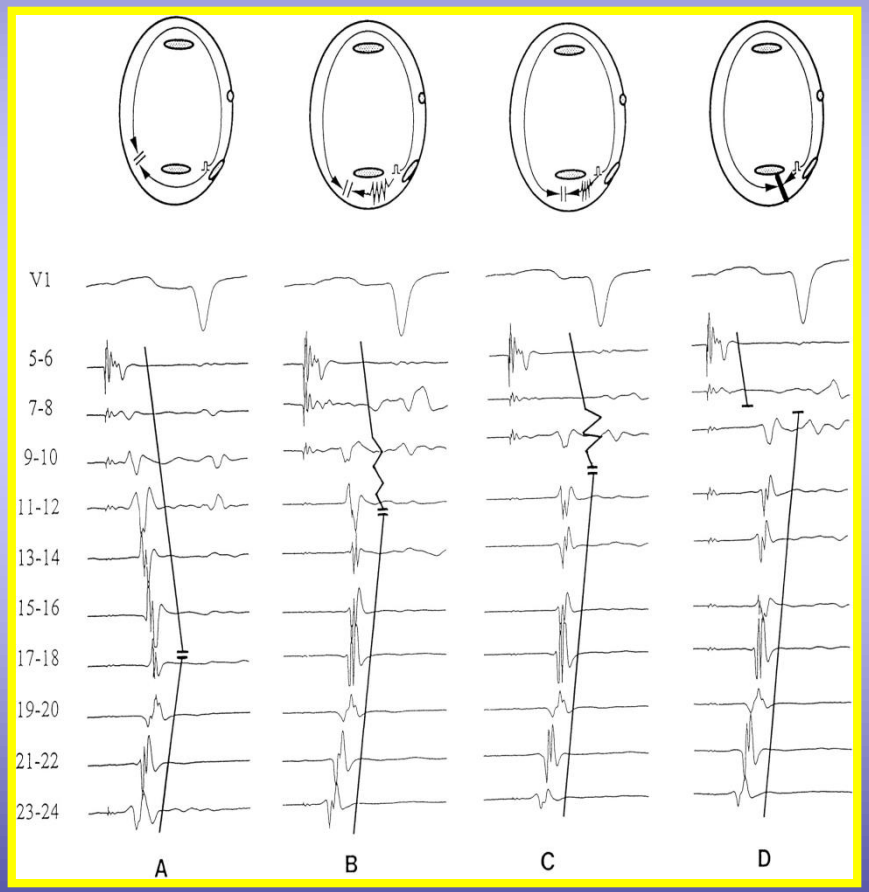


Typical AFL



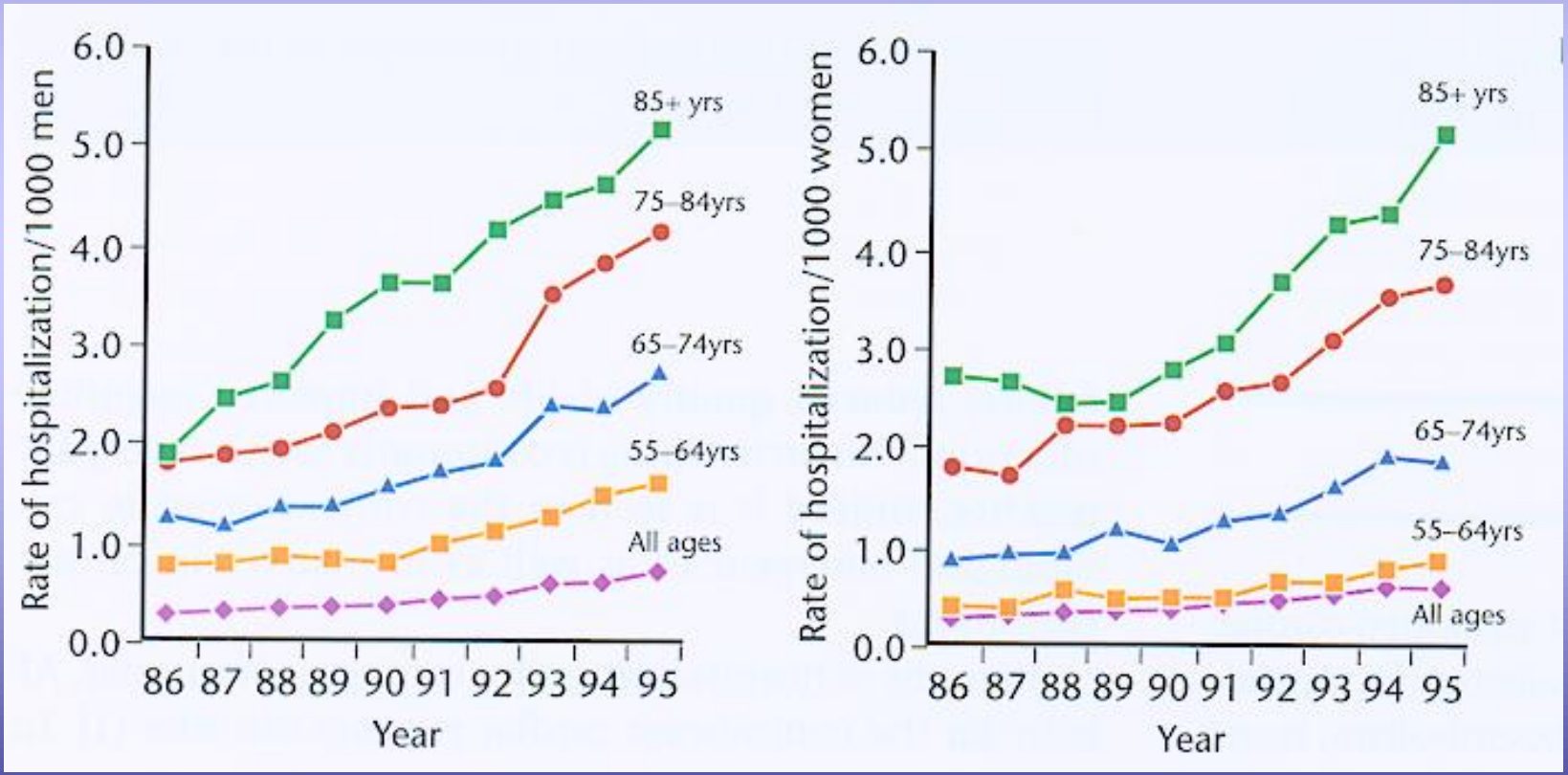
RFA of AFL


DL-Program 1
LIH 1
02.09.02
09.20
/2
02.09.02
ID: 20020902075950
FN Bohunice


V1
5-6
7-8
9-10
11-12
13-14
15-16
17-18
19-20
21-22
23-24
A
B
C
D

Epidemiologie

- **nárůst prevalence FISI z 3,2% (68-70) → 9,1% (87-89)**



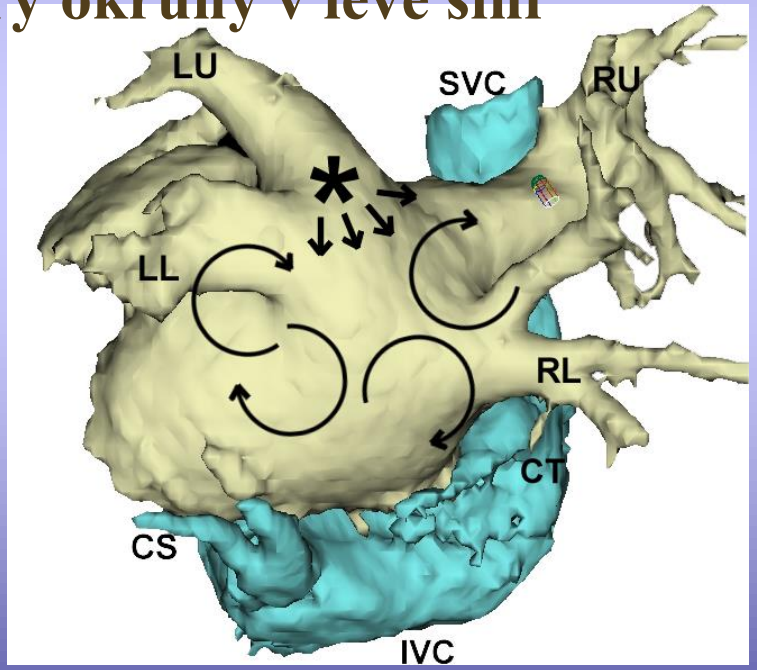
Wolf PA et al. Arch Intern Med 1987;147:1561-1564

Psaty BM et al. Circulation 1997;96:2455-2461

Mechanismus vzniku a trvání FISI

Spouštění - ektopická aktivita z plicních žil

Udržování - reentry okruhy v levé síni



Anatomické struktury

Levá síň

Plicní žíly

Koronární sinus

Marshallovo ligamentum

Pravá síň

Mechanismy

Ektopická aktivita

Rotory

Makroreentry

ANS

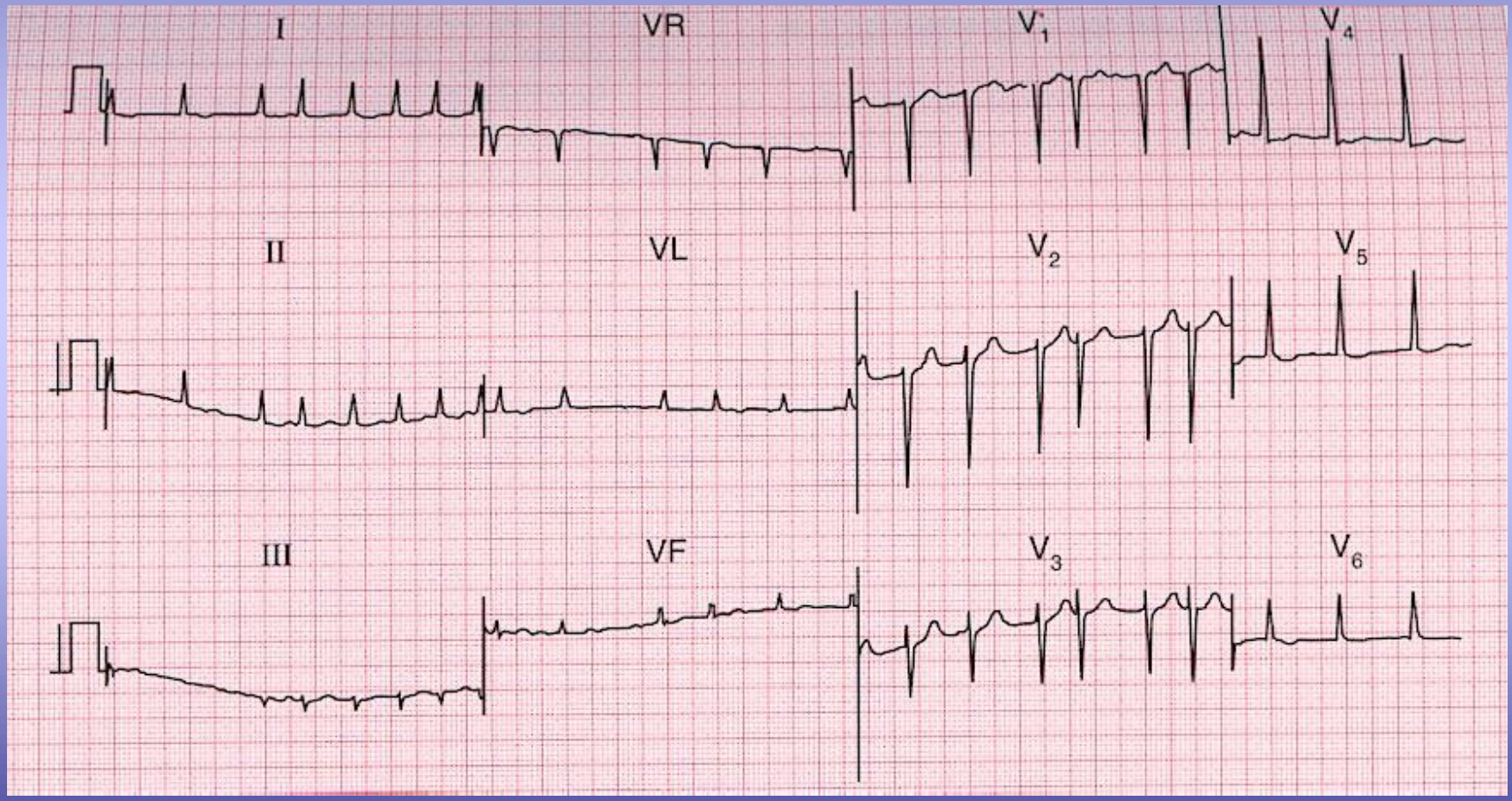
AF

- **Population - 0,95%**
- **Patients > 80 - 9,0%**
- **Remodellation: electric**

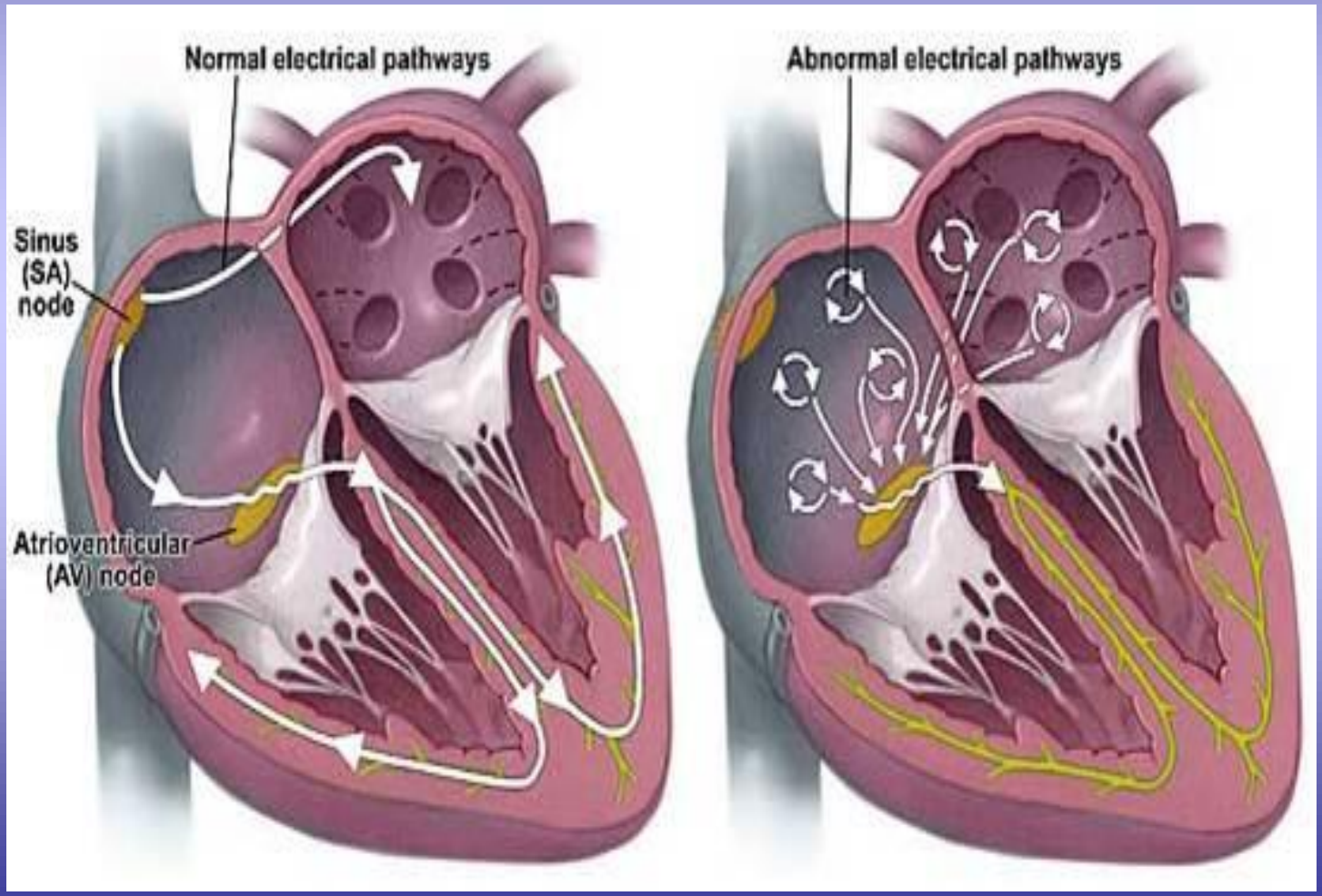
  contractile

  structural
- **2 x higher mortality in AF x S.R.**

Atrial fibrillation

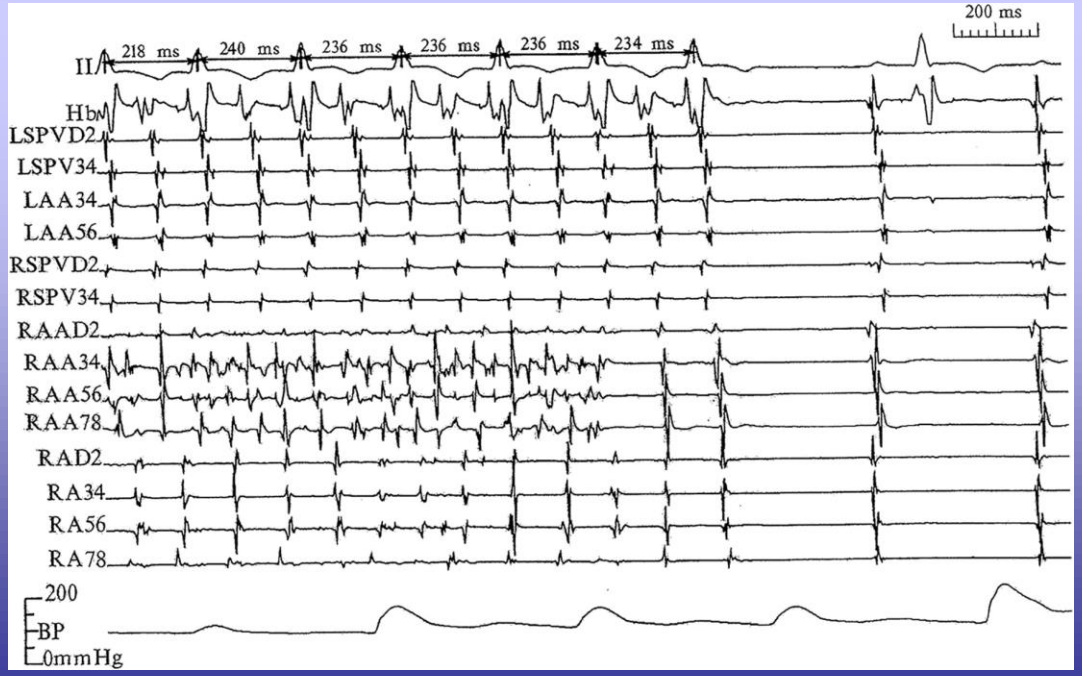


Atrial fibrilation



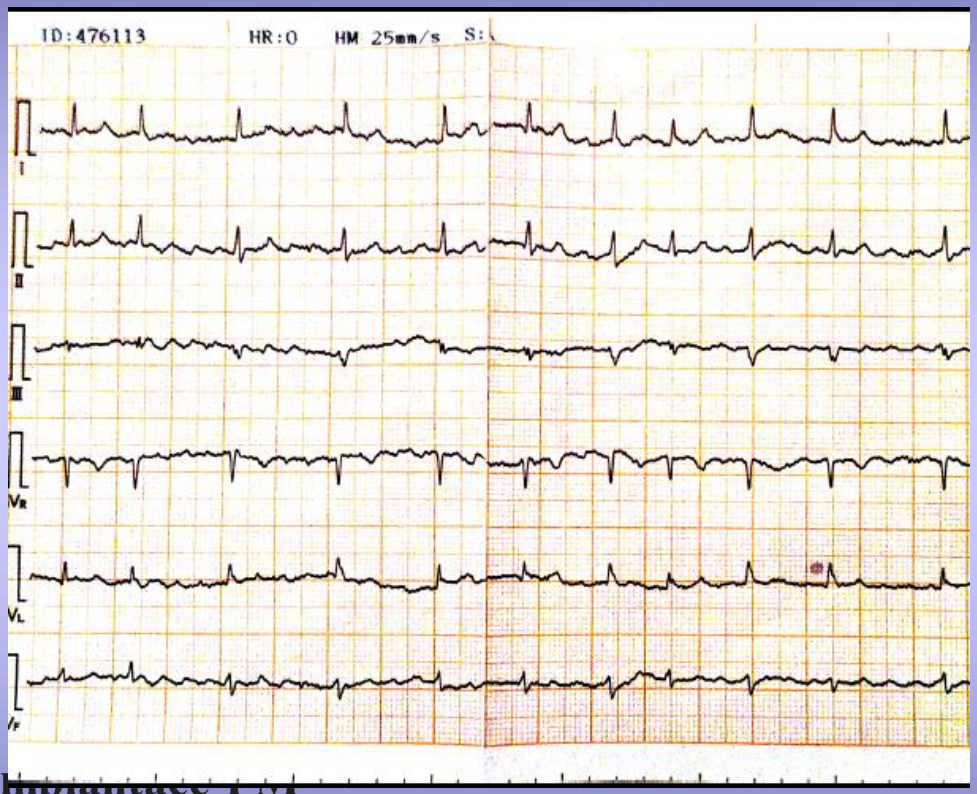
Indikace k RFA FISI

- paroxysmální formy
- symptomatické formy
- mladší pacienti (< 65 let)
- nepřítomnost organického onemocnění srdce
- selhání ≥ AA I / III třídy



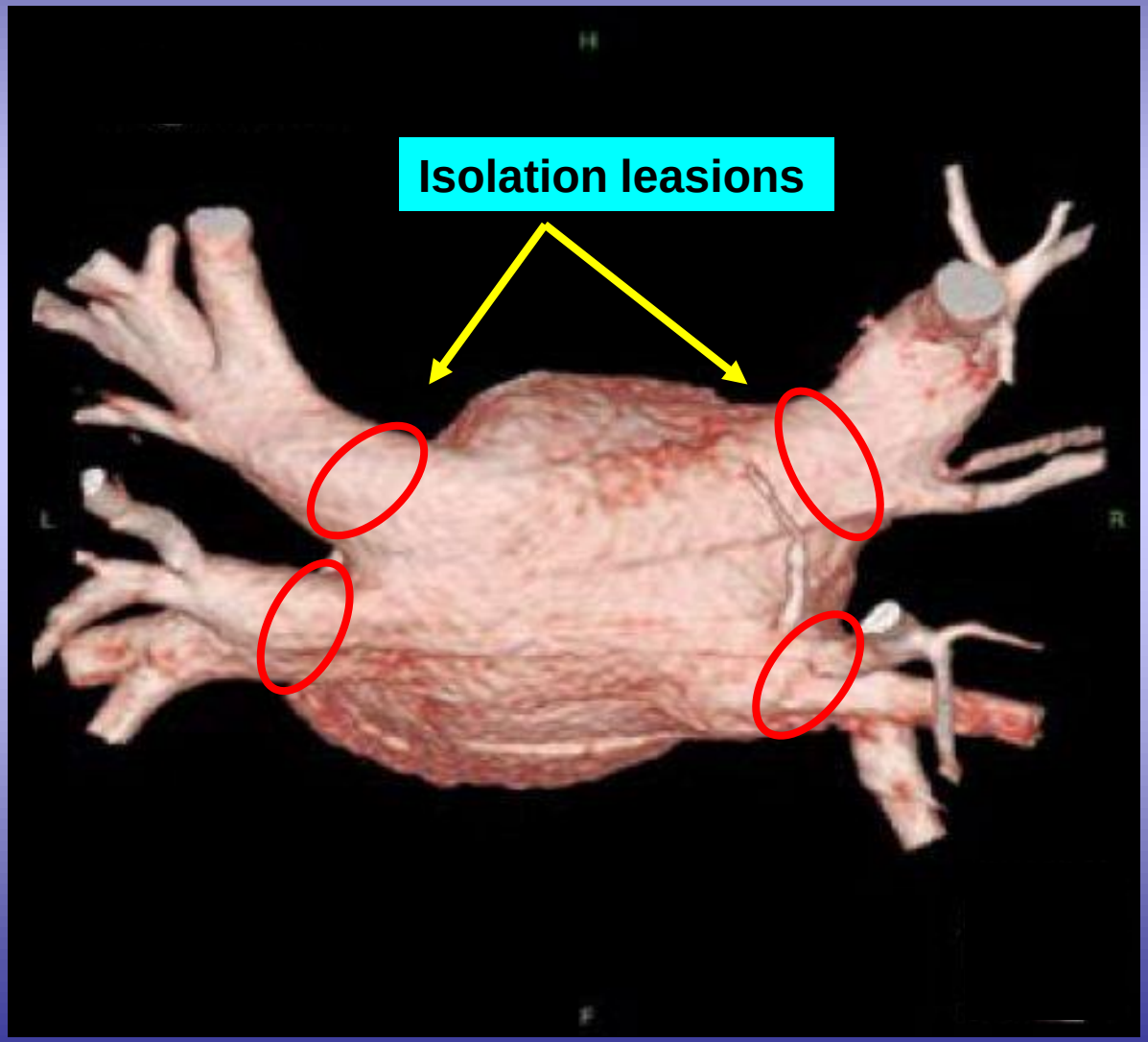
Kontrola frekvence při permanentní FISI

- **Digoxin**
- **Betablokátory**
- **CAA**
- **Propafenon**
- **Sotalol**
- **Amiodaron**
- **Dronedaron?!**

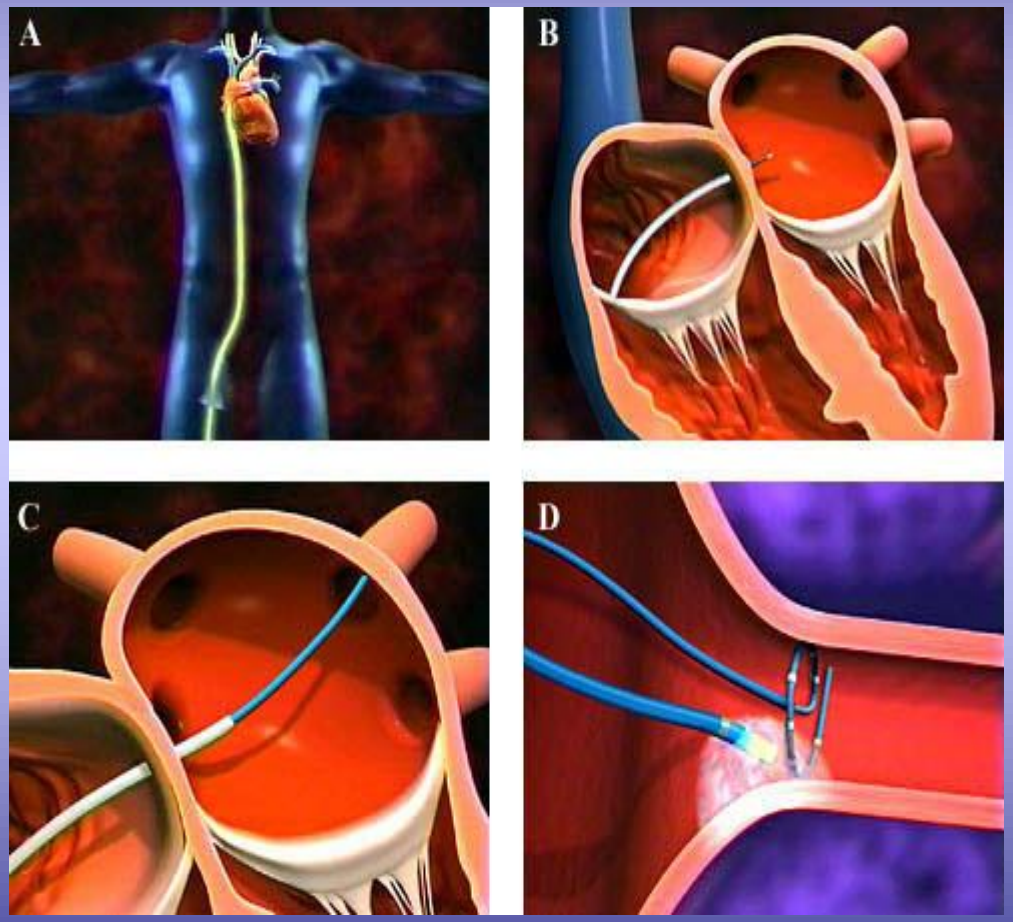


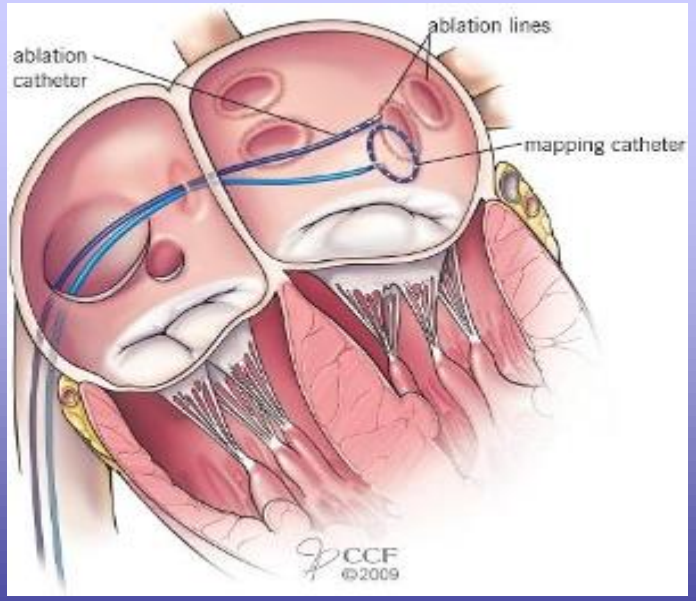
- **Neselektivní ablace AV uzlu + implantace PM**

MRI image of LA with PW

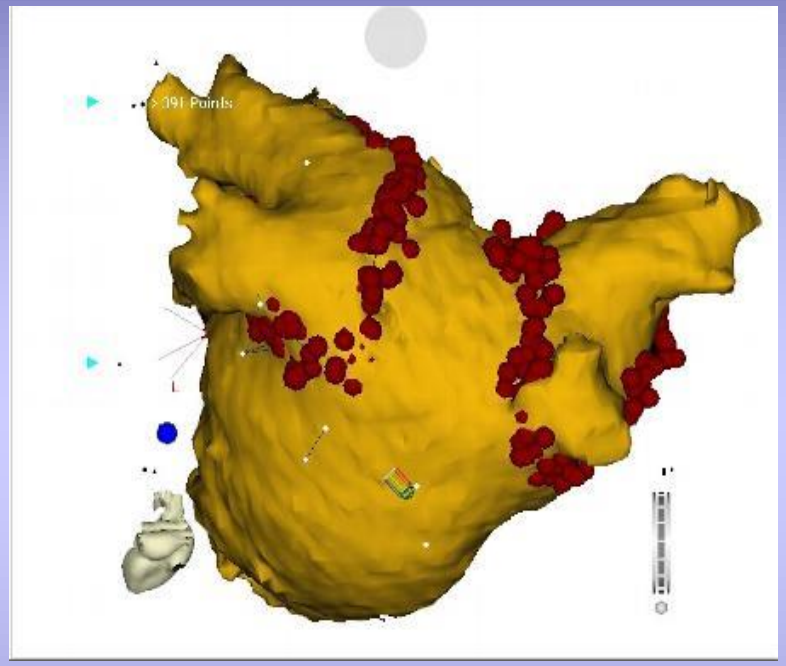


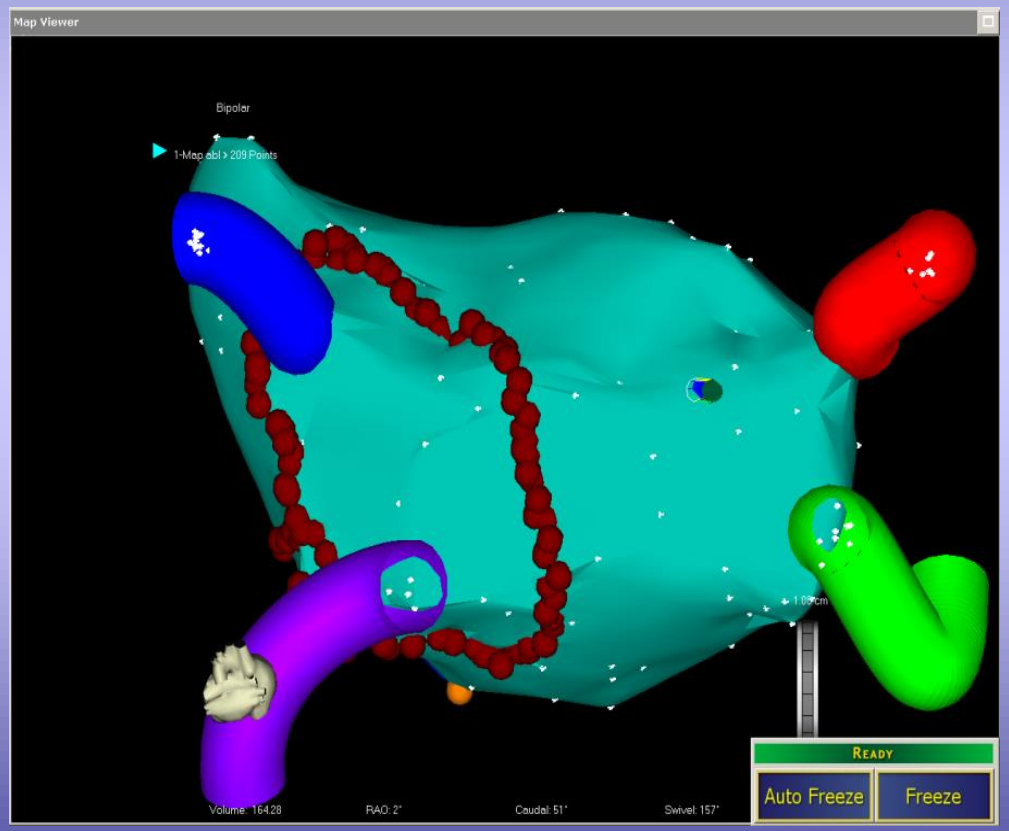
RFA x Cryoablation



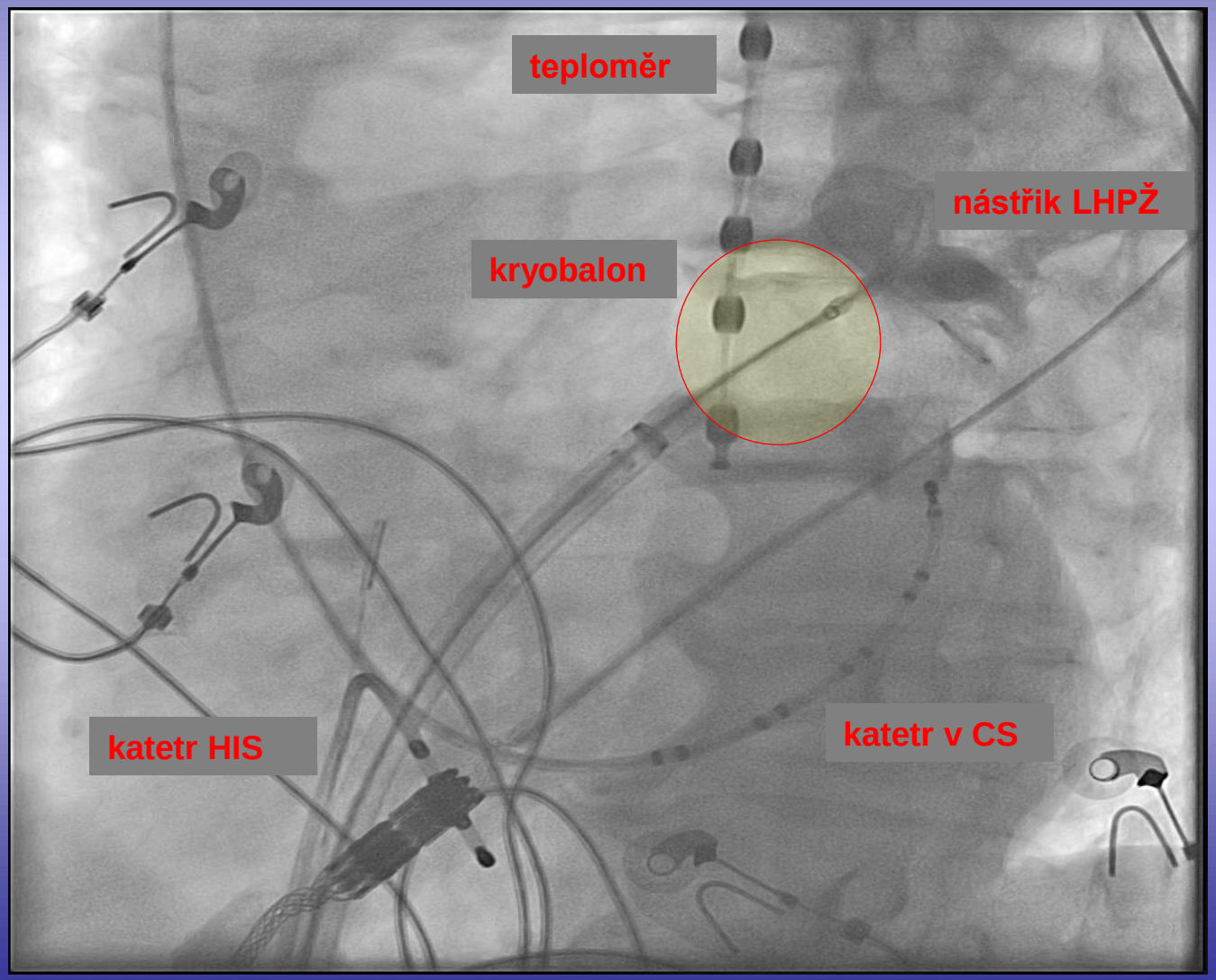


3D mapping

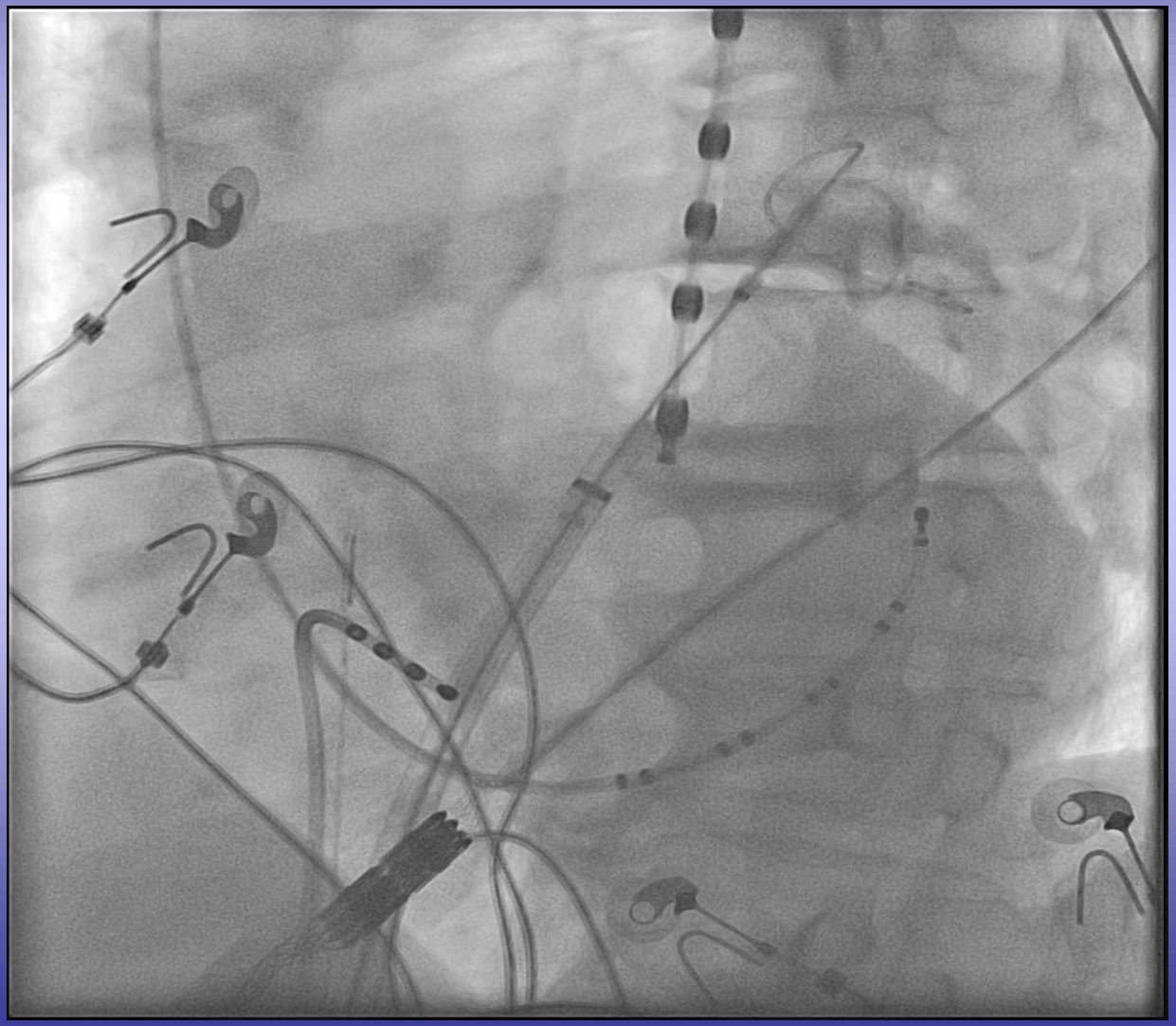

191 Points


Map Viewer
Bipolar
1-Map abl > 209 Points
Volume: 164.28
RAO: 2°
Caudal: 51°
Swivel: 157°
READY
Auto Freeze
Freeze

Rozmístění katetrů v LAO

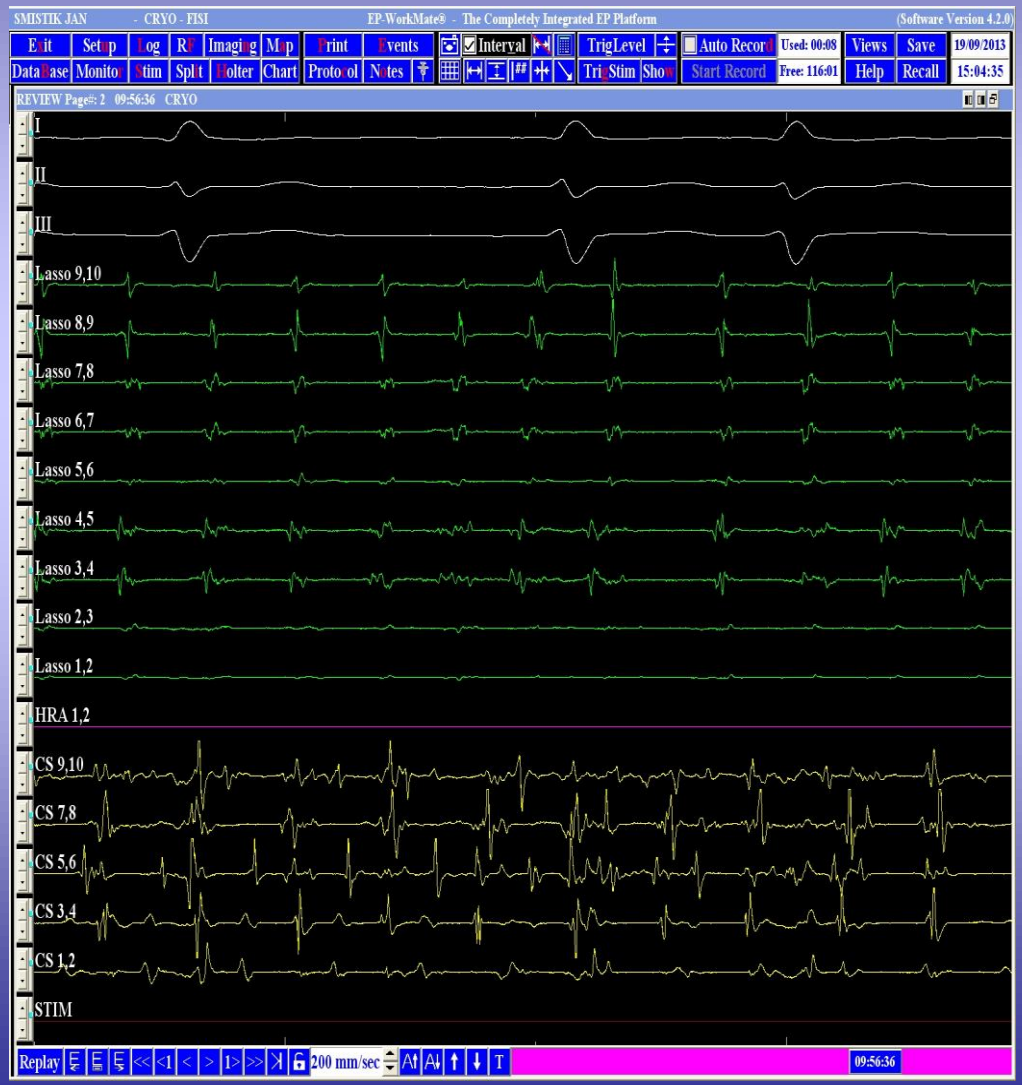


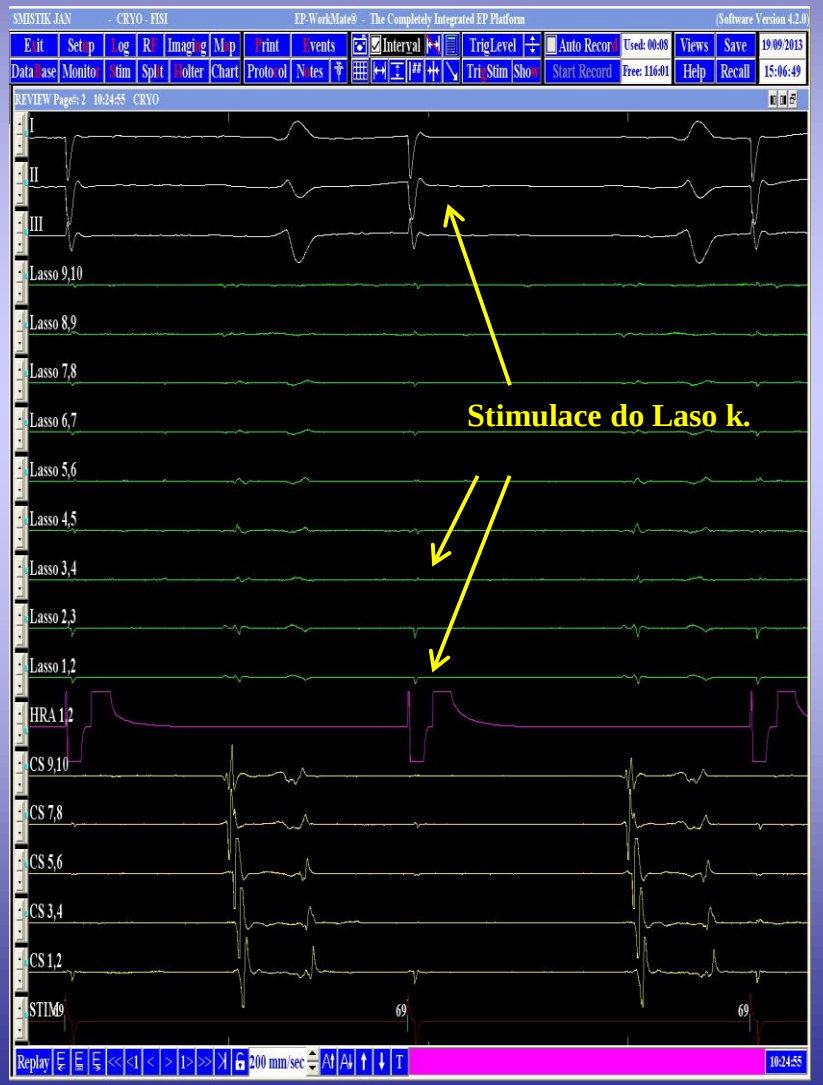
Verifikace okluze PŽ kontrastem



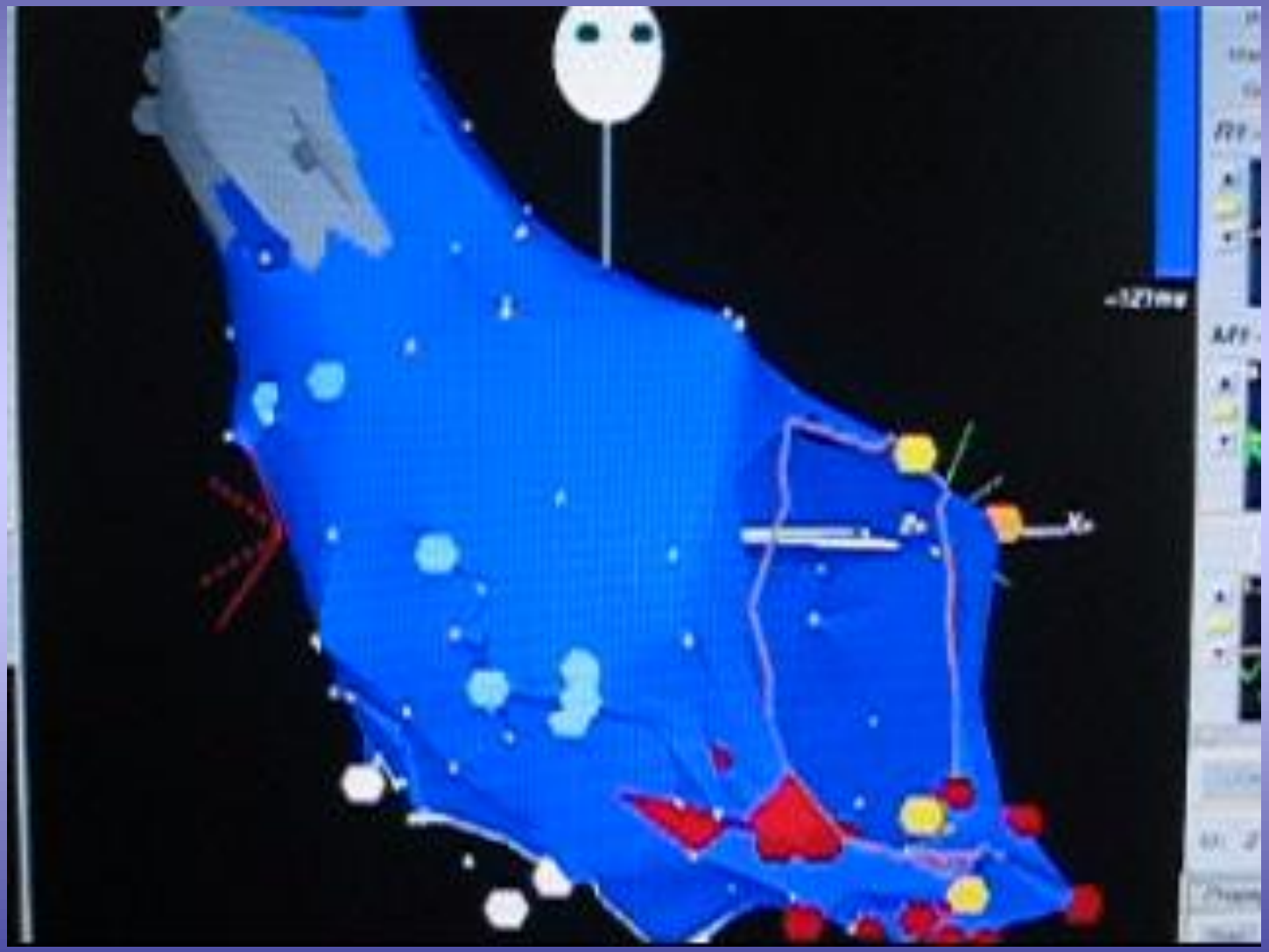
Dosažení optimálních teplot při aplikaci

Signály v PŽ před a po aplikaci





3D mapping



Ventricular arrhythmias

Lown PVCs classification

- **0** without PVCs
- **I** < 30 PVCs / hour
- **II** > 30 PVCs / hour
- **IIIa** PVCs of multiple origin
- **IIIb** bigeminal, trigeminal PVCs
- **IVa** couplets, triplets
- **IVb** NSVT, Ssustained VT, ventricular fibrillation
- **V** fenomen R / T

Risk classification

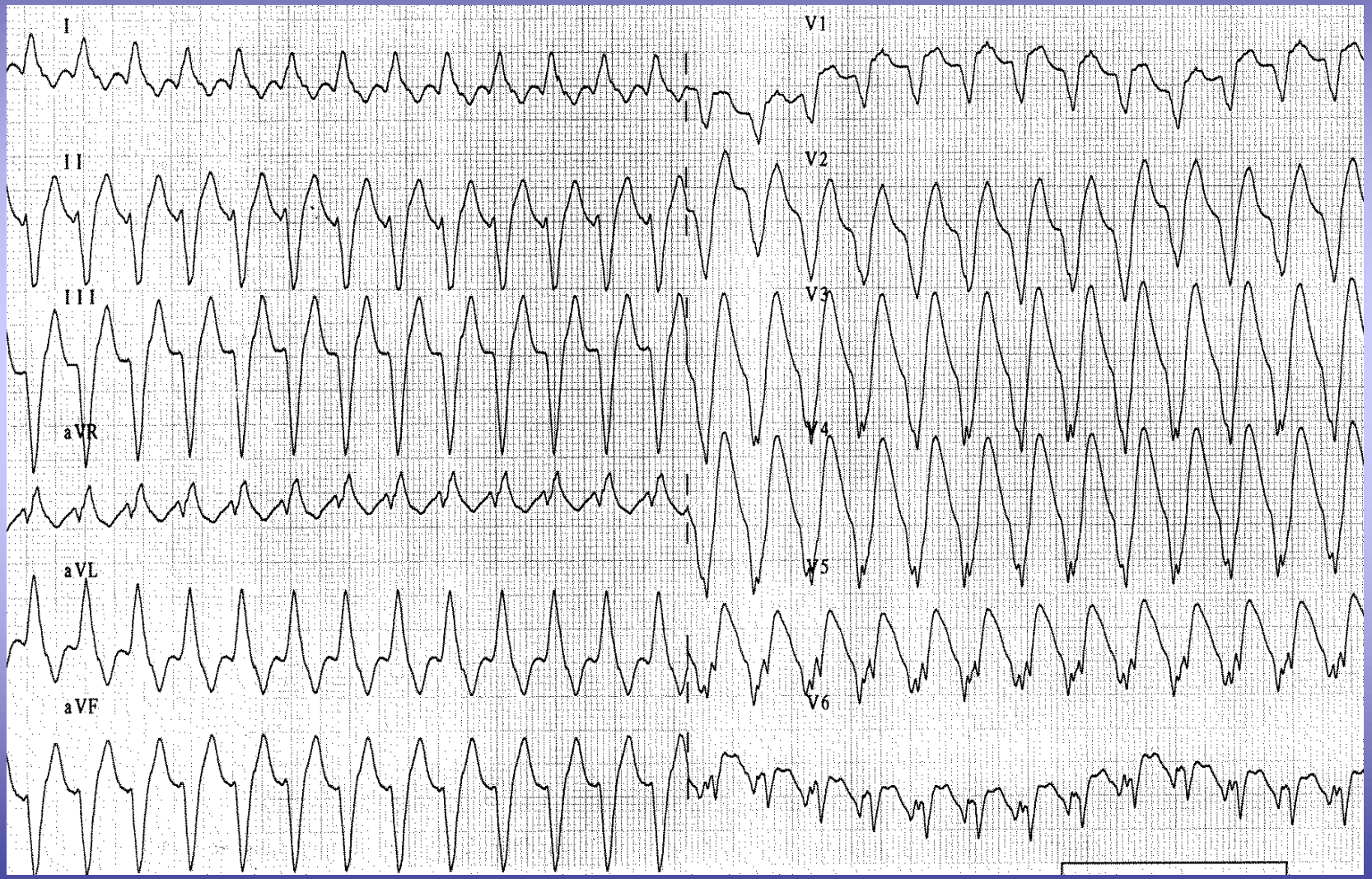
- **Benign**
  (PVCs up to NSVT without organic disease, or CHF)

- **Potentially malignant**
  (NSVT – in presence of CHF, CAD, DCMP)

- **Malignant**
  (ventricular tachycardia, ventricular fibrillation)

VT

LBBB-like VT



Sudden cardiac death

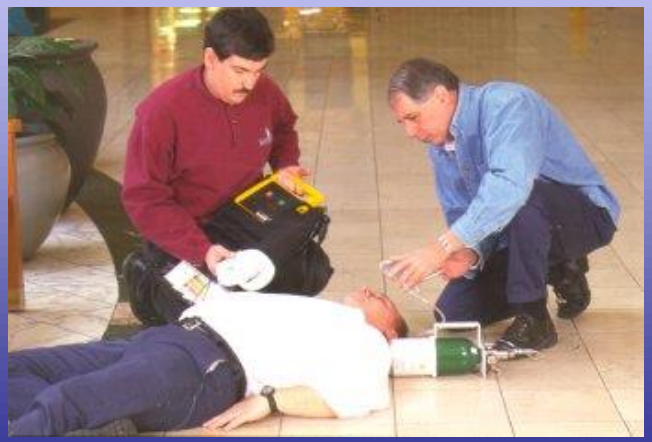
- **Natural death due to cardiac causes with abrupt loss of consciousness within one hour of the onset of acute symptoms. Preexisting heart disease may be known, but time and mode of death are unexpected.**

Braunwald 1992

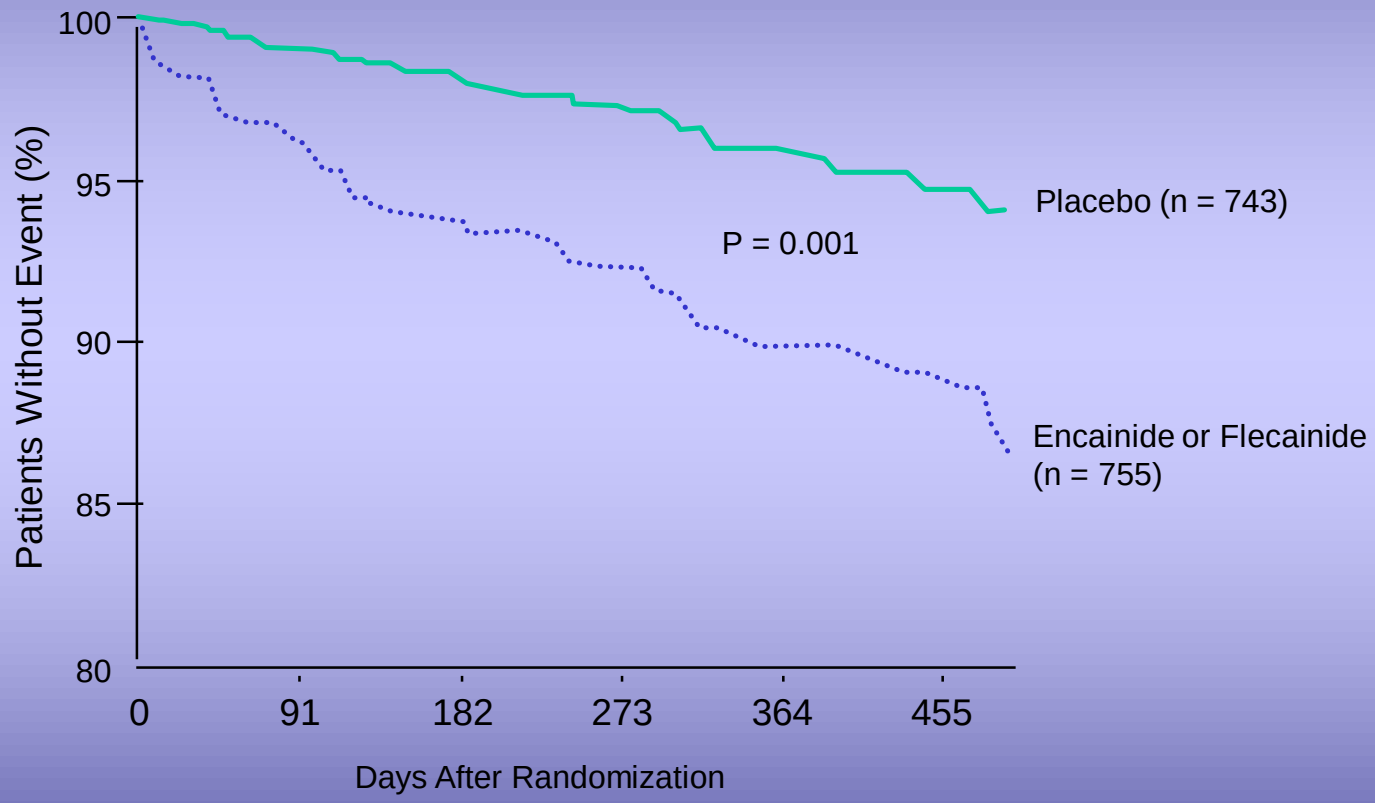
Epidemiology

- USA SCD / year: 200.000 – 450.000
- World / year: 3.000.000 with estimated survival 1%
- ¾ CAD and 80% SCD is due to malignant arrhythmias
- Symptomatic HF: 20-25% risk of death in 2,5 years
- 50% deaths in CHFS is due to VT and VF

Cobb LA., et. al. JAMA 2002
Cannom DS. J Cardiovasc Electrophysiol 2005
Huikuri - N Engl J Med 2001

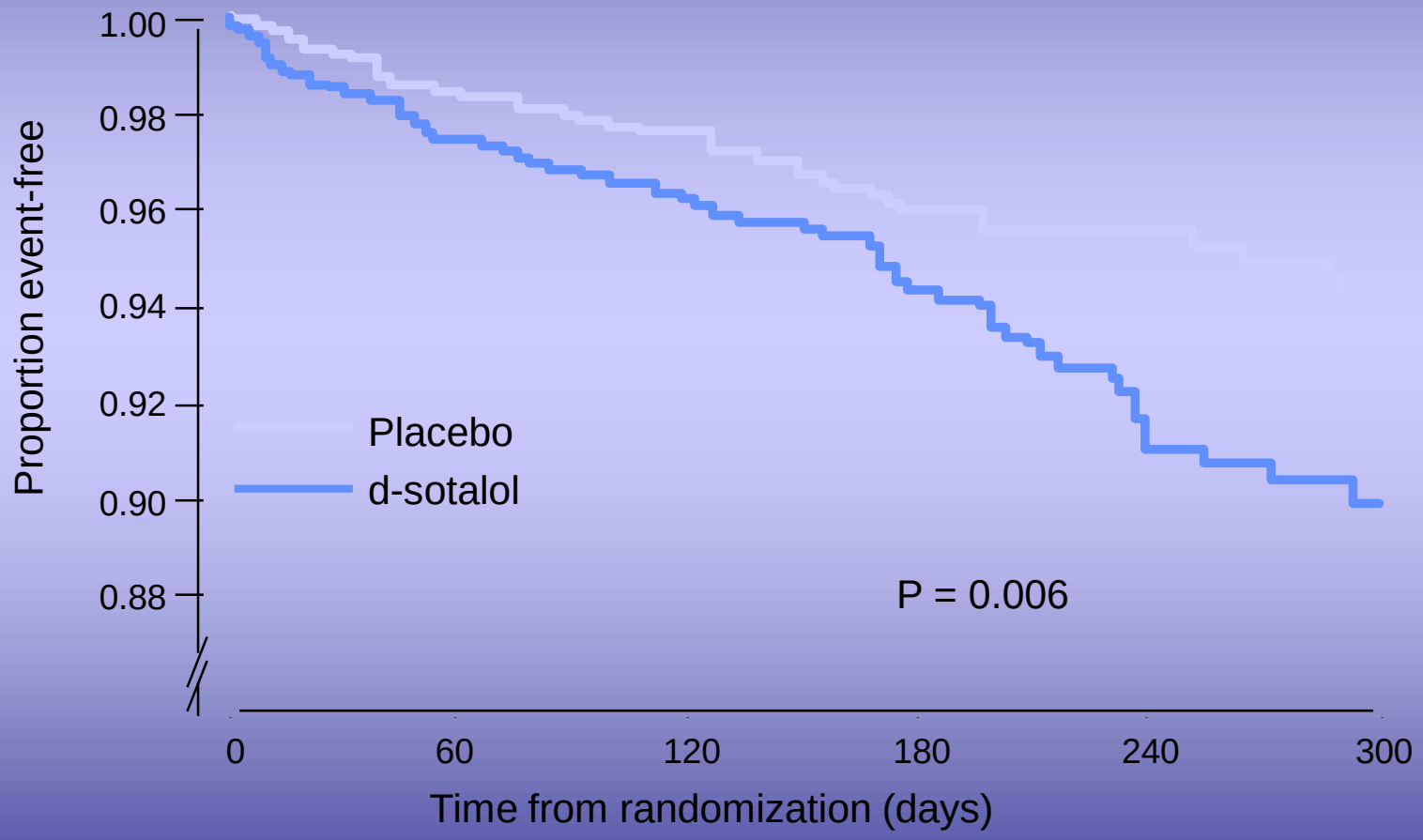


CAST I – Prognosis of Post-MI Patients



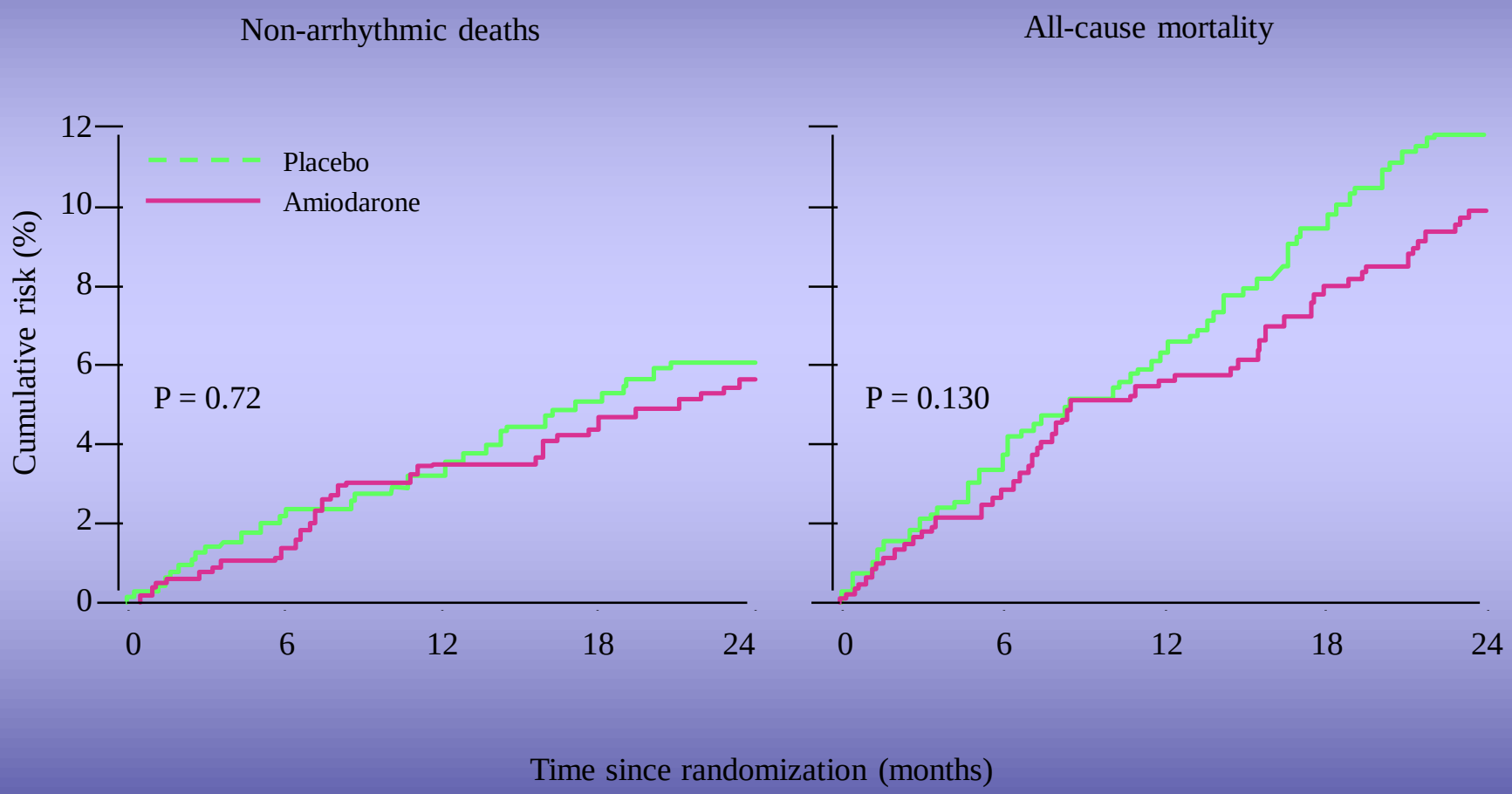
Echt DS. *N Engl J Med*. 1991;324:781-788.

SWORD – Survival with d-sotalol vs. Placebo



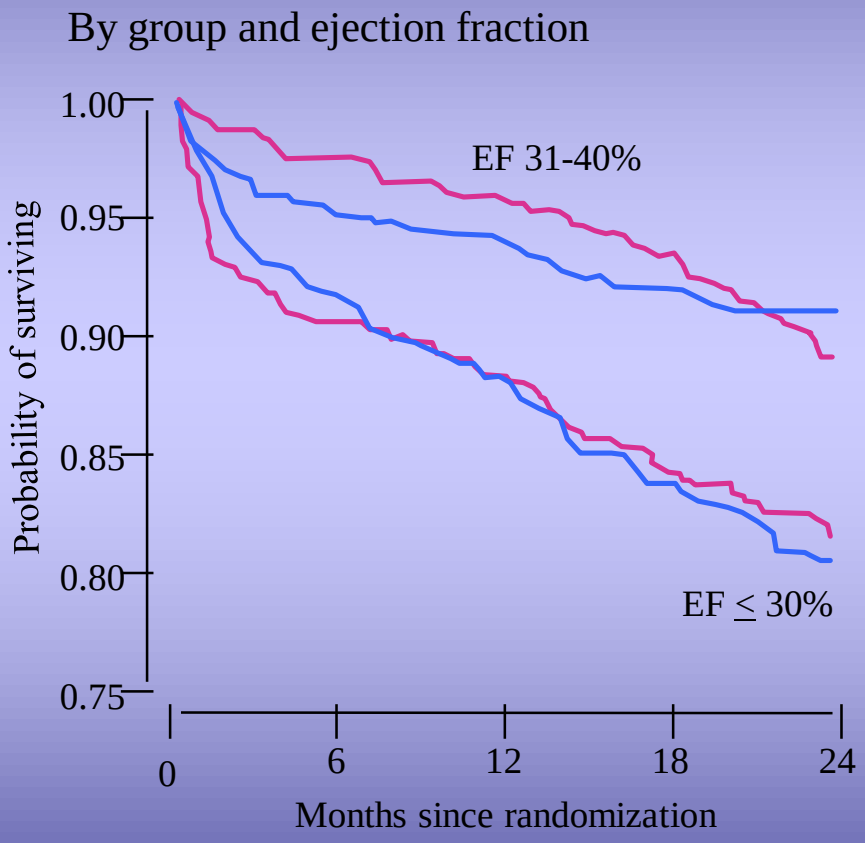
Waldo AL. *Lancet.* 1996;348:7-12.

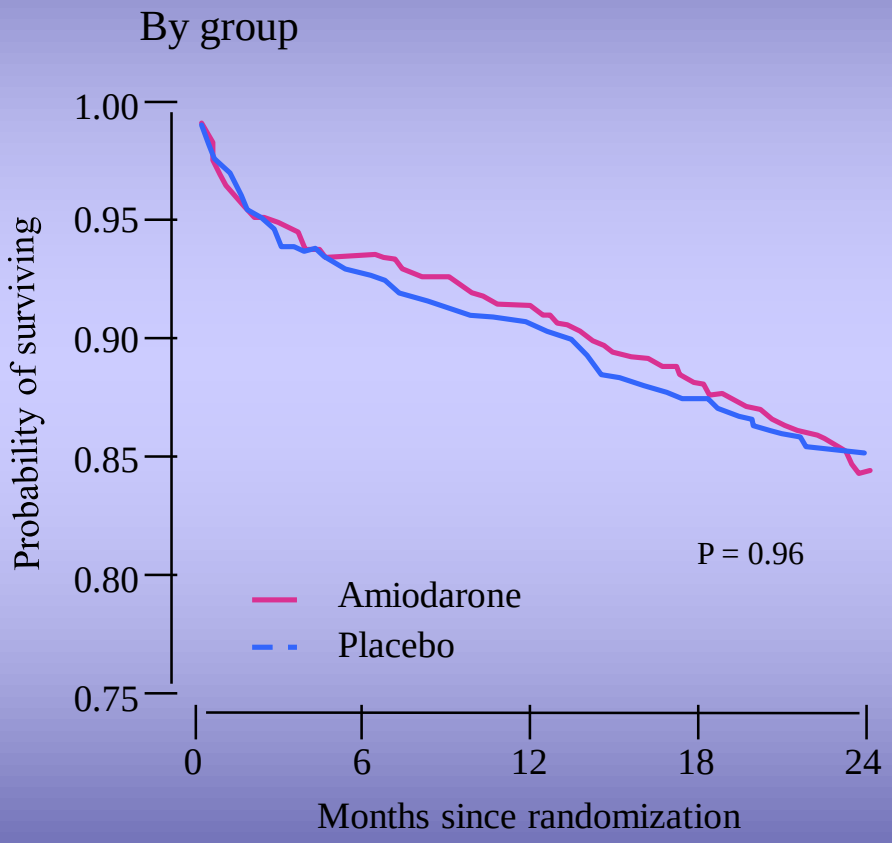
CAMIAT Results



Cairns JA. *Lancet.* 1997;349:675-682.

EMIAT Results – All Cause Mortality

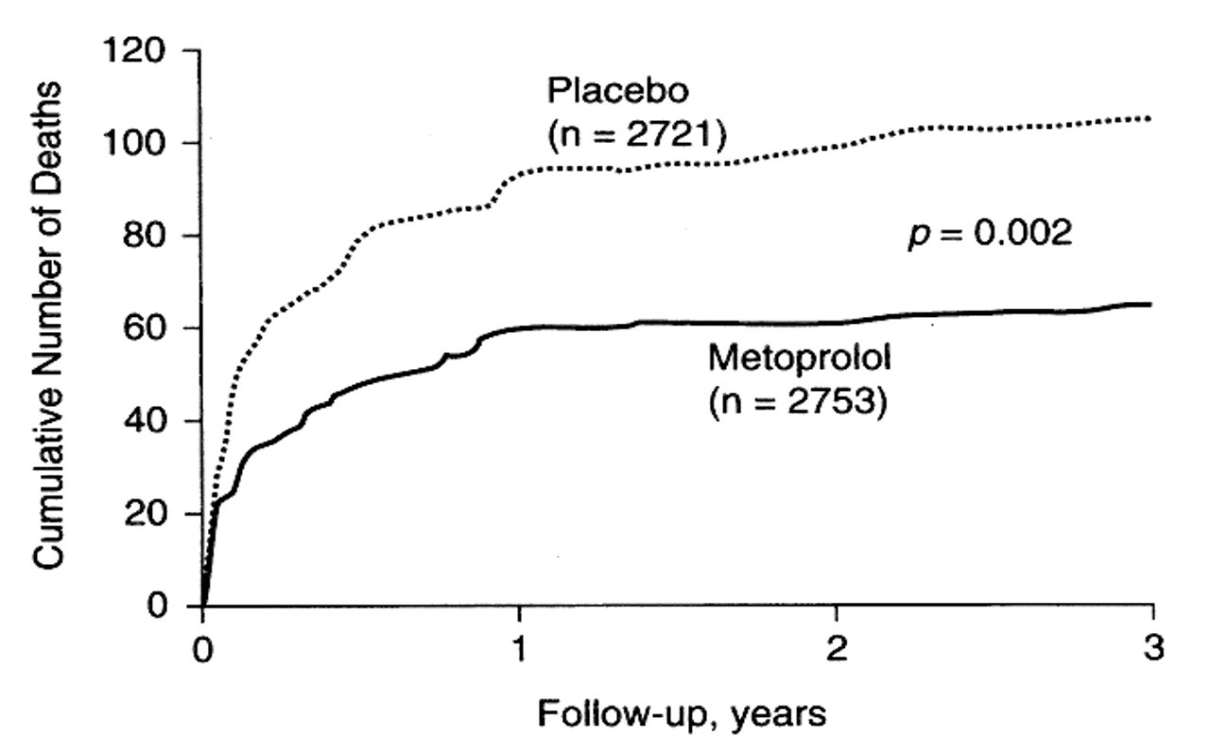




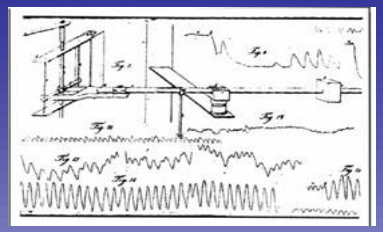
Julian DG. *Lancet*. 1997;349:667-674.

BB and SCD

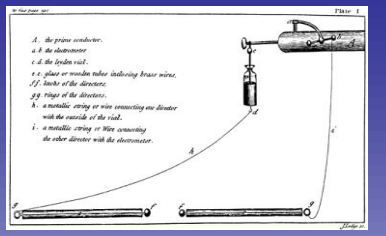
Metaanalyses with BB after MI showed RR reduction 30-50%



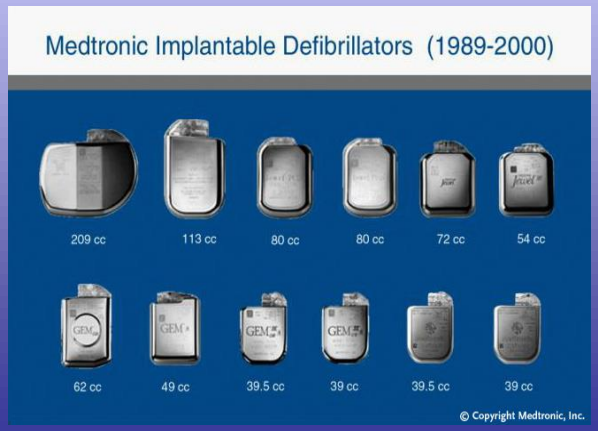
Huikuri HV. JACC 2003

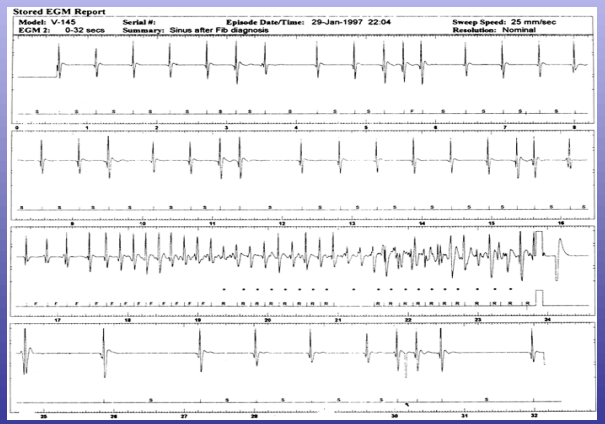


ICD history



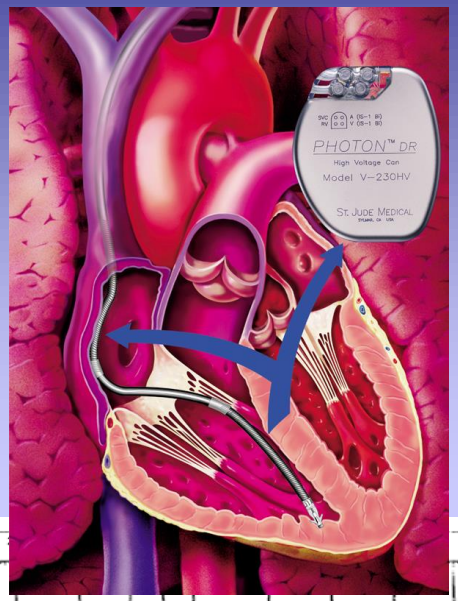
- 1899 – Prevost + Battelli terminated VF in dogs by the DC discharge
- 1930 – Electric current influence on heart may induce / terminate VF
- 1931 – White P.D. „…a condition of little importance so far as we know now“
- 1947 – Claude Beck 1. succ. Defibrillation in human during the thorax operation
- 1970 - Mirowski automatic standby defibrillator in animals
- 1980 – Mirowski ICD first 3 patients



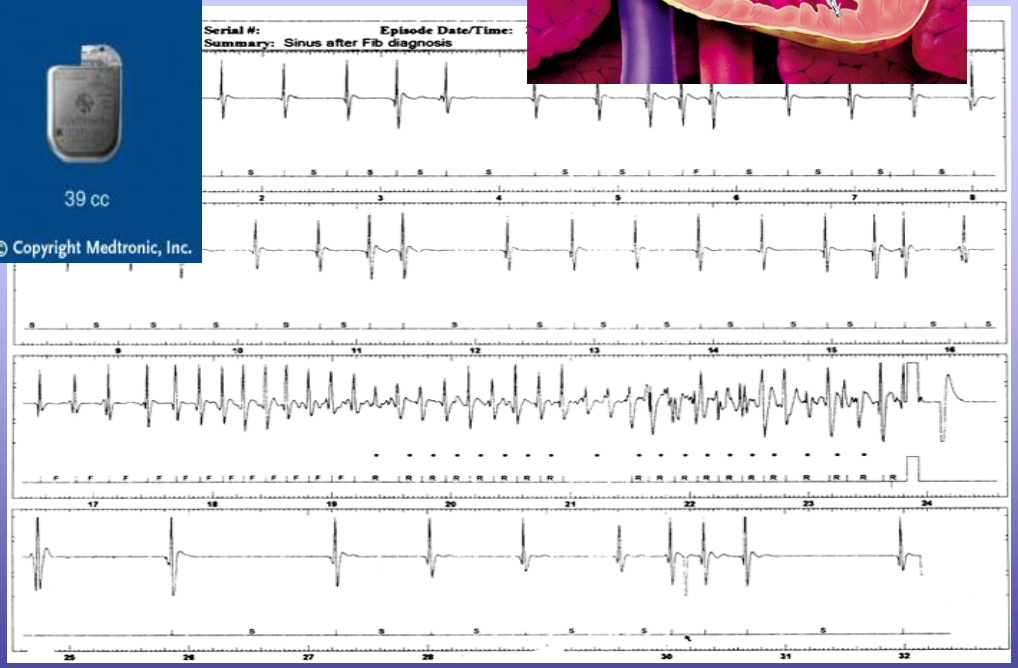


ICD therapy

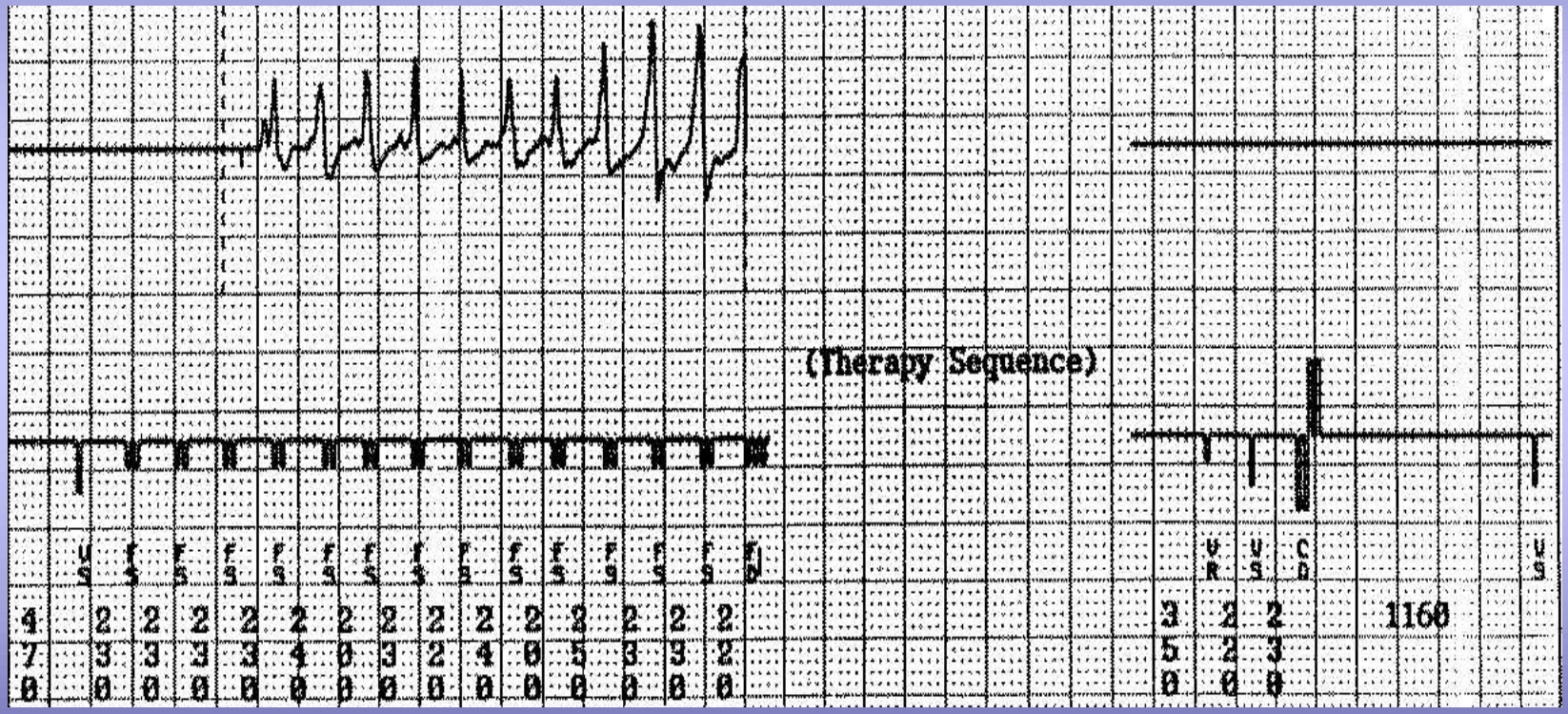

Medtronic Implantable Defibrillators (1989-2000)
209 cc
113 cc
80 cc
80 cc
72 cc
54 cc
62 cc
49 cc
39.5 cc
39 cc
39.5 cc
39 cc
© Copyright Medtronic, Inc.


PHOTON DR
High Voltage Can
Model V-230HV
ST. JUDE MEDICAL

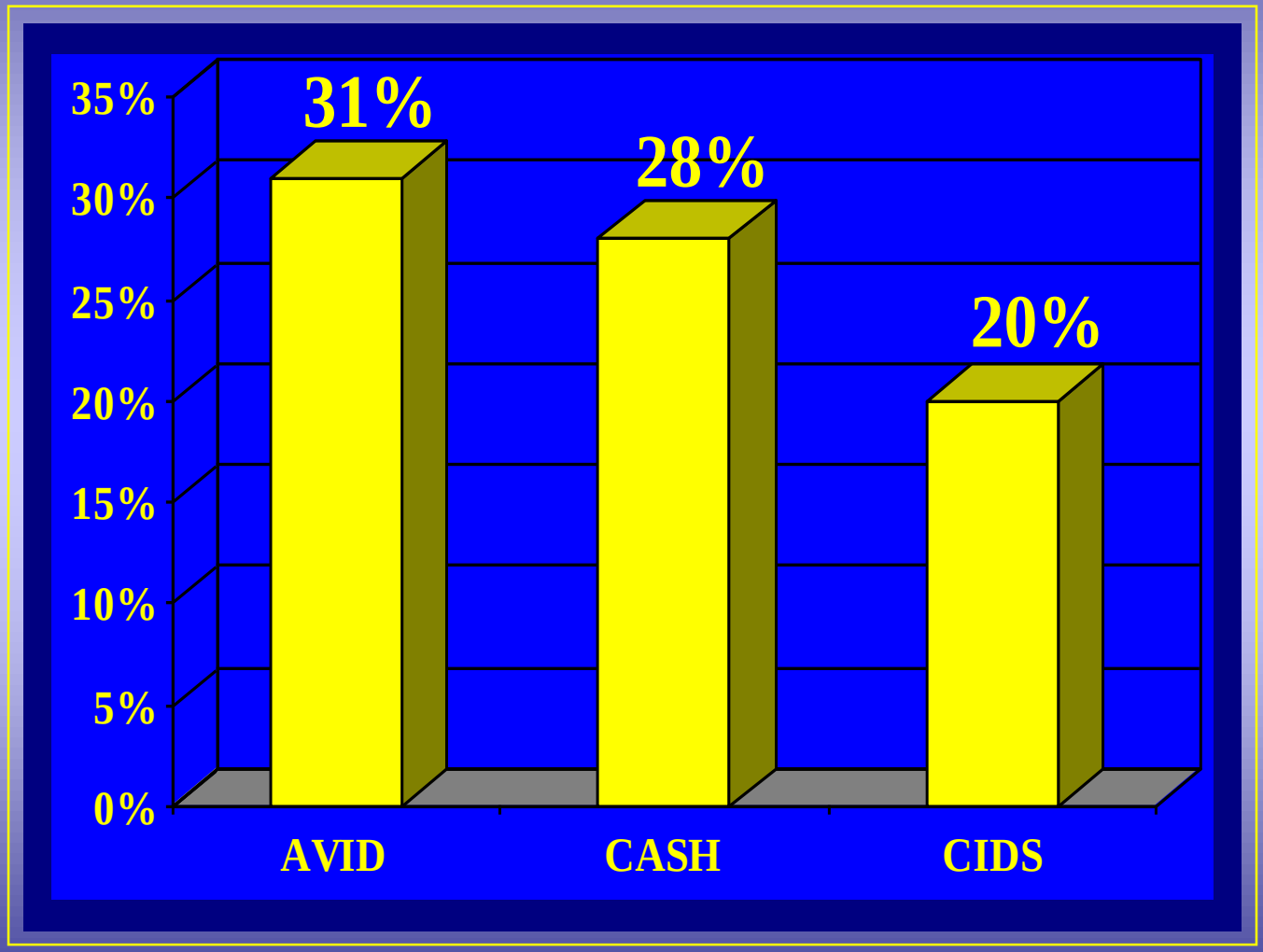

ANGSTROM
High Voltage Can
Model V-190HV3
SN-51772 NFHU
Ventritex
Sunnyvale, CA, USA


Serial #:
Episode Date/Time:
Summary: Sinus after Fib diagnosis

Arrhythmic episode from ICD memory



Secondary prevention studies

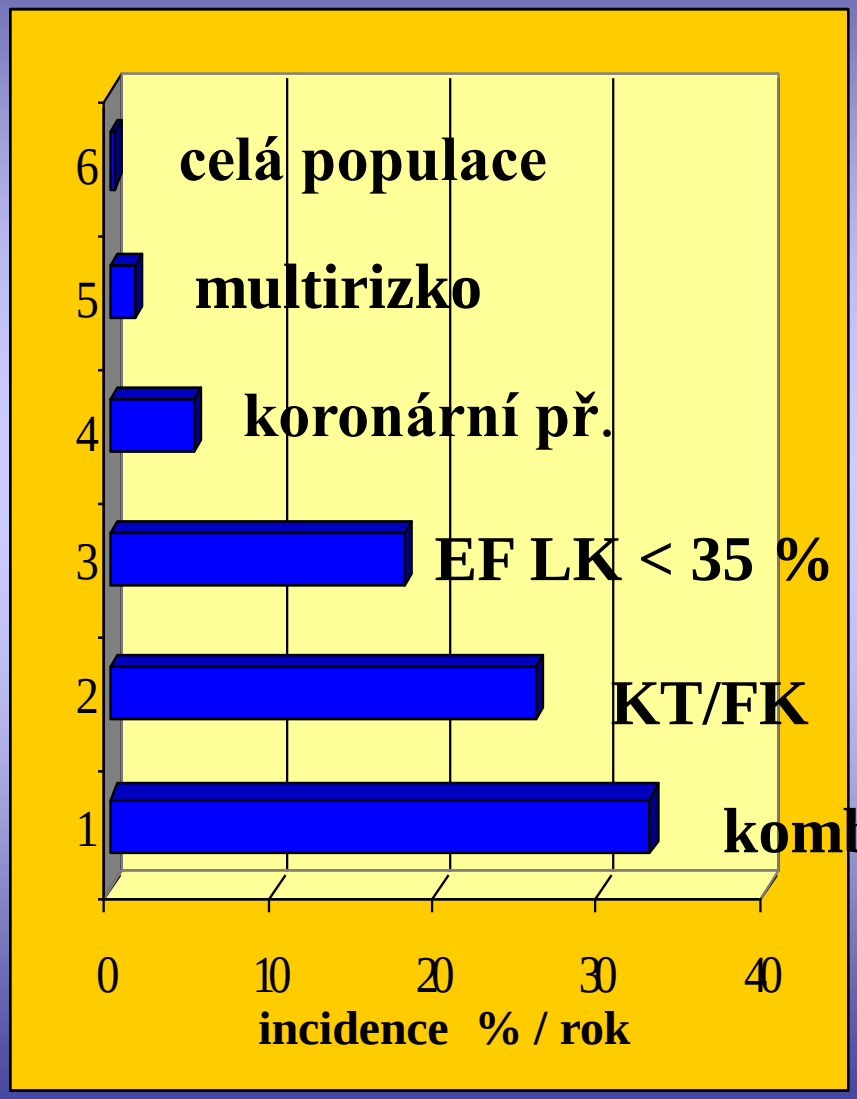


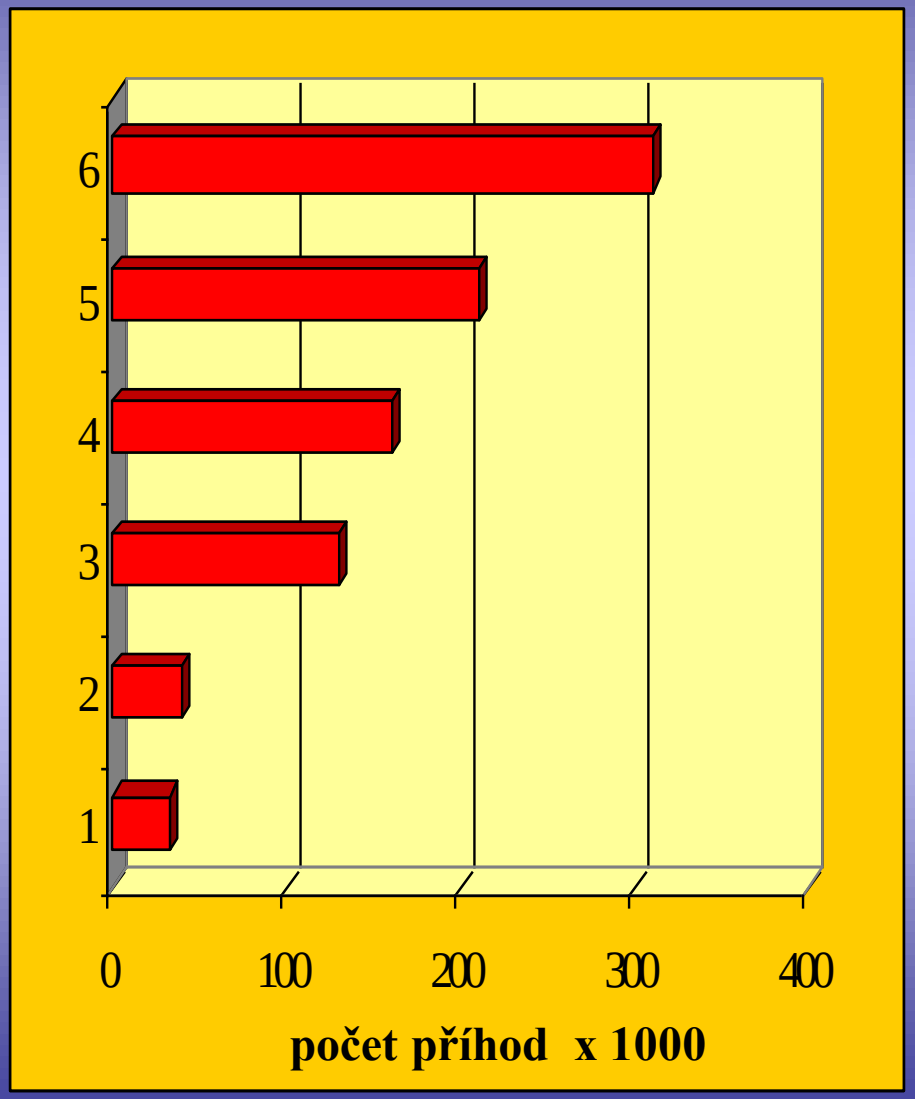
Malignant ventricular arrh.

- Sustained VT, FVT
- Ventricular fibrillation
- Risk SCD after CPR - in 1 year 40 - 55%

- Therapy - NECESSARY!!, Antiarrhythmics, revascularization, ICD

INCIDENCE / number of SCDs

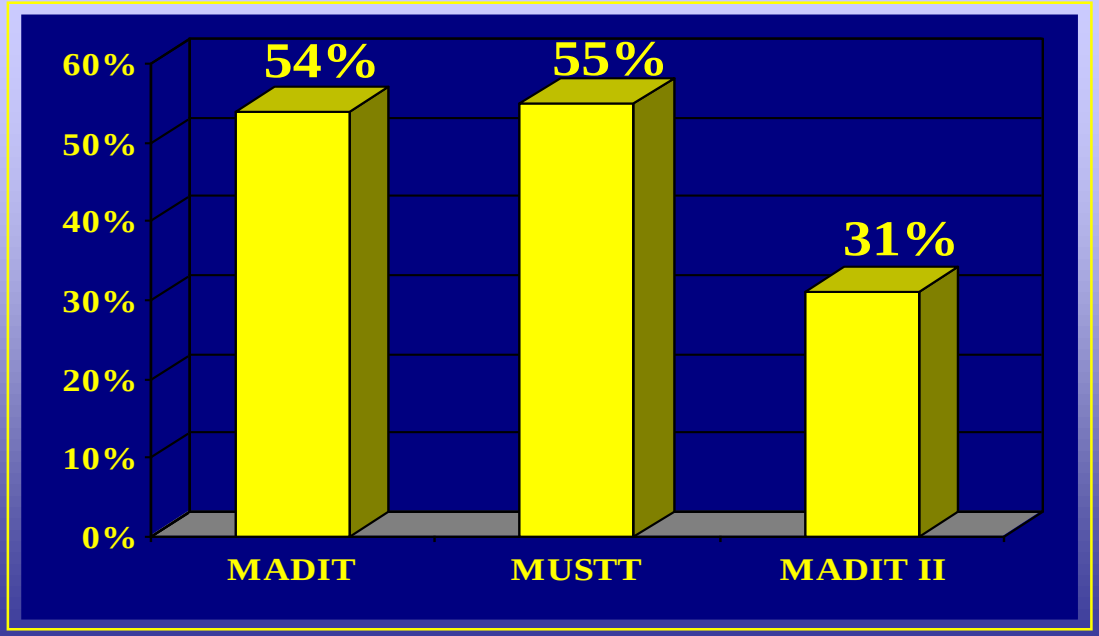




Myerburg et al., Circulation, 1998

Primary prevention studies

MADIT	MUSTT	MADIT II
196 pacientů	704 pacientů	1232 pacientů
sledování 27m	sledování 39m	sledování 20m
54% redukce CM	55% redukce CM	31% redukce CM



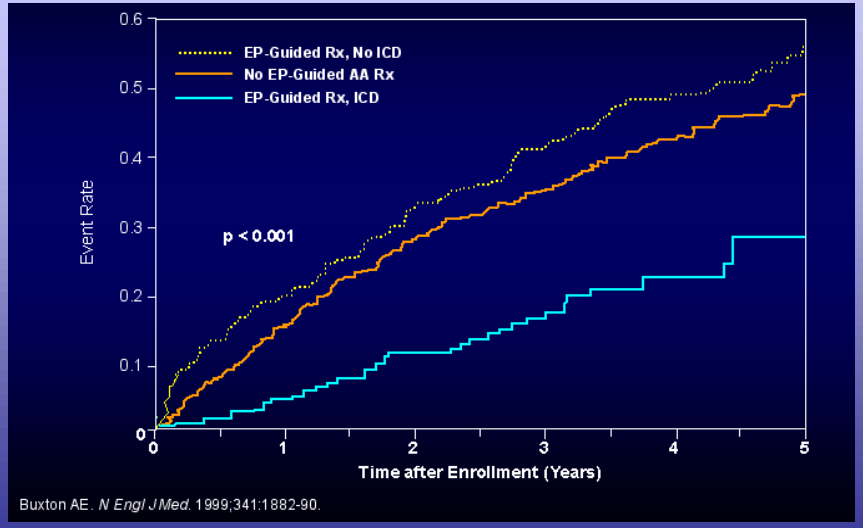
Moss. N Engl J Med 1996

Buxton. N Engl J Med 1999

Moss. N Engl J Med 2002

CAD patients – inclusion criteria

Vstupní kriteria	MADIT	MUSTT	MADIT II
ICHS po IM	x	x	x
EF LK	<35%	<40%	<30%
NSKT	x	x	
Induc. KT při EPS	x	x	
Nesupresibilní KT	x		



SCD HeFT

2.521 patients

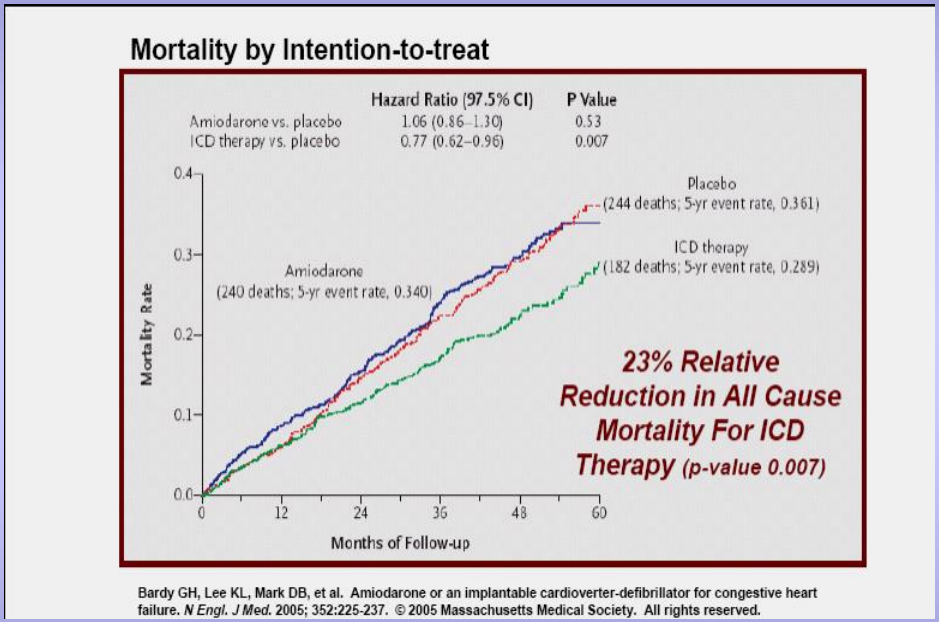
70% NYHA II, 30% NYHA III

LVEF ≤ 35%

52% CAD, 48% DCMP

Placebo x Amiodaron x ICD therapy

Follow – up: 40,8 months



ICD terapie comparatively reduced total mortality by 23% irrespective of cardiac failure etiology.

Bardy GH., et. al.N Engl J Med 2005;352:225-237

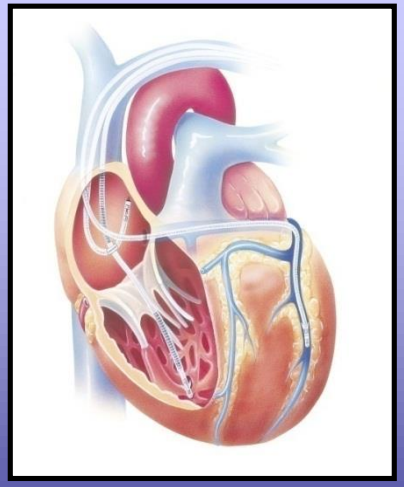
COMPANION

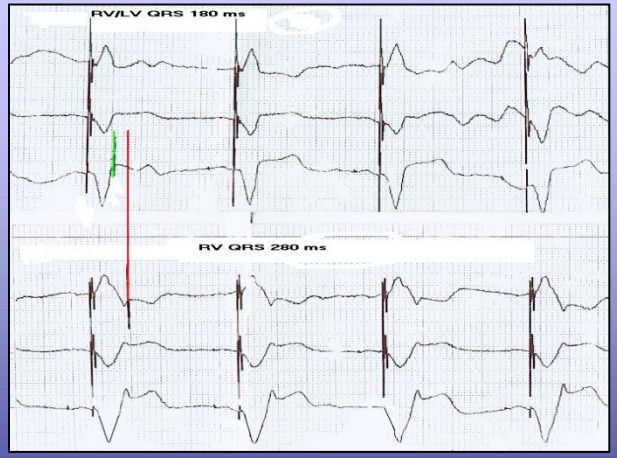
1520 patients NYHA III, IV, CAD, DCMP, SR, QRS > 120 ms, LVEF < 35%

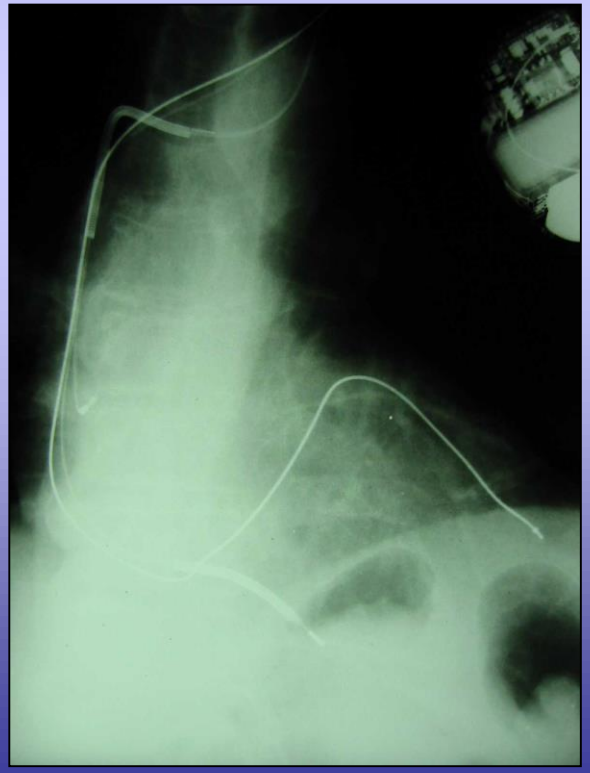
randomized 1:2:2 - OPT, OPT+CRT, OPT+CRT – D

Total mortality CRT -24%, CRT/ICD - 36%

36% reduction of mortality in CRT – D group !!







N Engl J Med 2004

Baldasseroni, AHJ 2002

Number needed to treat to save 1 life during 5 years ICD longevity

study	RRR	ARR – 5 yrs	NNT-5 yrs
MADIT I	54	46	**2,2**
MUSTT	51	36	**2,8**
MADIT II	31	16	**6,3**
COMPANION	36	34	**2,9**
DEFINITE	35	12	**8,3**
SCD-HeFT	23	8	**12,5**

Dorian P., et al. Can J Cardiol 2005;21:31A-36A

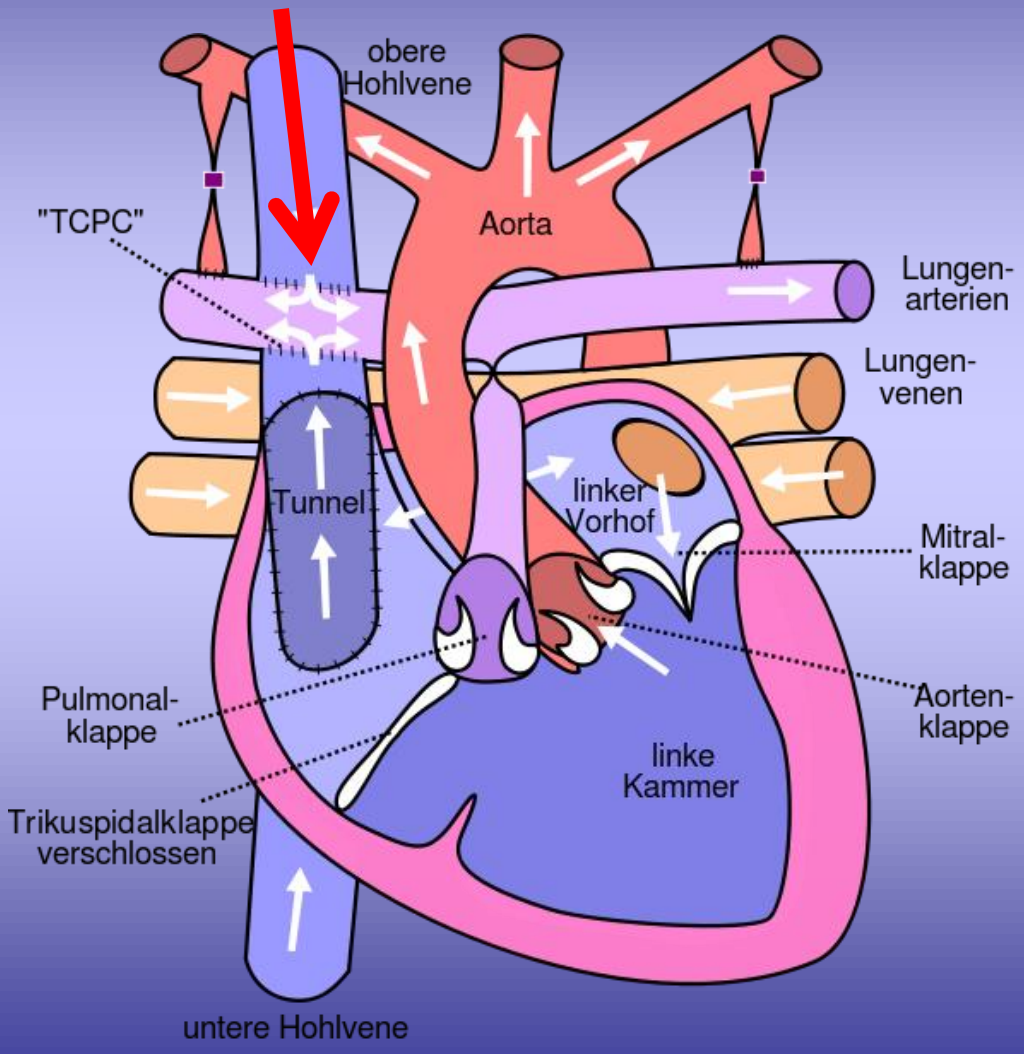
Risk factors increasing nonarrhythmic mortality

Patients with low profit from PP ICD	Patients with high profit from PP ICD
female	male
age > 70 years	age < 70 years
renal failure	QRS > 120ms
NYHA I, IV	NYHA II,III
MTWA negative	
LVEF> 35%	

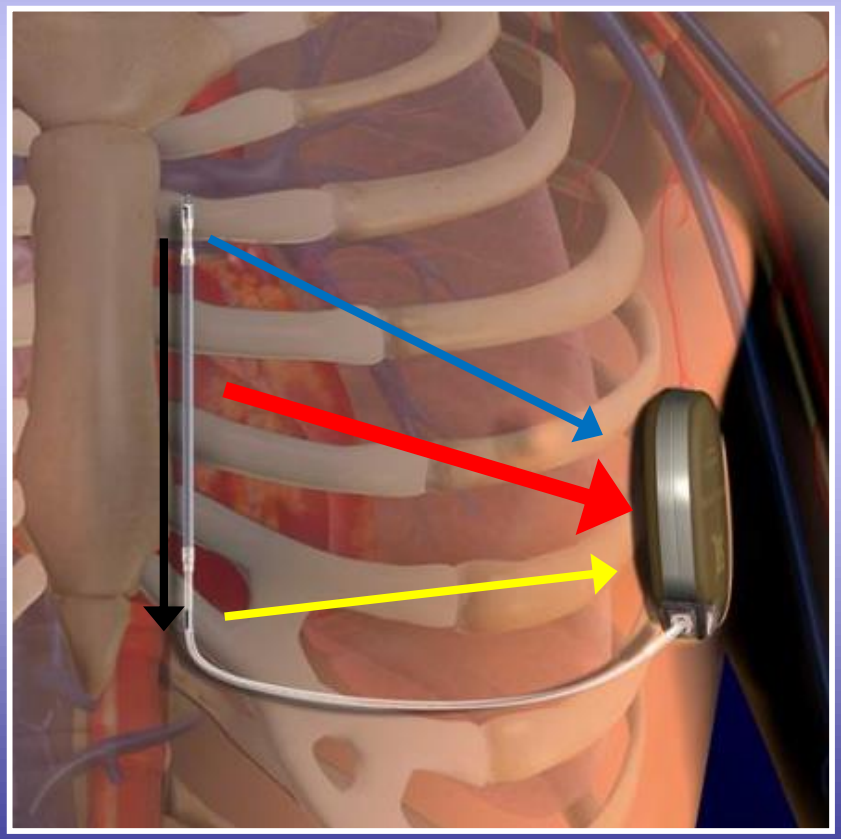
Cumulation of risk factors in the left column increase the likelihood of noncardiac or nonarrhythmic death.

Goldenberg I., et al. JACC 2008
Křivan L. Vnitř Lék 2010
Křivan L. Cor Vasa 2010

Congenital VD (TCPC)



SQ ICD



Arrhythmia treatment

- AA, RFA, no Tx - for SV arrhytmias

- ICD - for ventricular tachycardias