Chronic forms of coronary artery disease

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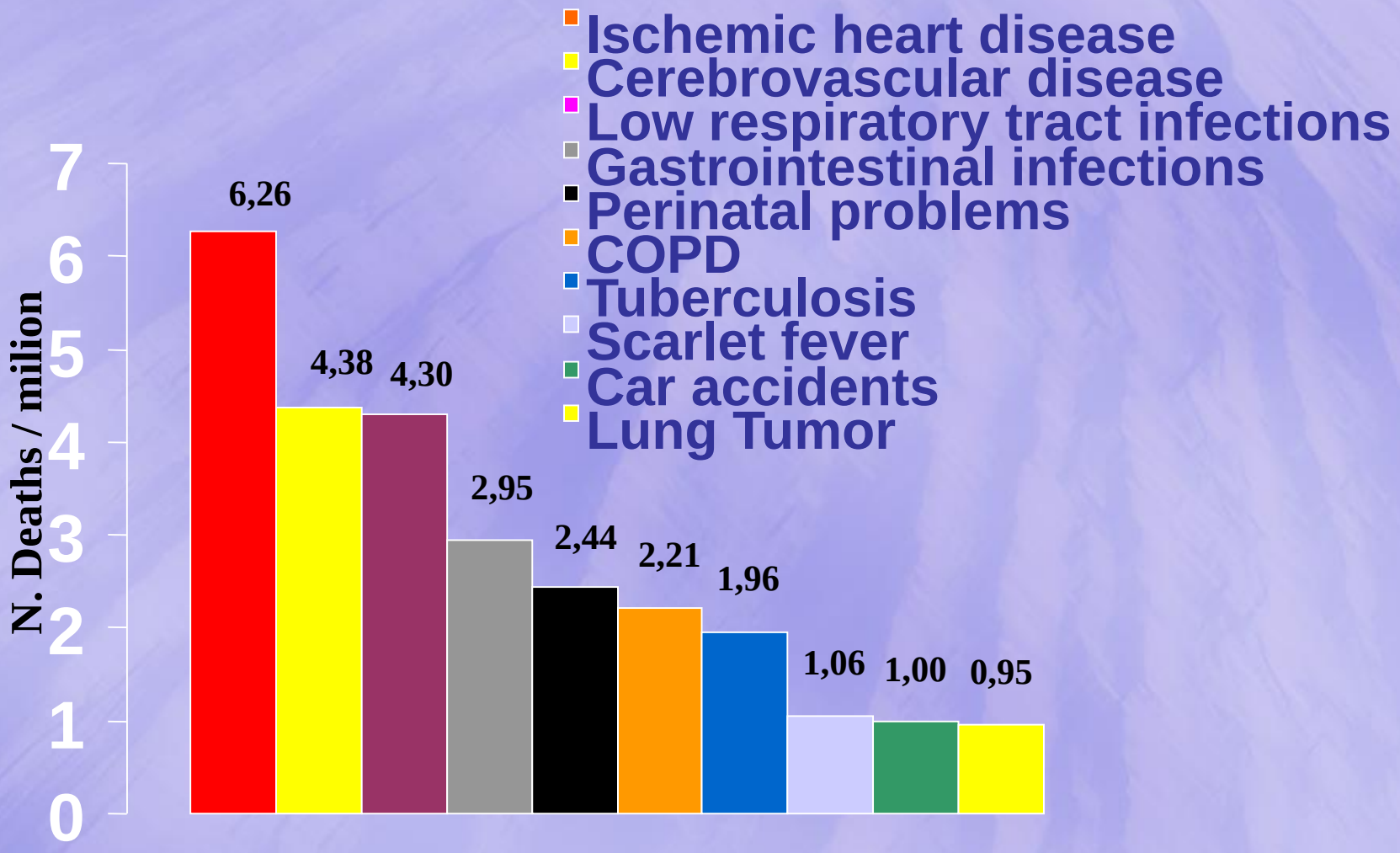
CAD is the first cause of death



Murray & Lopez. Lancet. 1997;349:1269-1276

Pathophysiology

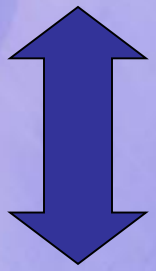
Vascular resistance

(metabolic control, humoral and neural factors)

Coronary blood flow

(duration of diastole / pressure gradient)

Oxygen demand

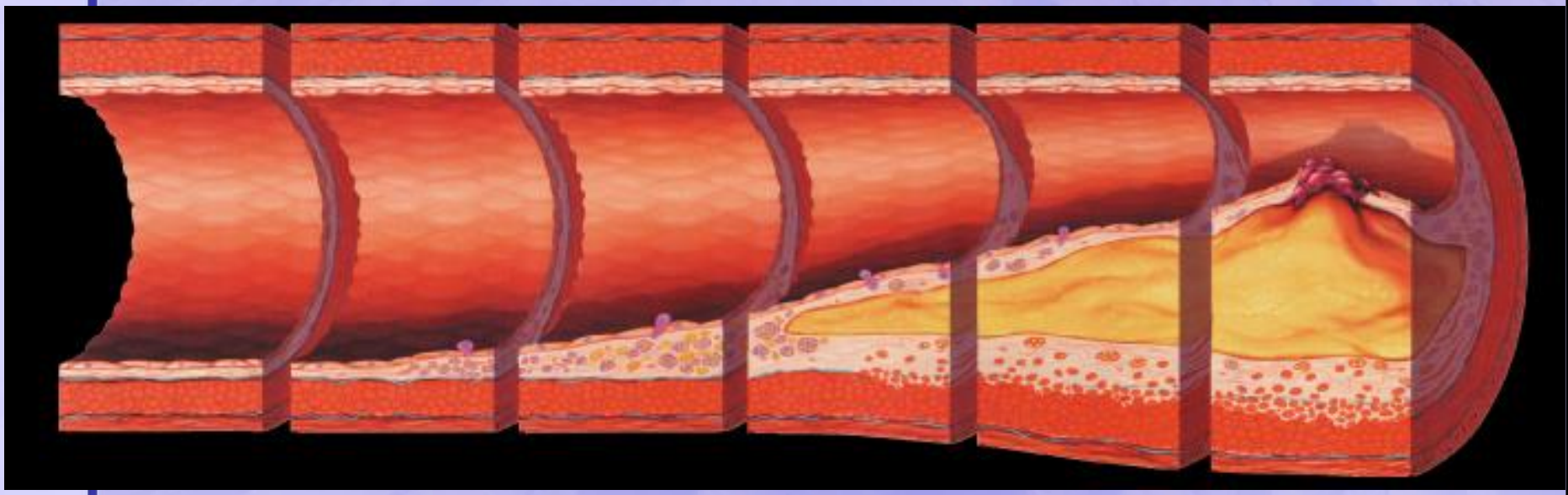


Oxygen suply

- **Heart rate**
- **Contractility**
- **Systolic wall stress**

Timeline

Foam Cells | Fatty Streak | Intermediate Lesion | Atheroma | Fibrous Plaque | Complicated Lesion/ Rupture



Endothelial Dysfunction

From First Decade	From Third Decade	From Fourth Decade

Adapted from Pepine CJ. *Am J Cardiol.* 1998;82(suppl 104).

Diagnosis

- History of patient
  - Familiar history
  - Personal history
  - Sex (M>F), age
  - pain
- Physical examination
- Clinical test
- Risk assessment (low, probable, high)

Estimate of CAD Probability (Duke Clinical Score)

- **age**, **gender** **and** **pain type** were the most powerful predictors
- other predictors
  - **smoking** (defined as a history of smoking half a pack or more of cigarettes per day within five years of the study or at least 25 pack-years)
  - **Q wave or ST-T-wave** changes
  - **hyperlipidemia** (defined as a cholesterol level >250 mg/dL / 6,4 mmol/L)
  - **diabetes** (glucose >140mg/dL / 7,8 mmol/L). Of these risk factors, diabetes had the greatest influence on increasing risk.

Am J Med 1983;75:771-80 ; Am J Med 1990;89:7-14
Ann Intern Med 1993;118:81-90

Estimate of CAD Probability

- a 64-year-old man with typical angina has
- a 94 % likelihood of having significant CAD

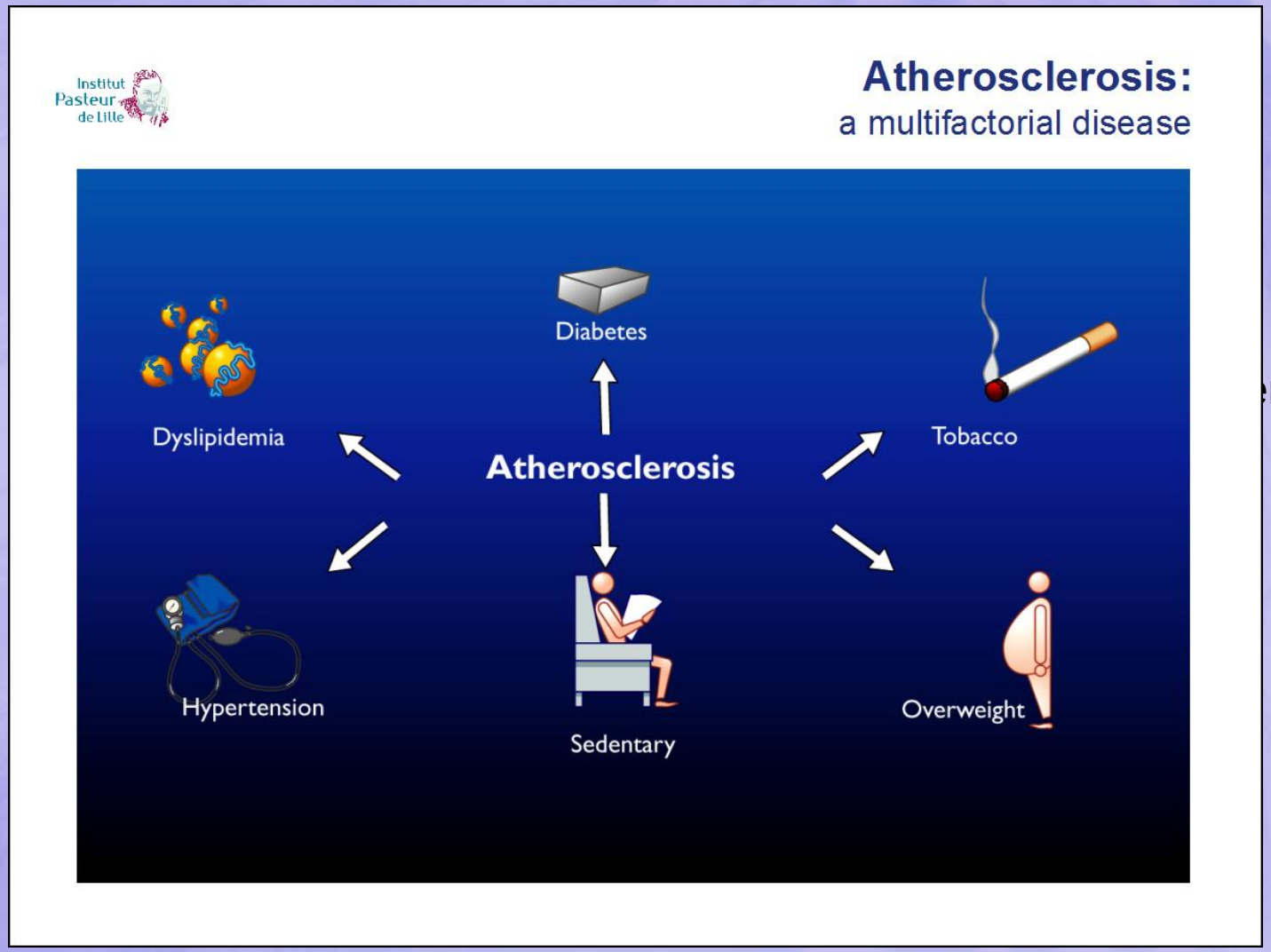
- a 32-year-old woman with nonanginal chest pain has
- a 1 % chance of CAD

N Engl J Med 1979;300:1350-8

Duke Clinical Score

Risk factors

- Major independent risk factors



- erides

Angina pectoris

- Typical angina (definite)
  - 1. Substernal chest discomfort with a characteristic quality and duration that is
  - 2. Provoked by exertion or emotional stress and
  - 3. Relieved by rest or nitroglycerin.
- Atypical angina (probable)
  - Meet
- Noncar
  - Meets

A pain or discomfort in the chest or adjacent areas caused by insufficient blood flow to the heart muscle.

J Am Coll Cardiol. 1983;1:574, Letter

Pain - descriptio

- (1) location
  - located substernally or
  - Less often - over the pr
  - Nevertheless - can be l the neck; rarely, it may back.
  - radiates down the arms back, left side is more c aspect of the arm
- (2) quality
  - deep visceral pressure or stabbing or pinprick-
  - Angina is almost never change with position or
- (3) duration of the discomfo
  - 10-30 sec plateau and
- (4) inciting factors
  - physical activity, emotio
- (5) factors relieving the pain

Grading of Angina of Effort by the Canadian Cardiovascular Society

I. "Ordinary physical activity does not cause … angina," such as walking and climbing stairs. Angina with strenuous or rapid or prolonged exertion at work or recreation.

II. "Slight limitation of ordinary activity." Walking or climbing stairs rapidly, walking uphill, walking or stair climbing after meals, or in cold, or in wind, or under emotional stress, or only during the few hours after awakening. Walking more than 2 blocks on the level and climbing more than one flight of ordinary stairs at a normal pace and in normal conditions.

III. "Marked limitation of ordinary physical activity." Walking one to two blocks on the level and climbing one flight of stairs in normal conditions and at normal pace.

IV. "Inability to carry on any physical activity without discomfort -- anginal syndrome *may be* present at rest."

Circulation 1976; 54:522-523

Stable / Unstable angina

- Stable: duration > 60 days

- Unstable angina: rest angina
  - severe new-onset angina
  - or prior angina increasing in severity
  - the acute coronary syndromes of unstable angina and non–ST-segment elevation myocardial infarction were linked
  - Now. ACUTE CORONARY SYNDROME

Silent ischemia

- Asymptomatic ischemic episodes
- The prevalence : approximates 40 percent in patients with chronic stable angina
- ST-segment depression on ECG monitoring
- Pathophysiology of Silent Ischemia: ? less severe ischemia? , neuropaty (diabetic)

Diagnosis – tests I.

- Resting 12-lead ECG (normal in 50% pts)
  - Q waves, ST segment denivelation
- Echocardiography
  - impaired systolic LV function
  - regional and global abnormalities

ID: 391206 Examined: 05/01/06 09:22

Judge < - >

<< No Diagnosis >>

Name: stp QIMDS

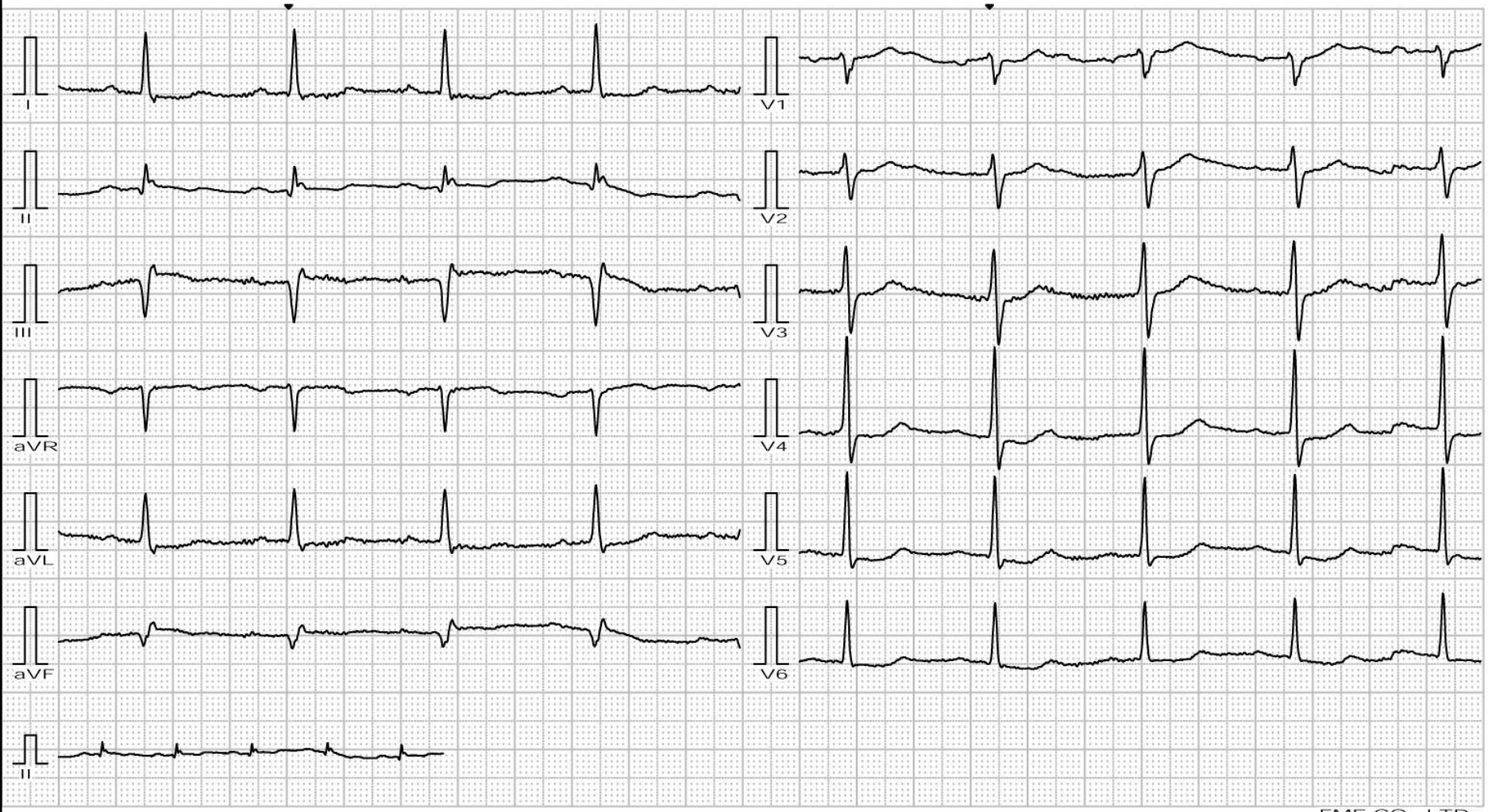
HR: 57 BPM Axis: -11 <

QRS: 93 ms QTc: 470

PQ: 267 ms RV5+SV1: 18.8mm

Comments:

M.D.



FME CO., LTD.

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<< No Diagnosis >>

Name: QS AL

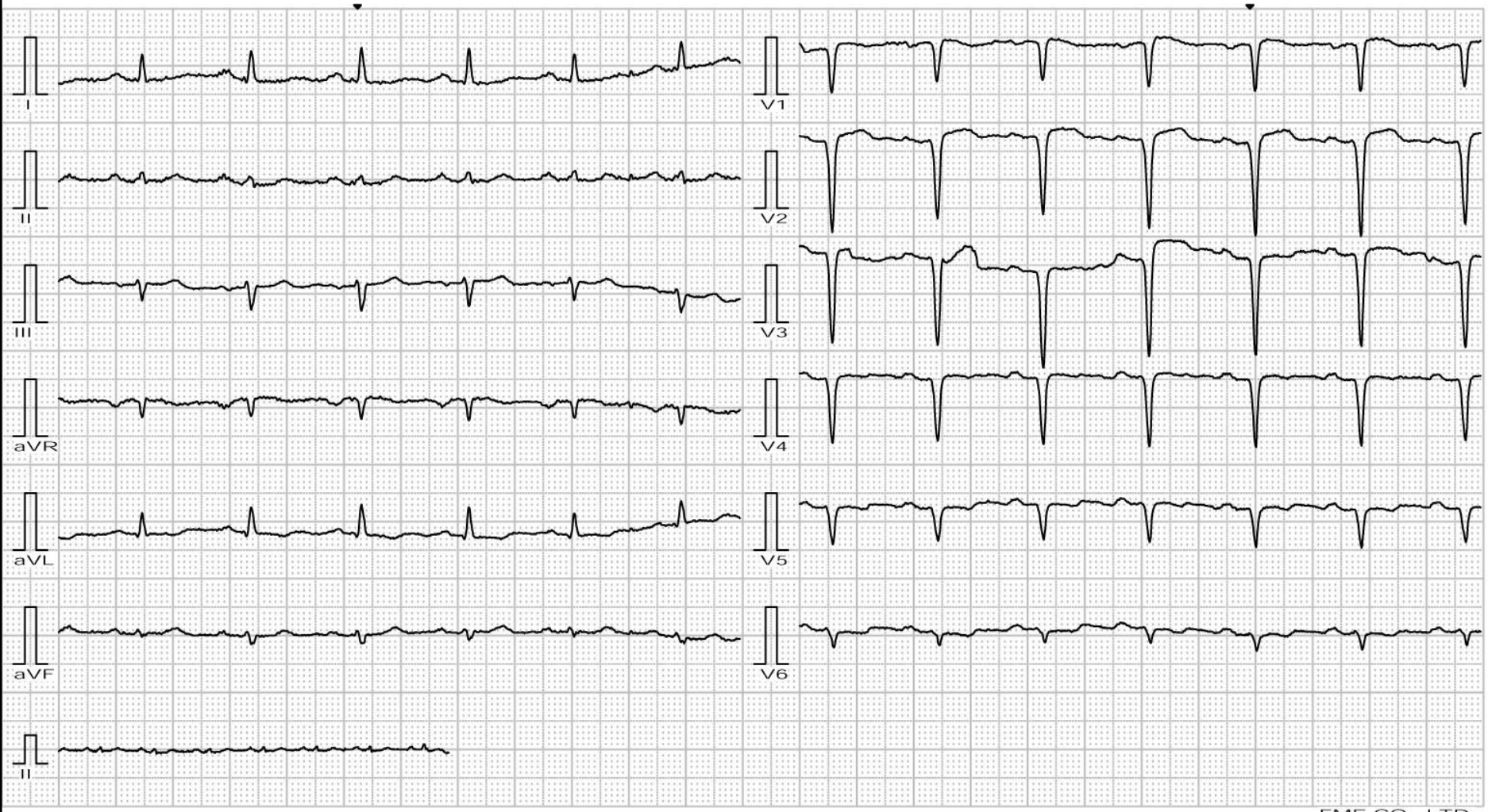
HR: 80 BPM Axis: -6 <

QRS: 80 ms QTc: 400

PQ: 203 ms RV5+SV1: 8.3mm

Comments:

M.D.



FME CO., LTD.

ID: 440502 Examined: 05/01/13 10:01

Judge < - >

<< No Diagnosis >>

Name: LBBB 2

HR: 65 BPM Axis: -13 <

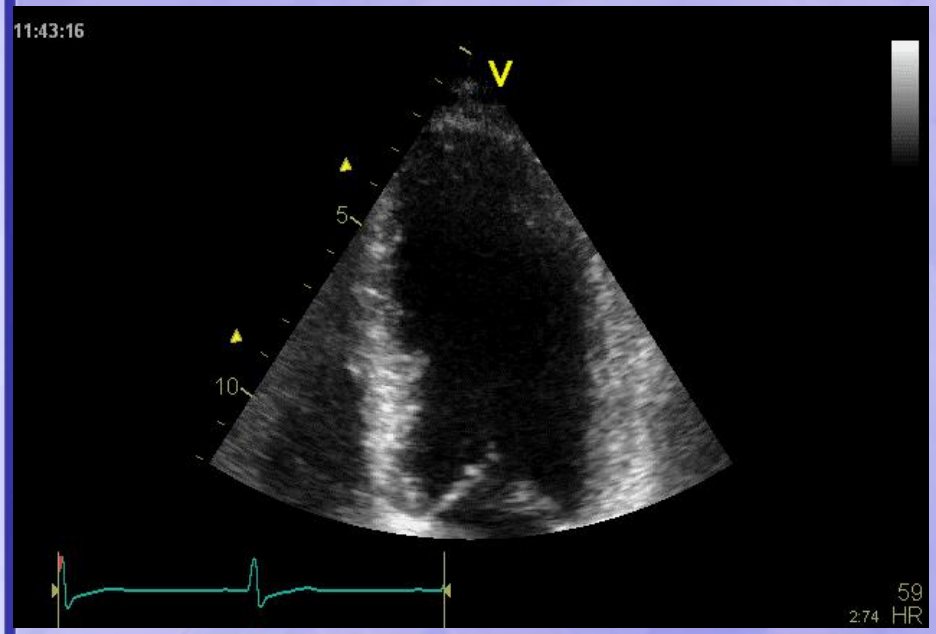
QRS: 137 ms QTc: 470

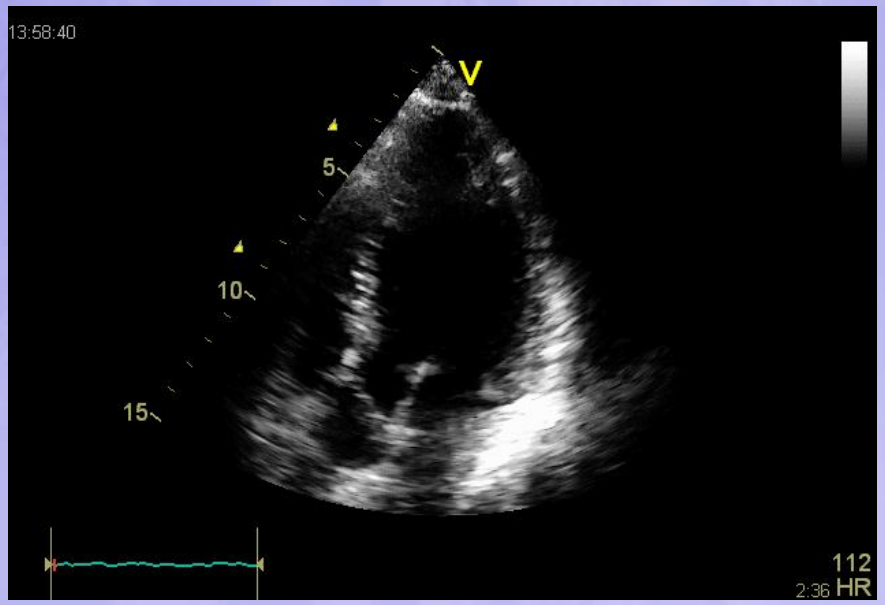
PQ: 187 ms RV6+SV1: 30.7mm

Comments:

M.D.

Echocardiography – lateral wall



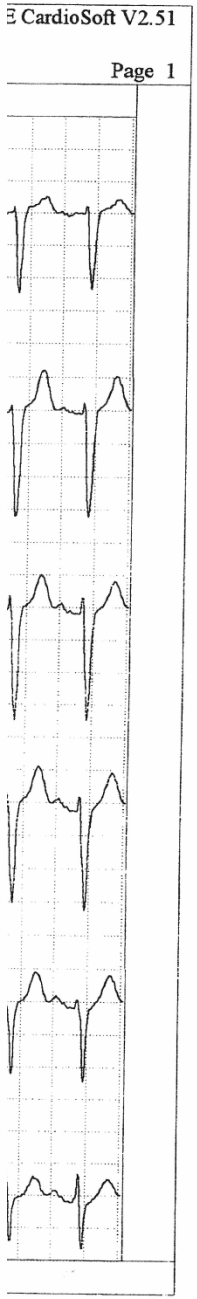


Courtesy of:
MUDr. Jan Maňoušek

Diagnosis – tests II

- Exercise ECG stress testing
  - Ergometry, treadmill , hand-grip
  - Ecg, BP, heart rate
  - dificulties in woman
- Myocardial Perfusion Imaging
  - thallium -201 (201Tl); technetium-99m (99mTc)
  - single-photon emission computed tomography (SPECT)
- Stress Echocardiography - dobutamine
  - (1) decrease in wall motion in one or more LV segments with stress
  - (2) diminution in systolic wall thickening in one or more segments during stress, and
  - (3) compensatory hyperkinesis in complementary (nonischemic) wall segments


Karel Králík
23.04.1947 (59 y.)
Male, Caucasian, 178 cm, 110.0 kg
EXERCISE TEST / Stored ECG
Patient ID 470423/500
HELLIGE CardioSoft V2.51
Page 2
8:48 20 W 130 BPM 165/80 mmHg
V1
V2
V3
V4
V5
V6
09:07:25
10 mm/mV 25 mm/s 35 Hz 50 Hz ADS
Physician: dr.Dokoupilová
User: FN Brno-Bohunice


E CardioSoft V2.51
Page 1


Name: Jan Burda
EXERCISE TEST / Stored ECG
HELLIGE CardioSoft V2.51
Jan Burda
of Birth: 01.01.1948 (57 y.)
Male, 174 cm, 83.0 kg
EXERCISE TEST / Stored ECG
Patient ID 480101/440
HELLIGE CardioSoft V2.51
Page 3
Page 1
7:47 124 W 127 BPM 200/100 mmHg
I
II
III
AVR
AVL
AVF
V1
V2
V3
V4
V5
V6
26.04.2005 09:09:50
10 mm/mV 25 mm/s 35 Hz 50 Hz ADS
Physician: dr.Floriánová
User: FN Brno-Bohunice

Comparison of Stress Tests

- **meta-analysis on 44 articles (published between 1990 and 1997)**

	Sensitivity	Specificity
ECG	**52%**	**71%**
Echocardiography	**85%**	**77%**
Scintigraphy	**87%**	**64%**

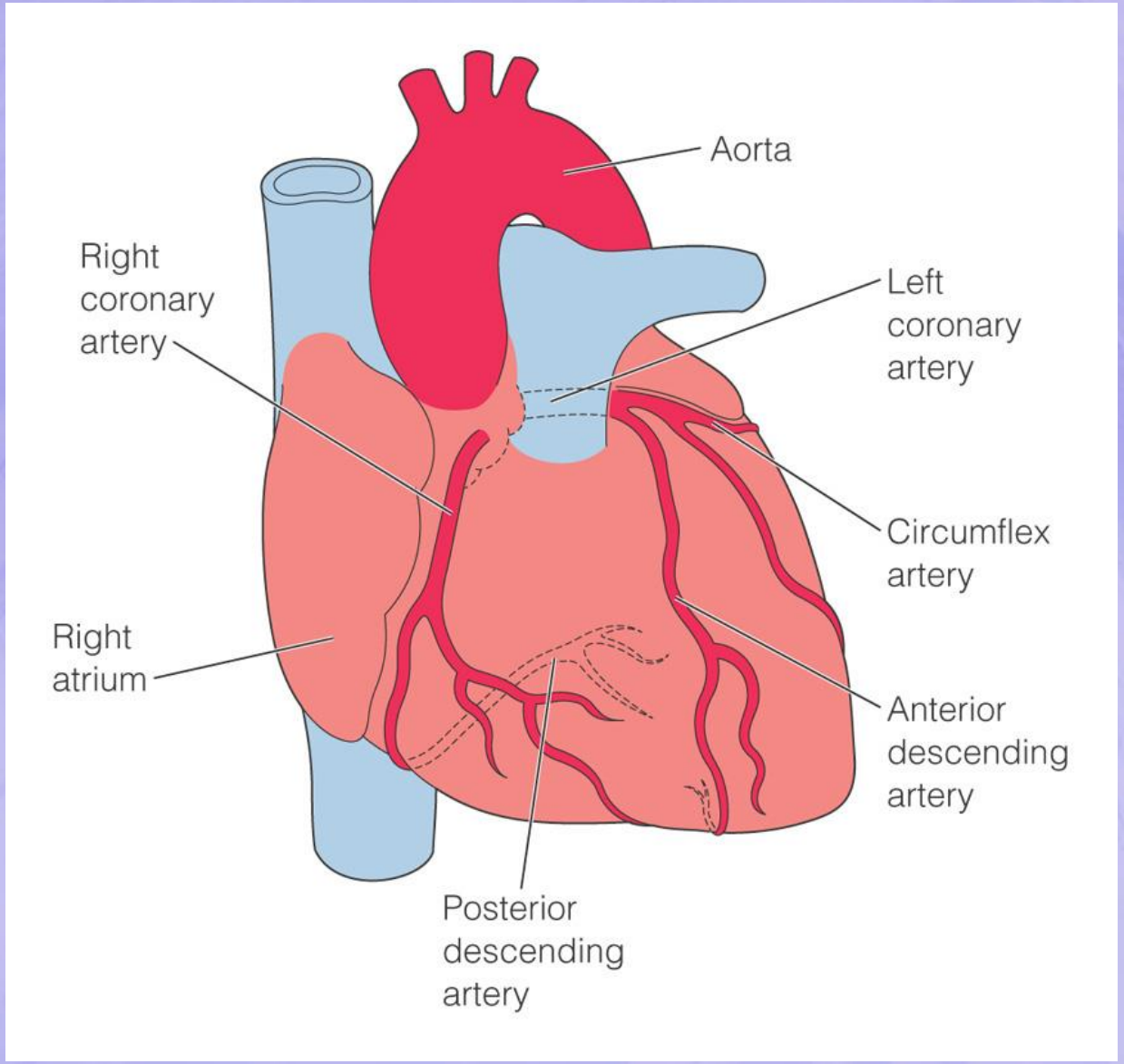
exercise echocardiography had significantly better discriminatory power than exercise myocardial perfusion imaging

JAMA 1998;280:913-20

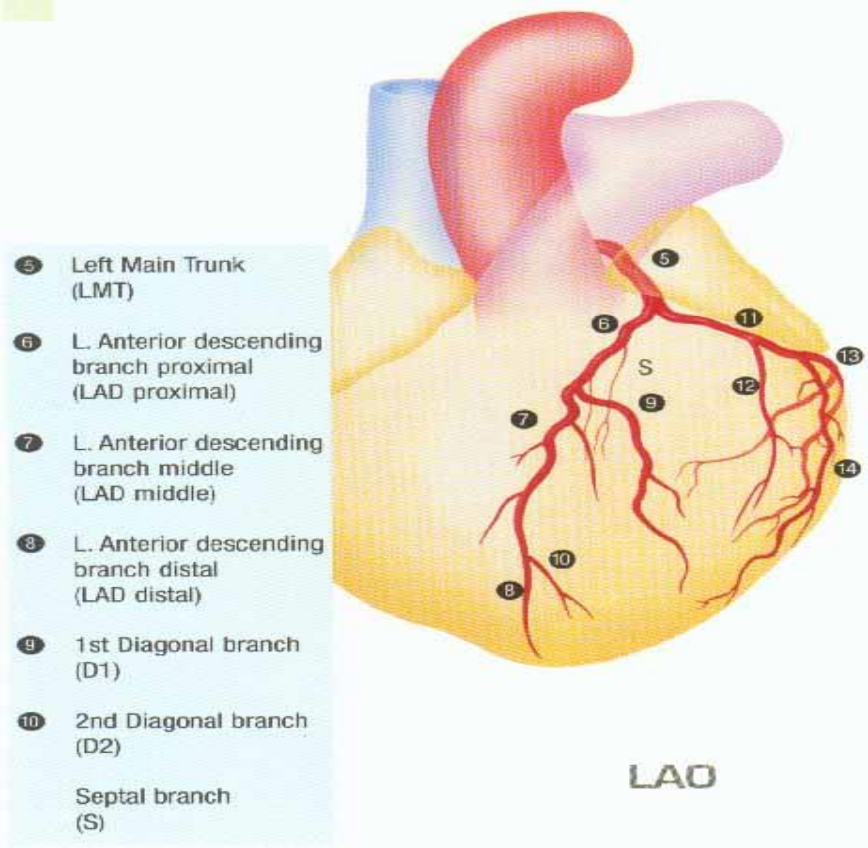
Diagnosis – coronary angiography

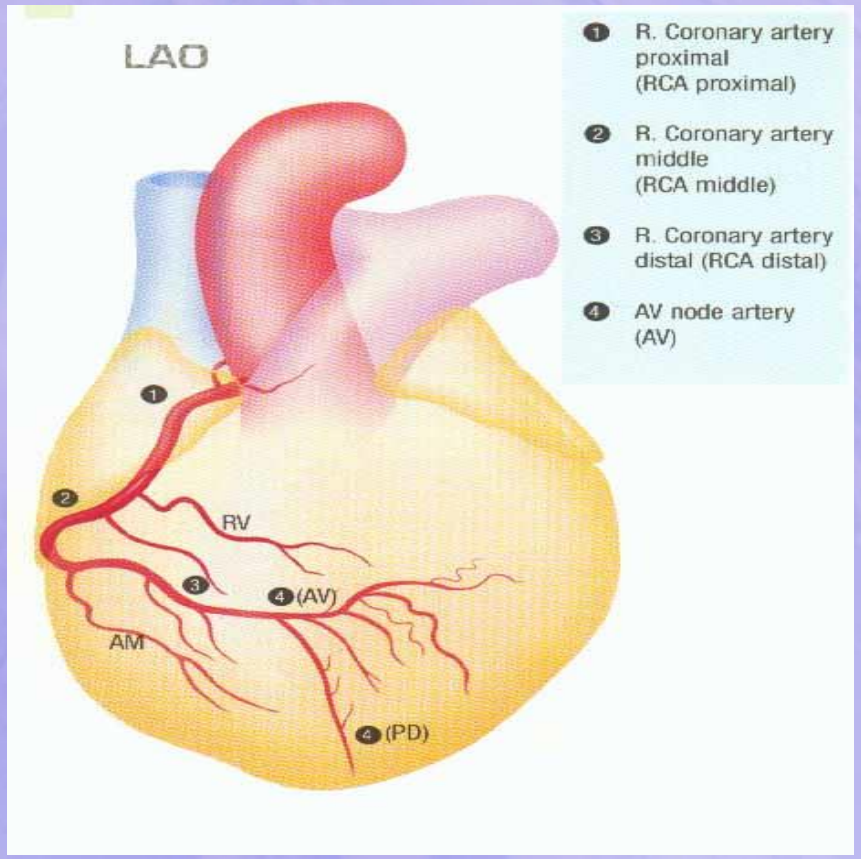
- Who?
  - pain + pathological non-invasive tests
  - Clinical probability (smoker, obesity, familiar history, male)
  - Low LVEF
  - Other problem: arrhythmias, unstability

- rationale is to identify high risk patients in whom coronary angiography and subsequent revascularization might improve survival


Aorta
Right coronary artery
Left coronary artery
Circumflex artery
Right atrium
Anterior descending artery
Posterior descending artery

Coronary Angiography





Chronic Stable Angina
Treatment Objectives

- To reduce the risk of mortality and morbid events

- To reduce symptoms
  - anginal chest pain or exertional dyspnea
  - palpitations or syncope
  - fatigue, edema or orthopnea

Treatment

- Non – pharmacological
  - Revascularisation
    - Coronary artery bypass grafting (CABG)
    - percutaneous coronary intervention (PCI, PTCI)
  - Heart transplantation
- Pharmacological
    - Betablockers
    - antiplatelet agens
    - Lipid lowering agens
    - angiotensin-converting enzyme inhibitor ACEI
    - Nitroglycerin / nitrates
    - (Calcium – antagonist)

Indications of revascularisation

1. To be candidate for revascularization procedure, one must have symptomatic or objective signs of ischemia.

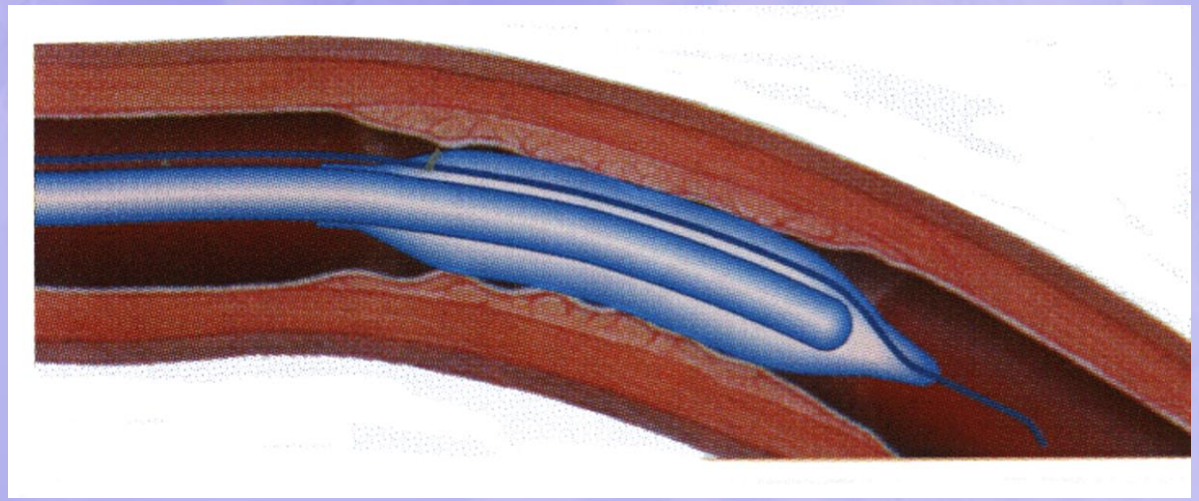
2. Indications for PTCA or CABG may vary from one center to another according to experience, skills and results.

3. Definite indications for CABG: LM disease and 3 VD with proximal stenosis.

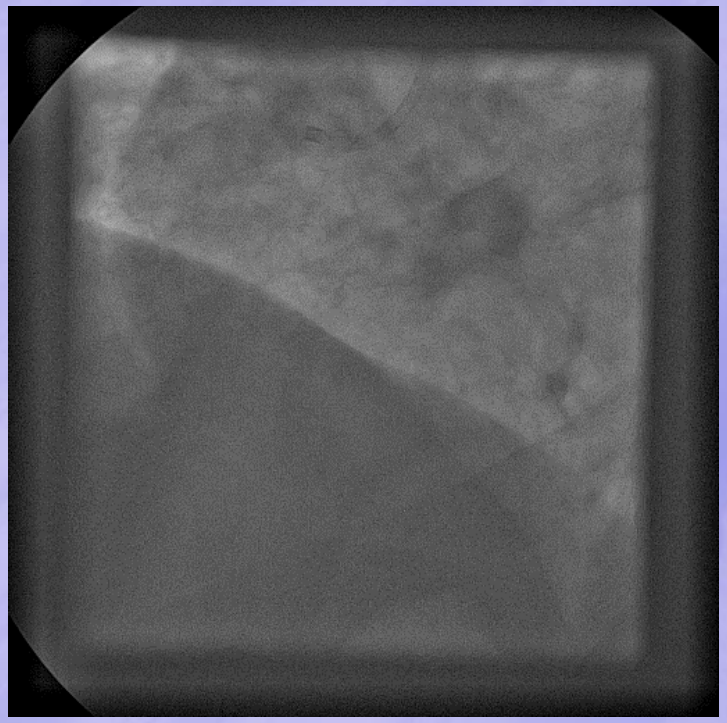
4. Definite indications for PTCA: SVD (apart from ostial LAD), favourable morphology .

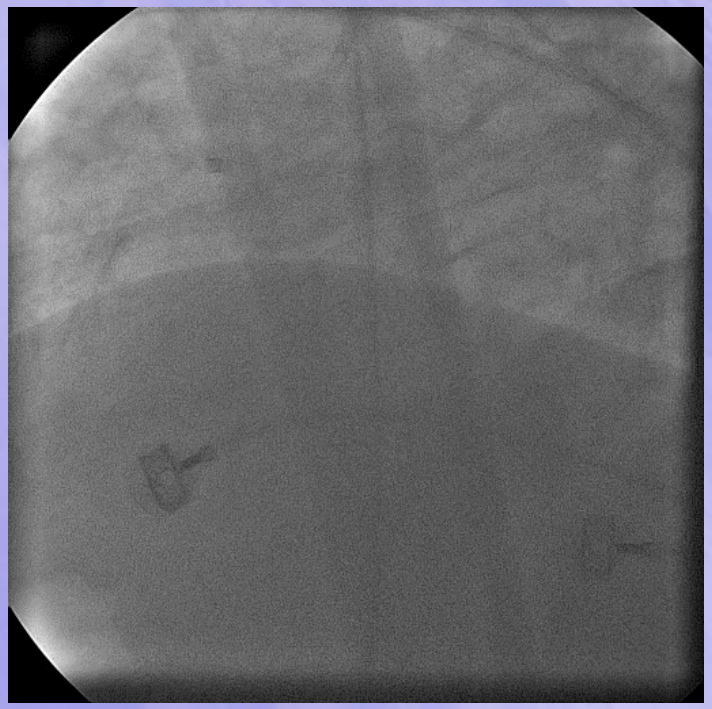
Procedure

- Sheath in femoral, radial or brachial artery
- diameter sheath (usually 6F, but also 5 to 8)
- guiding catheter
- guide wire 0.014 inch
- balloon
- stent



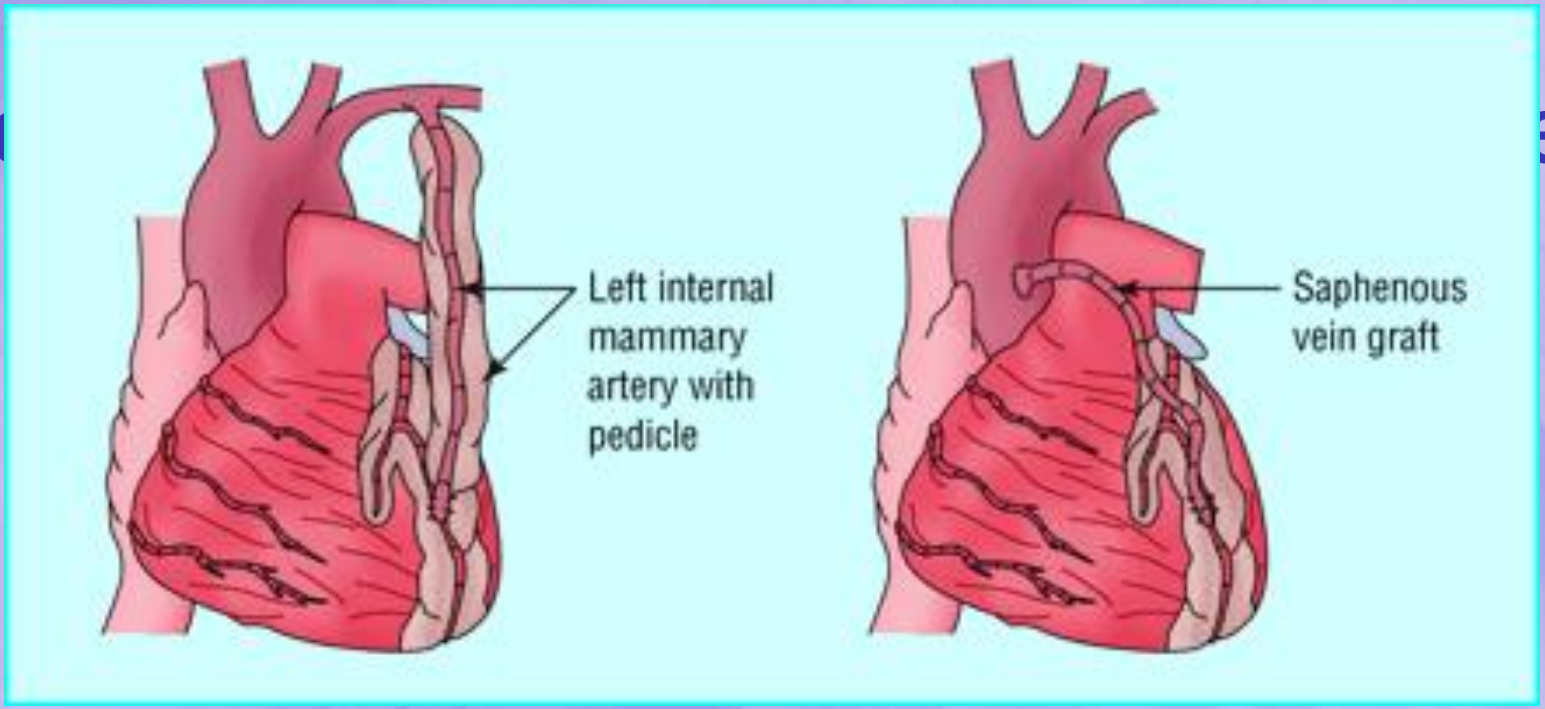
PCI - ACD





Courtesy of: MUDr. Roman Miklík, Ph.D.

Co...ery



- Saphenous vein grafts (SVG) are conduits made by harvesting a piece of vein from the patient's leg and attaching it between the aorta and coronary artery

- Arterial bypass grafts involve re-routing an artery from its normal course and attaching it to the coronary artery
  - Internal Mammary Artery
  - Gastroepiploic Artery
  - Radial Artery

Current Medical State of SVG Disease

- Average lifespan for a vein graft is 5-10 years
  - 50% of SVGs will be occluded within 10 years
  - 75% will develop severe narrowing in same period
- SVG lesions presenting within the first year after surgery are typically caused by intimal hyperplasia
  - respond well to balloon dilatation
- Late vein graft stenoses are more commonly caused by diffuse atherosclerosis
  - friable plaque and thrombus tend to fragment and embolize into distal coronary vessels

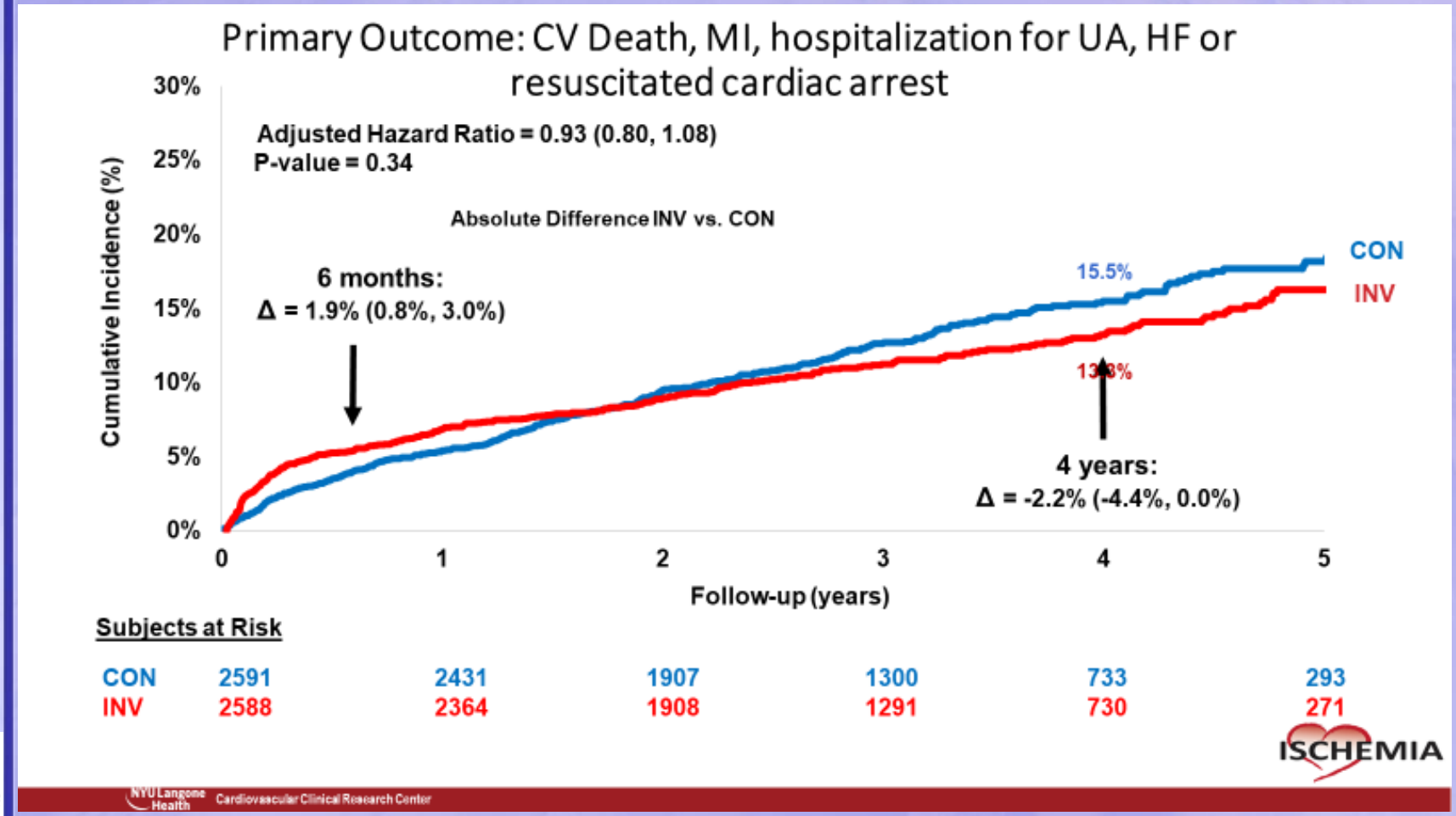
Ischemia Trial 2019

- Patients with **stable** ischemic ischemic heart disease and moderate to severe ischemia were randomized to routine **invasive therapy** (n = 2,588) versus **optimal medical therapy** (n = 2,591)
- Duration of follow-up: 3.3 years
- Mean patient age: 64 years

- Inclusion: Moderate to severe ischemia on noninvasive stress testing

- Presented by Judith S. Hochman at the American Heart Association Annual Scientific Sessions (**AHA 2019**), Philadelphia, PA, November 16, 2019.

Ischemia Trial



ISCHEMIA trial showed that **heart procedures added** to taking medicines and making lifestyle changes **did not reduce the overall rate of heart attack or death** compared with medicines and lifestyle changes alone.

Treatment

- Non – pharmacological
  - Revascularisation: CABG / PCI
  - heart transplantation
- Pharmacological
  - antiplatelet agens
  - Betablockers
  - ACEI
  - Calcium – antagonist
  - Lipid lowering agens
  - Nitroglycerin / nitrates

Treatment – antiplatelet agens

- Cyclooxygenase inhibitors
  - Aspirin (Acetylosalicylic acid) 100 mg daily
- Adenosine diphosphate (ADP) receptor inhibitors 6-12 month after MI
  - Ticagrelor (Brilique)
  - Prasugrel (Efient)
  - Clopidogrel 75 mg daily
  - (Ticlopidine)

Treatment - betablockers

- Cardioselective
  - Metoprolol: 100-400 mg
  - Atenolol: 50-200 mg
  - Betaxolol 5-40 mg (long half-life)
- With intrinsic sympathomimetic activity
  - Acebutolol 400-1200 mg
- Non-selective (with alfa α-blocking activity)
  - Carvedilol 25-100mg

Treatment - betablockers

• Freemantle Nick, et al: **β Blockade after myocardial infarction: systematic review and meta regression analysis** BMJ 1999;318:1730

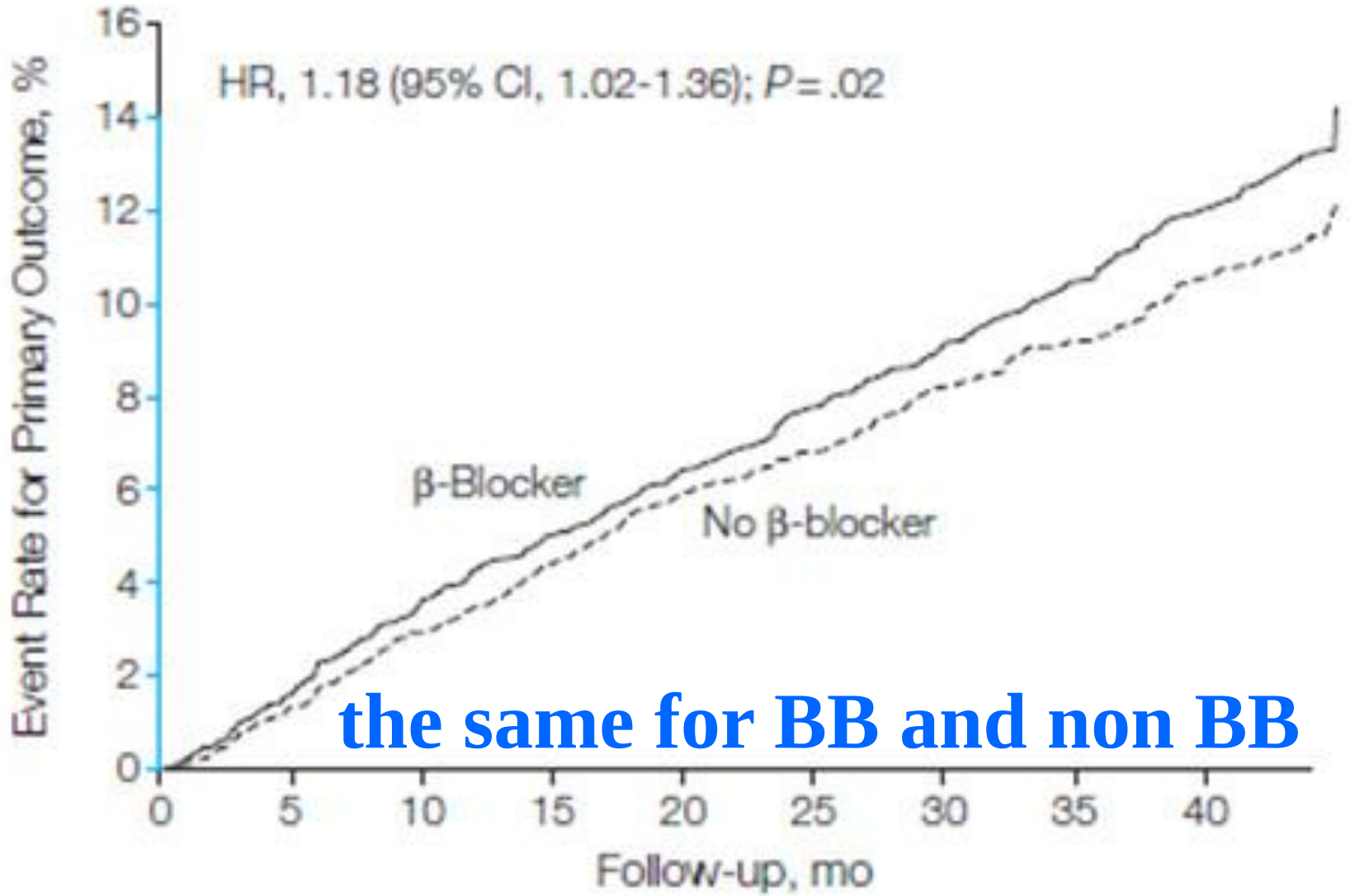
•Systematic review of randomised controlled trials.

•**Subjects**: Patients with acute or past myocardial infarction.

•**Intervention**: βBlockers compared with control.

•**Main**:outcome measures All cause mortality and non-fatal reinfarction

•We identified a **23% reduction in the odds of death** in long term trials (95% confidence interval 15% to 31%)



the same for BB and non BB

•Bangalore S, Steg G, Deedwania P, et al; REACH Registry Investigators. JAMA. 2012;308(13):1340-1349

40

Treatment : lipid lowering agents

Tab. 4 Metaanalýza studií – kvantifikace účinku statinů[4]

	Denní dávka statinu				
	5 mg	10 mg	20 mg	40 mg	80 mg
a) Absolutní pokles (mmol/l) LDL cholesterolu v séru					
Simvastatin	1,08	1,31	1,54	1,78	2,01
Lovastatin		1,02	1,3	1,77	2,15
Pravastatin	0,73	0,95	1,17	1,38	1,6
Fluvastatin	0,46	0,74	1,02	1,3	1,58
Atorvastatin	1,51	1,79	2,07	2,36	2,64
Rosuvastatin	1,84	2,08	2,32	2,56	2,8
b) Procentuální pokles (%) LDL cholesterolu v séru					
Simvastatin	23	27	32	37	42
Lovastatin		21	29	37	45
Pravastatin	15	20	24	29	33
Fluvastatin	10	15	21	27	33
Atorvastatin	31	37	43	49	55
Rosuvastatin	38	43	48	53	58

Barevně jsou vyznačeny ekvipotence dle Wenga a spol., 2010.[5] Dávky statinů schopné snížit LDL cholesterol zhruba o 20–30 % jsou označeny bíle a dávky schopné snížit LDL cholesterol zhruba o 30–40 % jsou označeny tmavě zeleně.

Tab. 1 Cílové hodnoty cholesterolu a apolipoproteinu B

	Populace obecně	Bez KVO, riziko ≥ 5 %, DM2 nebo DM1 s mikro-albuminurií	Přítomnost KVO
Celkový cholesterol	< 5 mmol/l	< 4,5 mmol/l	< 4,0 mmol/l
LDL cholesterol	< 3 mmol/l	< 2,5 mmol/l	< 2,0 mmol/l
Non-HDL cholesterol	< 3,8 mmol/l	< 3,3 mmol/l	< 2,8 mmol/l
Apolipo--protein B	< 1,0 g/l	< 0,9 g/l	< 0,8 mmol/l

Podle: Doporučení pro diagnostiku a léčbu dyslipidémií v dospělosti[1]

Tab. 2 Optimální hodnoty HDL cholesterolu a triglyceridů (stejné pro všechny kategorie rizika)

	Muži	Ženy
HDL cholesterol	> 1,0 mmol/l	> 1,2 mmol/l
Triglyceridy	< 1,7 mmol/l	< 1,7 mmol/l

Podle: Doporučení pro diagnostiku a léčbu dyslipidémií v dospělosti[1]

Treatment - nitrates

- tolerance is a problem
- **Nitroglycerin 0.4 mg spray** (Aborts acute attacks; headaches, hypotension)
- Nitroglycerin 0.4–0.6 mg SL
- Nitroglycerin 0.1–0.6 mg/h patches Prophylactic therapy
- Isosorbide dinitrate 10–60 mg three times daily
- **Isosorbide mononitrate** 20 mg twice daily Take 7 h apart, slow release form – once daily

- Night: molsidomin 2-8 mg (vasodilators)

Treatment : ca blockers

- Calcium Channel Blockers:
  - Heart Rate Lowering
  - Verapamil 120–480mg Heart-rate lowering; AV block, heart failure, constipation
- Dihydroperidine Calcium Channel Blockers
  - Amlodipine 5–10mg Least myocardial depression
  - Felodipine 5–20mg High vascular selectivity

Alternative Diagnoses to Angina for Patients with Chest Pain I

- Non-Ischemic CV: aortic dissection, pericarditis
- Pulmonary
  - pulmonary embolus
  - pneumothorax
  - Pneumonia, pleuritis
- Chest Wall / backbone
  - Costochondritis, fibrositis, rib fracture
  - sternoclavicular arthritis
  - herpes zoster
- Gastrointestinal
  - Esophageal: esophagitis, spasm, reflux
  - Biliary: colic, cholecystitis, choledocholithiasis, cholangitis
  - Peptic ulcer / Pancreatitis

Alternative Diagnoses to Angina for Patients with Chest Pain II

- Gastrointestinal
- Esophageal
  - esophagitis
  - spasm
  - reflux
- Biliary
  - colic
  - cholecystitis
  - choledocholithiasis
  - cholangitis
- Peptic ulcer
- Pancreatitis

Variant (Prinzmetal's) angina

- Spasmus of vessels
- Provocation during coronarography

  (ergonovine=ergometrine intra arterially)
- Ca blockers (verapamil)

Cíle po IM – sekundární prevence

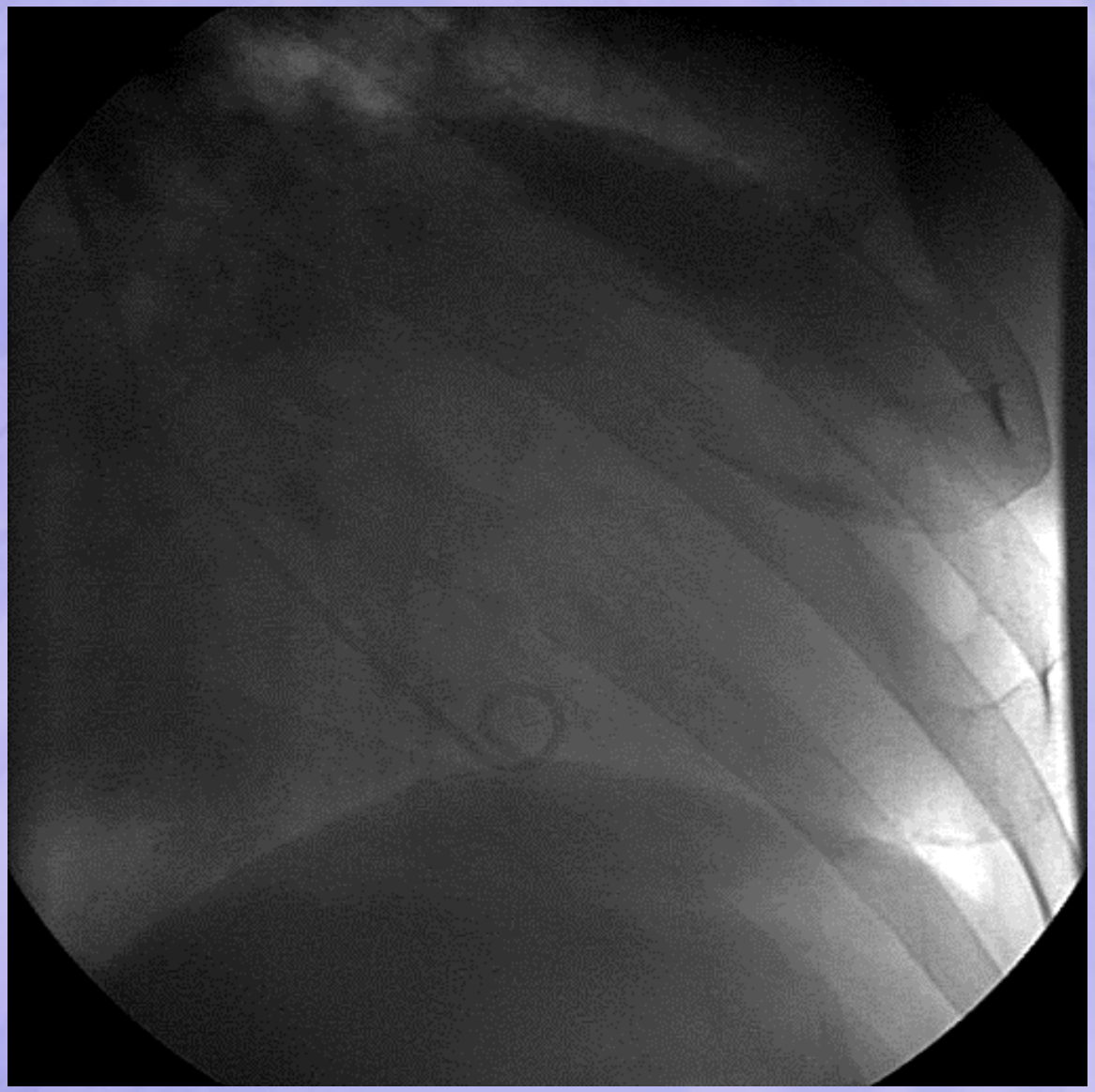
- Zanechat kouření
- Kompenzace DM – HbA1C < 6,5%
- Redukce nadváhy (BMI ≤ 30 kg/m2)
- TK < 130/80
- TCH < 4,0 mmol/l
- LDL < 2,0 mmol/l
- TG <1,7 mmol/l, HDL > 1 (1,2 ženy) mmol/l

Treatment

- A = Aspirin and Antianginal therapy
- B = Beta-blocker and Blood pressure (BP)
- C = Cigarette smoking and Cholesterol
- D = Diet and Diabetes
- E = Education and Exercise

- Therapy (risk reduction of new MI)
  - ASA (clopidogrel / ticlopidin) : -25%
  - BB risk reduction of new MI: -20% ?
  - ACEI risk reduction of new MI: -25
  - Statins risk reduction of new MI: -30%

CAD with heart failure



Courtesy of: MUDr. Roman Miklík, Ph.D.

CAD with heart failure

- Diagnosis: echo, CT scan, coronarography
- Therapy: revascularisation
- Therapy of heart failure
  - diuretics
  - BB
  - ACEI
  - ASA
  - CRT / ICD

Arrhythmias - supraventricular

- Atrial fibrillation
  - Th: Beta blockers /propafenone/ verapamilum/ amiodarone
  - Radiofrequency ablation
- Sick sinus syndrome
- Atrio ventricular block
  - Pacemakers (VVI, DDD,CRT)

Arrhy

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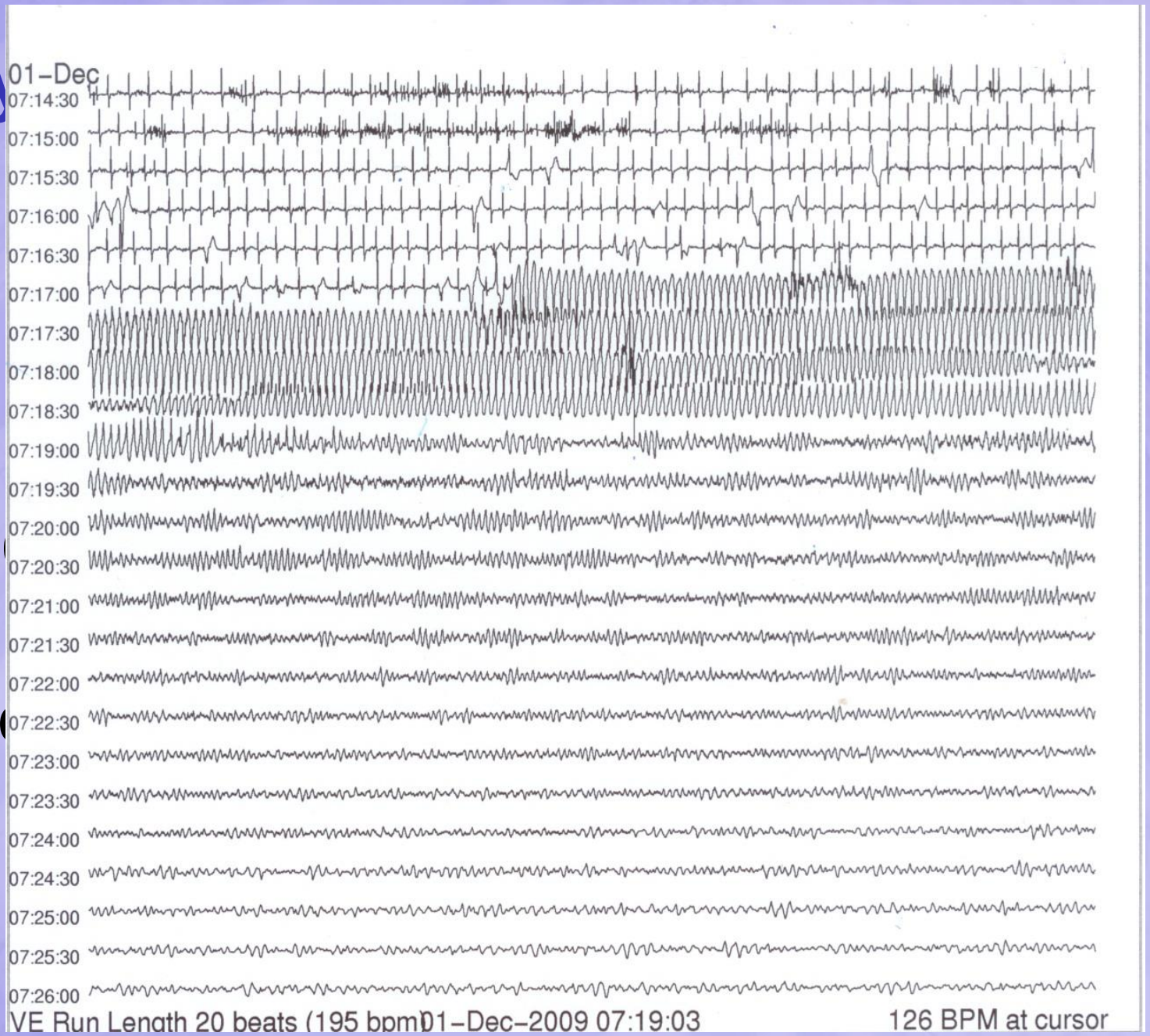

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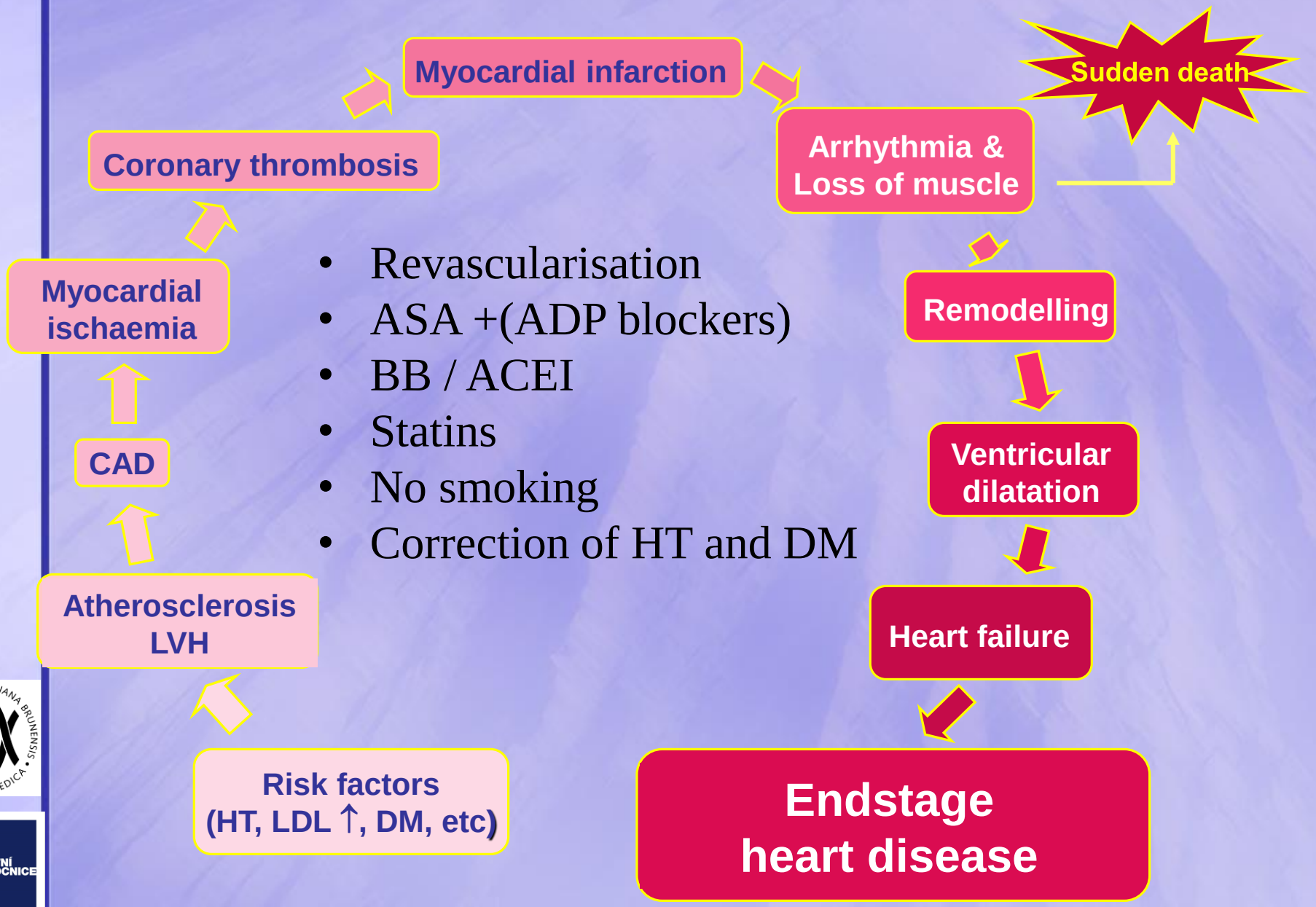
Myocardial infarction
Sudden death
Arrhythmia &
Loss of muscle
Coronary thrombosis
Remodelling
Myocardial
ischaemia
Ventricular
dilatation
CAD
Heart failure
Atherosclerosis
LVH
Endstage
heart disease
Risk factors
(HT, LDL ↑, DM, etc)
• Revascularisation
• ASA +(ADP blockers)
• BB / ACEI
• Statins
• No smoking
• Correction of HT and DM

Thank You for You attention!