Náhlá smrt

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XXIV. výroční sjezd ČKS
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Komplexní kardiovaskulární centrum
Lékařská fakulta Univerzity Palackého v Olomouci
I. INTERNÍ KLINIKA KARDIOLOGICKÁ
FAKULTNÍ NEMOCNICE OLOMOUC

I. Epidemilogie a definice NS

Historie NS

- 350 000 úmrtí ročně v USA

- První popis: Hippocrates 400 pnl
- 1490: daVinci – souvislost postižení koronárních cév a náhlého úmrtí
- 1706: Lancisi – první epidemiol. studie

Definice:

Náhlá smrt: Přirozené úmrtí z kardiálních příčin do 1 hodiny od počátku symptomů akutního onemocnění.

Čtyři podmínky:

- 1. prodromy
- 2. definovaný začátek obtíží
- 3. oběhová zástava
- 4. biologická smrt

Definice NS 2015

Term	Definition	Ref [a]
Sudden death	Non-traumatic, unexpected fatal event occurring within 1 hour of the onset of symptoms in an apparently healthy subject. If death is not witnessed, the definition applies when the victim was in good health 24 hours before the event.	1
SUDS and SUDI	Sudden death without an apparent cause and in which an autopsy has not been performed in an adult (SUDS) or in an infant <1 year of age (SUDI).	14
SCD	The term is used when: • A congenital, or acquired, potentially fatal cardiac condition was known to be present during life; OR • Autopsy has identified a cardiac or vascular anomaly as the probable cause of the event; OR • No obvious extra-cardiac causes have been identified by post-mortem examination and therefore an arrhythmic event is a likely cause of death.	1, 14, 15
SADS and SIDS	Both autopsy and toxicology investigations are inconclusive, the heart is structurally normal at gross and histological examination and non-cardiac aetiologies are excluded in adults (SADS) and in infants (SIDS).	16
Aborted cardiac arrest	Unexpected circulatory arrest, occurring within 1 hour of onset of acute symptoms, which is reversed by successful resuscitation manoeuvres (e.g. defibrillation).	-
Idiopathic ventricular fibrillation	Clinical investigations are negative in a patient surviving an episode of ventricular fibrillation.	17, 18
Primary prevention of SCD	Therapies to reduce the risk of SCD in individuals who are at risk of SCD but have not yet experienced an aborted cardiac arrest or life-threatening arrhythmias.	-
Secondary prevention of SCD	Therapies to reduce the risk of SCD in patients who have already experienced an aborted cardiac arrest or life-threatening arrhythmias.	1

SADS = sudden arrhythmic death syndrome; SCD = sudden cardiac death; SIDS = sudden infant death syndrome; SUDI = sudden unexplained death in infancy; SUDS = sudden unexplained death syndrome.

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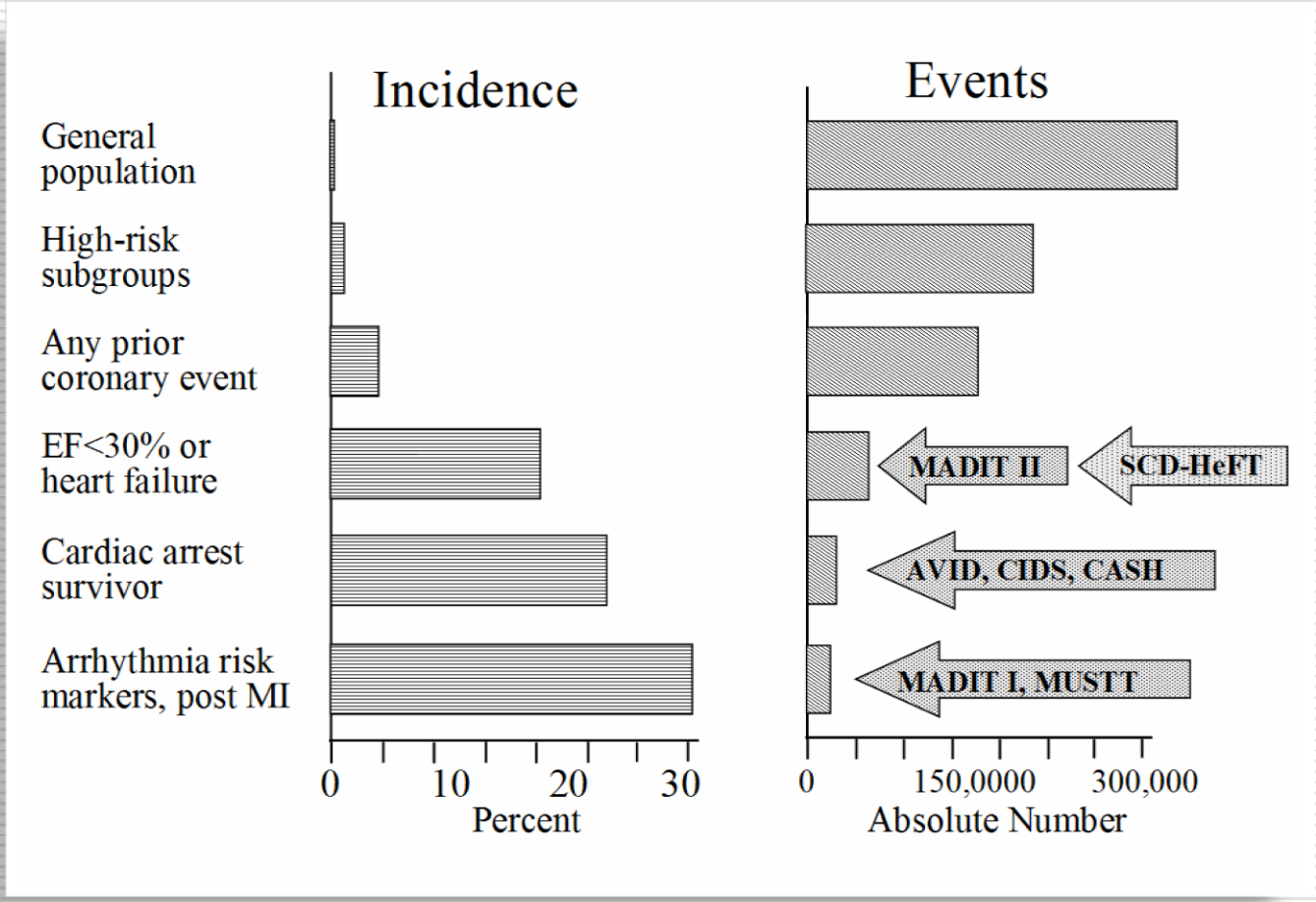
doi:10.1093/eurheartj/ehv316

Epidemiologie NS

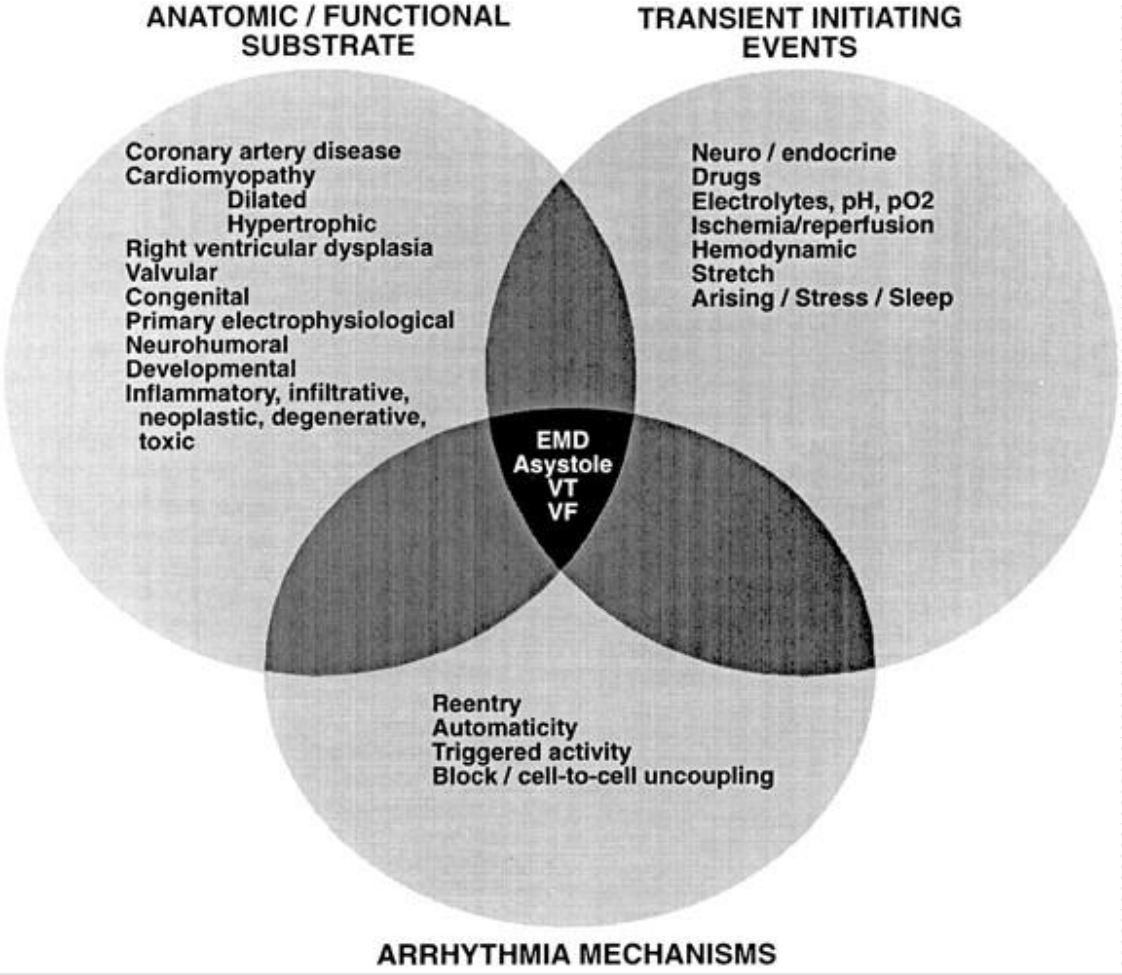
- Data na základě retrospektivních analýz
- 2 úmrtí na 1000 osob
- 12-15 % všech úmrtí
- 90 % pacientů s NS má preexistující kardiální onemocnění
- 50 % úmrtí pacientů s ICHS je NSS – v době před ICD

Incidence NS v závislosti na základním onemocnění

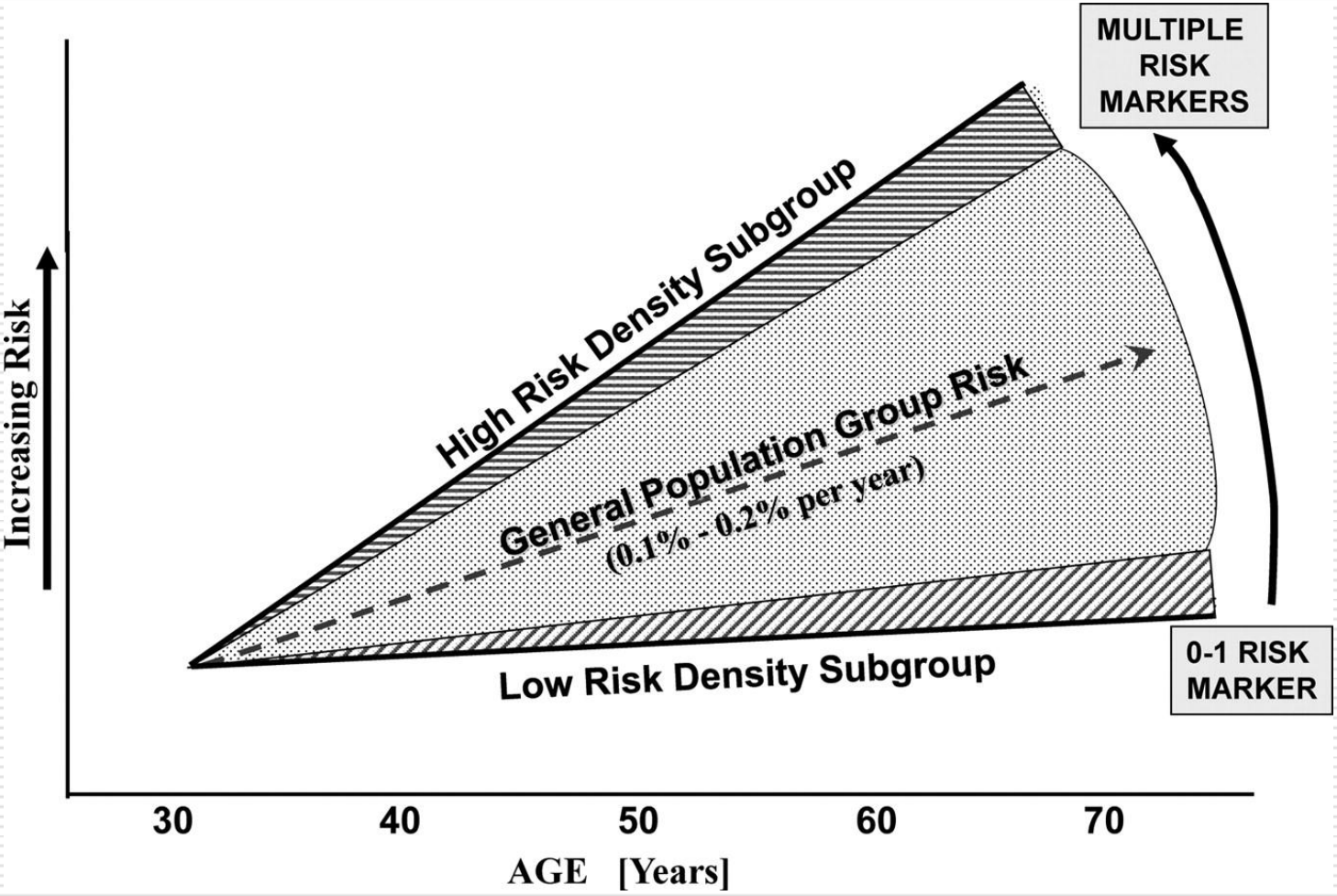


Myerburg RJ, Kessler KM, Castellanos A. Circulation 1992;85:12-10.

Patofyziologie NS

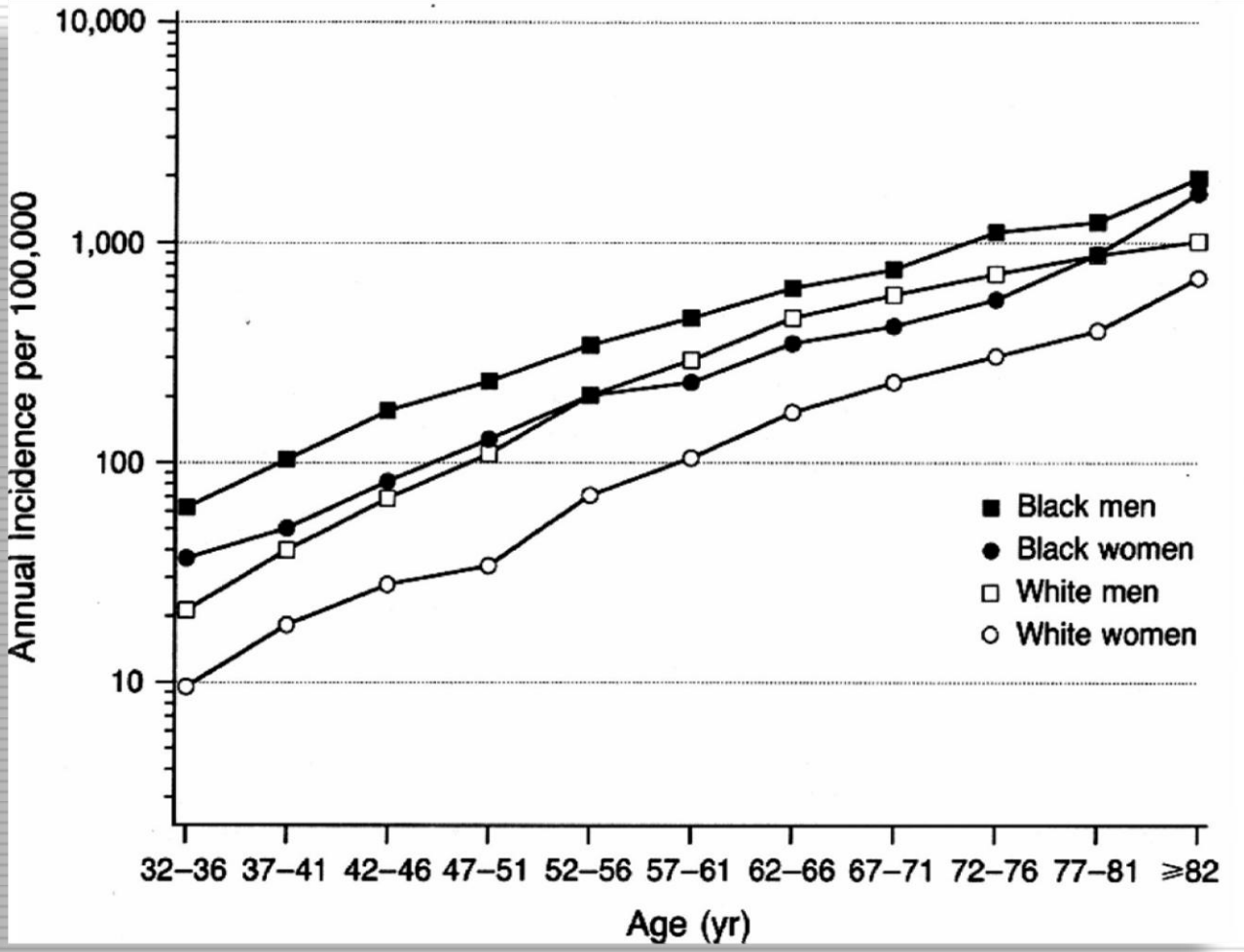


Riziko NS v obecné populaci a podskupinách



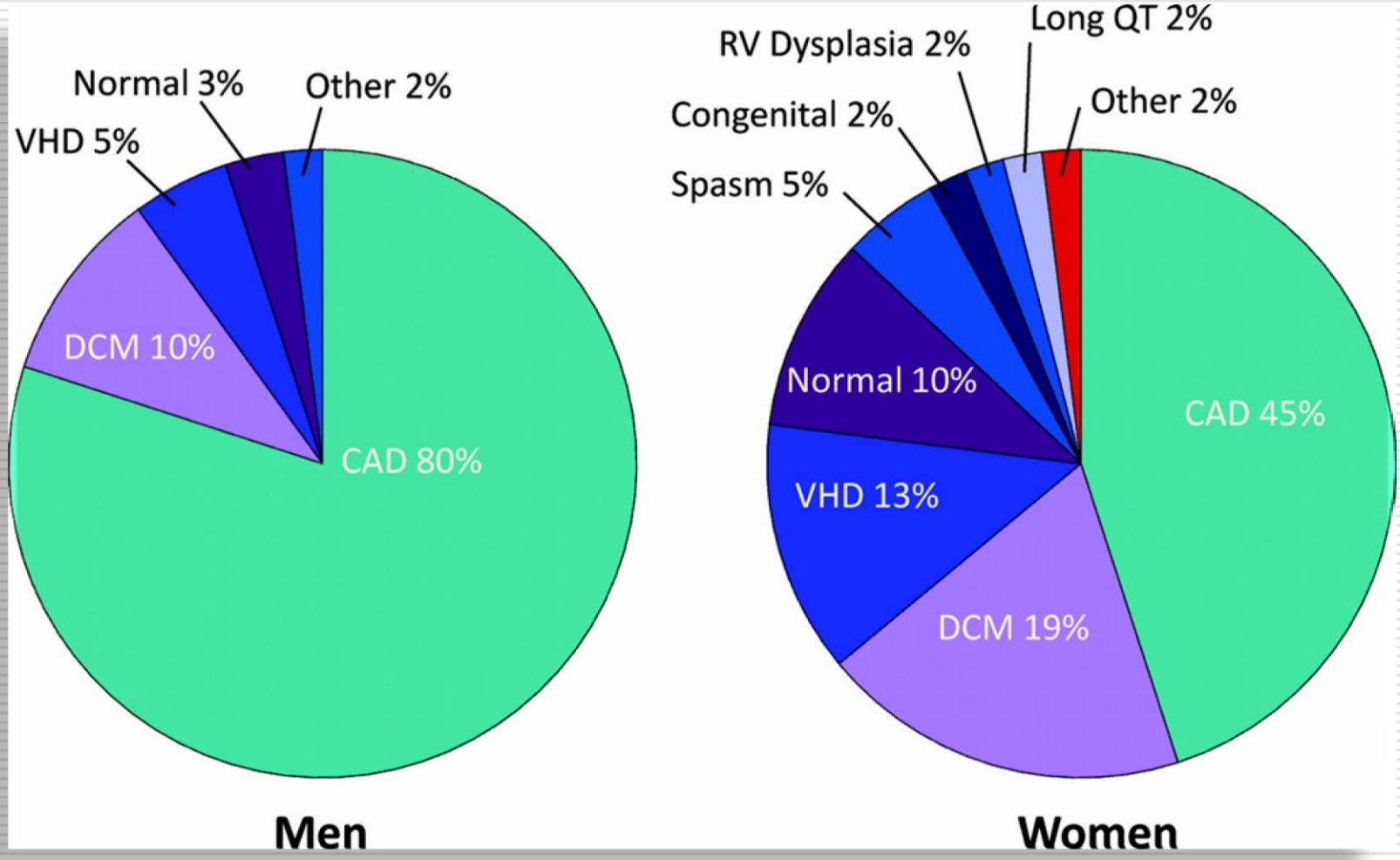
Robert J. Myerburg, and M. Juhani Junttila Circulation. 2012;125:1043-1052

NS a věk



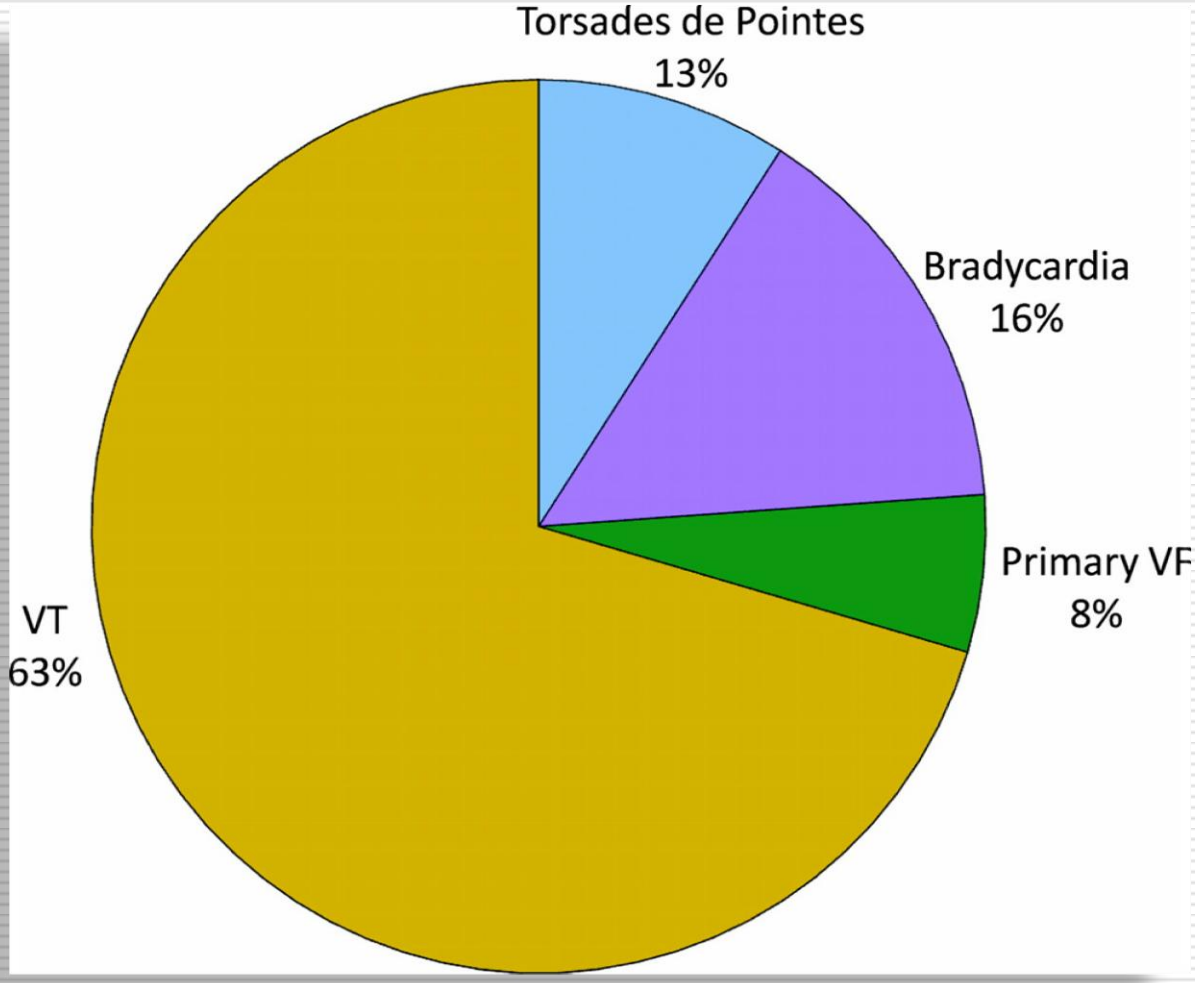
Rajat Deo, and Christine M. Albert
Circulation. 2012;125:620-637

Strukturální postižení myokardu u pacientů kteří přežili NS



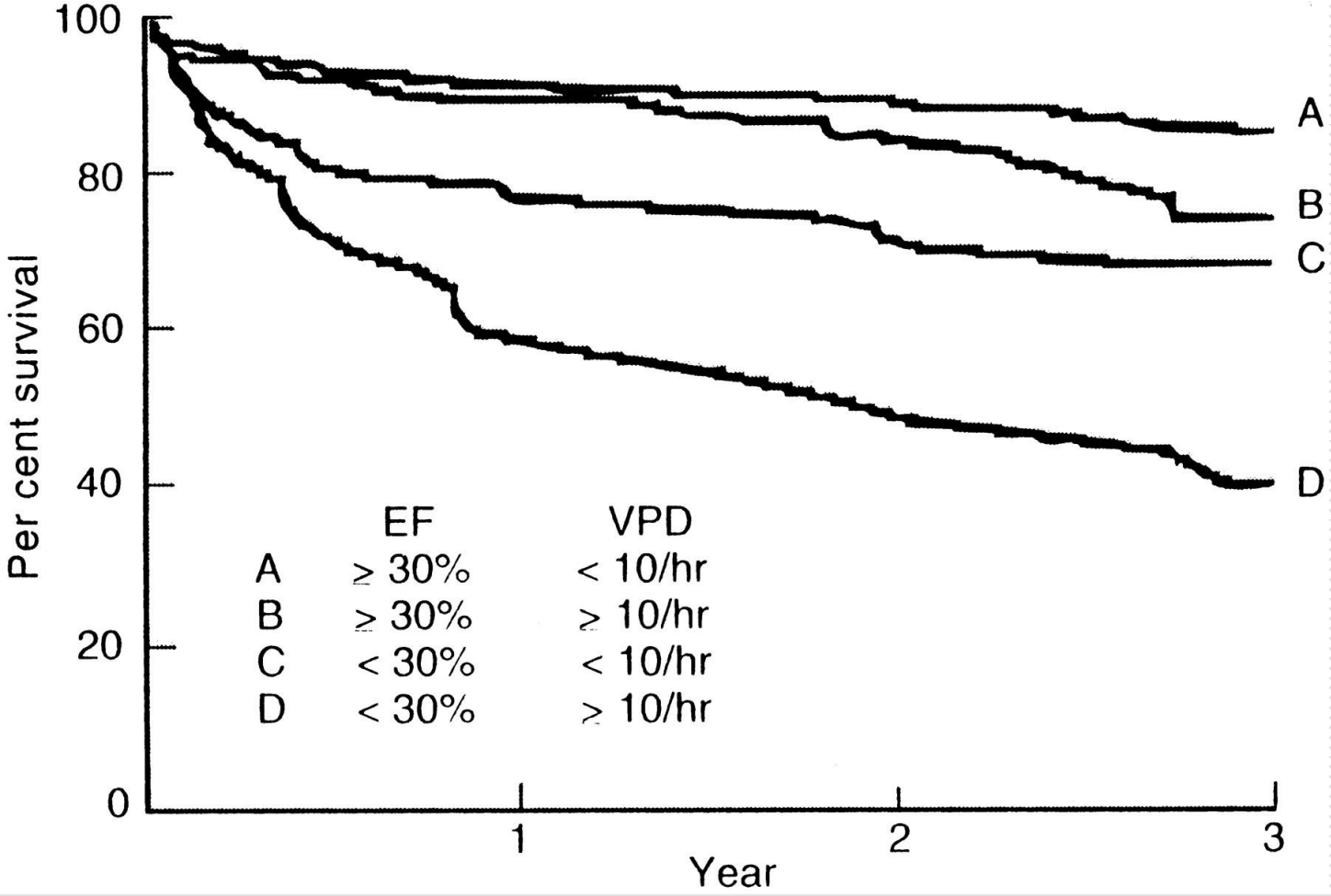
Rajat Deo, and Christine M. Albert
Circulation. 2012;125:620-637

První dokumentovaný rytmus u pacientů s NS



Rajat Deo, and Christine M. Albert
Circulation. 2012;125:620-637

Přežívání po IM v závislosti na funkci LK a VES: Doba před ICD



Douglas P. Zipes, and Hein J. J. Wellens Circulation. 1998;98:2334-2351

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Klasifikace komorových arytmií 2015

Terminology - Type of VA	Definition - ECG classification
Bidirectional VT	VT with a beat-to-beat change in the QRS axis.
Bundle-branch re-entrant tachycardia	VT due to re-entry involving the His-Purkinje system, usually with LBBB morphology; most common in DCM with prolonged HV interval.
Idioventricular rhythm	Arrhythmia of three or more consecutive complexes originating from ventricles at a rate of <100 bpm.
Monomorphic VT	Stable single QRS morphology during VT.
Non-sustained VT	Three or more consecutive ventricular complexes in duration, terminating spontaneously in <30 seconds.
Pleomorphic VT	More than one stable QRS morphology during an episode of VT.
Polymorphic VT	A changing or multiform QRS morphology at cycle length between 100 and 300 bpm during VT.
Premature ventricular complexes	A ventricular depolarization that occurs earlier than expected and appears on the ECG as an early, wide QRS complex without a preceding related P wave.
Sustained VT	VT ≥30 seconds in duration and/or requiring termination due to haemodynamic compromise in <30 seconds.
Torsade de pointes	VT characterized by twisting of the QRS complexes around the isoelectric line on the ECG during the arrhythmia, which may be associated with a Long QT Syndrome.
Ventricular flutter	A regular (cycle length variability ≤30 ms) VT approximately 300 bpm with a monomorphic appearance; no isoelectric interval between successive QRS complexes.
Ventricular fibrillation	Rapid, usually >300 bpm (cycle length ≤200 ms), grossly irregular ventricular rhythm with marked variability in QRS cycle length, morphology, and amplitude.
Ventricular tachycardia	Arrhythmia of three or more consecutive complexes in duration originating from the ventricles at a rate of ≥100 bpm.

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Klinické manifestace NS

- Asymptomatic individuals with or without electrocardiographic
- abnormalities
- Persons with symptoms potentially attributable to ventricular
- arrhythmias
  - ♥ Palpitations
  - ♥ Dyspnea
  - ♥ Chest pain
  - ♥ Syncope and presyncope
- VT that is hemodynamically stable
- VT that is not hemodynamically stable
- Cardiac arrest
  - ♥ Asystolic (sinus arrest, atrioventricular block)
  - ♥ VT
  - ♥ Ventricular fibrillation (VF)
  - ♥ Pulseless electrical activity

II: vyšetřovací postupy u pacientů s KT

Neinvazivní vyšetření při podezření na KT, resp. s dokumentovanou KT

Recommendations	Class[a]	Level[b]	Ref.[c]
Resting 12-lead ECG			
Resting 12-lead ECG is recommended in all patients who are evaluated for VA.	I	A	1
ECG monitoring			
Ambulatory ECG is recommended to detect and diagnose arrhythmias. Twelve-lead ambulatory ECG is recommended to evaluate QT-interval changes or ST changes.	I	A	93
Cardiac event recorders are recommended when symptoms are sporadic to establish whether they are caused by transient arrhythmias.	I	B	94
Implantable loop recorders are recommended when symptoms, e.g. syncope, are sporadic and suspected to be related to arrhythmias and when a symptom–rhythm correlation cannot be established by conventional diagnostic techniques.	I	B	95
SA-ECG is recommended to improve the diagnosis of ARVC in patients with VAs or in those who are at risk of developing life-threatening VAs.	I	B	96,97
Exercise stress testing			
Exercise stress testing is recommended in adult patients with VA who have an intermediate or greater probability of having CAD by age and symptoms to provoke ischaemic changes or VA.	I	B	98
Exercise stress testing is recommended in patients with known or suspected exercise-induced VA, including CPVT, to achieve a diagnosis and define prognosis.	I	B	99
Exercise stress testing should be considered in evaluating response to medical or ablation therapy in patients with known exercise-induced VA.	IIa	C	1
Imaging			
Echocardiography for assessment of LV function and detection of structural heart disease is recommended in all patients with suspected or known VA.	I	B	100, 101
Echocardiography for assessment of LV and RV function and detection of structural heart disease is recommended for patients at high risk of developing serious VAs or SCD, such as those with dilated, hypertrophic or RV cardiomyopathies, survivors of acute myocardial infarction or relatives of patients with inherited disorders associated with SCD.	I	B	100
Exercise testing plus imaging (exercise stress echocardiography test or nuclear perfusion, SPECT) is recommended to detect silent ischaemia in patients with VAs who have an intermediate probability of having CAD by age or symptoms and in whom an ECG is less reliable (digoxin use, LV hypertrophy, >1-mm ST-segment depression at rest, WPW syndrome, or LBBB).	I	B	102
Pharmacological stress testing plus imaging modality is recommended to detect silent ischaemia in patients with VAs who have an intermediate probability of having CAD by age or symptoms and are physically unable to perform a symptom-limited exercise test.	I	B	103
CMR or CT should be considered in patients with VAs when echocardiography does not provide accurate assessment of LV and RV function and/or evaluation of structural changes.	IIa	B	1

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Invazivní vyšetření při podezření na KT, resp. s dokumentovanou KT

Recommendations	Class[a]	Level[b]	Ref.[c]
Coronary angiography			
Coronary angiography should be considered to establish or exclude significant obstructive CAD in patients with life-threatening VAs or in survivors of SCD, who have an intermediate or greater probability of having CAD by age and symptoms.	IIa	C	104
Electrophysiological study			
Electrophysiological study in patients with CAD is recommended for diagnostic evaluation of patients with remote myocardial infarction with symptoms suggestive of ventricular tachyarrhythmias, including palpitations, presyncope and syncope.	I	B	105
Electrophysiological study in patients with syncope is recommended when bradyarrhythmias or tachyarrhythmias are suspected, based on symptoms (e.g. palpitations) or the results of non-invasive assessment, especially in patients with structural heart disease.	I	C	106
Electrophysiological study may be considered for the differential diagnosis of ARVC and benign RVOT tachycardia or sarcoidosis.	IIb	B	107

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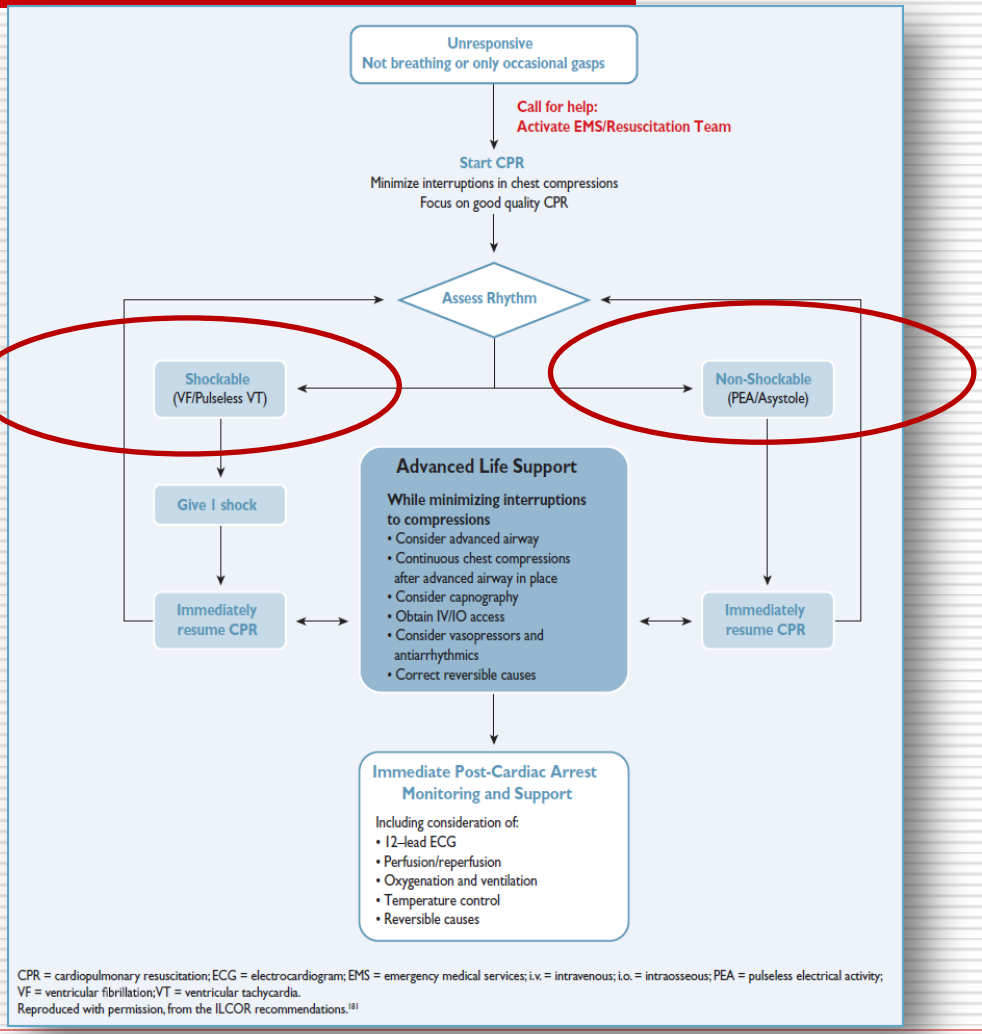
III: Terapie

Oběhová zástava: Univerzální algoritmus



CPR = cardiopulmonary resuscitation; ECG = electrocardiogram; EMS = emergency medical services; i.v. = intravenous; i.o. = intraosseous; PEA = pulseless electrical activity; VF = ventricular fibrillation; VT = ventricular tachycardia.
Reproduced with permission, from the ILCOR recommendations.[181]

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Akutní management KT

Recommendations	Class[a]	Level[b]	Ref.[c]
Direct current cardioversion is recommended for patients presenting with sustained VT and haemodynamic instability.	I	C	180
In patients presenting with sustained haemodynamically tolerated VT in the absence of structural heart disease (e.g. idiopathic RVOT), i.v. flecainide or a conventional beta-blocker, verapamil or amiodarone may be considered.	IIb	C	

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AA v prevenci NS

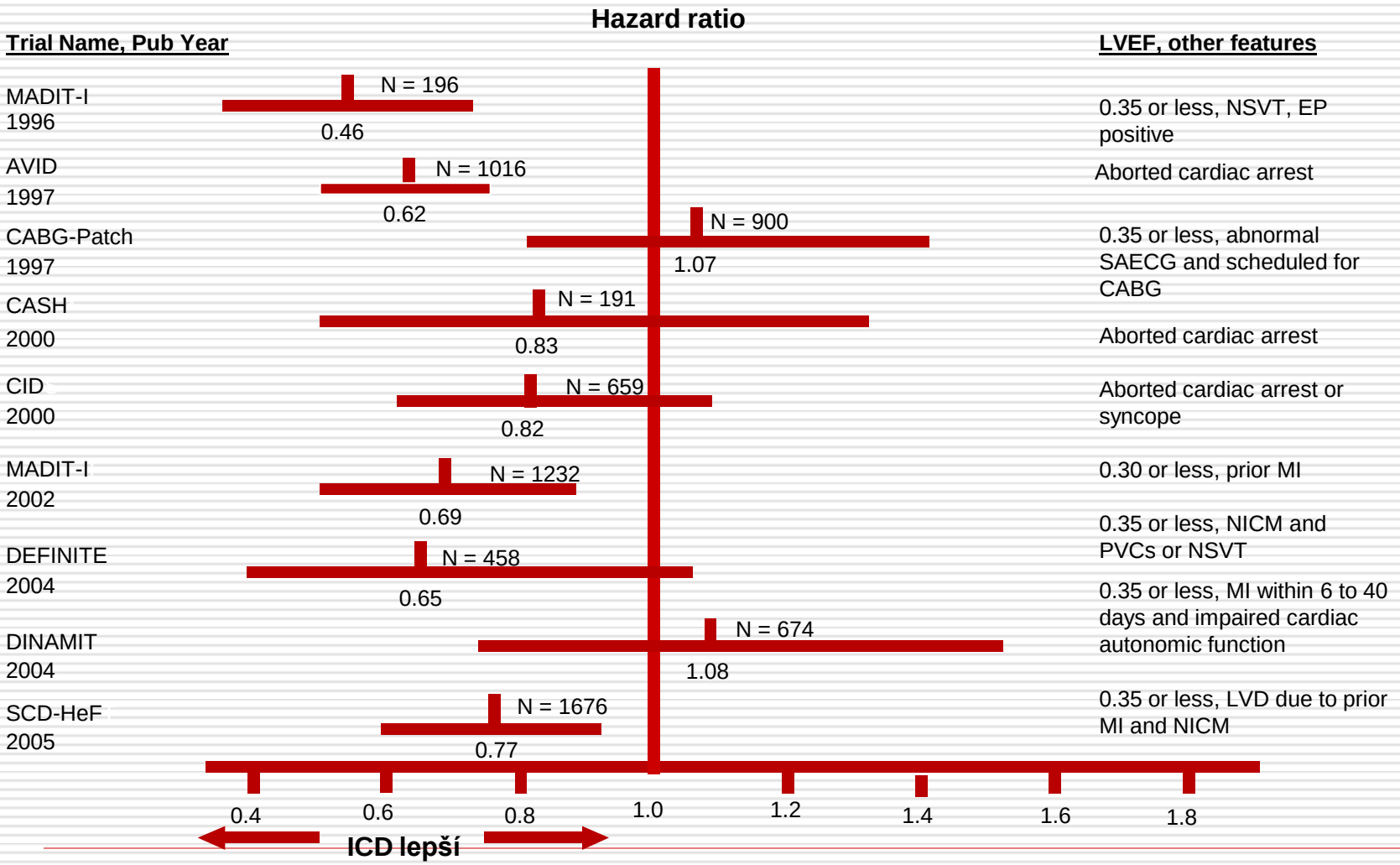
- ♥ Beta Blockers: Effectively suppress ventricular ectopic beats & arrhythmias; reduce incidence of SCD
- ♥ Amiodarone: No definite survival benefit; some studies have shown reduction in SCD in patients with LV dysfunction especially when given in conjunction with BB. Has complex drug interactions and many adverse side effects (pulmonary, hepatic, thyroid, cutaneous)
- ♥ Sotalol: Suppresses ventricular arrhythmias; is more pro-arrhythmic than amiodarone, no survival benefit clearly shown
- ♥ Conclusions: Antiarrhythmic drugs (except for BB) should not be used as *primary* therapy of VA and the prevention of SCD

Další FT NS

- ♥ **Electrolytes:** magnesium and potassium administration can favorably influence the electrical substrate involved in VA; are especially useful in setting of hypomagnesemia and hypokalemia
- ♥ **ACE inhibitors, angiotensin receptor blockers and aldosterone blockers** can improve the myocardial substrate through reverse remodeling and thus reduce incidence of SCD
- ♥ **Antithrombotic and antiplatelet agents:** may reduce SCD by reducing coronary thrombosis
- ♥ **Statins:** have been shown to reduce life-threatening VA in high-risk patients with electrical instability
- ♥ **n-3 Fatty acids:** have anti-arrhythmic properties, but conflicting data exist for the prevention of SCD

ICD v terapii komorových arytmií

Přehled výsledků PP a SP studií

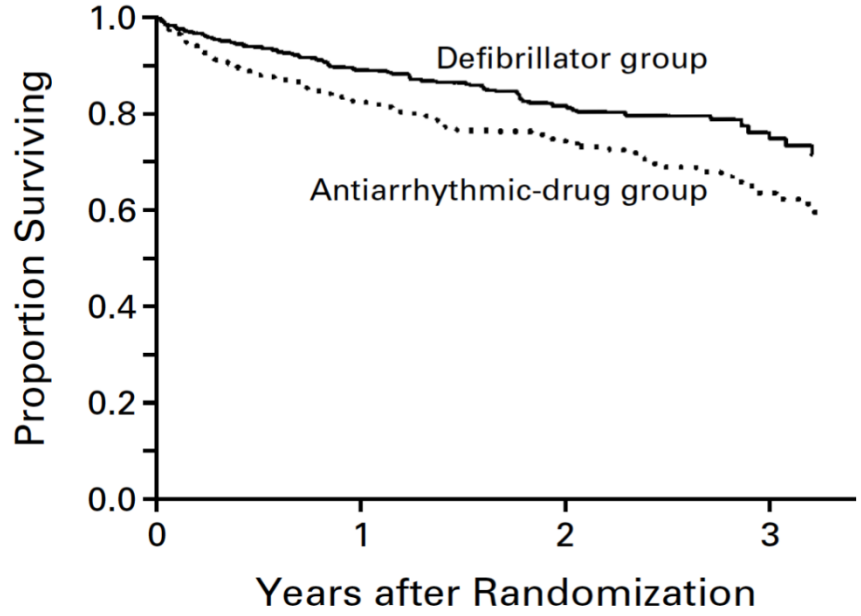


Sekundární prevence NS: AVID

The New England Journal of Medicine

A COMPARISON OF ANTIARRHYTHMIC-DRUG THERAPY WITH IMPLANTABLE DEFIBRILLATORS IN PATIENTS RESUSCITATED FROM NEAR-FATAL VENTRICULAR ARRHYTHMIAS

THE ANTIARRHYTHMICS VERSUS IMPLANTABLE DEFIBRILLATORS (AVID) INVESTIGATORS*



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

Primární prevence NS: MADIT I

The New England
Journal of Medicine

VOLUME 335 DECEMBER 26, 1996 NUMBER 26

IMPROVED SURVIVAL WITH AN IMPLANTED DEFIBRILLATOR IN PATIENTS WITH CORONARY DISEASE AT HIGH RISK FOR VENTRICULAR ARRHYTHMIA

ARTHUR J. MOSS, M.D., W. JACKSON HALL, PH.D., DAVID S. CANNOM, M.D., JAMES P. DAUBERT, M.D., STEVEN L. HIGGINS, M.D., HELMUT KLEIN, M.D., JOSEPH H. LEVINE, M.D., SANJEEV SAKSENA, M.D., ALBERT L. WALDO, M.D., DAVID WILBER, M.D., MARY W. BROWN, M.S., AND MOONSEONG HEO, PH.D., FOR THE MULTICENTER AUTOMATIC DEFIBRILLATOR IMPLANTATION TRIAL INVESTIGATORS*

Moss AJ: N Engl J Med 1996;335:1933-40.

ICD: Sekundární prevence

Recommendations	Class[a]	Level[b]	Ref.[c]
ICD implantation is recommended in patients with documented VF or haemodynamically not tolerated VT in the absence of reversible causes or within 48 h after myocardial infarction who are receiving chronic optimal medical therapy and have a reasonable expectation of survival with a good functional status >1 year.	I	A	151–154
ICD implantation should be considered in patients with recurrent sustained VT (not within 48 h after myocardial infarction) who are receiving chronic optimal medical therapy, have a normal LVEF and have a reasonable expectation of survival with good functional status for >1 year.	IIa	C	This panel of experts
In patients with VF/VT and an indication for ICD, amiodarone may be considered when an ICD is not available, contraindicated for concurrent medical reasons or refused by the patient.	IIb	C	155, 156

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Indikace ICD u pacientů s dysfunkcí LK

Recommendations	Class[a]	Level[b]	Ref.[c]
ICD therapy is recommended to reduce SCD in patients with symptomatic HF (NYHA class II–III) and LVEF ≤35% after ≥3 months of optimal medical therapy who are expected to survive for at least 1 year with good functional status:			
– Ischaemic aetiology (at least 6 weeks after myocardial infarction).	I	A	63,64
– Non-ischaemic aetiology.	I	B	64,316, 317

NYHA IV

Recommendation	Class[a]	Level[b]	Ref.[c]
ICD implantation should be considered for primary and secondary prevention of SCD in patients who are listed for heart transplant.	IIa	C	320, 321

Recommendations	Class[a]	Level[b]	Ref.[c]
CRT is recommended to reduce all-cause mortality in patients with an LVEF ≤35% and LBBB despite at least 3 months of optimal pharmacological therapy who are expected to survive at least 1 year with good functional status:			322–326
– With a QRS duration >150 ms	I	A	313, 314, 327–329
– With a QRS duration of 120–150 ms	I	B	313, 314
CRT should or may be considered to reduce all-cause mortality in patients with an LVEF ≤35% without LBBB despite at least 3 months of optimal pharmacological therapy who are expected to survive at least 1 year with good functional status:			326 323–325
– With a QRS duration >150 ms	IIa	B	313, 314
– With a QRS duration of 120–150 ms	IIb	B	313, 314

CRT-SR

CRT-AF

Recommendations	Class[a]	Level[b]	Ref.[c]
CRT should be considered to reduce all-cause mortality in patients with chronic HF, QRS ≥120 ms and LVEF ≤35% who remain in NYHA functional class III/ambulatory class IV despite at least 3 months of optimal pharmacological therapy who are expected to survive at least 1 year with good functional status, provided that biventricular pacing as close as possible to 100% can be achieved.	IIa	B	330, 331
AV junction ablation should be considered in case of incomplete biventricular pacing.	IIa	B	332, 333

Recommendations	Class[b]	Level[c]	Ref.[d]
CRT-D is recommended to reduce all-cause mortality in patients with a QRS duration ≥130 ms, with an LVEF ≤30% and with LBBB despite at least 3 months of optimal pharmacological therapy who are expected to survive at least 1 year with good functional status.	I	A	148, 322, 323, 325, 327, 329
CRT-D may be considered to prevent hospitalization for HF in patients with a QRS duration ≥150 ms, irrespective of QRS morphology, and an LVEF ≤35% despite at least 3 months of optimal pharmacological therapy who are expected to survive at least 1 year with good functional status.	IIb	A	148, 327–329, 334

NYHA II

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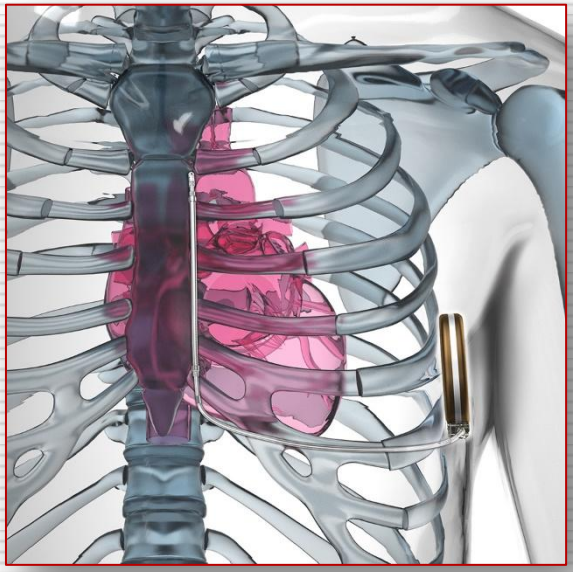
Indikace SQ ICD

Recommendations	Class[a]	Level[b]	Ref.[c]
Subcutaneous defibrillators should be considered as an alternative to transvenous defibrillators in patients with an indication for an ICD when pacing therapy for bradycardia support, cardiac resynchronization or antitachycardia pacing is not needed.	IIa	C	157, 158
The subcutaneous ICD may be considered as a useful alternative to the transvenous ICD system when venous access is difficult, after the removal of a transvenous ICD for infections or in young patients with a long-term need for ICD therapy.	IIb	C	This panel of experts



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Wearable defibrillator

Recommendation	Class[a]	Level[b]	Ref.[c]
The WCD may be considered for adult patients with poor LV systolic function who are at risk of sudden arrhythmic death for a limited period, but are not candidates for an implantable defibrillator (e.g. bridge to transplant, bridge to transvenous implant, peripartum cardiomyopathy, active myocarditis and arrhythmias in the early post-myocardial infarction phase).	IIb	C	167, 168

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Public defibrillation AED

Recommendations	Class[a]	Level[b]	Ref.[c]
It is recommended that public access defibrillation be established at sites where cardiac arrest is relatively common and suitable storage is available (e.g. schools, sports stadiums, large stations, casinos, etc.) or at sites where no other access to defibrillation is available (e.g. trains, cruise ships, airplanes, etc.).	I	B	173, 174
It may be considered to teach basic life support to the families of patients at high risk of SCD	IIb	C	This panel of experts

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Intervenční terapie: Katetrizační ablace KT

Recommendations	Class[a]	Level[b]	Ref.[c]
Urgent catheter ablation is recommended in patients with scar-related heart disease presenting with incessant VT or electrical storm.	I	B	183
Catheter ablation is recommended in patients with ischaemic heart disease and recurrent ICD shocks due to sustained VT.	I	B	184–186
Catheter ablation should be considered after a first episode of sustained VT in patients with ischaemic heart disease and an ICD.	IIa	B	184–186

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Intervenční terapie: Chirurgická ablace KF

Recommendations	Class[a]	Level[b]	Ref.[c]
Surgical ablation guided by preoperative and intraoperative electrophysiological mapping performed at an experienced centre is recommended in patients with VT refractory to anti-arrhythmic drug therapy after failure of catheter ablation by experienced electrophysiologists.	I	B	212–215
Surgical ablation at the time of cardiac surgery (bypass or valve surgery) may be considered in patients with clinically documented VT or VF after failure of catheter ablation.	IIb	C	216, 217

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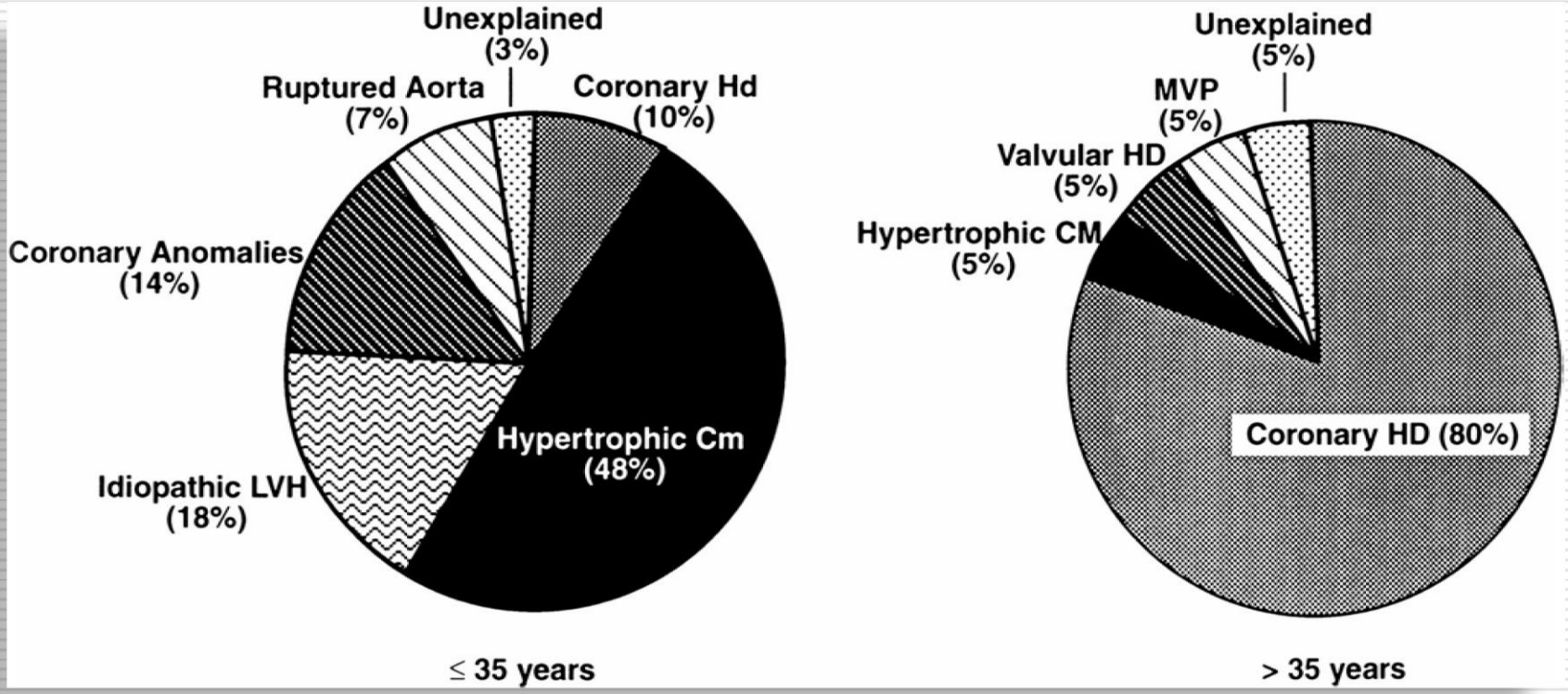
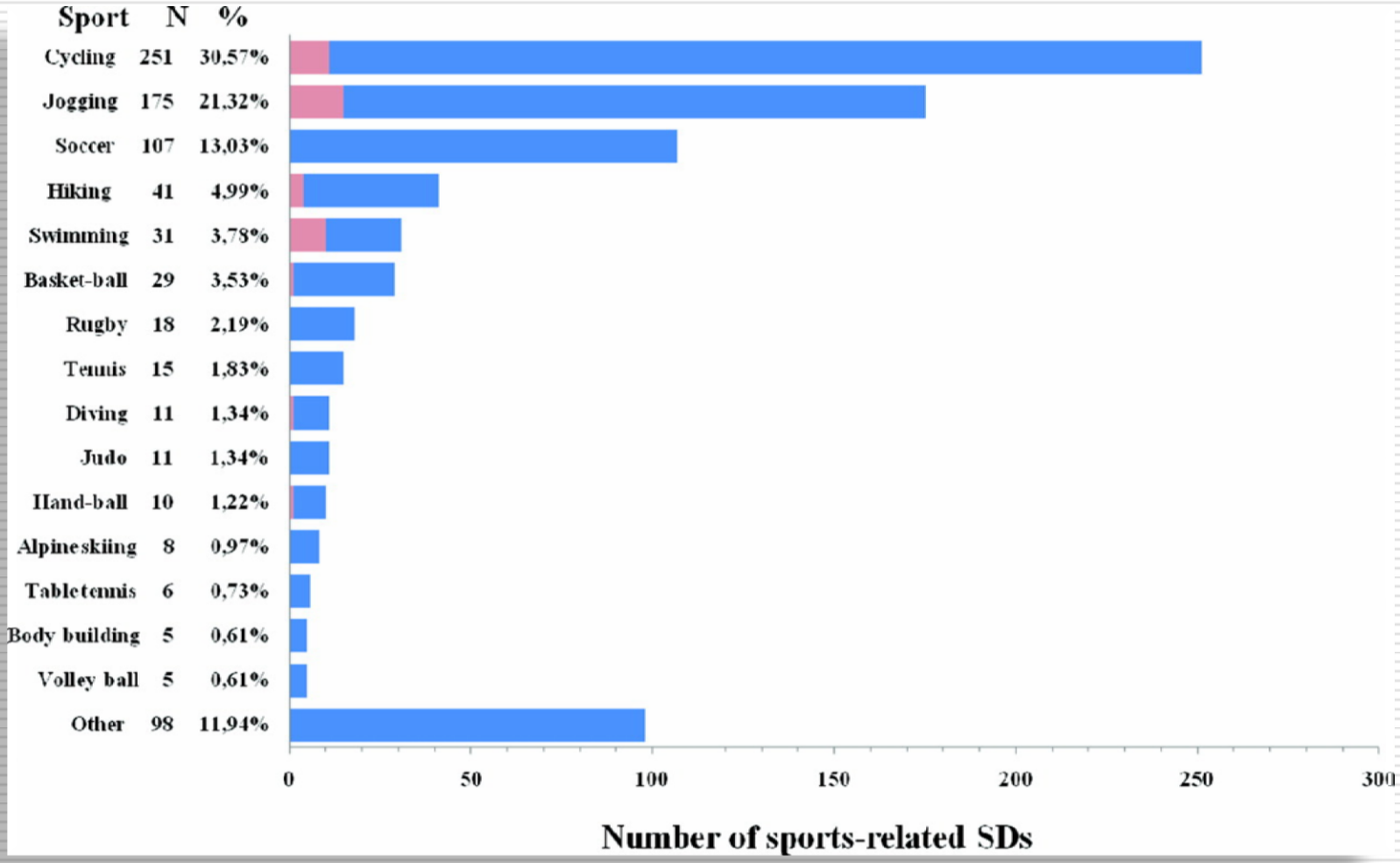
IV: NS u atletů

Příčiny NS u atletů



Douglas P. Zipes, and Hein J. J. Wellens Circulation. 1998;98:2334-2351

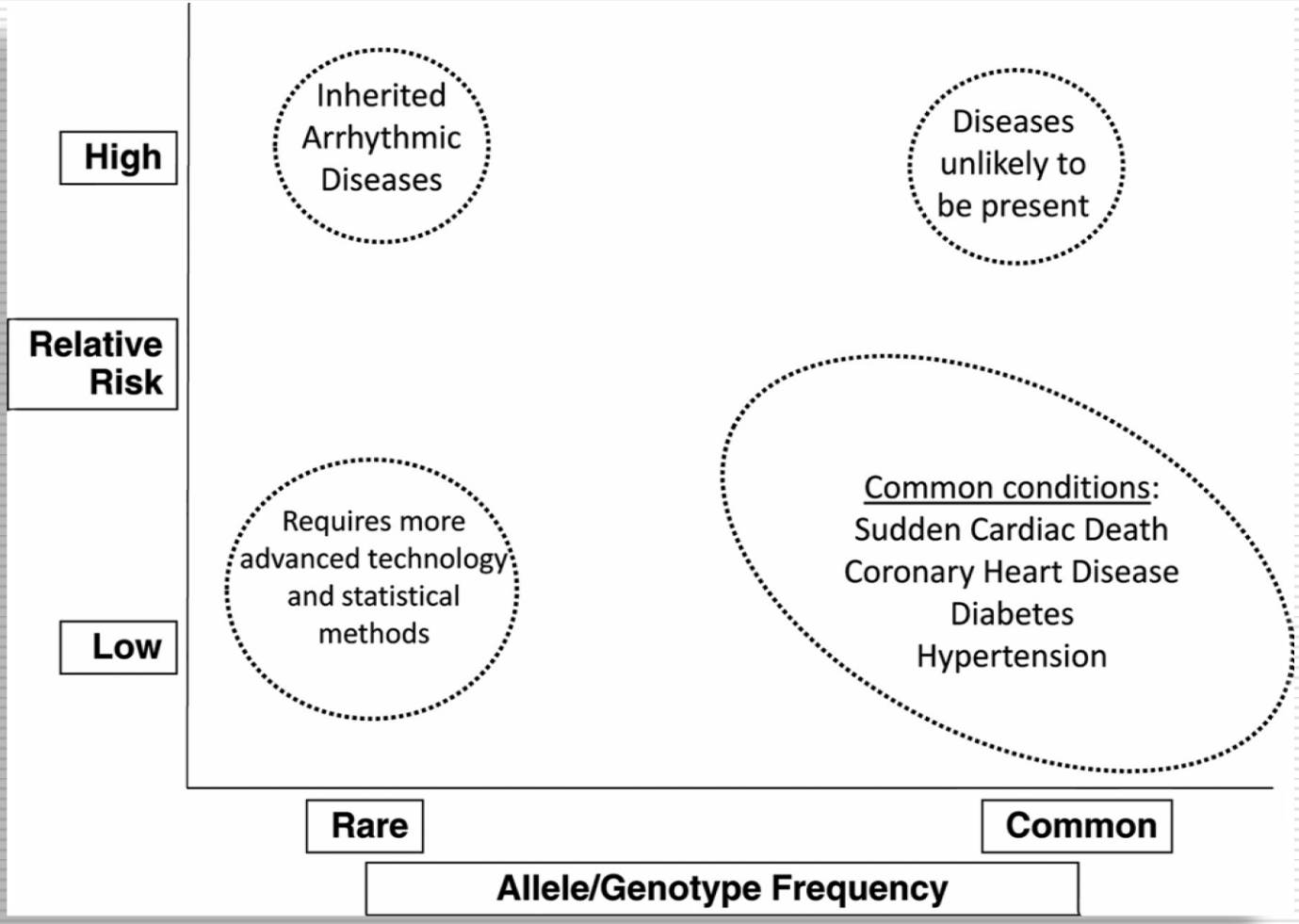
Typy sportů u atletů s NS



Rajat Deo, and Christine M. Albert
Circulation. 2012;125:620-637

V: Genetika a molekulární analýza

Význam genetiky u NS



Rajat Deo, and Christine M. Albert
Circulation. 2012;125:620-637

Doporučení pro provedení pitvy a molekulární analýzy

Recommendations	Class[a]	Level[b]	Ref.[c]
An autopsy is recommended to investigate the causes of sudden death and to define whether SCD is secondary to arrhythmic or non-arrhythmic mechanisms (e.g. rupture of an aortic aneurysm).	I	C	17
Whenever an autopsy is performed, a standard histological examination of the heart is recommended and it should include mapped labelled blocks of myocardium from representative transverse slices of both ventricles.	I	C	17
The analysis of blood and other adequately collected body fluids for toxicology and molecular pathology is recommended in all victims of unexplained sudden death.	I	C	17
Targeted post-mortem genetic analysis of potentially disease-causing genes should be considered in all sudden death victims in whom a specific inheritable channelopathy or cardiomyopathy is suspected.	IIa	C	17,50, 51

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doi:10.1093/eurheartj/ehv316

Vyšetření u příbuzných pacientů s SCD

Approach	Action[a]
History taking and physical examination	• Personal clinical history • Family history focused on cardiac diseases or sudden deaths
ECG	• Baseline 12-lead ECG with standard and high precordial leads • 24-hour ambulatory ECG • Exercise stress test • Signal-averaged ECG • Provocative test with ajmaline/flecainide (when Brugada syndrome is suspected)
Cardiac imaging	• Two-dimensional echocardiography and/or CMR (with or without contrast)
Genetic testing	• Targeted molecular testing and genetic counselling if there is the clinical suspicion of a specific disease • Referral to a tertiary centre specialized in evaluation of the genetics of arrhythmias

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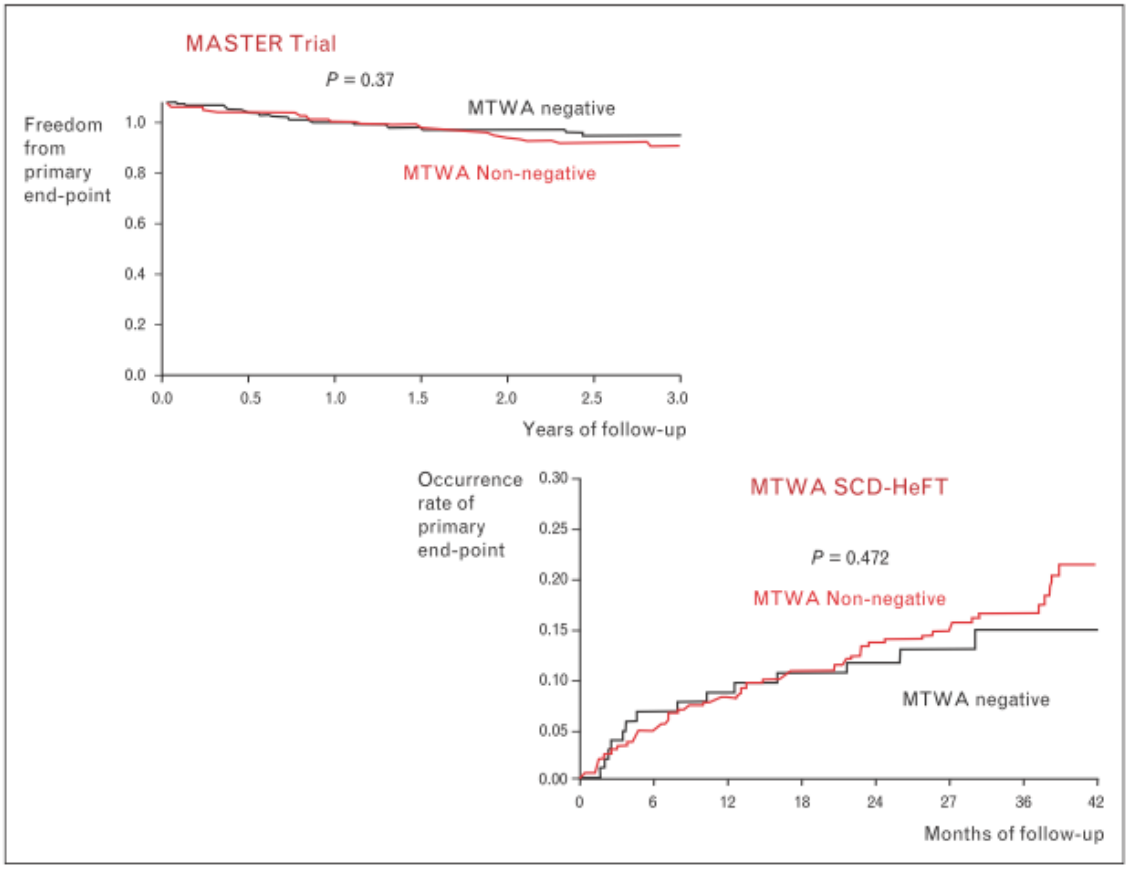
VI: Současný pohled na rizikovou stratifikaci NS

Má neinvazivní kardiologie v současné době význam ve stratifikaci pacientů po IM ?

Figure 4 Summary of the absence of difference in the primary end-point of the MASTER and MTWA SCD-HeFT trials for patients with negative MTWA compared to nonnegative MTWA results



MASTER Trial

EF LK:

- „zlatý standard“ stratifikace rizika NS
- Riziková skupina: EF LK < 0,35
- **Otázky:**

1. Současná populace pacientů s ICHS je diferentní proti době studí s SP a PP ICD
2. Co pacienti s hraniční EF LK (0,35-0,45) ?
3. Význam MRI – LA a stanovení periinfarktové zóny
4. Skutečná detekce KT/KF je u pacientů s ICD výrazně nižší, než se předpokládalo
5. Jak s (2-3.)výměnou u ICD pro EOL u pacienta bez dokumentace KA ?

VT and SCD ESC Guidelines 2015

European Heart Journal (2015) **36**, 2793–2867
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ESC GUIDELINES

2015 ESC Guidelines for the management of patients with ventricular arrhythmias and the prevention of sudden cardiac death

The Task Force for the Management of Patients with Ventricular Arrhythmias and the Prevention of Sudden Cardiac Death of the European Society of Cardiology (ESC)

Endorsed by: Association for European Paediatric and Congenital Cardiology (AEPC)

Authors/Task Force Members: Silvia G. Priori*(Chairperson) (Italy) Carina Blomström-Lundqvist*(Co-chairperson) (Sweden) Andrea Mazzanti† (Italy), Nico Blom[a] (The Netherlands), Martin Borggrefe (Germany), John Camm (UK), Perry Mark Elliott (UK), Donna Fitzsimons (UK), Robert Hatala (Slovakia), Gerhard Hindricks (Germany), Paulus Kirchhof (UK/Germany), Keld Kjeldsen (Denmark), Karl-Heinz Kuck (Germany), Antonio Hernandez-Madrid (Spain), Nikolaos Nikolaou (Greece), Tone M. Norekvål (Norway), Christian Spaulding (France), and Dirk J. Van Veldhuisen (The Netherlands)

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Komplexní kardiovaskulární centrum

Lékařská fakulta Univerzity Palackého v Olomouci

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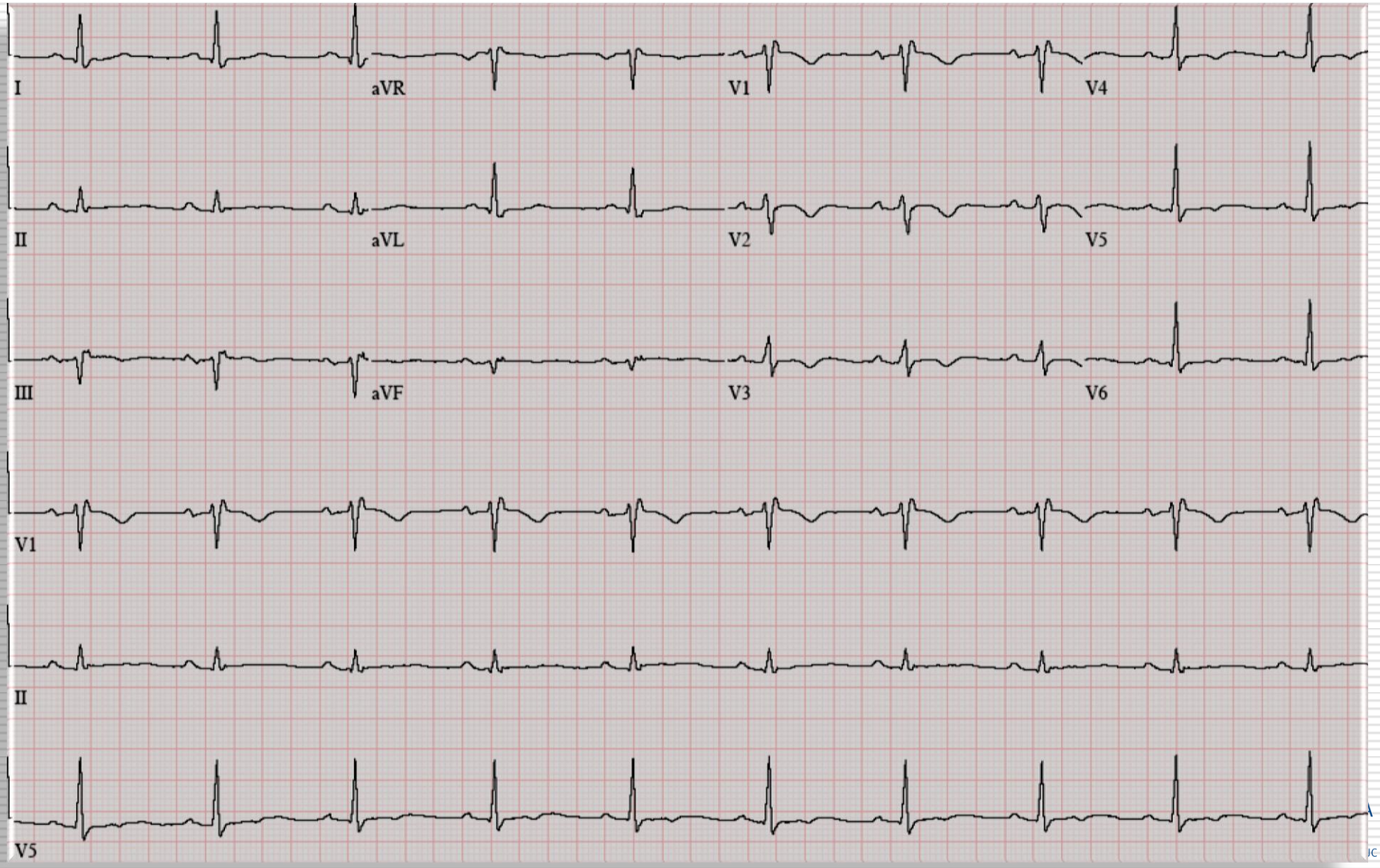
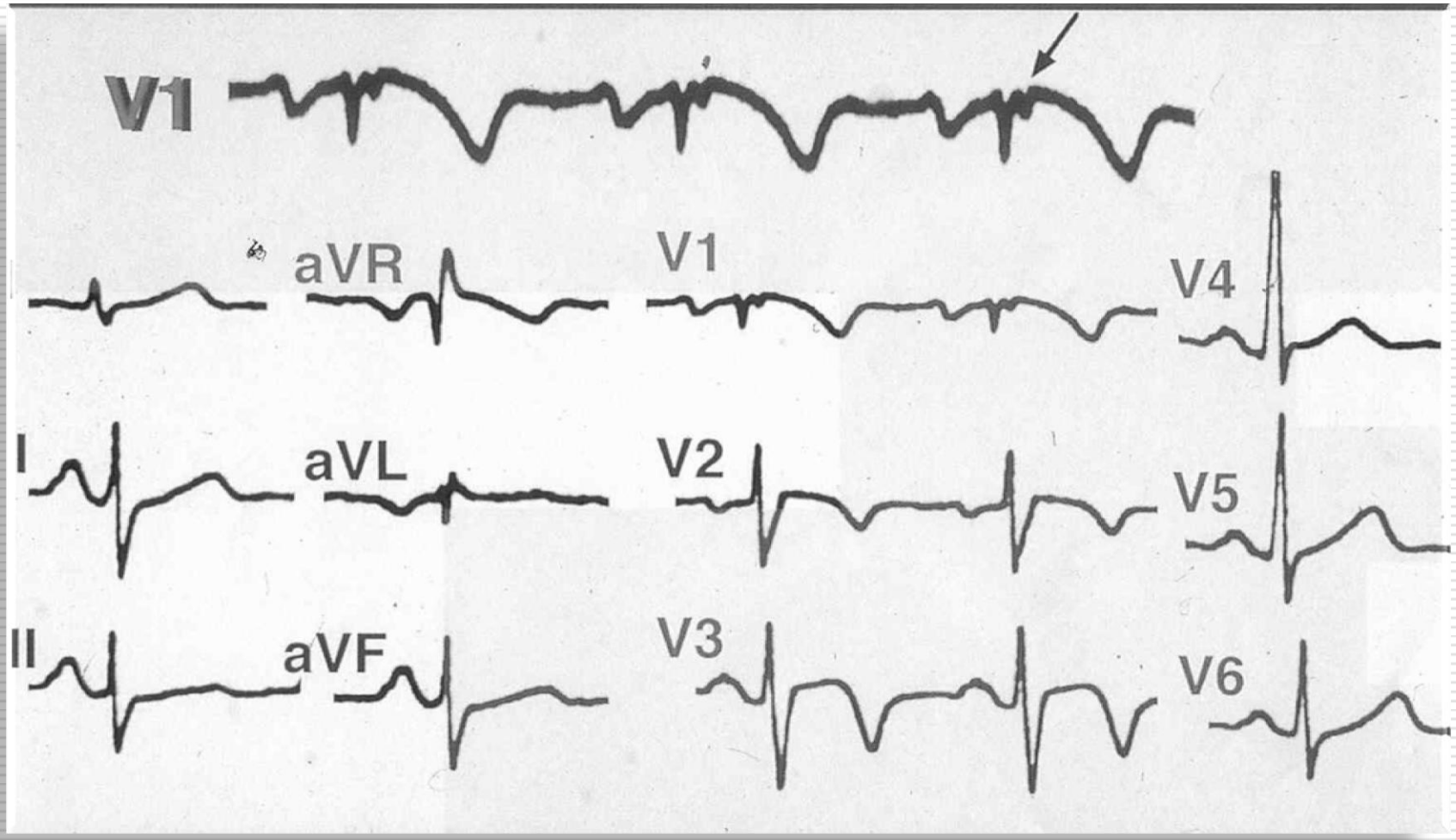
VII: EKG příklady v souvislosti s NS

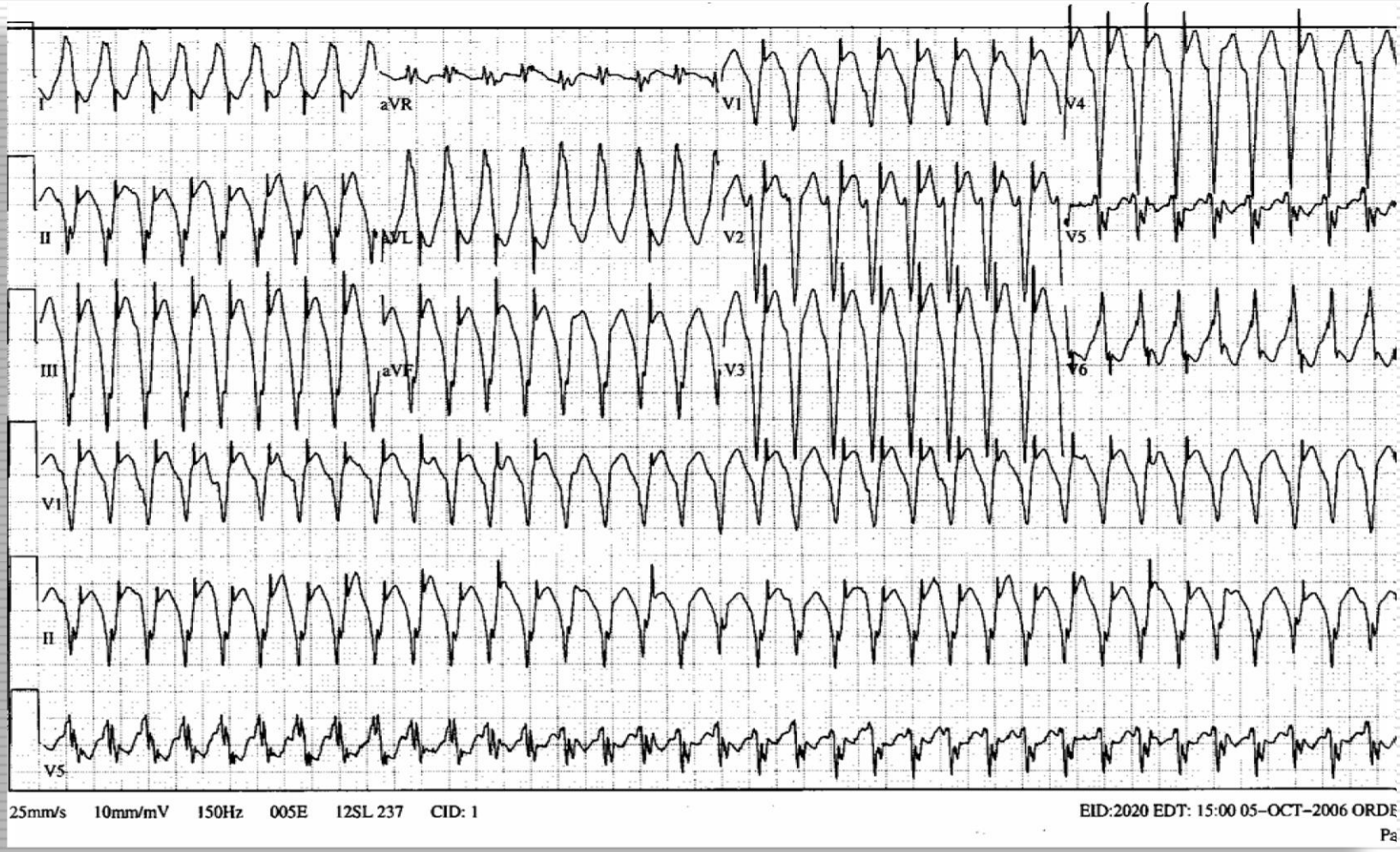
Arytmogení KMP PK



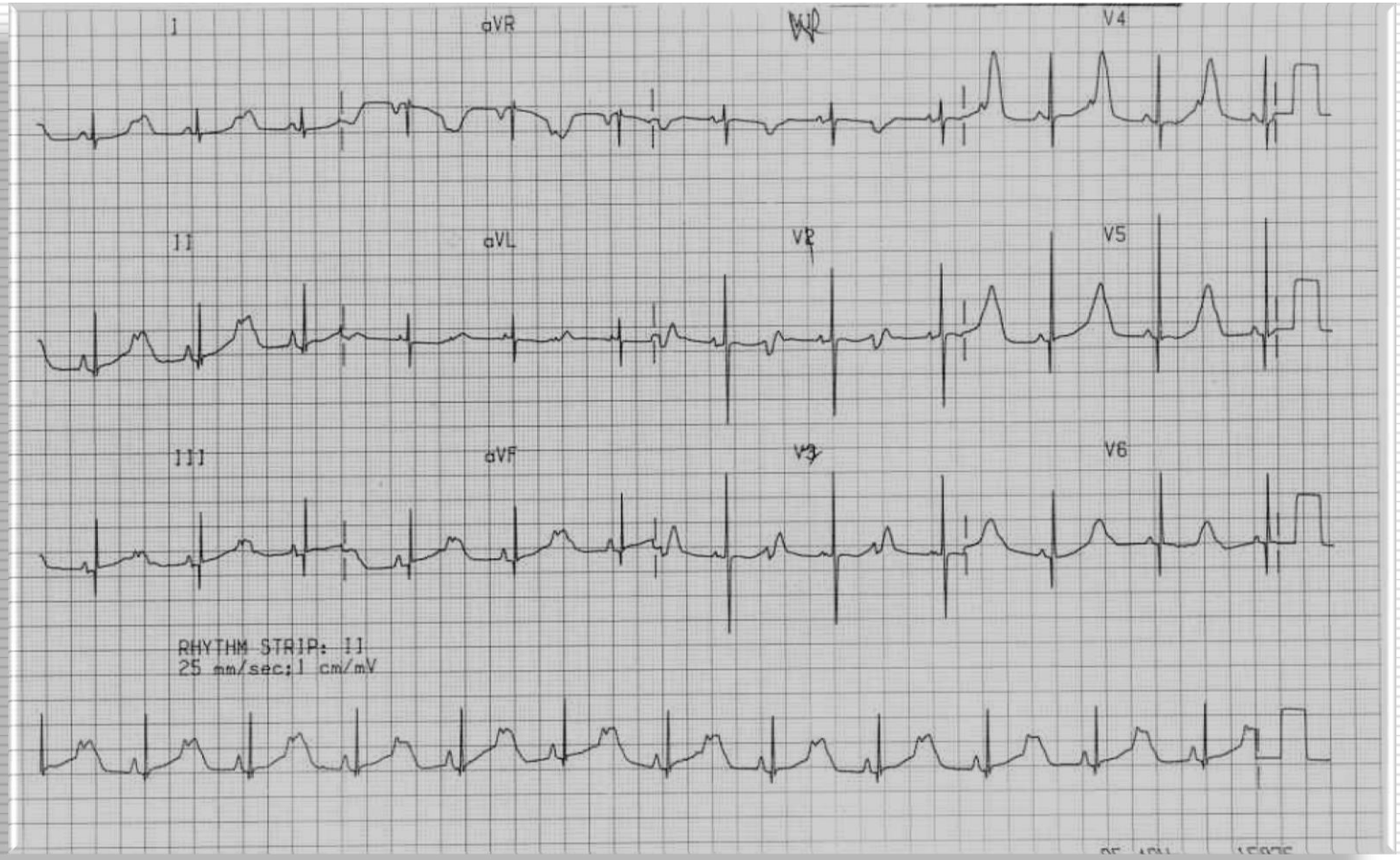
AKMP PK s epsilon vlnou



Udržující se KT u pac. S AKMP PK



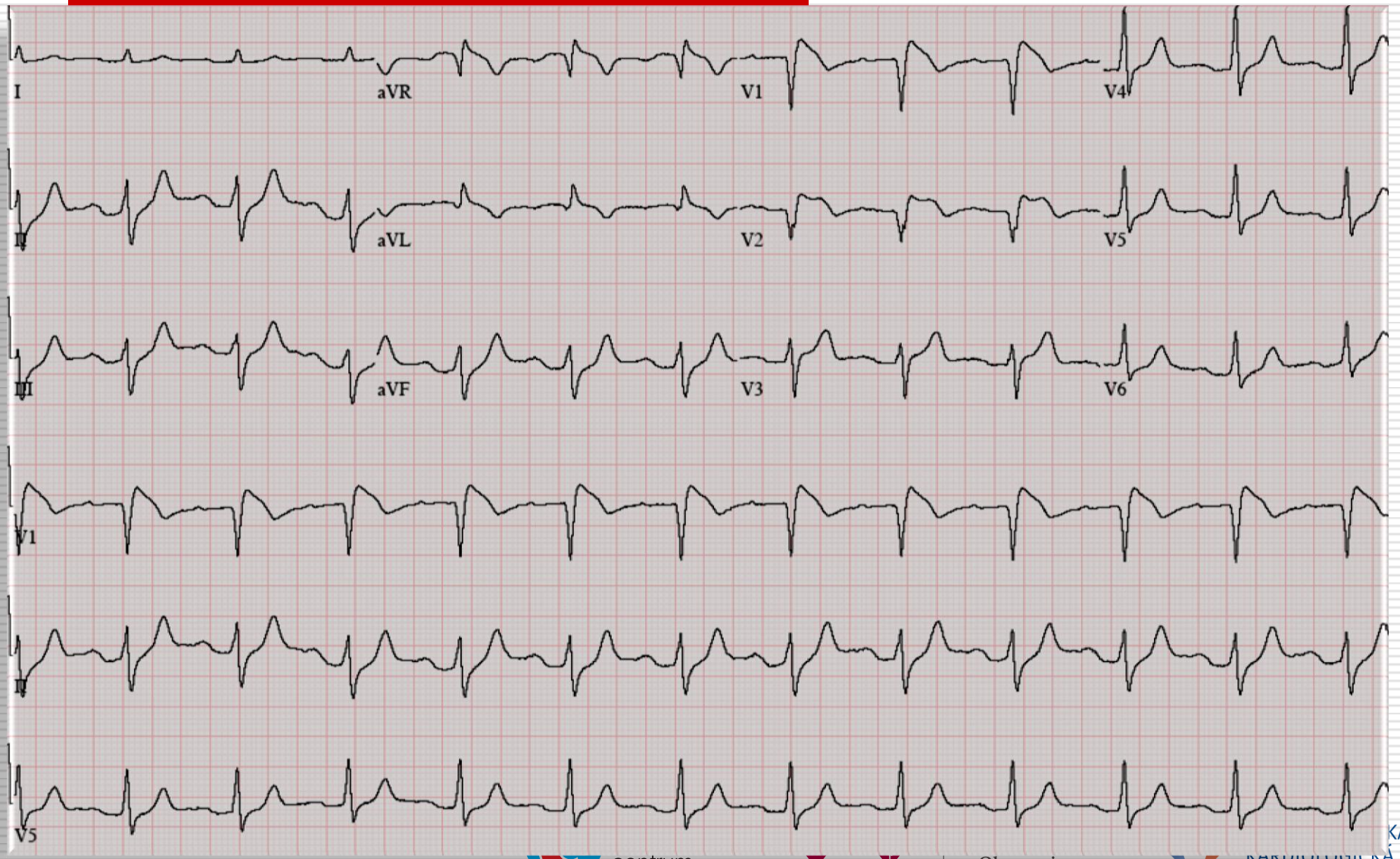
LQT sy:



QTc : 500 ms
A tachy 2:1

TdP

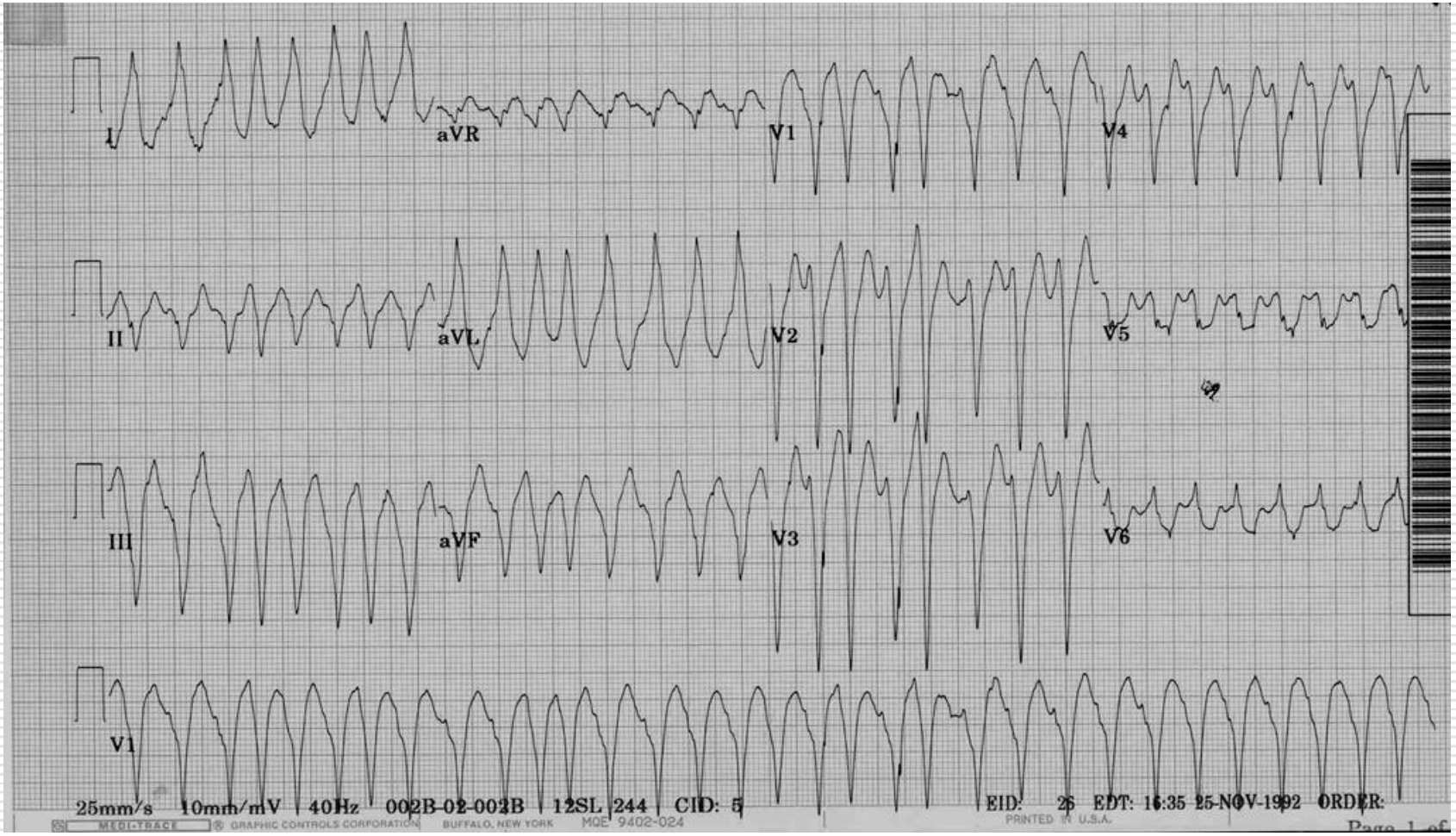
Brugada sy



BB reentry tachykardie

Polymorfní udržující se KT

Kvíz


I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
V1
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EID: 26 EDT: 16:35 25-NOV-1992 ORDER:
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Autor: D. Klimeš, I. IKK FNOL

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