MALIGNANT ARRHYTHMIAS / SUDDEN CARDIAC DEATH

M. Kozák

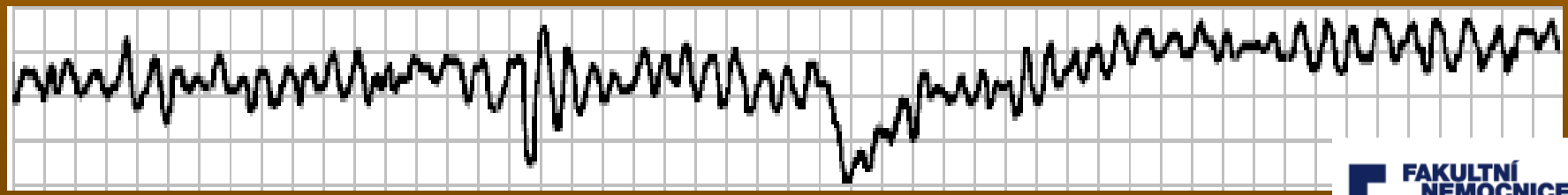
Department of Medicine and Cardiology, University hospital Brno

FAKULTNÍ NEMOCNICE BRNO

SCD

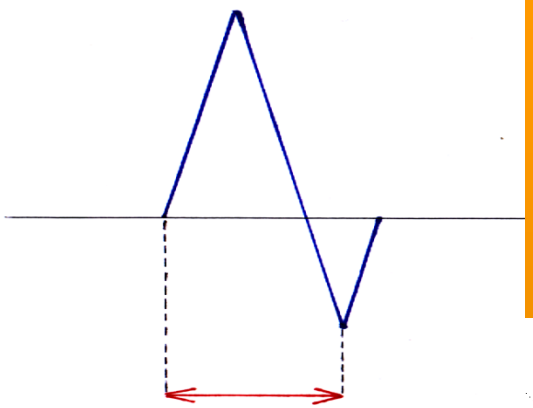
- sudden unexpected death caused by loss of heart function (1 hour time window)

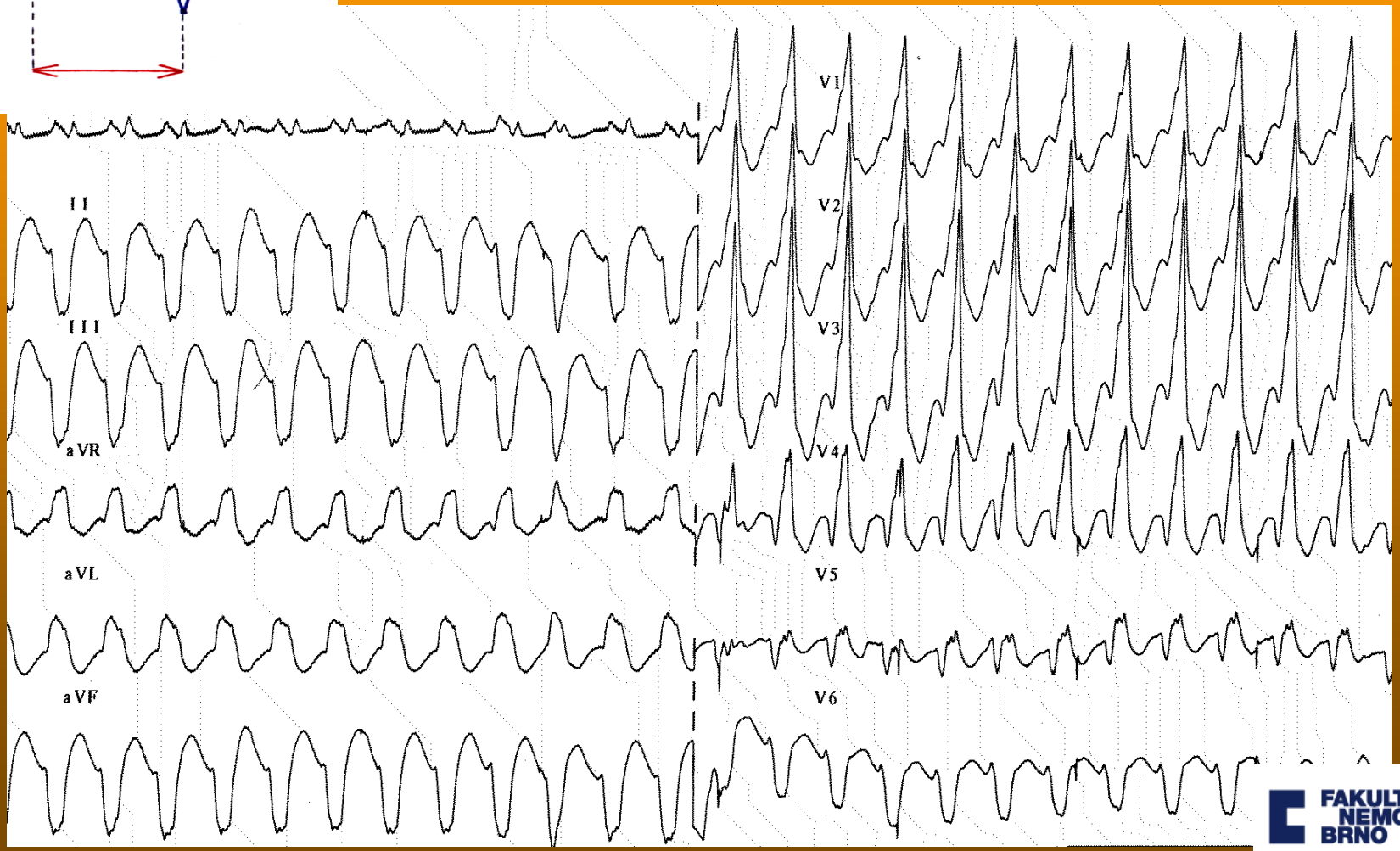
- sudden collapse
- no pulse
- no breathing
- loss of consciousness



FAKULTNÍ NEMOCNICE BRNO

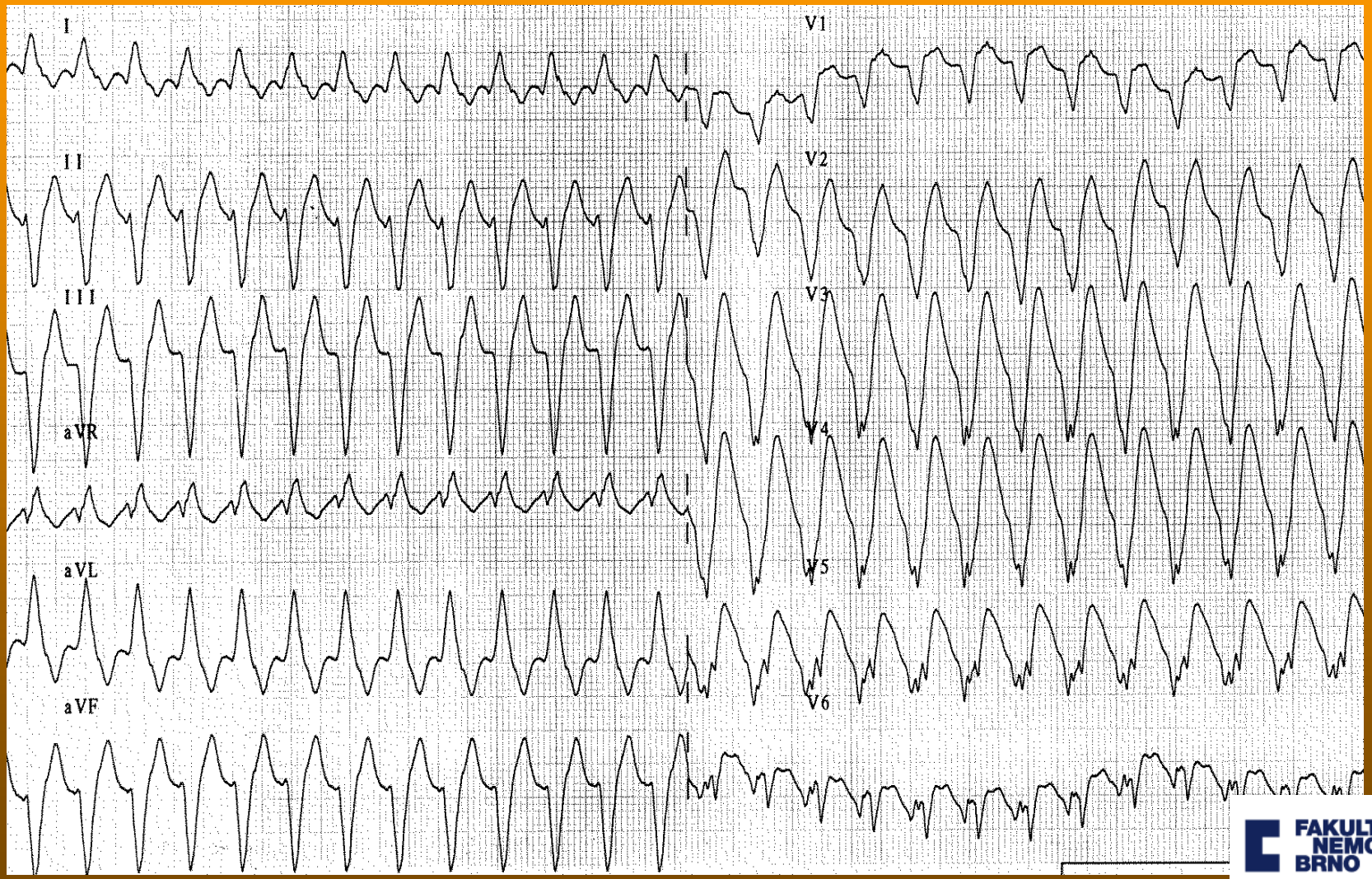
RBBB VT





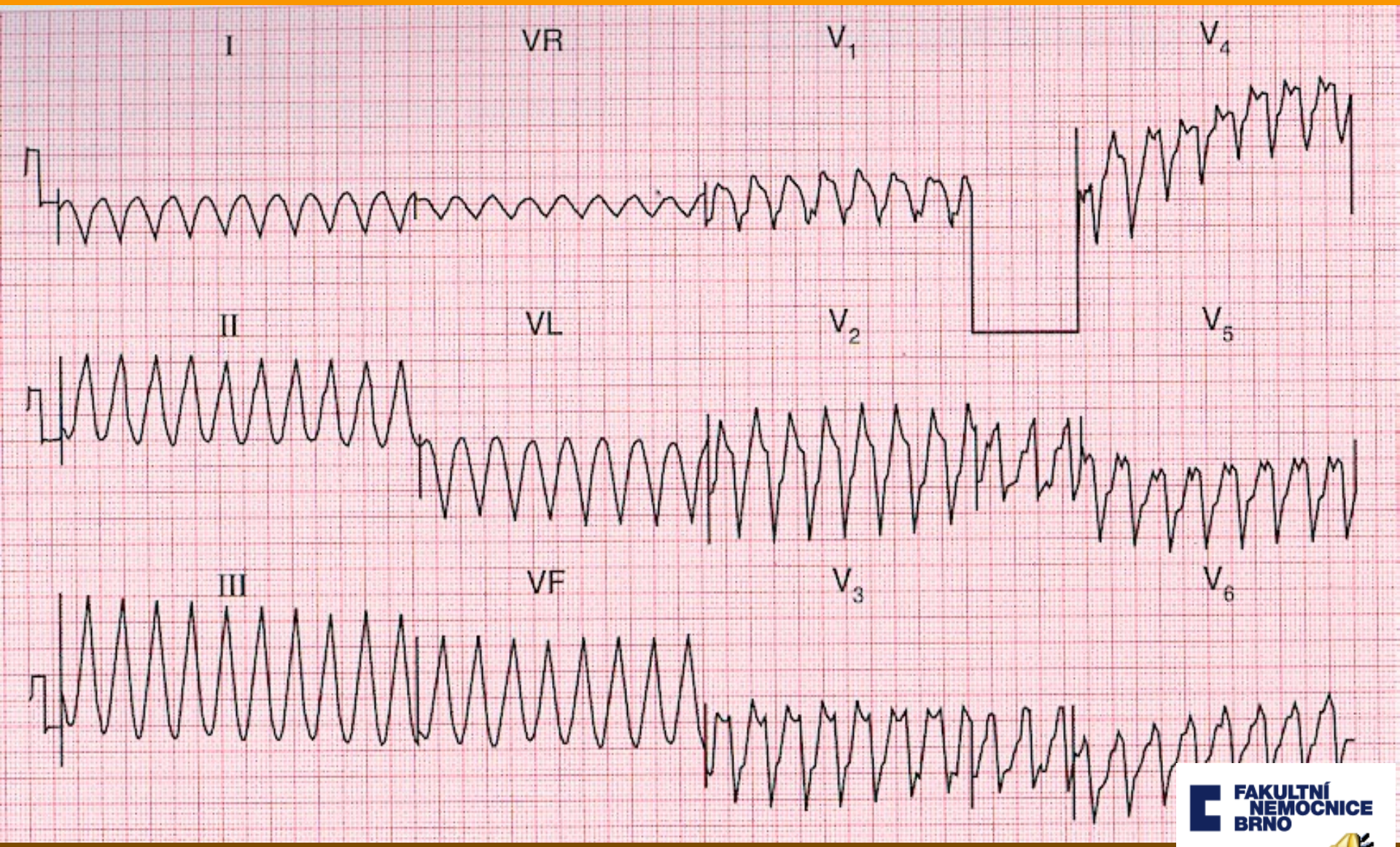
FAKULTNÍ NEMOCNICE BRNO

LBBB VT

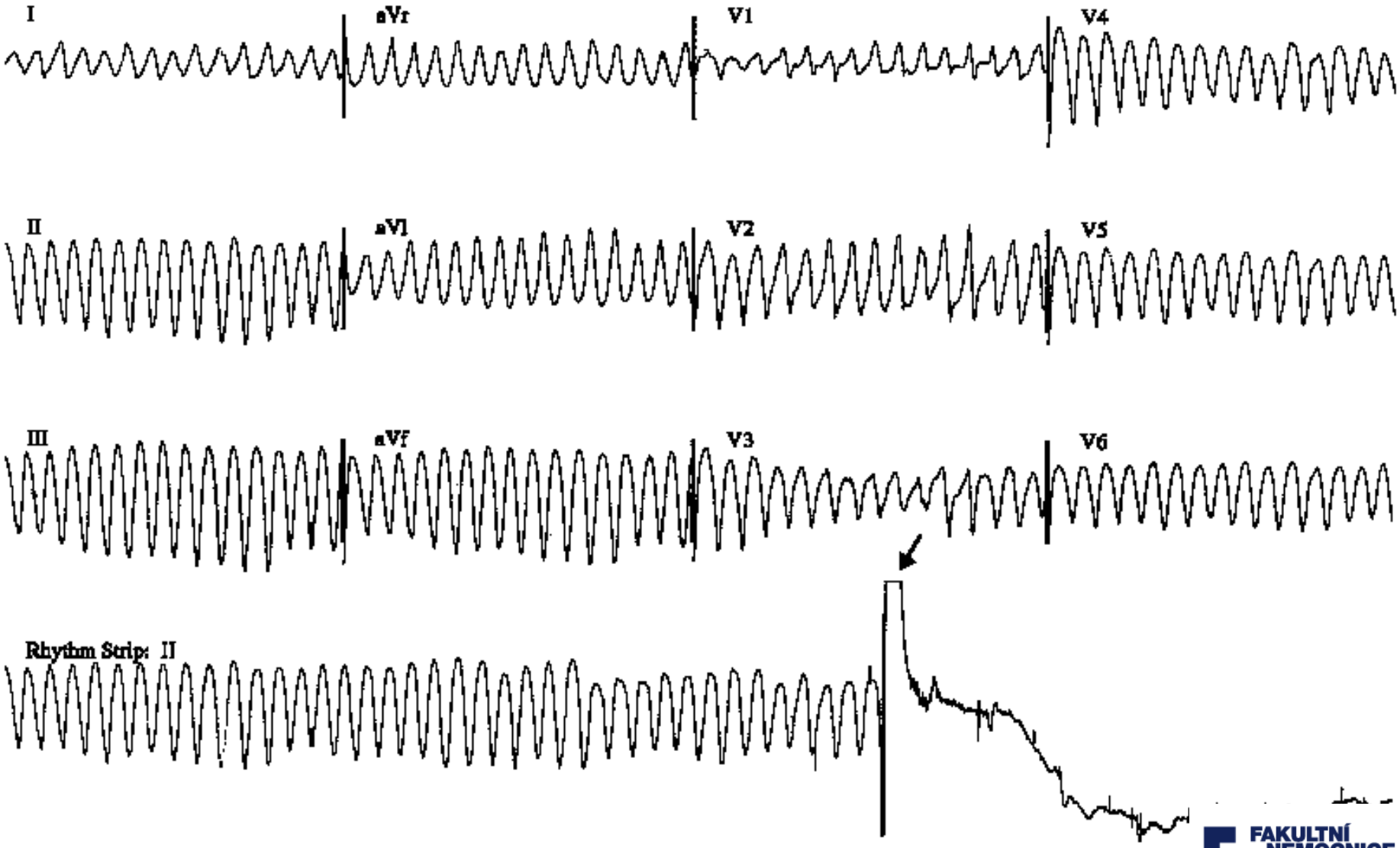


FAKULTNÍ NEMOCNICE BRNO

FVT



FAKULTNÍ NEMOCNICE BRNO



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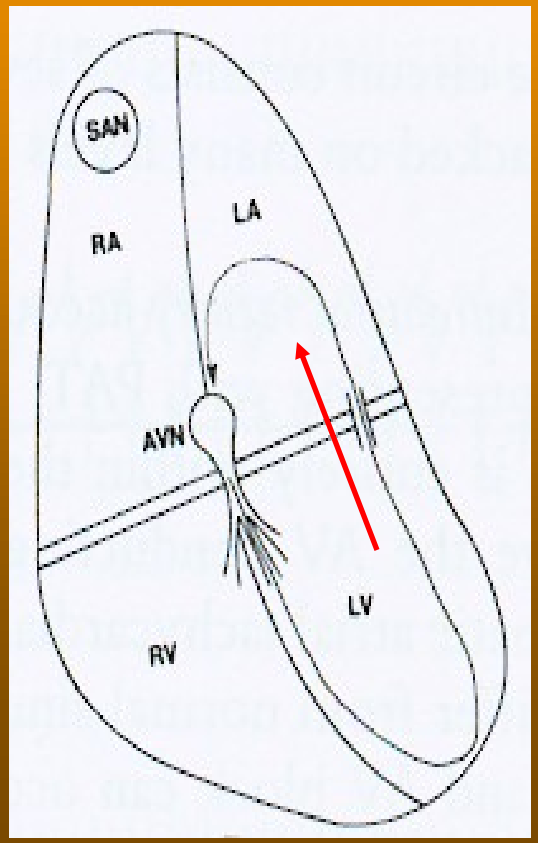
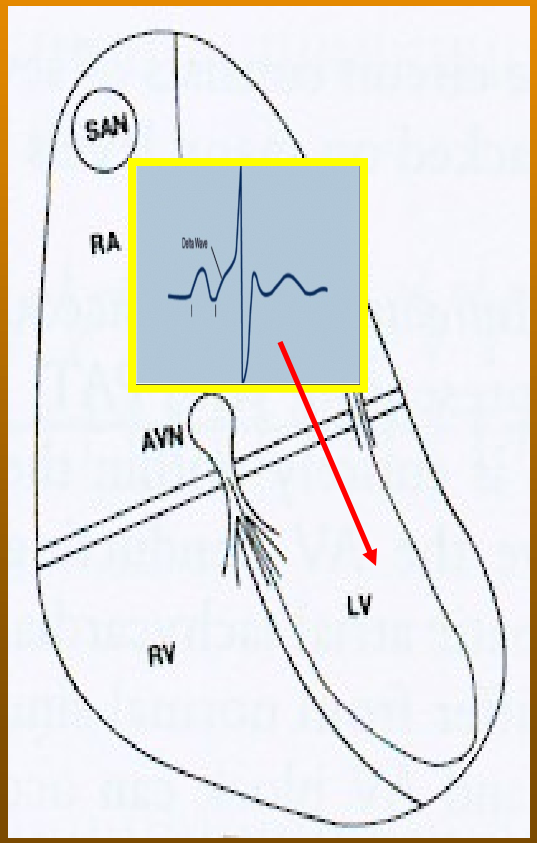
AVRT

prevalence 3/1000 inhabitants





WPW sy

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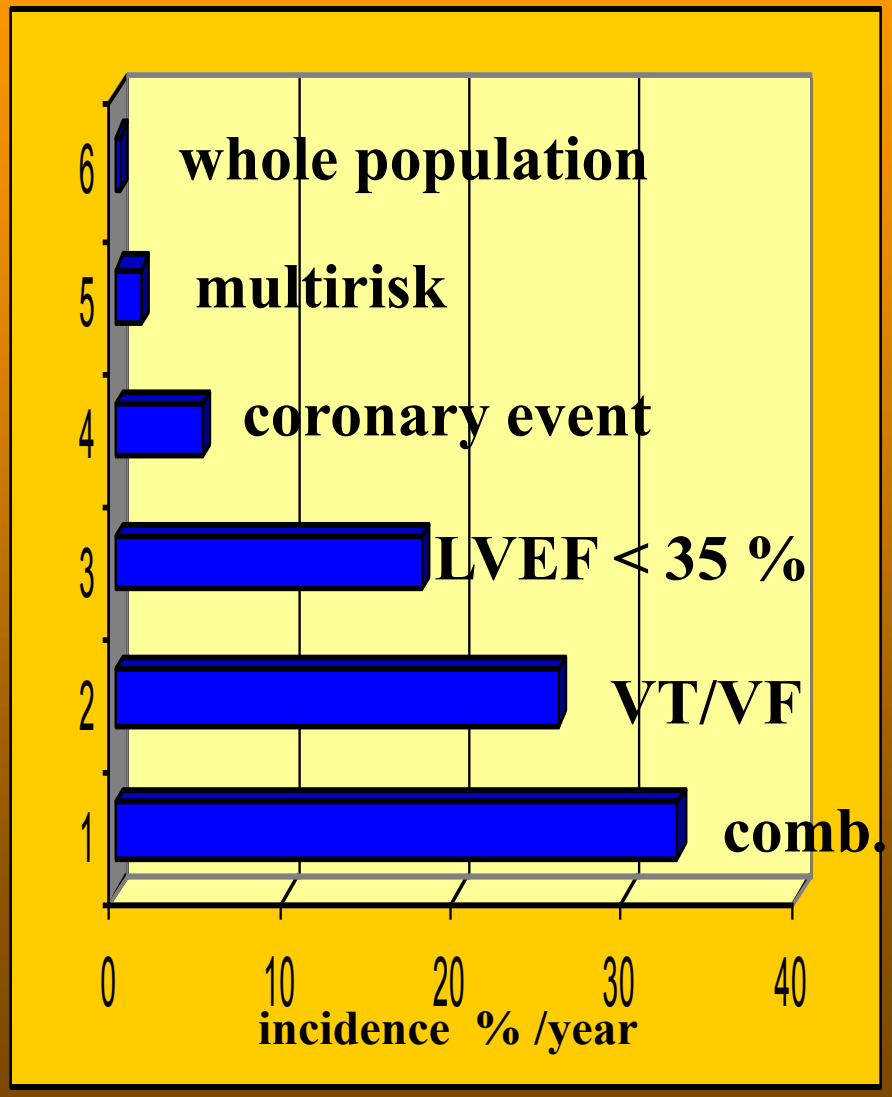
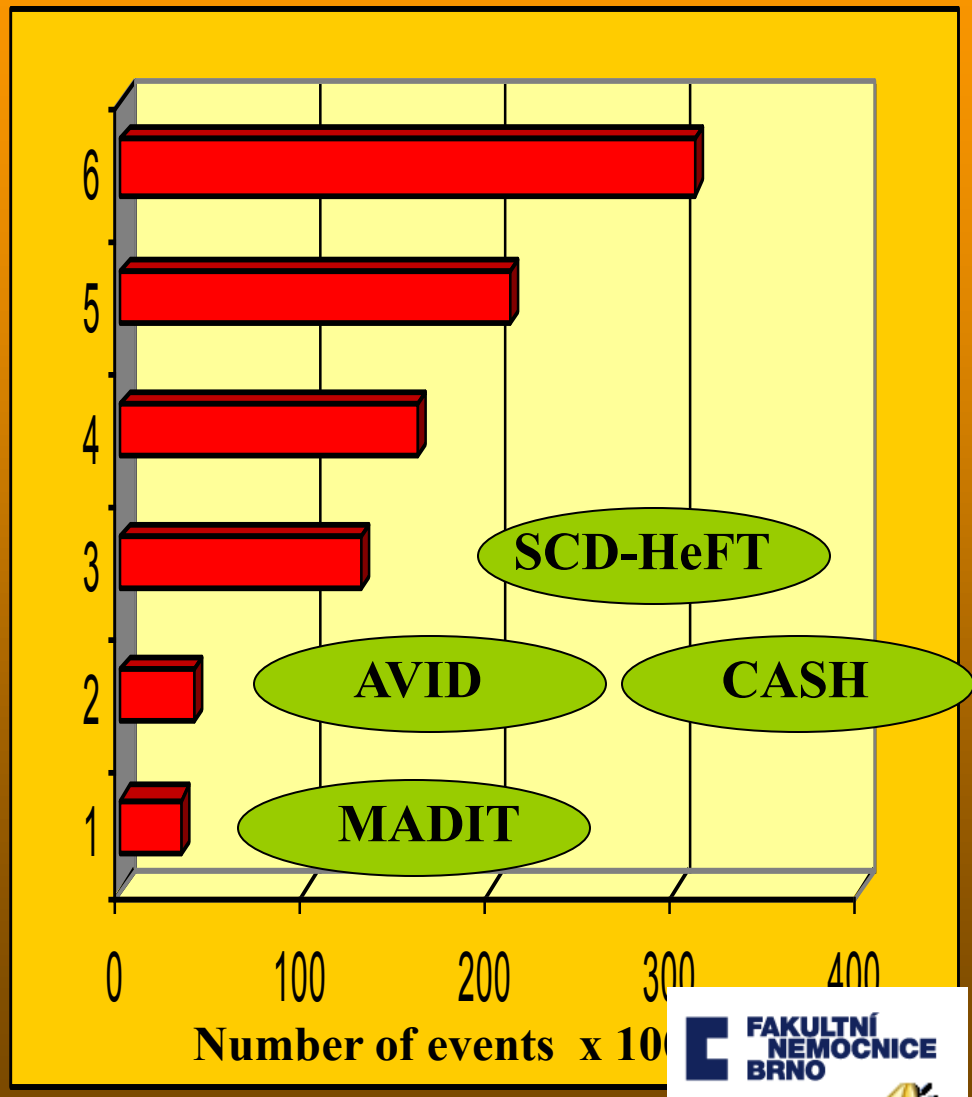
INCIDENCE / SCD TOTAL NUMBER





Myerburg et al., Circulation, 1998

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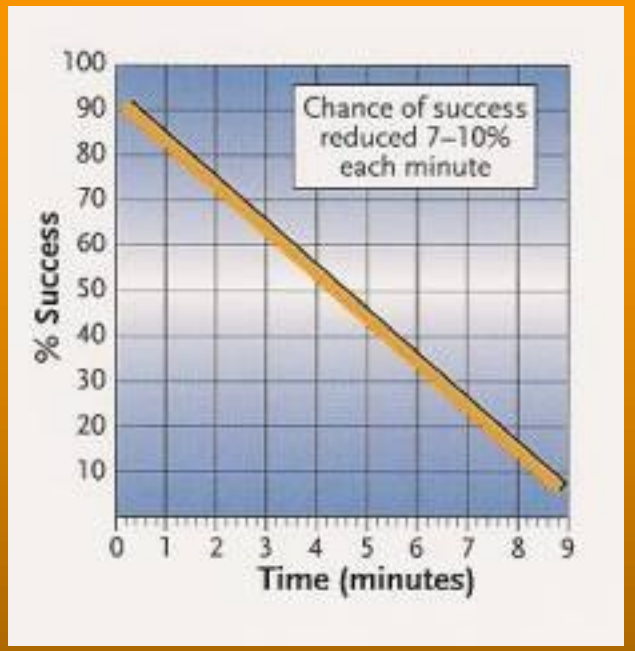
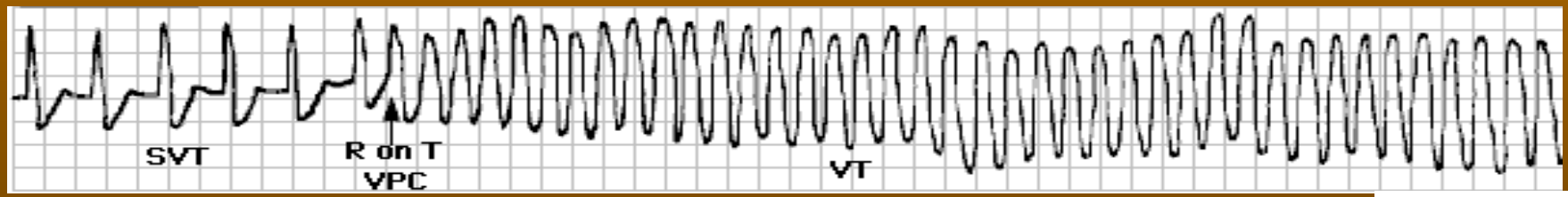
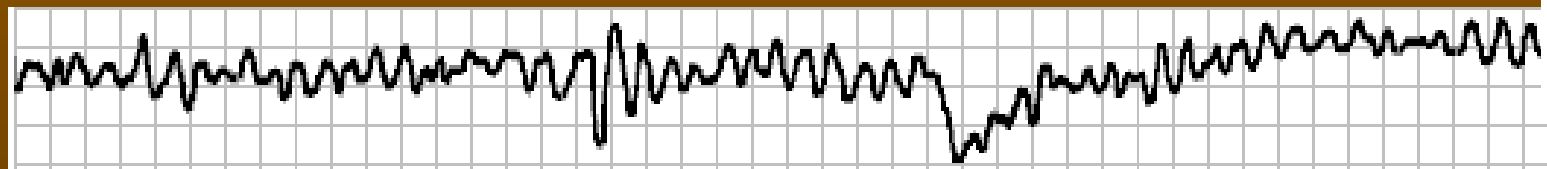
SCD - STATISTICS

SCD USA	200-400 000/ year Gillum RF., Circul 1989
SCD EU	250/day Pisa Z., Sudden death 1980
Malignant arrhythmias	80-90% Gillum RF., Pisa
Efficacy of CPR	10-15%







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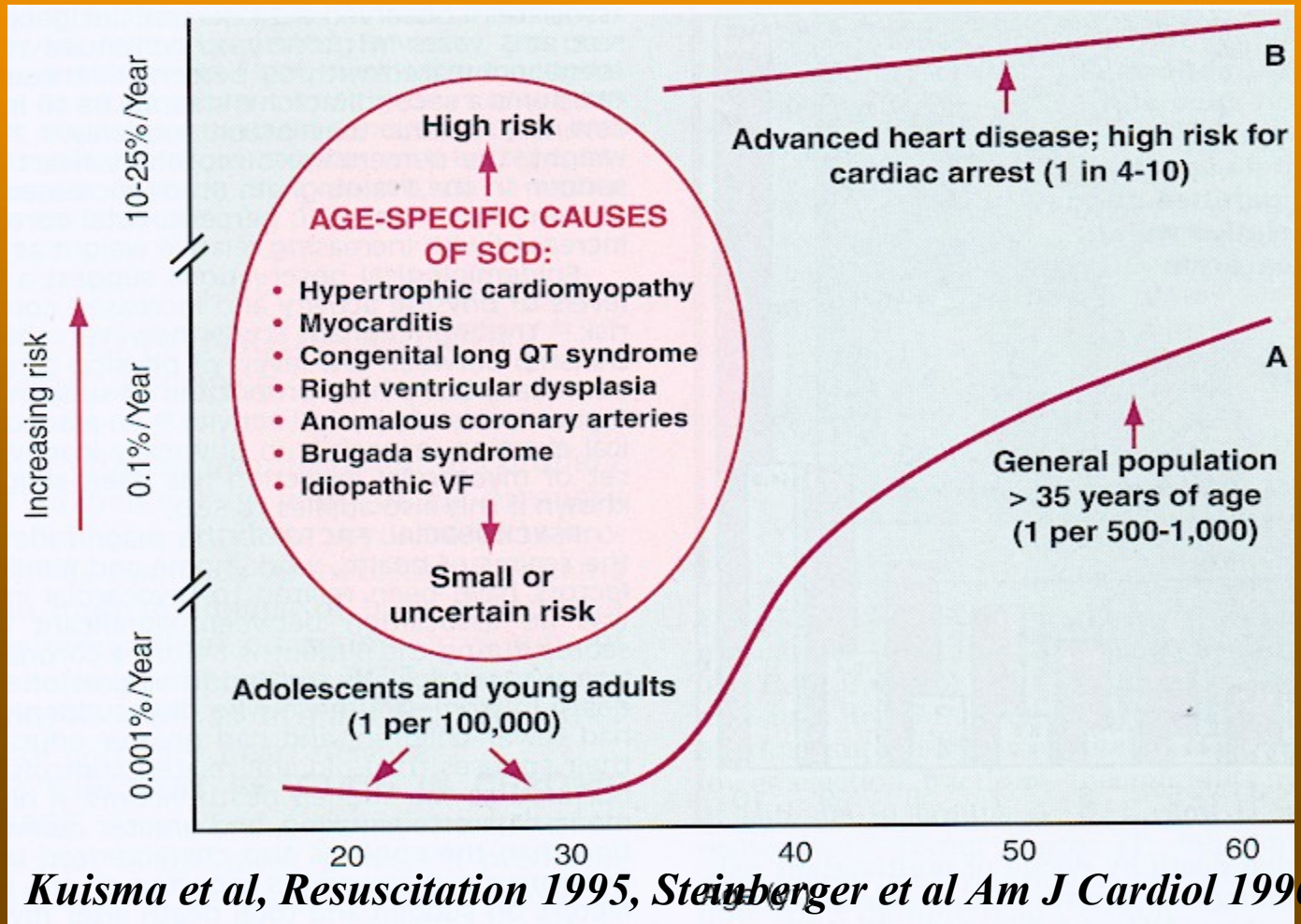
SCD x AGE

- incidence 1SCD/100.000 inhabitants < 35 (x 1/1000 u population > 35)
- acute forms CAD 20-39 - 76% SCD *Kuller et al. JAMA 1966,198:158*



Kuisma et al, Resuscitation 1995, Steinberger et al Am J Cardiol 1996

FAKULTNÍ NEMOCNICE BRNO

PARIS PROSPECTIVE STUDY

- **7.079 man, age 43-52 years (1967-1972), follow-up 23 years**

•Jouven X et al. Circulation. 1999;99:1978-1983

TABLE 4. Adjusted RRs Associated With Sudden Death and Fatal Myocardial Infarction Before the Age of 65 Years in the Paris Prospective Study I by Multivariate Analysis

	Sudden Death at <65 y		Fatal Myocardial Infarction at <65 y	
Variables	RR (95% CI)	*P*	RR (95% CI)	*P*
Age at entry	0.96 (0.77–1.21)	NS	1.11 (0.87–1.41)	NS
Body mass index	1.29 (1.03–1.52)	0.04	0.87 (0.70–1.08)	NS
Tobacco consumption	1.39 (1.17–1.66)	0.0002	1.29 (1.09–1.55)	0.003
Diabetic status	2.64 (1.26–5.53)	0.01	0.96 (0.30–3.07)	NS
Heart rate	1.14 (0.98–1.38)	NS	1.21 (1.00–1.45)	0.04
Systolic arterial pressure	1.23 (1.01–1.51)	0.005	1.46 (1.22–1.75)	0.0001
Cholesterol	1.40 (1.13–1.65)	0.001	1.25 (1.00–1.52)	0.05
Triglycerides	0.98 (0.80–1.22)	0.93	1.06 (0.86–1.31)	NS
Parental myocardial infarction and death at <65 y	1.73 (0.42–7.14)	NS	3.42 (1.22–9.54)	0.0
Parental sudden death at <65 y	2.00 (1.02–3.90)	0.04	0.70 (0.26–1.81)	NS

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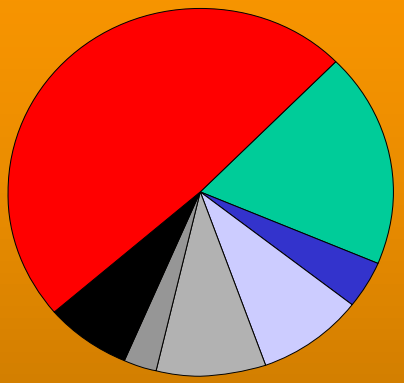
MUSTT

Schéma studie



ICHS, EF LK pod 40%, NSKT
2202 pacientů
PSK

PSK pozit.
704 p. (35%)
RANDOMIZACE

PSK neg.
1435 p. (65%)

noAA
353

EP guided terapie
351

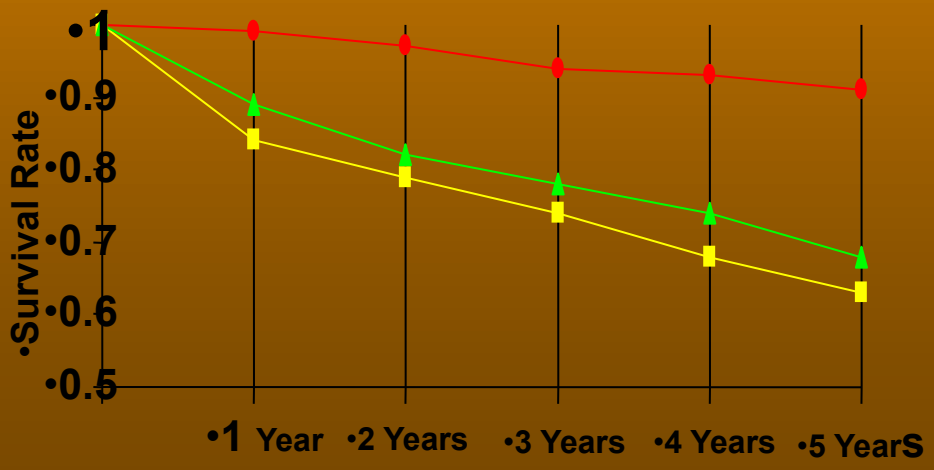
účinná AA
190

neúčinná AA
161

ICD

redukce TM
-50%

redukce TM
-27%



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MORTALITY – HISTORY x TODAY

Original Articles

Changing Characteristics and Mode of Death Associated With Chronic Heart Failure Caused by Left Ventricular Systolic Dysfunction

A Study Across Therapeutic Eras

Table 2. Use of Heart Failure Therapies

	Historic (n=281)	Contemporary (n=357)	P
Drug			
Angiotensin-converting enzyme inhibitor, % (n)	83 (233)	89 (317)	0.02
Mean dose, ramipril equivalent, mg	3.4 (0.2)	5.1 (0.2)	<0.001
β-Adrenoceptor blocker, % (n)	8.5 (24)	80 (284)	<0.001
Aldosterone antagonists, % (n)	0	36 (129)	<0.001
Statin, % (n)	3.2 (9)	58 (204)	<0.001
Amiodarone, % (n)	16 (46)	13 (45)	0.18
Digoxin, % (n)	21 (60)	13 (46)	0.004
Loop diuretic, % (n)	98 (274)	72 (254)	<0.001
Mean dose, furosemide equivalent, mg	79 (3.9)	47 (2.7)	<0.001
Device-based therapies			
ICD, % (n)	0	16 (57)	<0.001
CRT, % (n)	0	23 (82)	<0.001

Table 1. Patient Characteristics Within Historic and Contemporary Cohorts

	Historic Cohort (n=281)	Contemporary Cohort (n=357)	P
Age, y	62 (0.6)	66 (0.7)	<0.001
Male sex, % (n)	81 (227)	71 (254)	0.005
Ischemic etiology, % (n)	79 (221)	62 (222)	<0.001
NYHA class, % (n)			<0.001
I	1 (3)	25 (91)	
II	51 (144)	43 (153)	
III	46 (129)	29 (103)	
IV	2 (5)	3 (9)	
Nonfasting glucose, mmol/L	5.0 (4.6–5.8)	5.2 (4.8–5.8)	0.29
Sodium, mmol/L	140 (0.2)	140 (0.2)	0.39
Potassium, mmol/L	4.3 (0.03)	4.4 (0.02)	0.004
eGFR, mL/kg per minute	58 (1.1)	56 (0.9)	0.08
Cardiothoracic ratio	0.54 (0.004)	0.55 (0.003)	0.13
LV end-diastolic dimension, mm	65 (0.6)	60 (0.5)	<0.001
LV end-systolic dimension, mm	56 (0.6)	49 (0.6)	<0.001
LV ejection fraction, %	30 (0.5)	31 (0.5)	0.44
QRS maximum, ms	138 (1.9)	134 (1.8)	0.09
QRS maximum >120 ms, % (n)	70 (168)	58 (176)	0.003
QTc maximum, ms	502 (3.1)	471 (2.3)	<0.001
QTc dispersion, ms	82 (61–104)	30 (19–43)	<0.001
LV hypertrophy on ECG, % (n)	9 (22)	20 (60)	0.001

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- SCD 33,6% x 12,7%

MORTALITY – HISTORY x TODAY

- SCD 33,6% x 12,7%

Original Articles

Changing Characteristics and Mode of Death Associated With Chronic Heart Failure Caused by Left Ventricular Systolic Dysfunction

A Study Across Therapeutic Eras

Richard M. Cubbon, MRCP, PhD; Christopher P. Gale, MRCP, PhD; Lorraine C. Kearney, BSc; Clyde B. Schechter, FACPM, MD; W. Paul Brooksby, FRCP, MD; Jim Nolan, FRCP, MD; Keith A.A. Fox, FRCP, MD; Adil Rajwani, MRCP, PhD; Wazir Baig, FRCP, MD; David Groves, PhD; Pauline Barlow, BSc; Anthony C. Fisher, MD; Phillip D. Batin, FRCP, MD; Matthew B. Kahn, MRCP; Azfar G. Zaman, FRCP, MD; Ajay M. Shah, FRCP, MD; Jon A. Byrne, MRCP, MD; Steven J. Lindsay, FRCP, MD; Robert J. Sapsford, FRCP, MD; Stephen B. Wheatcroft, MRCP, PhD; Klaus K. Witte, MRCP, MD; Mark T. Kearney, FRCP, MD

Background—Therapies for patients with chronic heart failure caused by left ventricular systolic dysfunction have advanced substantially over recent decades. The cumulative effect of these therapies on mortality, mode of death, symptoms, and clinical characteristics has yet to be defined.

Methods and Results—This study was a comparison of 2 prospective cohort studies of outpatients with chronic heart failure caused by left ventricular systolic dysfunction performed between 1993 and 1995 (historic cohort: n=281) and 2006 and 2009 (contemporary cohort: n=357). In the historic cohort, 83% were prescribed angiotensin-converting enzyme inhibitors and 8.5% were prescribed β-adrenoceptor antagonists, compared with 89% and 80%, respectively, in the contemporary cohort. Mortality rates over the first year of follow-up declined from 12.5% to 7.8% between eras (P=0.04), and sudden death contributed less to contemporary mortality (33.6% versus 12.7%; P<0.001). New York Heart Association class declined between eras (P<0.001). QTc dispersion across the chest leads declined from 85 ms (SD, 2) to 34 ms (SD, 1) and left ventricular end-diastolic dimensions declined from 65 mm (SD, 0.6) to 59 mm (SD, 0.5) (both P<0.001).

(*Circ Heart Fail*. 2011;4:

FAKULTNÍ NEMOCNICE BRNO

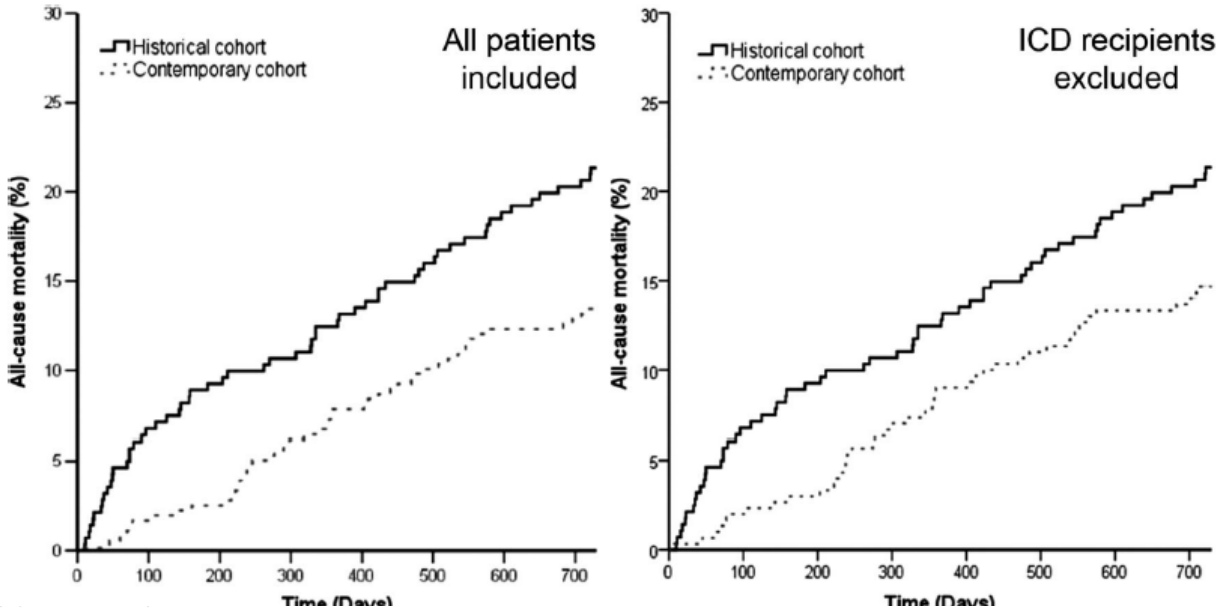
Changing Characteristics and Mode of Death Associated With Chronic Heart Failure Caused by Left Ventricular Systolic Dysfunction

A Study Across Therapeutic Eras

Richard M. Cubbon, MRCP, PhD; Christopher P. Gale, MRCP, PhD; Lorraine C. Kearney, BSc; Clyde B. Schechter, FACPM, MD; W. Paul Brooksby, FRCP, MD; Jim Nolan, FRCP, MD; Keith A.A. Fox, FRCP, MD; Adil Rajwani, MRCP, PhD; Wazir Baig, FRCP, MD; David Groves, PhD; Pauline Barlow, BSc; Anthony C. Fisher, MD; Phillip D. Batin, FRCP, MD; Matthew B. Kahn, MRCP; Azfar G. Zaman, FRCP, MD; Ajay M. Shah, FRCP, MD; Jon A. Byrne, MRCP, MD; Steven J. Lindsay, FRCP, MD; Robert J. Sapsford, FRCP, MD; Stephen B. Wheatcroft, MRCP, PhD; Klaus K. Witte, MRCP, MD; Mark T. Kearney, FRCP, MD

Table 3. Mode of Death

	Historic	Contemporary	*P*
All patients			
Sudden death	34 (43)	13 (9)	
Progressive heart failure	41 (53)	37 (26)	
Other cardiovascular	14 (18)	7.0 (5)	
Noncardiovascular	11 (14)	41 (29)	
Unclassifiable	0	2.8 (2)	
			$\chi^2<0.001$ Across groups
ICD recipients excluded			
Sudden death	34 (43)	8.1 (5)	
Progressive heart failure	41 (53)	37 (23)	
Other cardiovascular	14 (18)	8.1 (5)	
Noncardiovascular	11 (14)	44 (27)	
Unclassifiable	0	3.2 (2)	
			$\chi^2<0.001$ Across groups



Conclusions—Survival has significantly improved in patients with chronic heart failure caused by left ventricular systolic dysfunction over the past 15 years; furthermore, sudden death makes a much smaller contribution to mortality, and noncardiac mortality is a correspondingly greater contribution. This has been accompanied by an improvement in symptoms and some markers of adverse electric and structural left ventricular remodeling. (*Circ Heart Fail.* 2011;4: 396-403.)

FAKULTNÍ NEMOCNICE BRNO

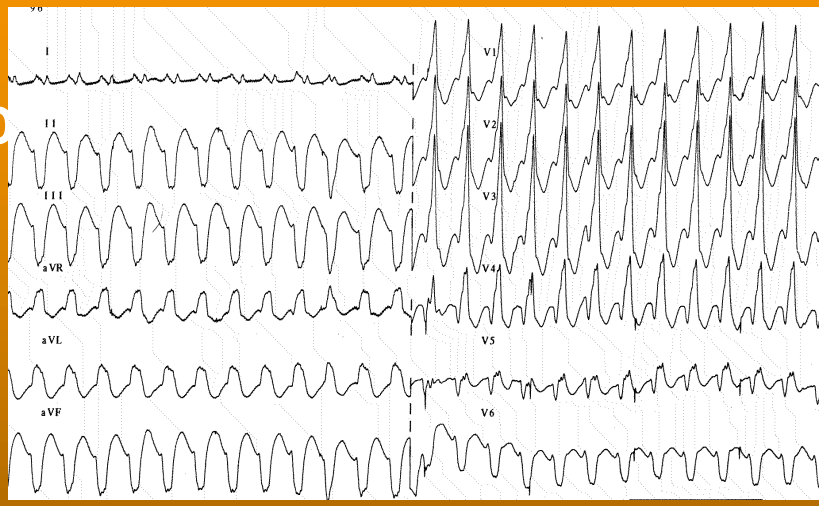
SCD/ PP

- •ACEI (SOLVD - 23% NSS, V-HeFT - 31% NSS, CHFSTAT -52% NSS)
  - • ACEI therapy – lower risk of SCD
  - • more than 50% pts. treated ACEI can profit from SCD prophylaxis
- •amiodaron (CHFSTAT,CAMIAT, EMIAT)
  - •Do not prolong survival with LV dysfunction
- •BB (CIBIS II, BEST, MERIT-HF)
  - • downgrade risk of SCD
  - • prolong survival of pts with CHF

FAKULTNÍ NEMOCNICE BRNO

SCD PREVENTION

- OPT + revascularization CAD
- ICD / CRT ICD
- RFA
- Heart transplant
- Surgery of CHF (MVP, aneurysmectomy)



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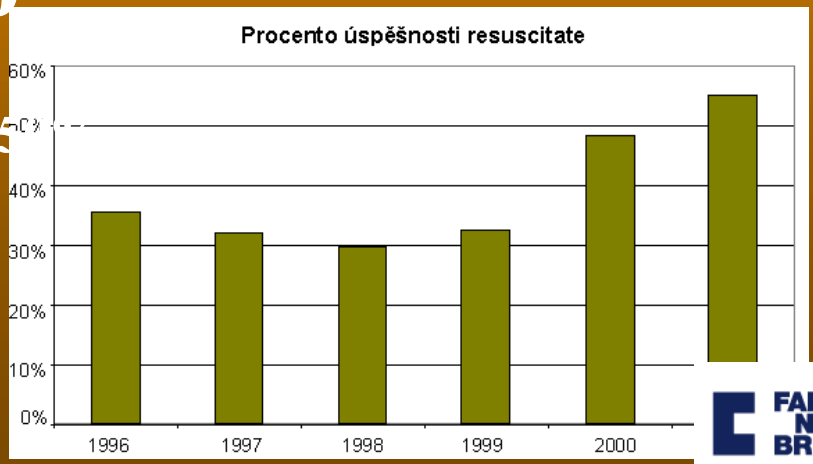
Profile of resuscitated patient

Who?

CAD (1. manifestation)	64-90% (25%)
64 years old man	81%
Minaram	45%

Cobb et al, Circulation, 1992



1996 2001

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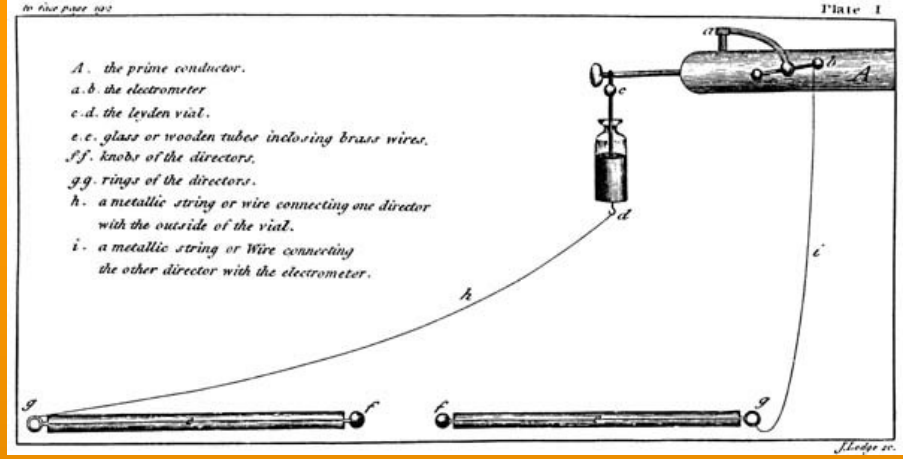
HISTORY

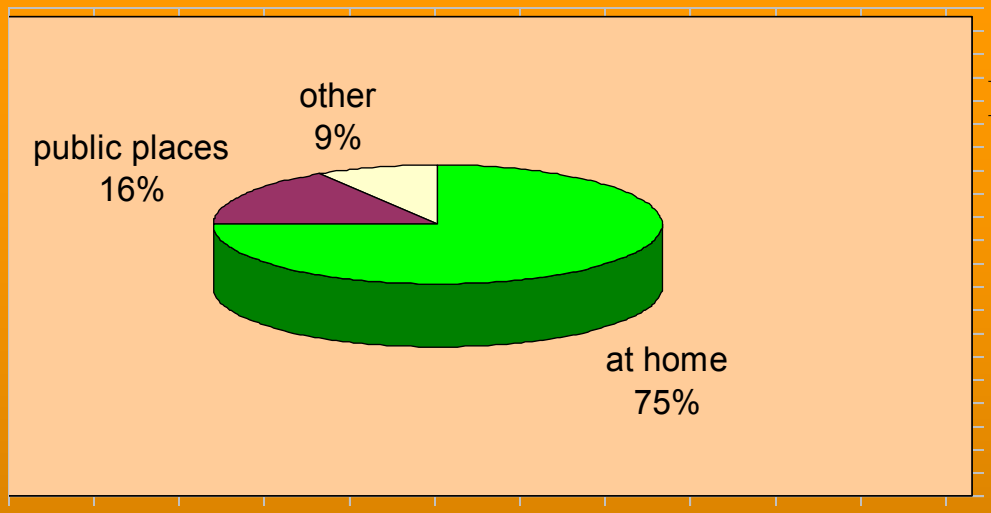


- **1788** Ch. Kite

An Assay on the Recovery of the Apparently Dead

with the consent of the parents, very humanely tried the effects of electricity. Twenty minutes had at least elapsed before he could apply the shock, which he gave to various parts of the body without any apparent success; but at length, on transmitting a few shocks through the thorax, he perceived a small pulsation; soon after the child began to breathe, though with great difficulty. In about ten minutes she vomited. A kind of stupor remained for some days; but the child was restored to perfect health and spirits in about a week.

Where?

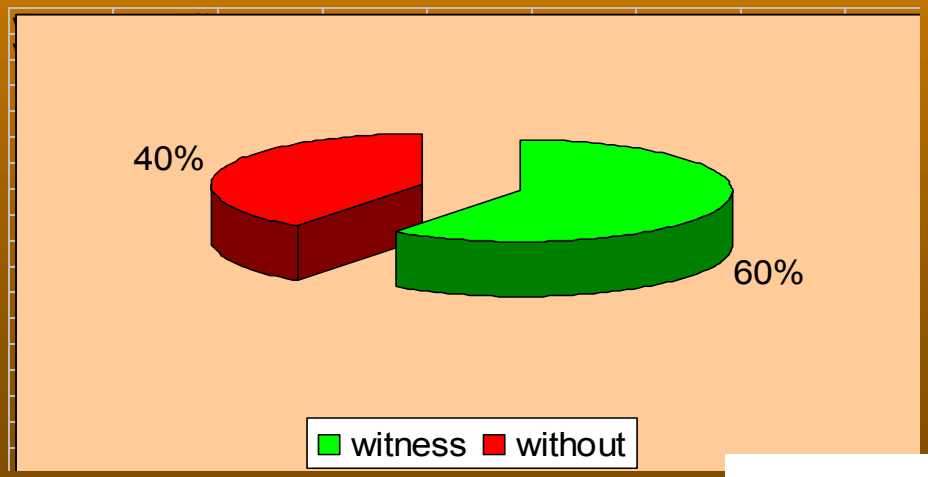


Incidence => 0.03 (30 places = 1 CA)

- **airports**
- **industrial zones**
- **golf clubs**
- **fitcenters**
- **casinas**

Atkins et al. Prehospital Disaster Med 1996, 11:47-49

Becker et al. Circulation. 1998,97:2106-2109



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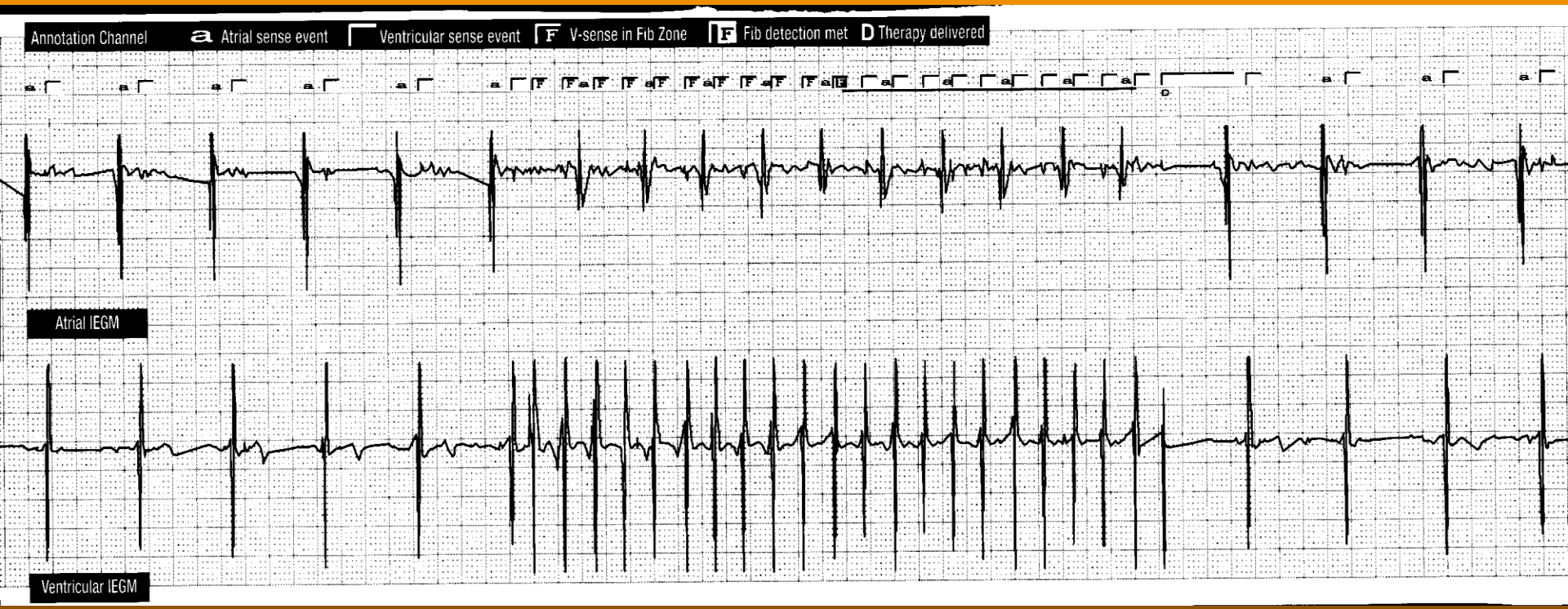
ICD IN SECONDARY PREVENTION OF SCD

ČR -75/1mil

FAKULTNÍ NEMOCNICE BRNO

ICD IN SECONDARY PREVENTION OF SCD



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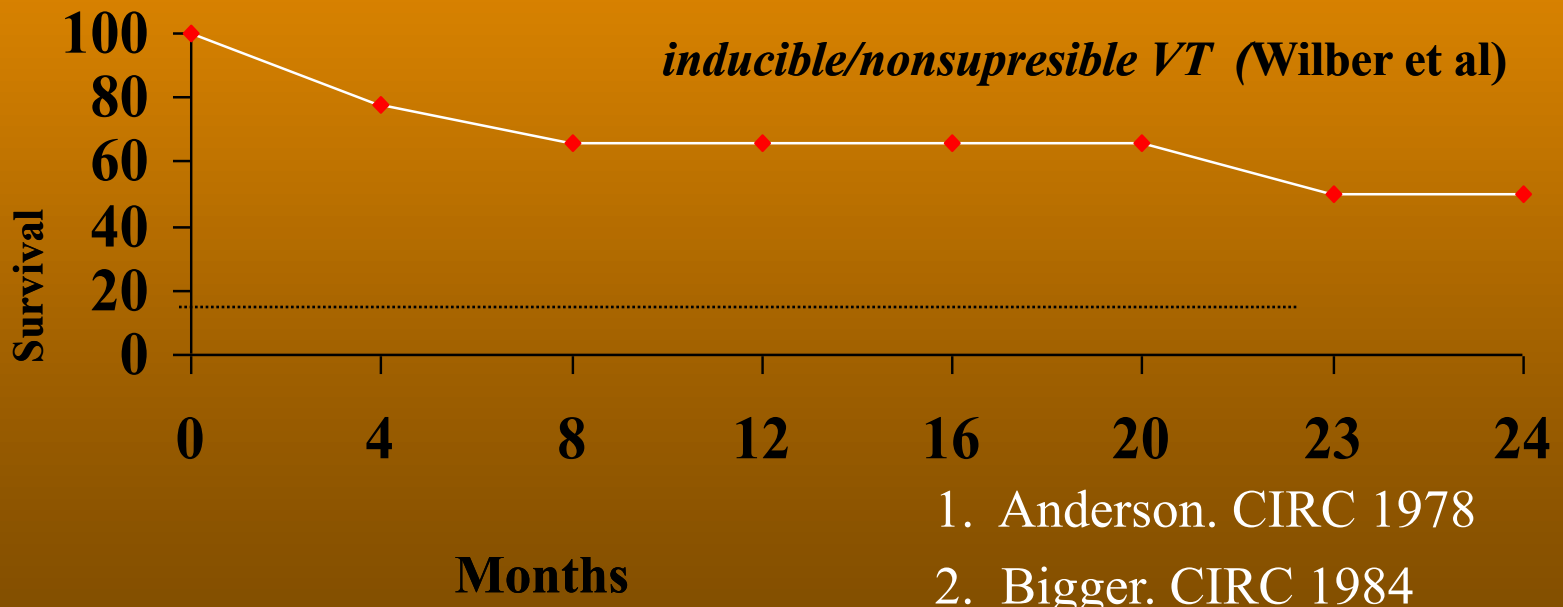
ICD - PRIMARY PREVENTION

CAD + NSVT

- **MI + NSVT + LV dysf. = 2 year mortality > 30%**
- **MI + NSVT + LV dysf. + EPS + = 50%**



1. Anderson. CIRC 1978
2. Bigger. CIRC 1984
3. Buxton. Am J C 19
4. Wilber CIRC 1990

FAKULTNÍ NEMOCNICE BRNO

For which patient?

- **A number of previous ICD studies* indicate patients are remarkably similar with respect to:**
  - **Age**
  - **Left Ventricular Ejection Fraction**
  - **Percentage with Coronary Artery Disease**
  - **NYHA classification**

Prophylactic patient is not different

*Sources: Moss, A, et al; *N Engl J Med* 1996; 335: 1933-40

Buxton, A, et al; *N Engl J Med* 1999; 341: 1882-90

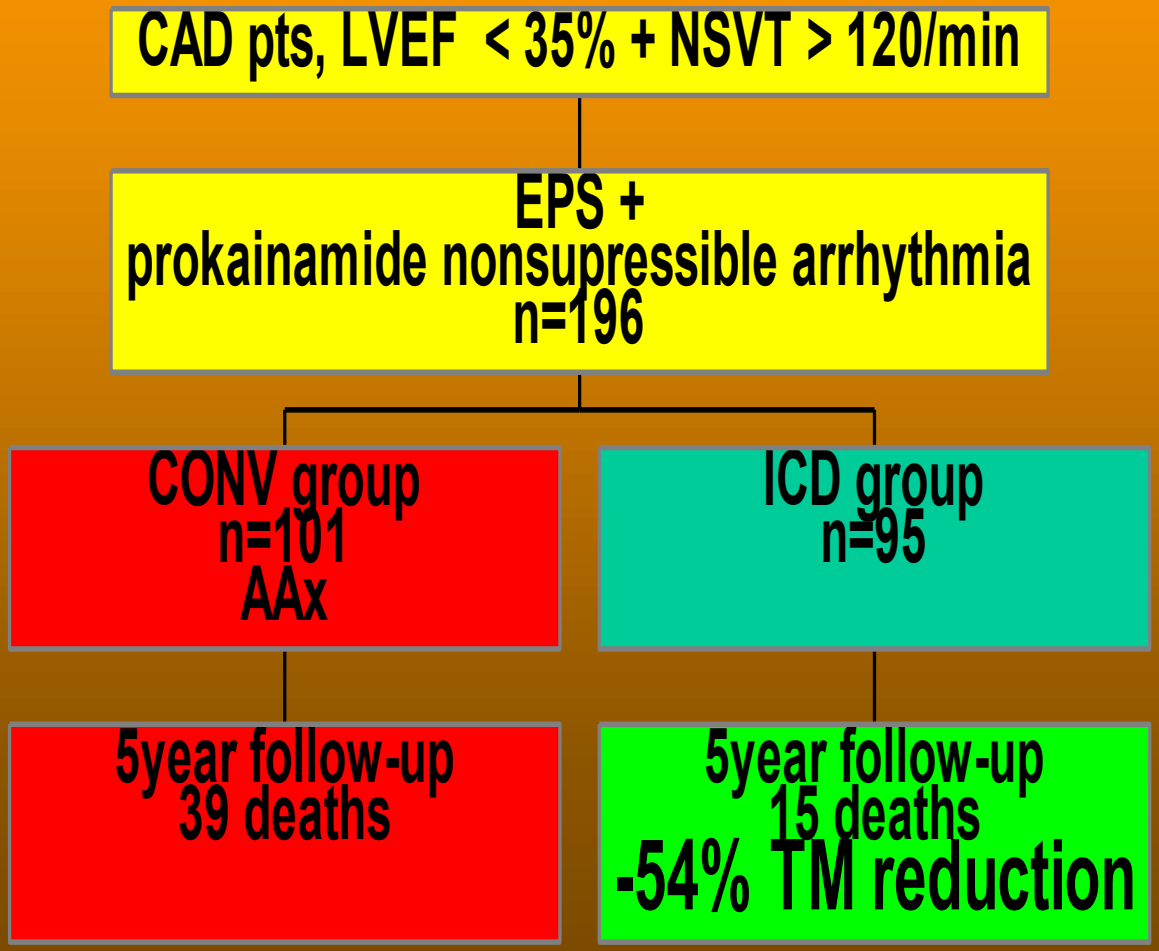
AVID Investigators; *N Engl J Med* 1997; 337: 1576-83

FAKULTNÍ NEMOCNICE BRNO

ICD IN PRIMARY PREVENTION OF SCD

MADIT

Schema of study



FAKULTNÍ NEMOCNICE BRNO

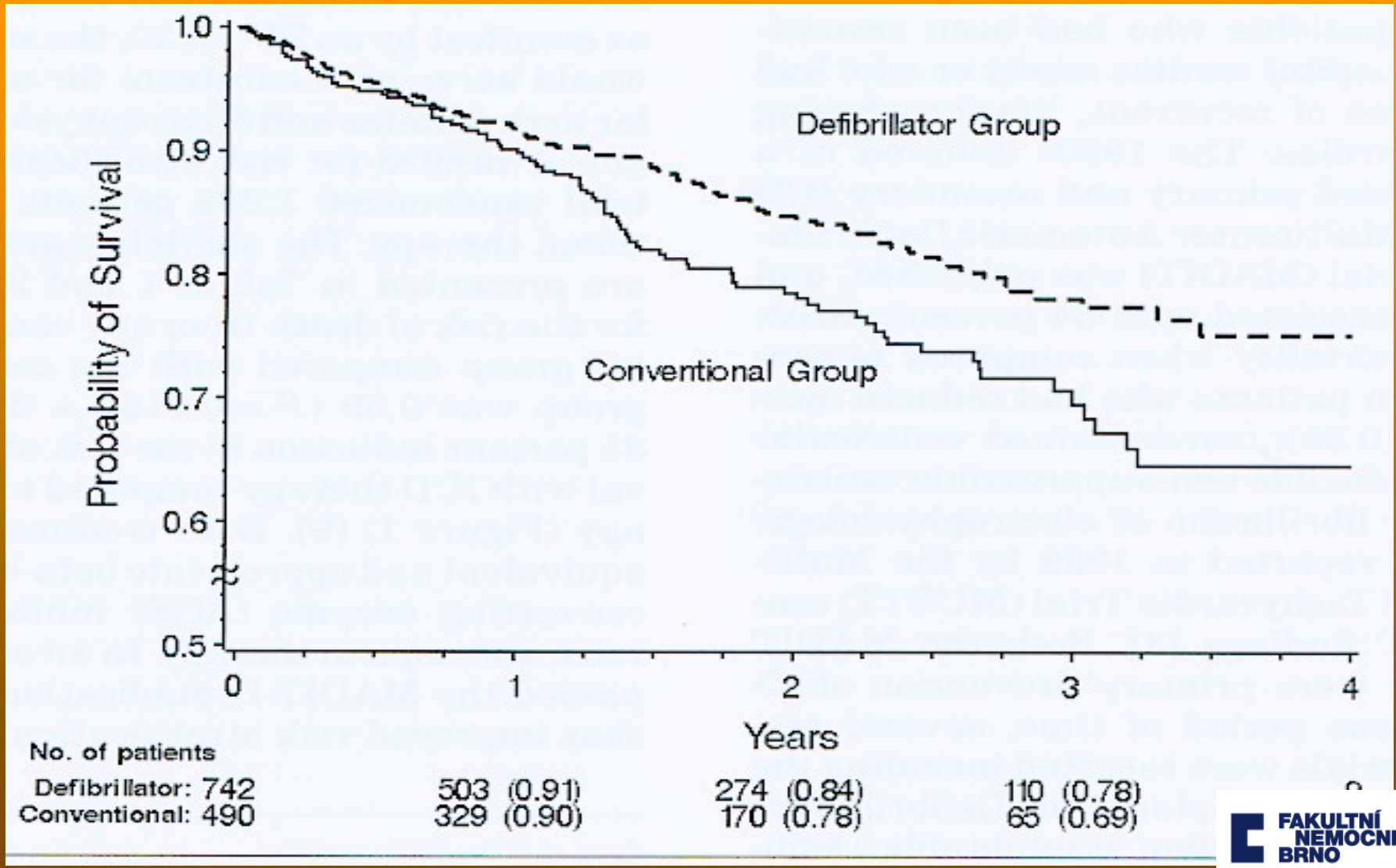
ICD - PRIMARY PREVENTION

- Documented episodes of NSVT in CAD post MI patients and LVEF < 0.35, sustained VT inducible in EPS.

FAKULTNÍ NEMOCNICE BRNO

ICD IN PRIMARY PREVENTION OF SCD

MADIT II



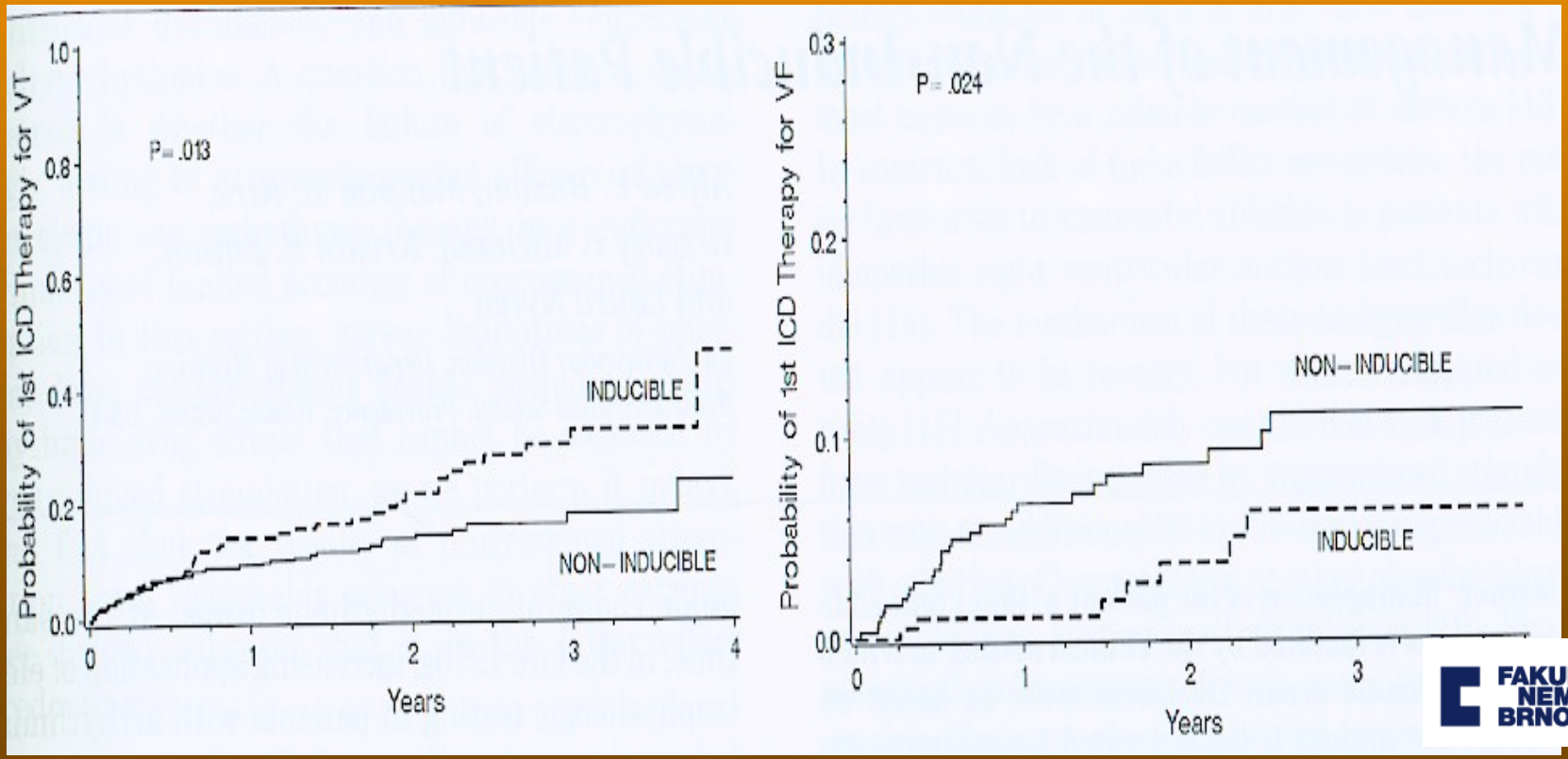
FAKULTNÍ NEMOCNICE BRNO

Moss AJ et al, CEPR 2002, 6(4), 463-465

ICD IN PRIMARY PREVENTION OF SCD

MADIT II

- ICD group (N=742) — 105 (14,2%) deaths
- CONV therapy (N=490) — 97 (19,8%)
- 31% reduction of deaths in ICD group
- 63% reduction of mortality - QRS > 120 ms



Moss AJ et al, CEPR 2002, 6(4), 463-465

FAKULTNÍ NEMOCNICE BRNO

ICD IN PRIMARY PREVENTION OF SCD

- 4.12.5.

CAD post MI, LV dysfunction, LVEF < 0.30, QRS > 120ms, NYHA II, 6 m post IM, standard pharmacotherapy (bb)

FAKULTNÍ NEMOCNICE BRNO

ICD IN PRIMARY PREVENTION OF SCD - CZ

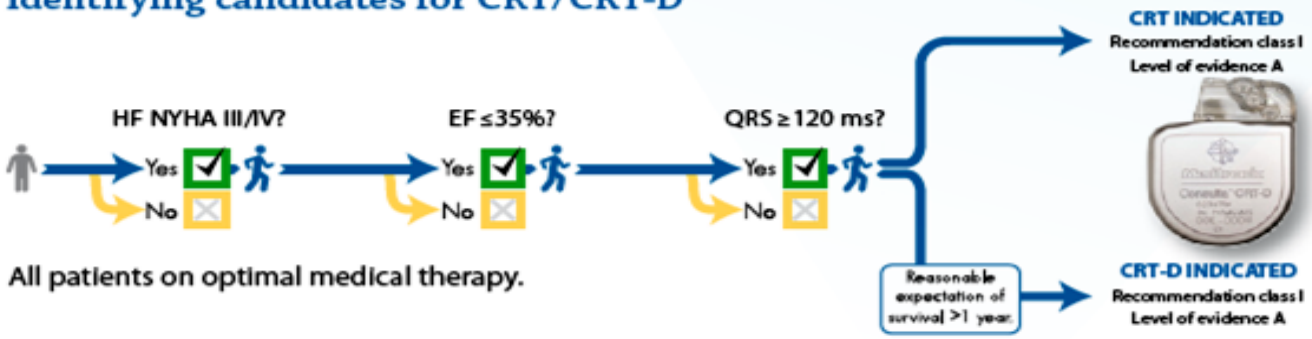
•2010 – 2019 - 75% primary preventive implantation

• 2004	5,5%
• 2005	7%
• 2006	22,8%
• 2007	34 %
• 2008	39%
• 2009	46%

FAKULTNÍ NEMOCNICE BRNO

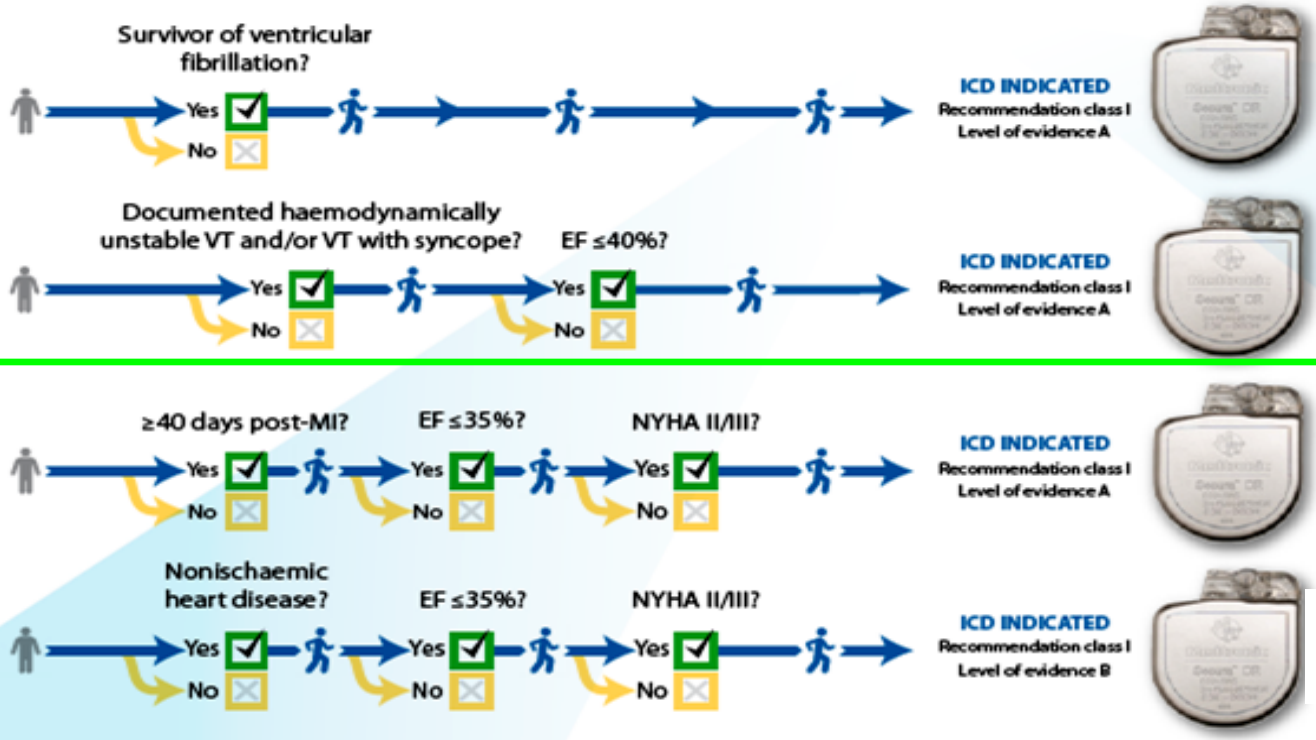
Recognising candidates for Heart Failure device therapies as indicated in ESC treatments guidelines

Identifying candidates for CRT/CRT-D



All patients on optimal medical therapy.

Identifying candidates for ICD



All patients on optimal medical therapy with reasonable expectation of survival > 1 year.

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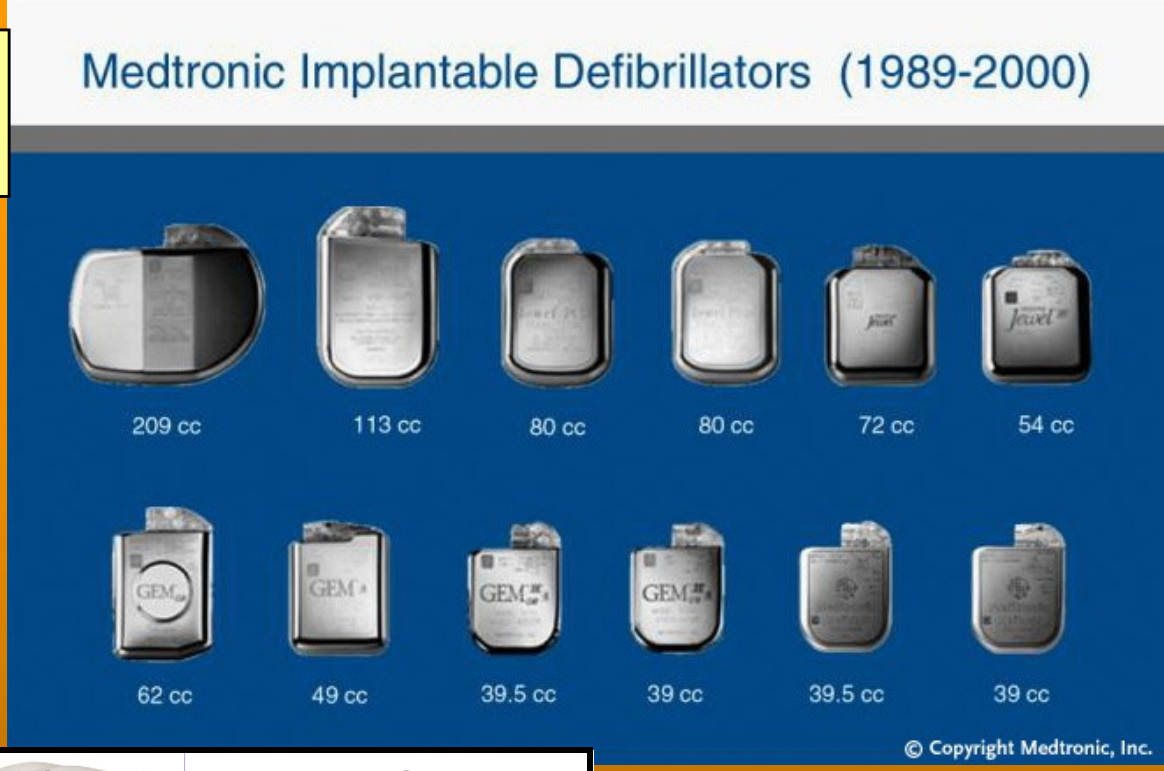
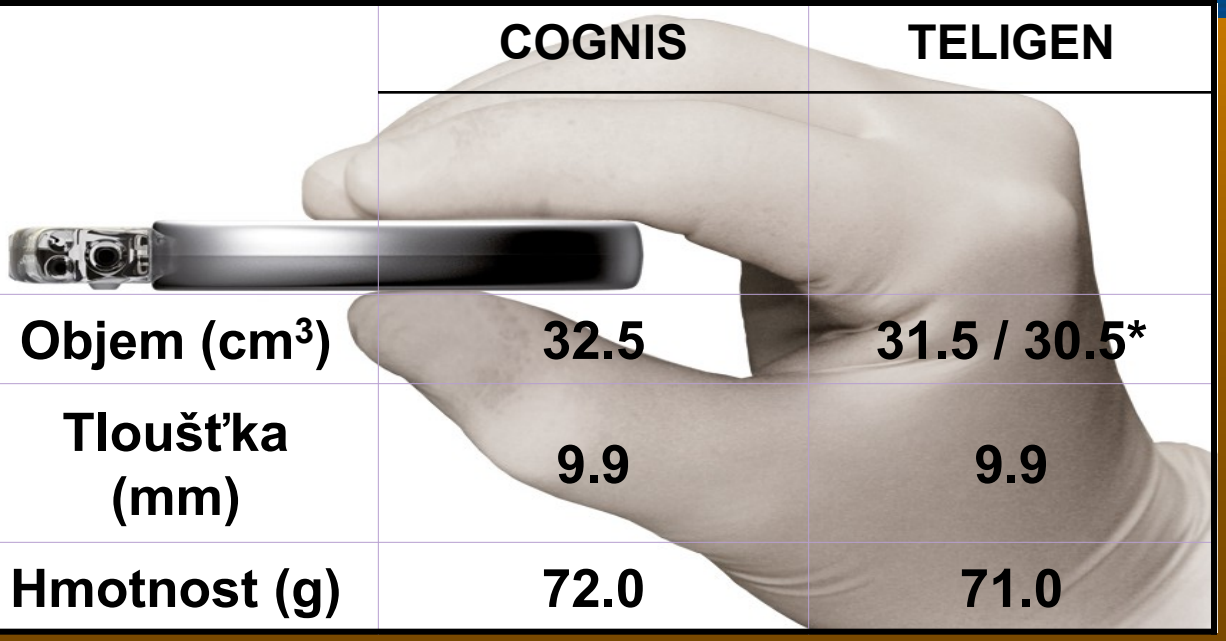
•ICD HARDWARE



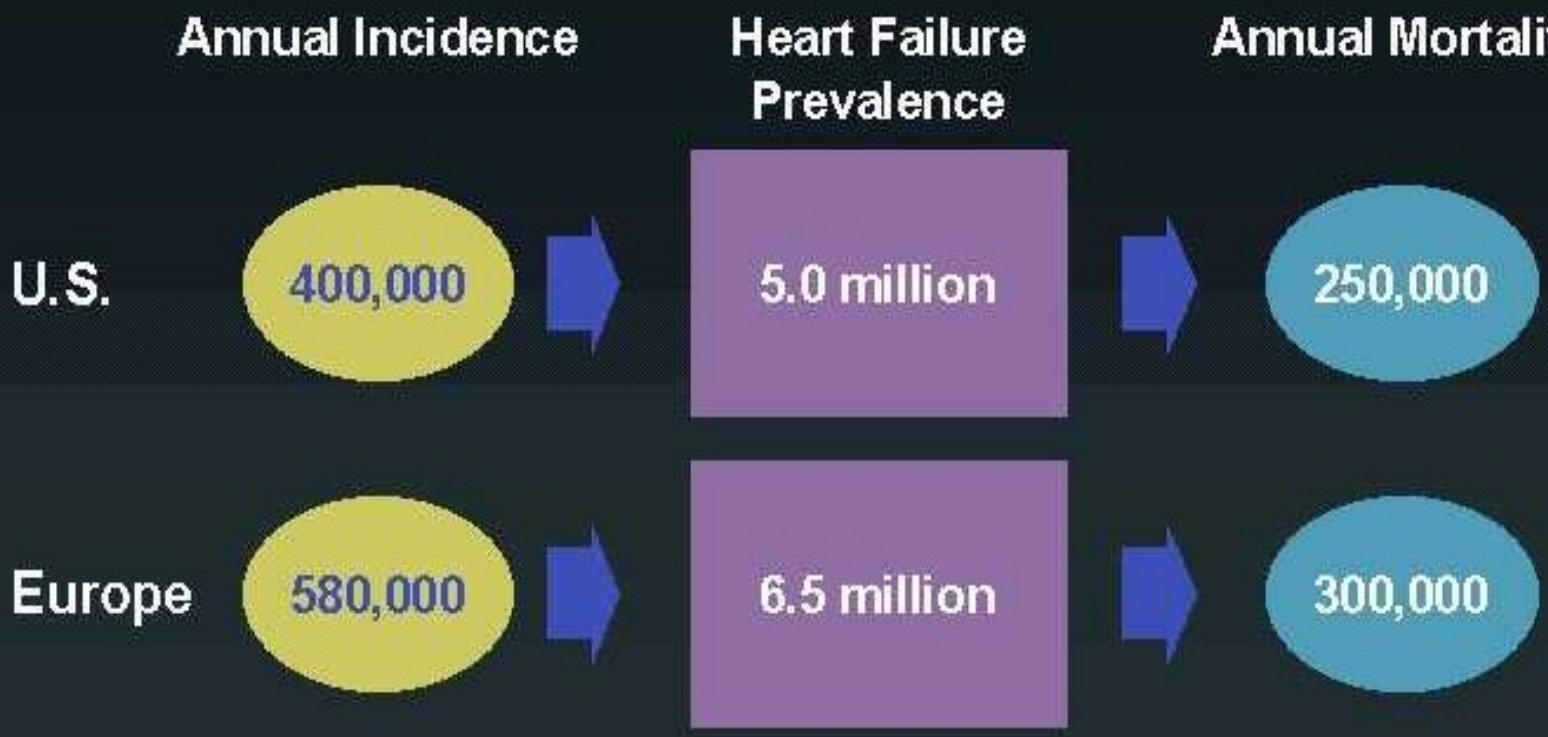


	COGNIS	TELIGEN
Objem (cm^3)	32.5	31.5 / 30.5*
Tloušťka (mm)	9.9	9.9
Hmotnost (g)	72.0	71.0

FAKULTNÍ NEMOCNICE BRNO

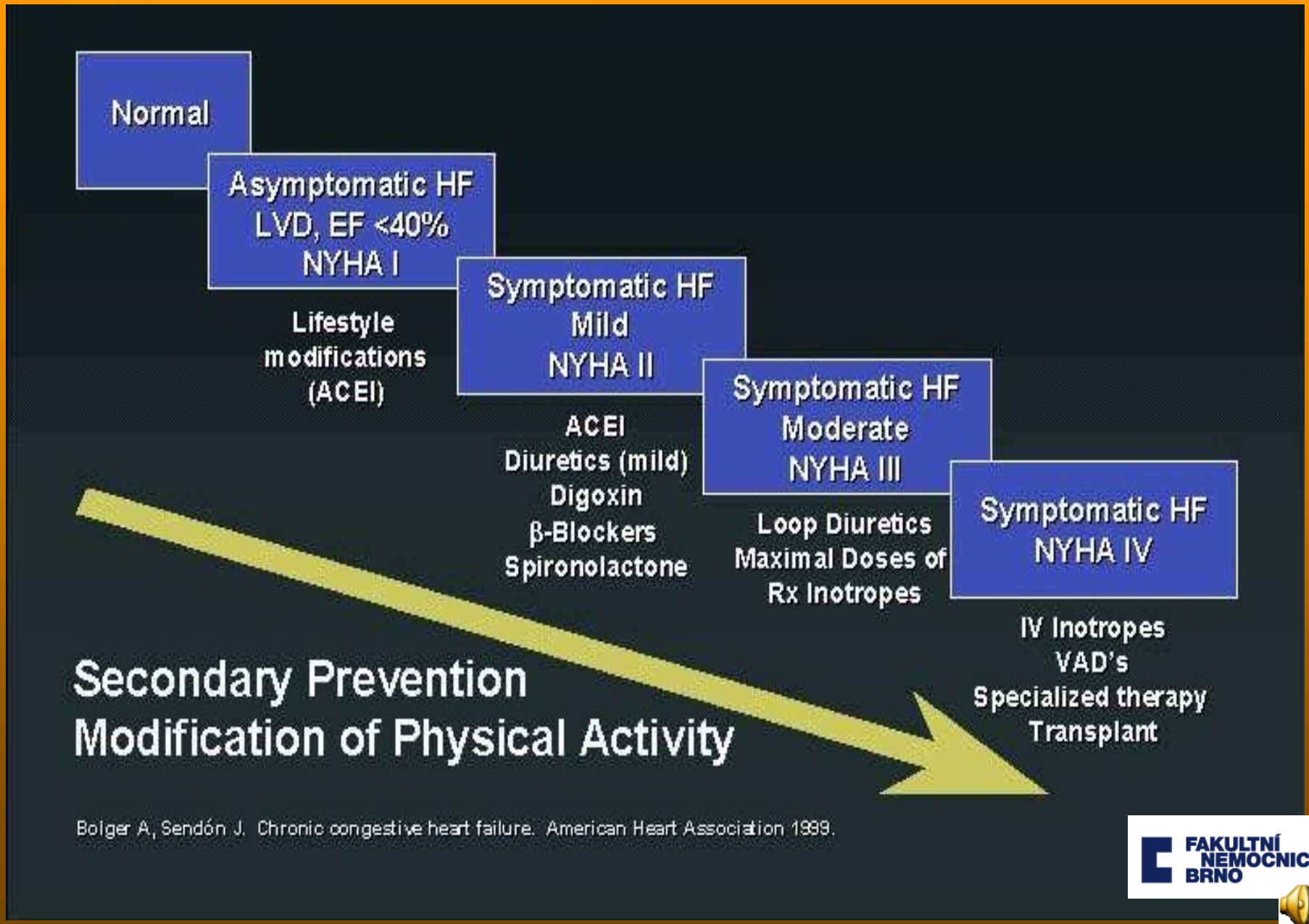
Heart Failure Management

A Growing Medical Challenge



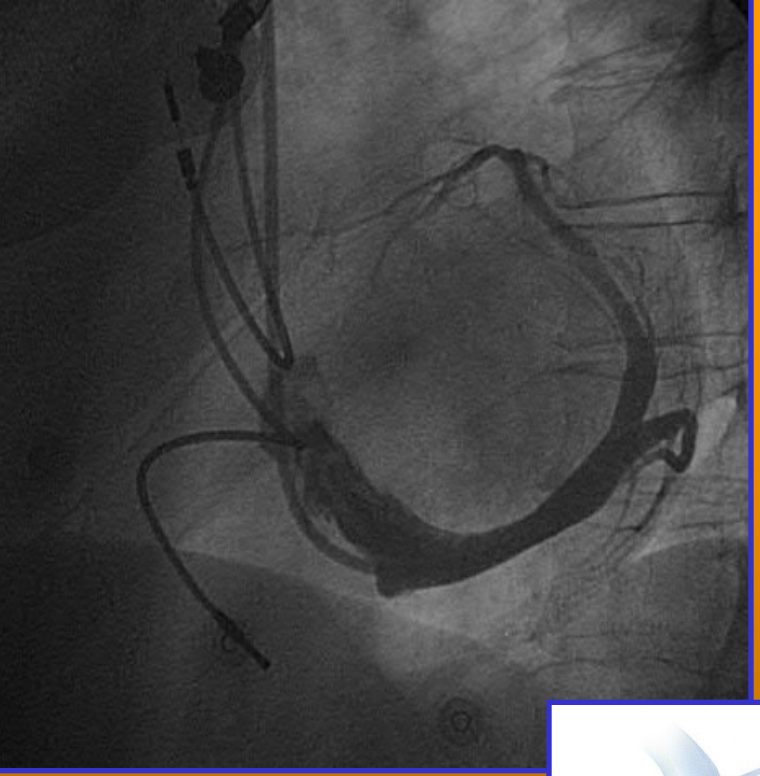
Congestive heart failure worldwide markets, clinical status and product development opportunities. *New Medicine, Inc.* 1997;1-40.
Wilkerson Group Survey, 1998.

FAKULTNÍ NEMOCNICE BRNO

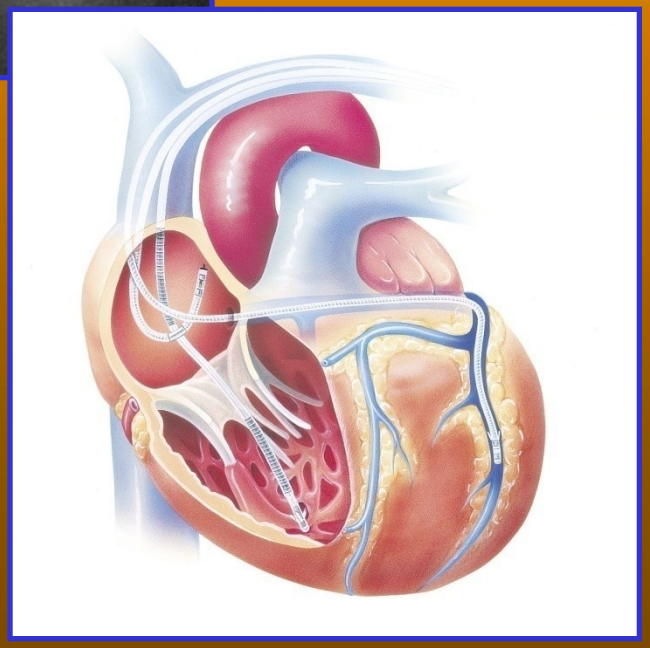


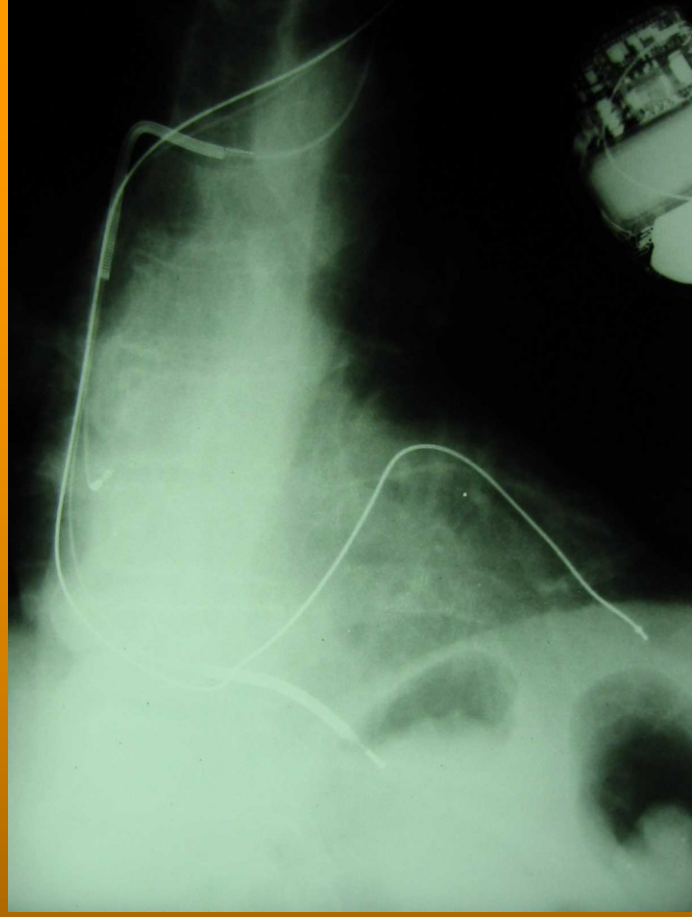
Bolger A, Sendón J. Chronic congestive heart failure. American Heart Association 1999.

FAKULTNÍ NEMOCNICE BRNO



CRT



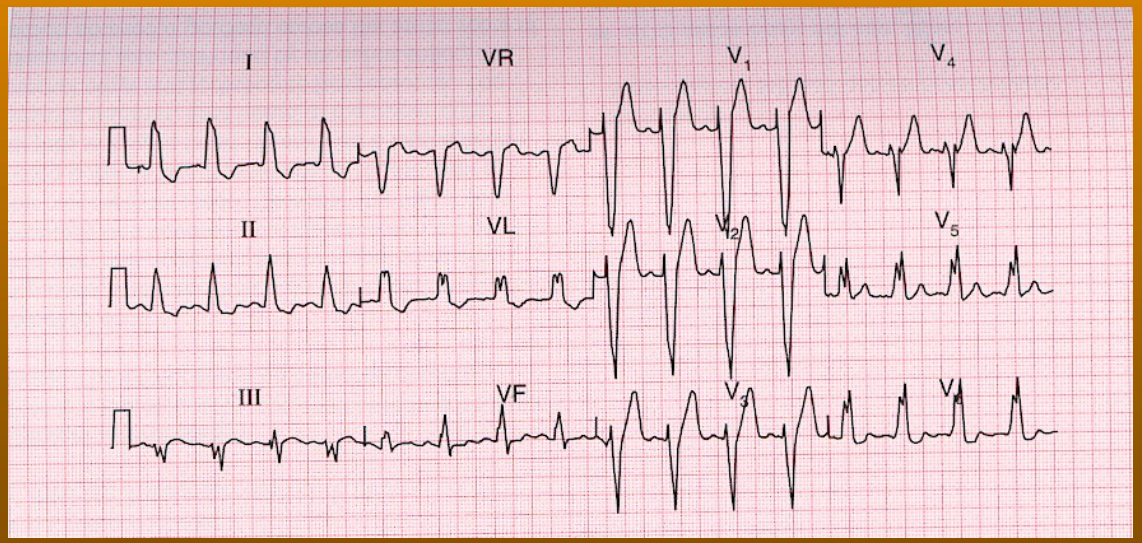


FAKULTNÍ NEMOCNICE BRNO

CRT INDICATION

- **4.10. HF, stand. Rx 6 months (NYHA II/ III 6 m, NYHA IV)**

  LVEF < 35%, QRS > 150 ms, 120-150ms, dyssynchrony



FAKULTNÍ NEMOCNICE BRNO

UP TO DATE STATUS

2003 2004 2005 2006 2007 2008

BIO

Home Monitoring (‘02)

Home Monitoring II

MDT

Directo - CareLink Programmer & RemoteView

CareLink Network (’02)

CareLink Network

SJM

HouseCall

HouseCall Plus

HouseCall Plus

BS

Renewal/Inductive/Frontier

Frontier

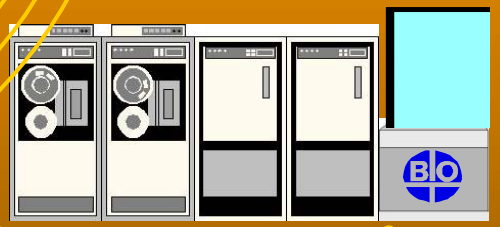
Home Monitoring

Implant with
Home Monitoring

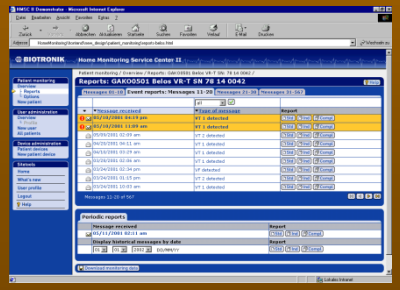
Patient

Patient Device
Cardio
Messenger

BIOTRONIK
Service Center



Cardio Report



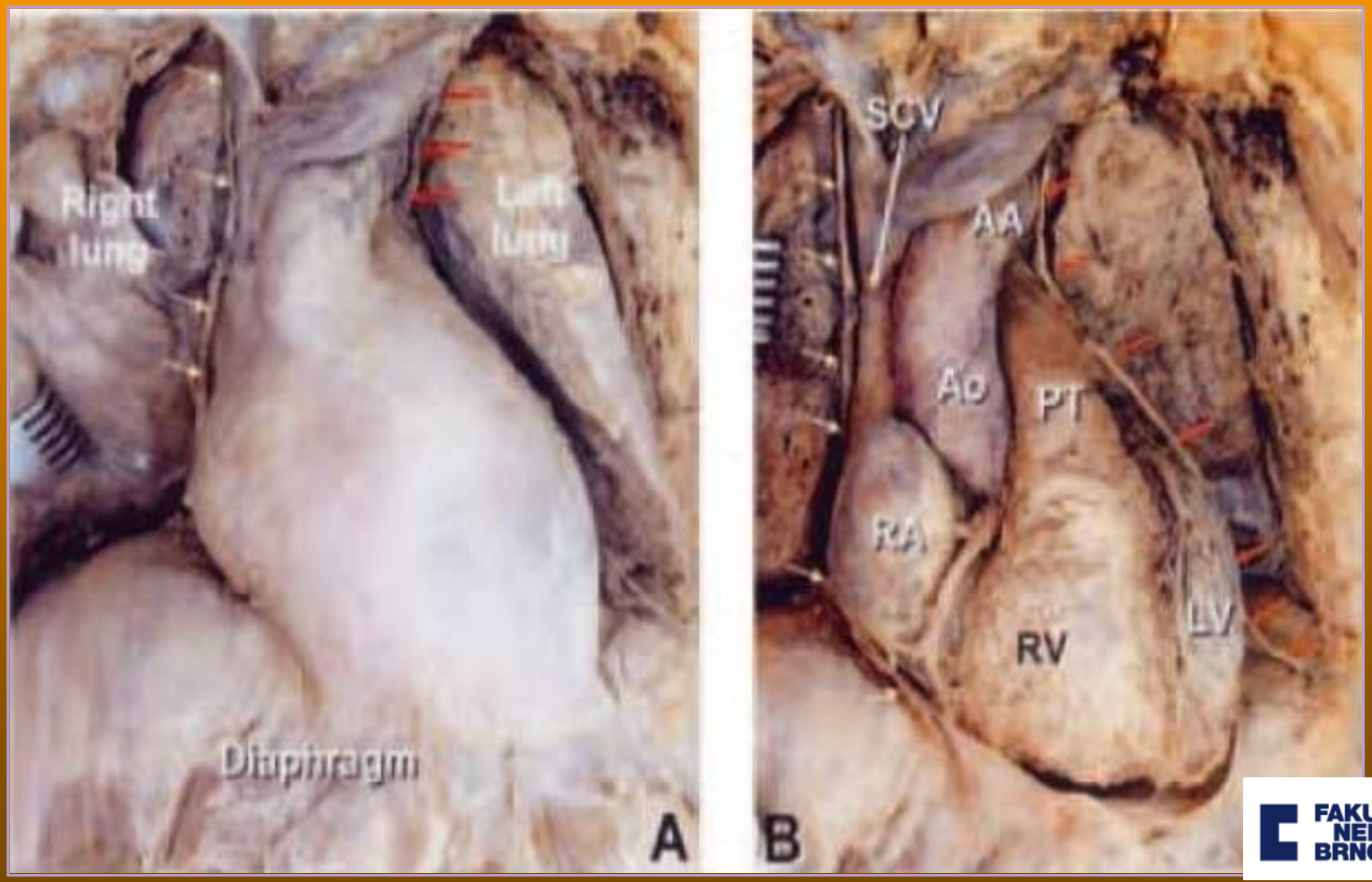
Physician

BIOTRONIK

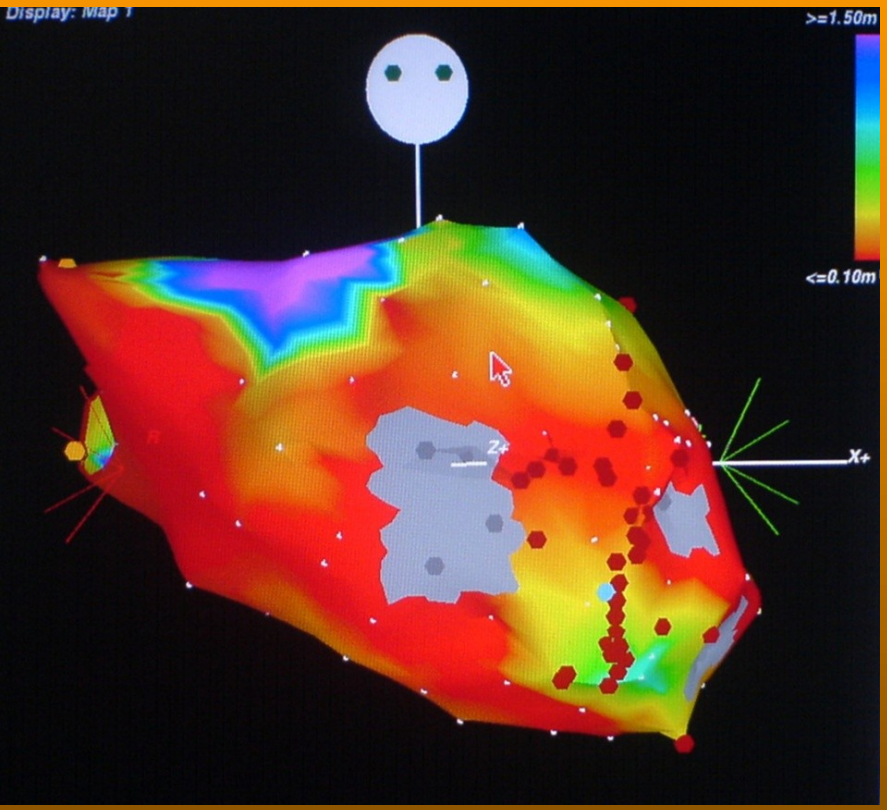
FAKULTNÍ NEMOCNICE BRNO

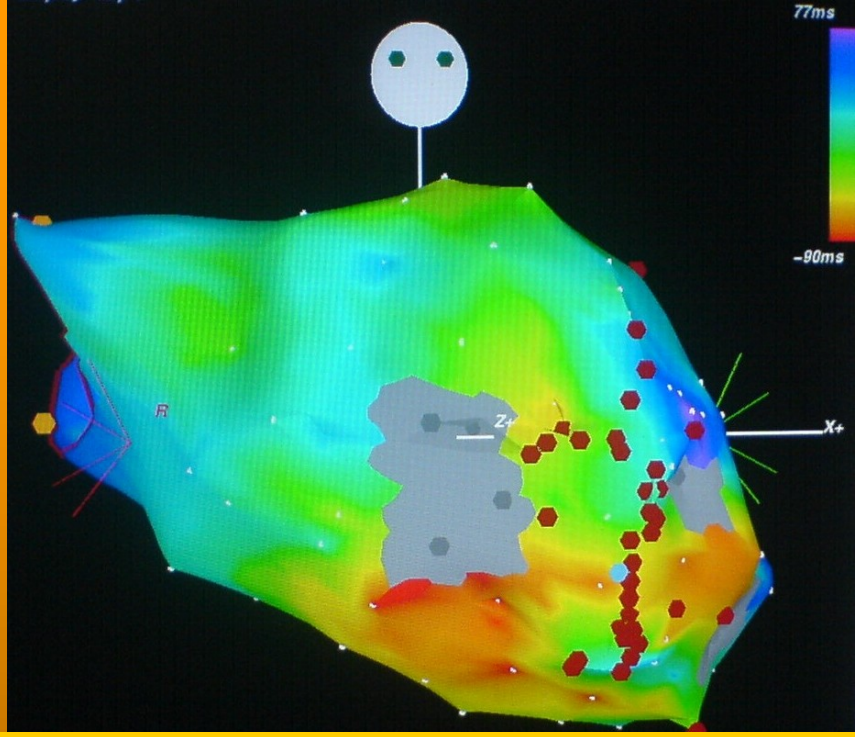
•ICD SOFTWARE

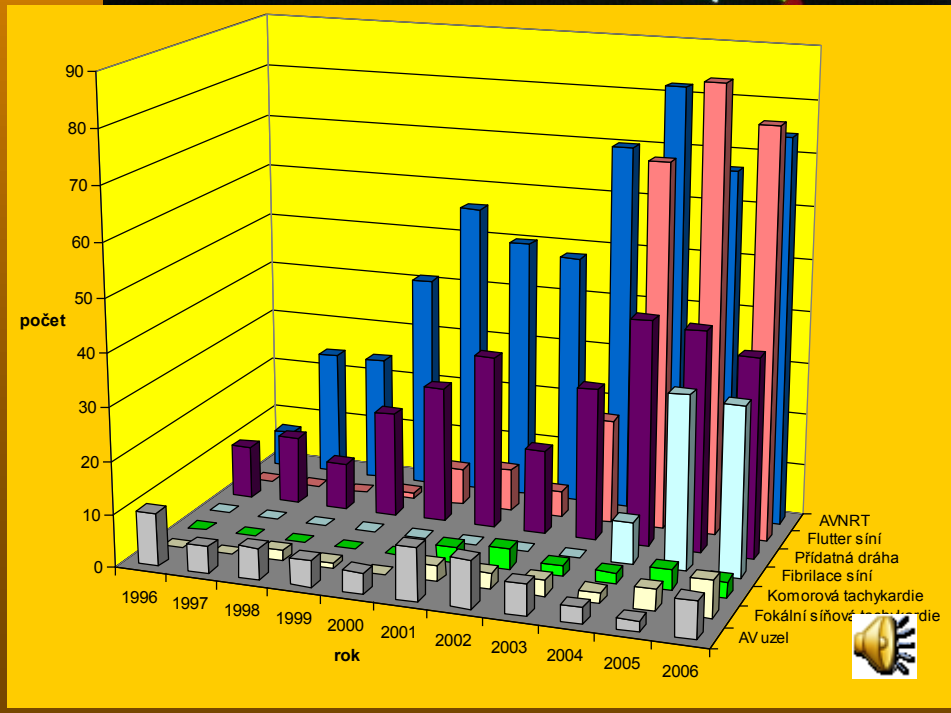
•Anatomie nervus phrenicus



RFA VT







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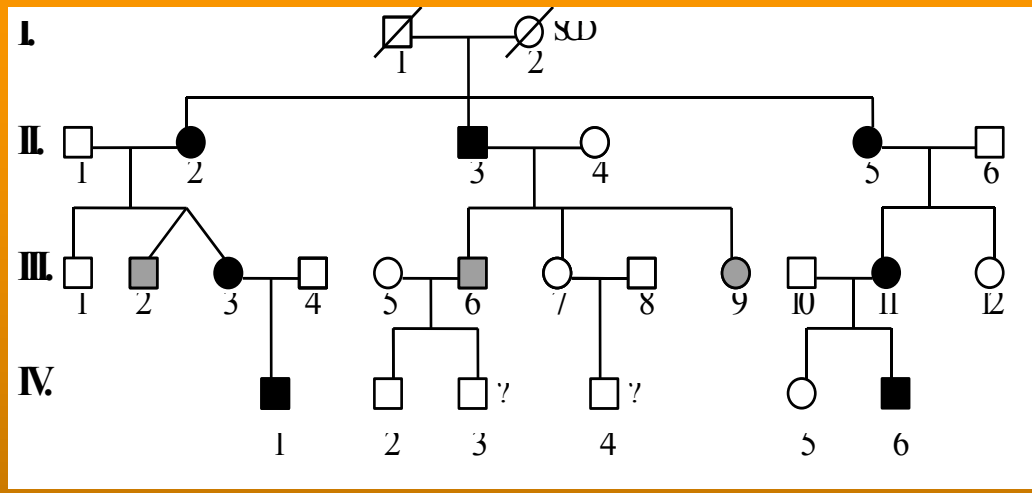
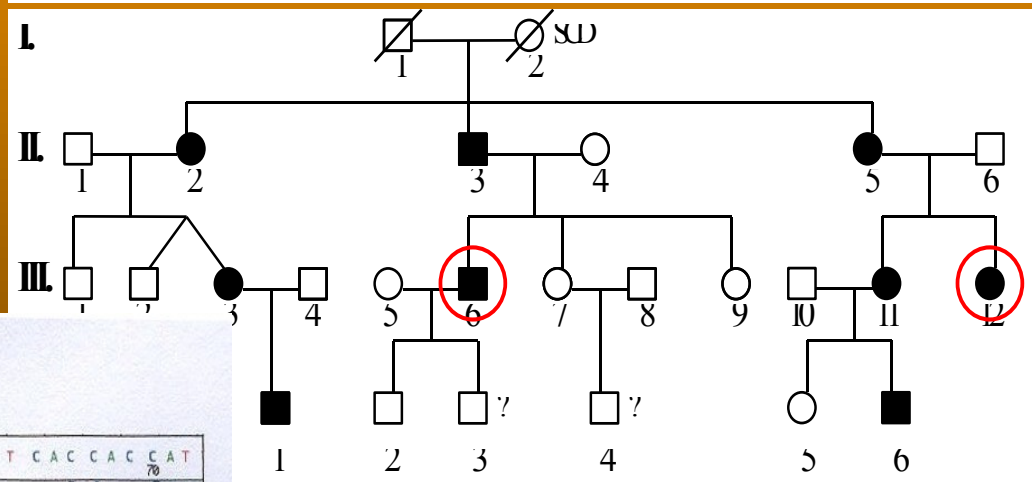
PREVENTIVE PROGRAMMS

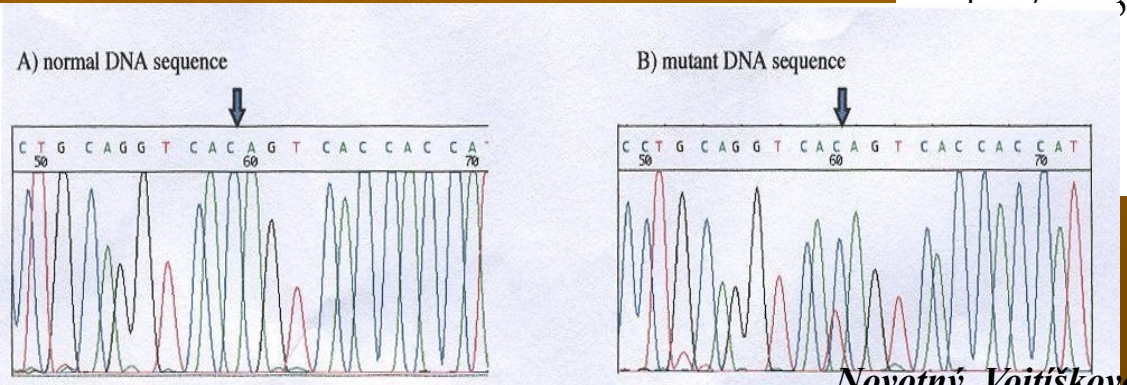
LQTsy

FENOTYPE



GENOTYPE





Novotný, Vojtíšková, Semrád, et al. Cor Vasa 2000;42:260-2

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CONCLUSION

- **Prophylactic ICD patient is not different to the general ICD population**
- **NNT ratio is low and reduced in time**
- **ICD therapy is cost effective**
- **Prophylactic pts require a full featured device, just like any other pt**

FAKULTNÍ NEMOCNICE BRNO

CONCLUSION

- No of PP ICD implantation is 75%

- Each fourth pt in CZ is implanted from secondary preventive reasons

- The most frequent - combined indication PP ICD + CRT

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