SPECT myokardu

M. Kamínek, KNM LF UP a FN Olomouc

24 ESC Guidelines for the management chronic coronary syndromes

European Heart Journal (2024) **00**, 1
https://doi.org/10.1093/eurheartj/eha

. What is new

2024 Guidelines contain a number of new and revised recommendations, which are summarized in *Tables 3* and *4*, respectively.

ble 3 New major recommendations in 2024

vasive functional myocardial imaging tests in the initial diagnostic management of individuals with suspected chronic co me—resting and stress single-photon emission computed tomography/positron emission tomography—cardiac magneti nce imaging, if available and supported by local expertise—*Section 3*	
duals with suspected CCS and moderate or high (>15%–85%) pre-test likelihood of obstructive CAD, SPECT or, preferably, PET dial perfusion imaging is recommended to: gnose and quantify myocardial ischaemia and/or scar; mate the risk of MACE; ntify myocardial blood flow (PET).	I
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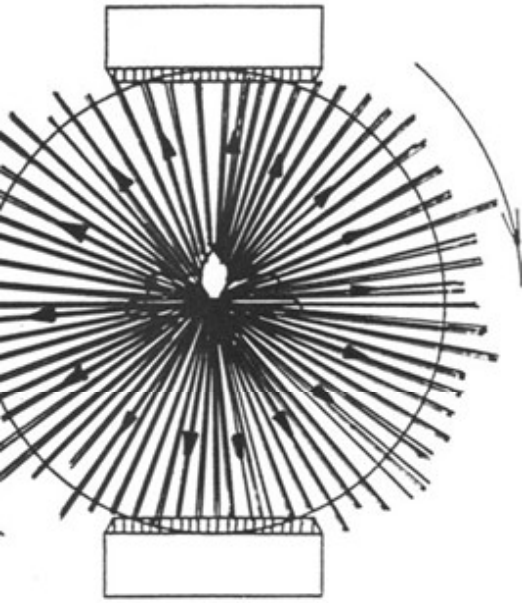
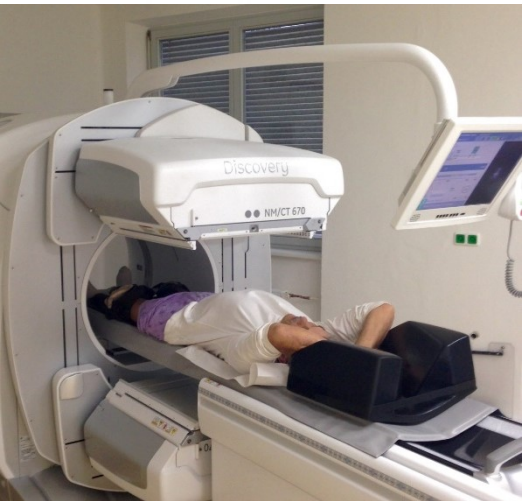
3.3.2.2. Myocardial perfusion scintigraphy—single-photon emission computed tomography

Newer-generation SPECT cameras based on cadmium–zinc–telluride (CZT) semiconductor detector technology enable a substantial reduction in radiation dose exposure and acquisition time, as well as an increased diagnostic accuracy[260] and absolute quantification of MBF. Hence, its diagnostic performance for multivessel CAD has improved substantially.[261]

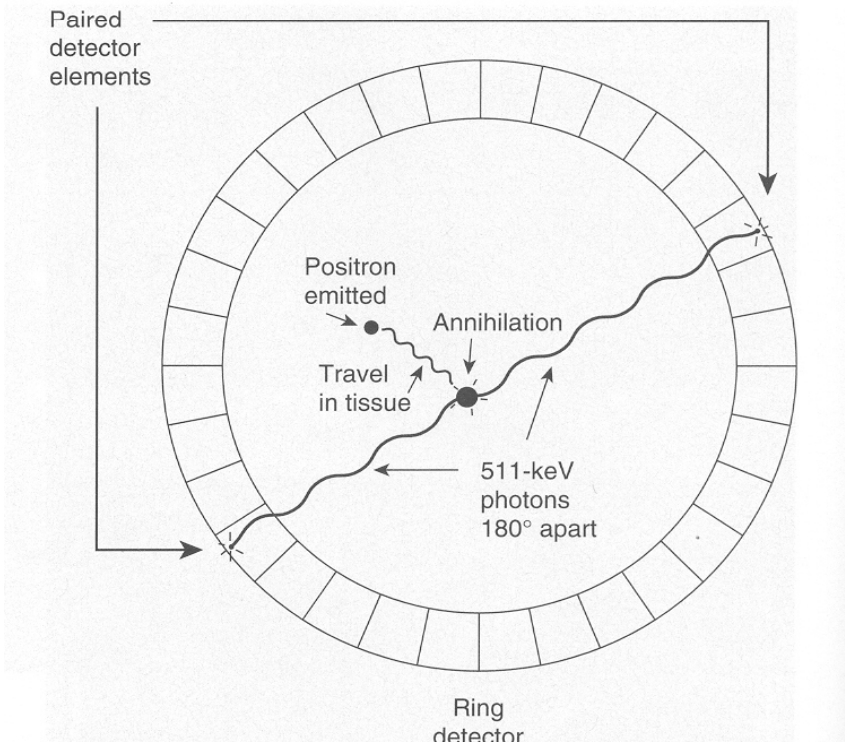
261. Panjer M, Dobrolinska M, Wagenaar NRL, Slart R. Diagnostic accuracy of dynamic CZT-SPECT in coronary artery disease. A systematic review and meta-analysis. *J Nucl Cardiol* 2022;**29**:1686–97. https://doi.org/10.1007/s12350-021-02721-8

Single Photon Emission Computed Tomography **(SPECT)**

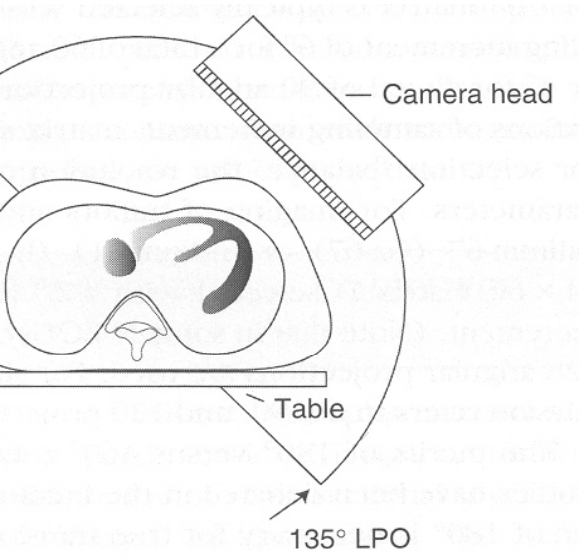


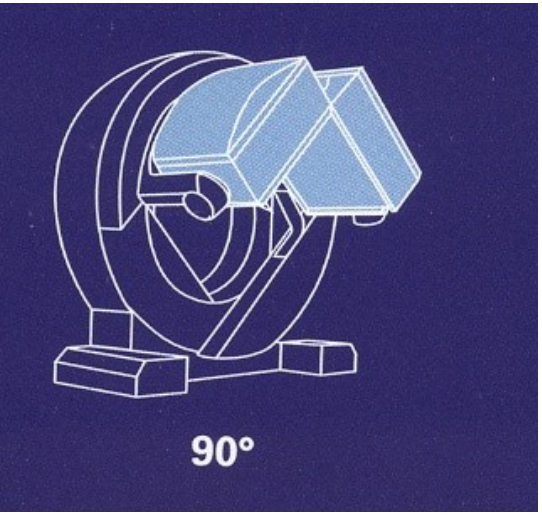


Pozitron Emission Tomography **(PET)**

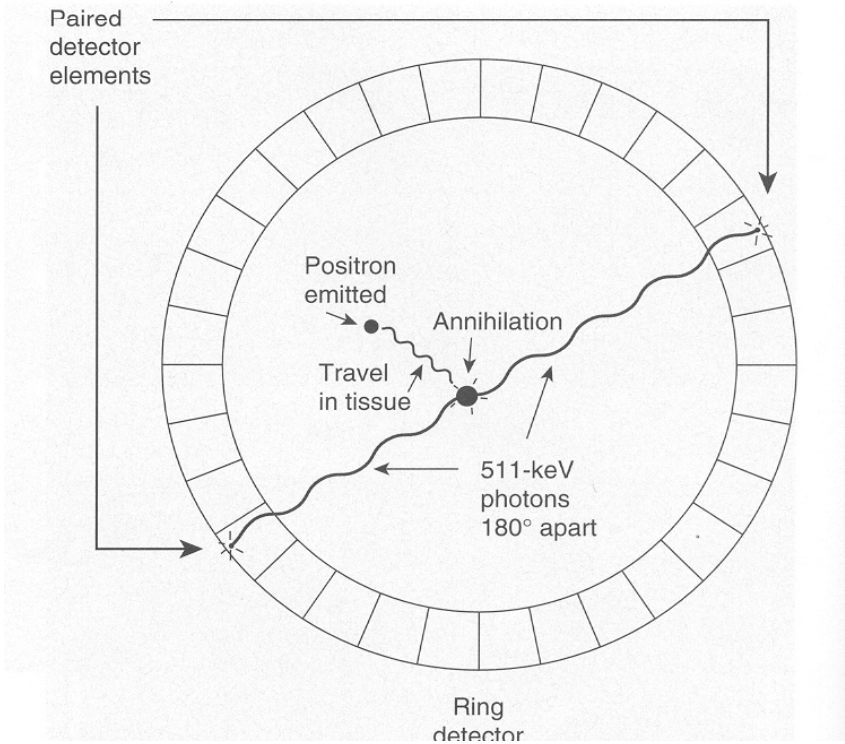


Single Photon Emission Computed Tomography (SPECT)





Pozitron Emission Tomography (PET)



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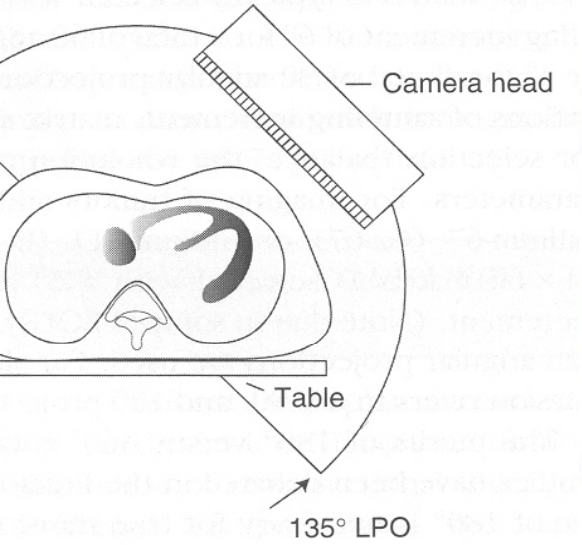
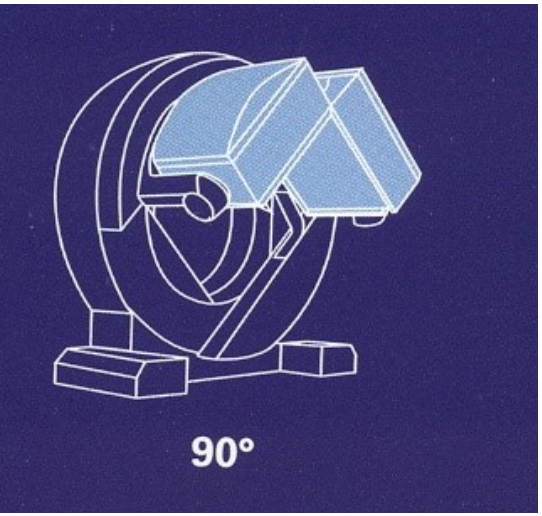
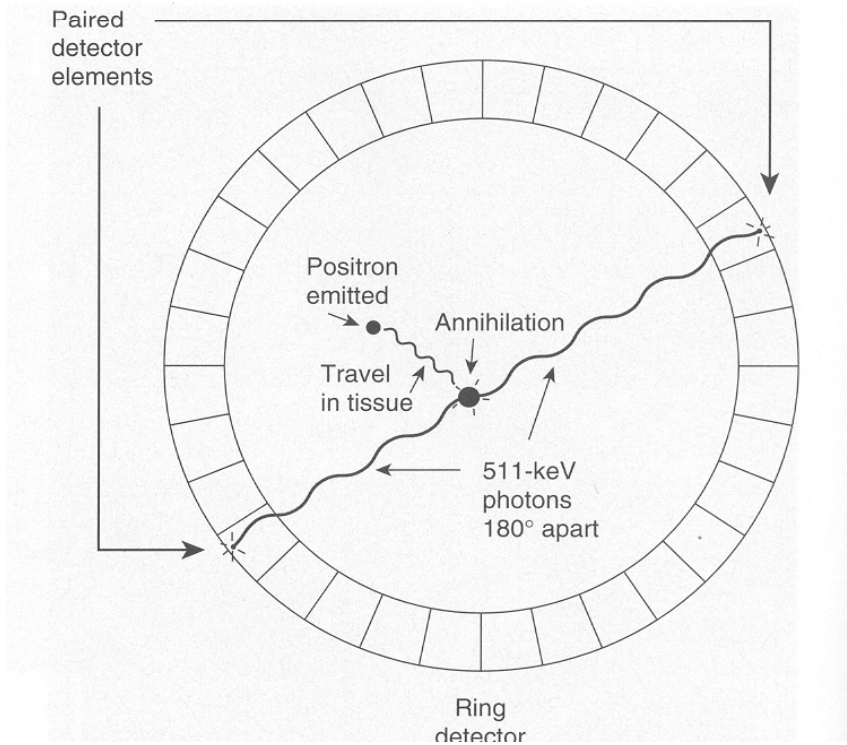


CZT kamery



PET like design

Pozitron Emission Tomography (PET)



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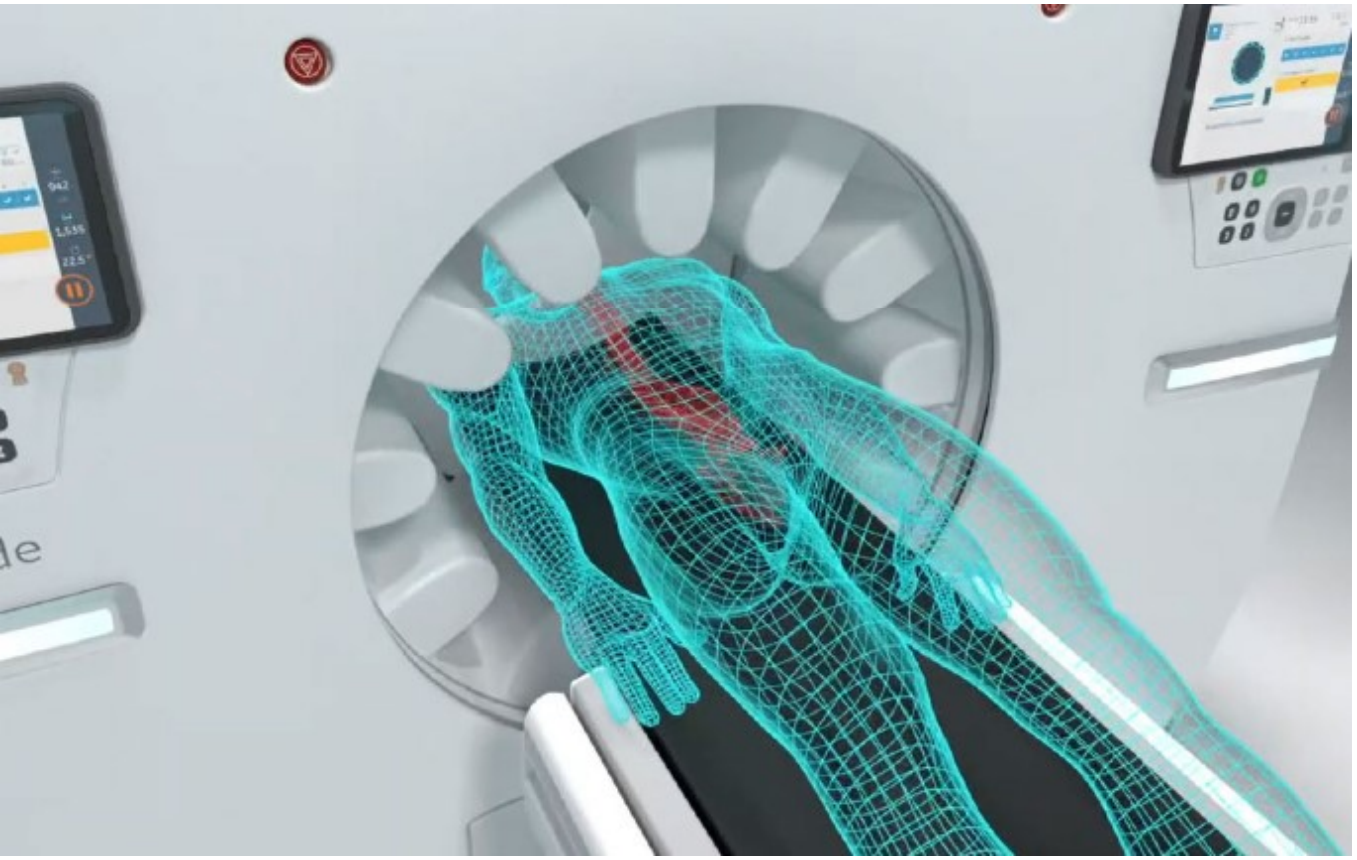
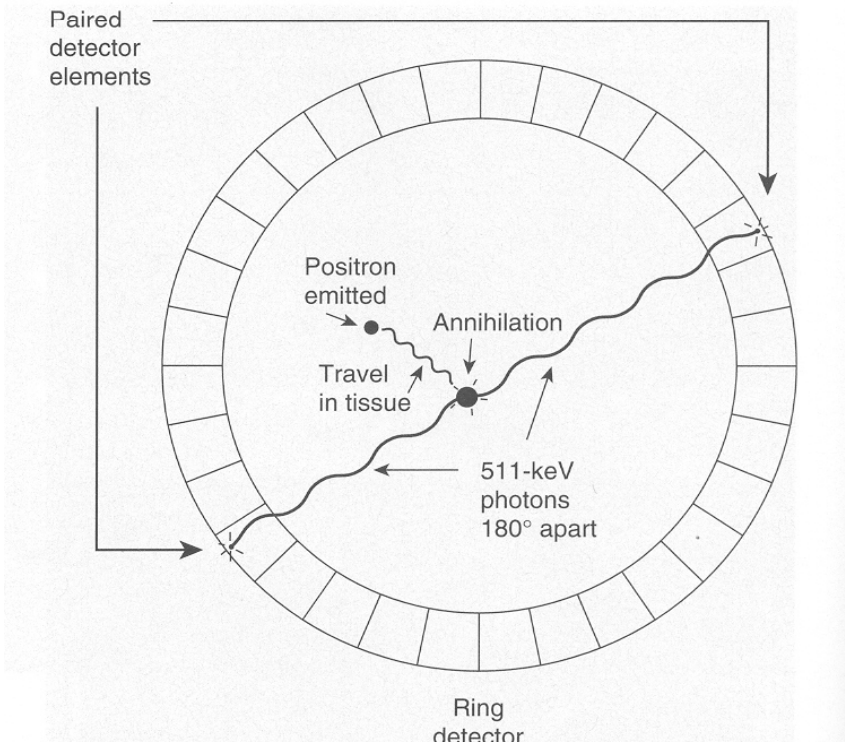


GE StarGuide - 12 CZT detektorů

Pozitron Emission Tomograph**y** **(PET)**

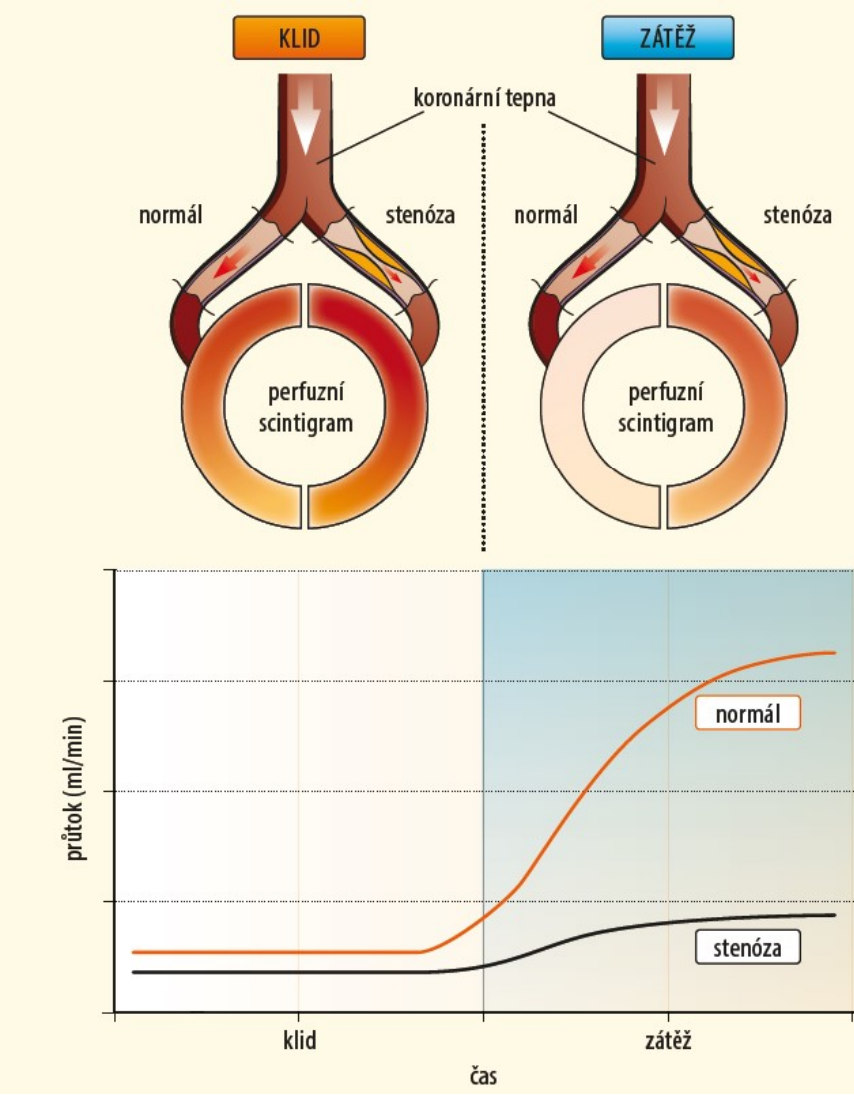


SPECT resp. PET myokardu

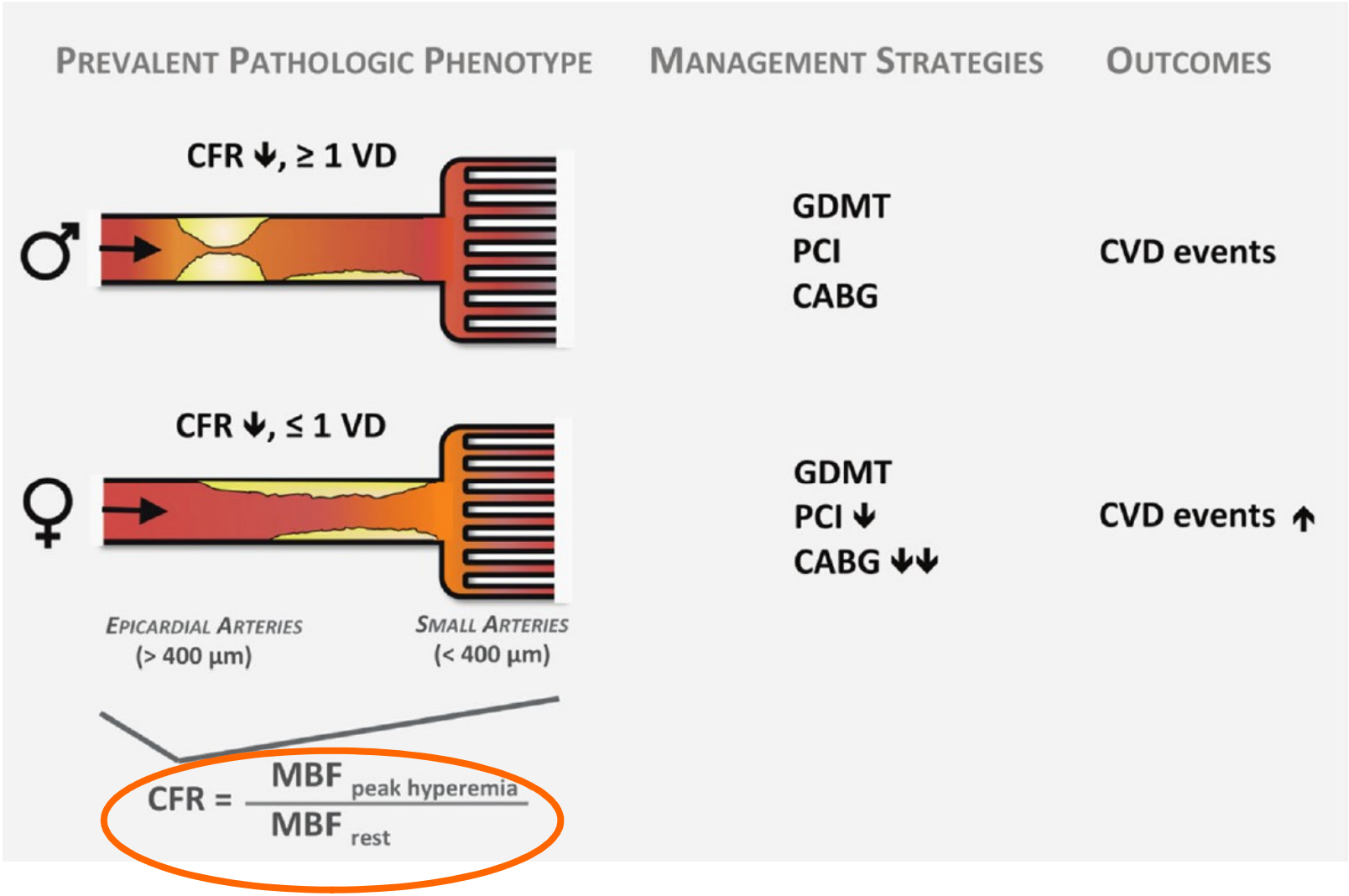
Konvenční SPECT resp. PET = relativní perfuze

Dynamický SPECT resp. PET = absolutní kvantifikace

Pozátěžové navození heterogenity perfuze



ASNC Consensus Statement : Women



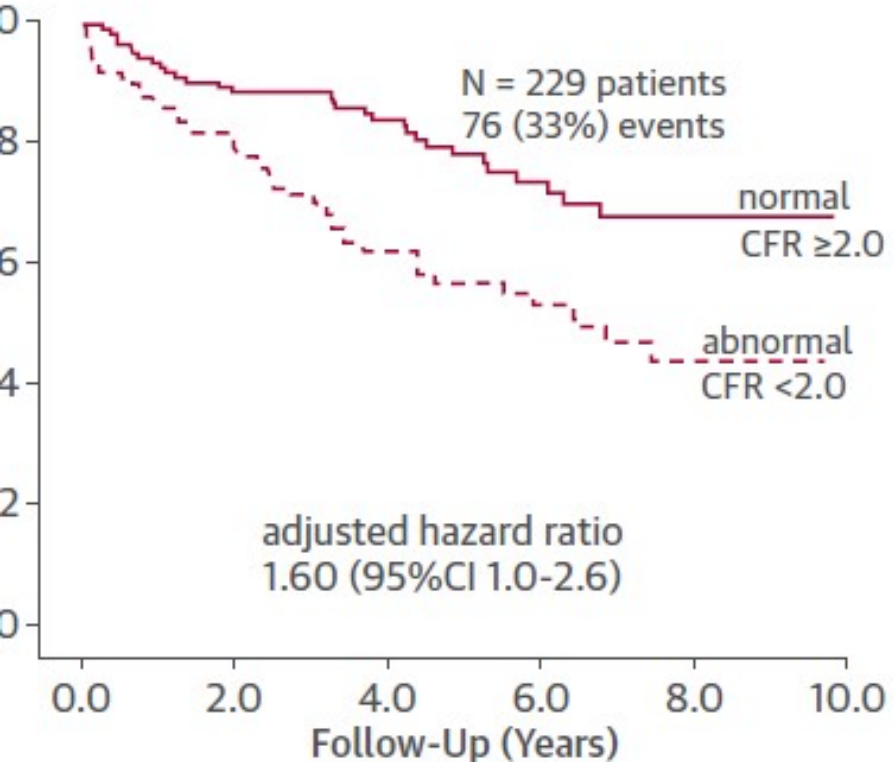
CFR - Coronary flow reserve

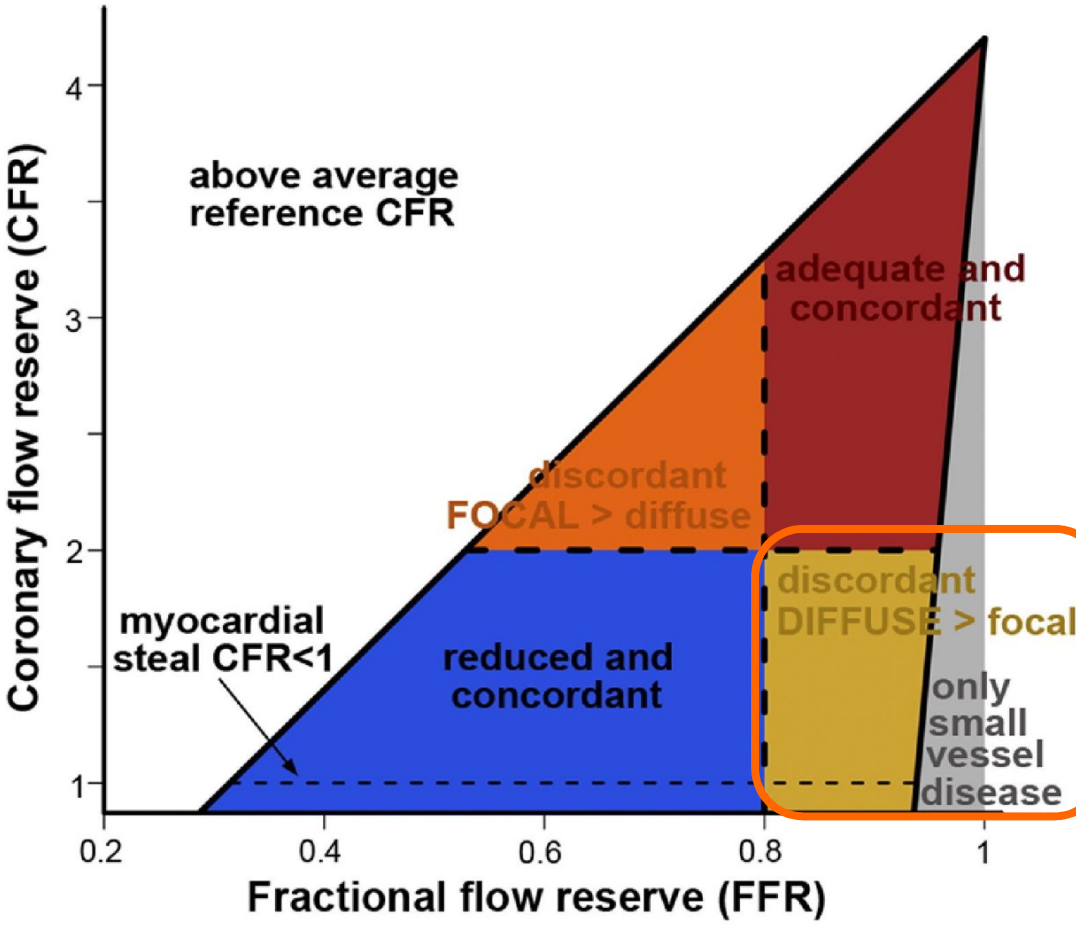
MBF - Myocardial blood flow

GDMT- guideline directed medical therapy

Johnson et al. JACC 2016;67:2772-88

Future of FFR and CFR





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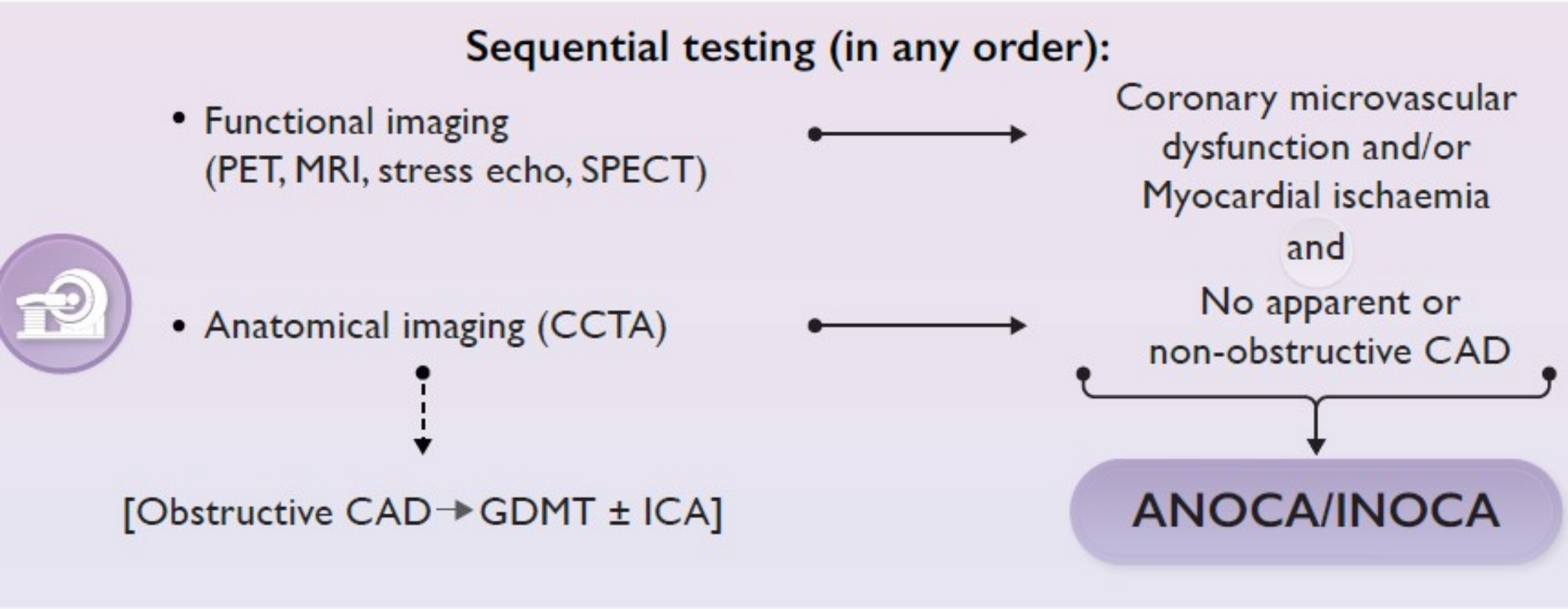


Dynamický PET: Coronary Flow Reserve (CRF)

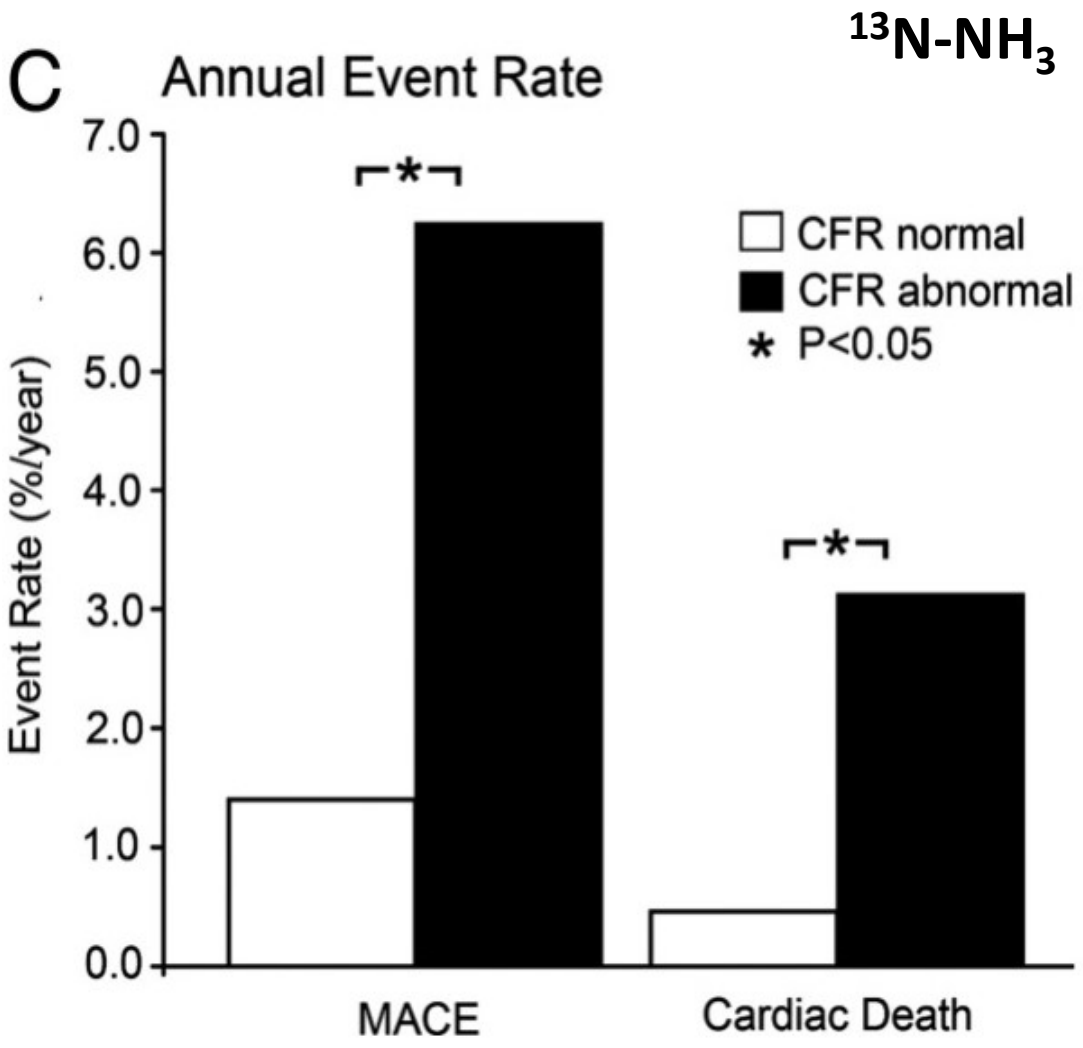
ET radiofarmaka

-NH_3

-H_2O

b ($^{82}Sr/^{82}Rb$ generátor)

flurpiridaz (čeká na schválení FDA)

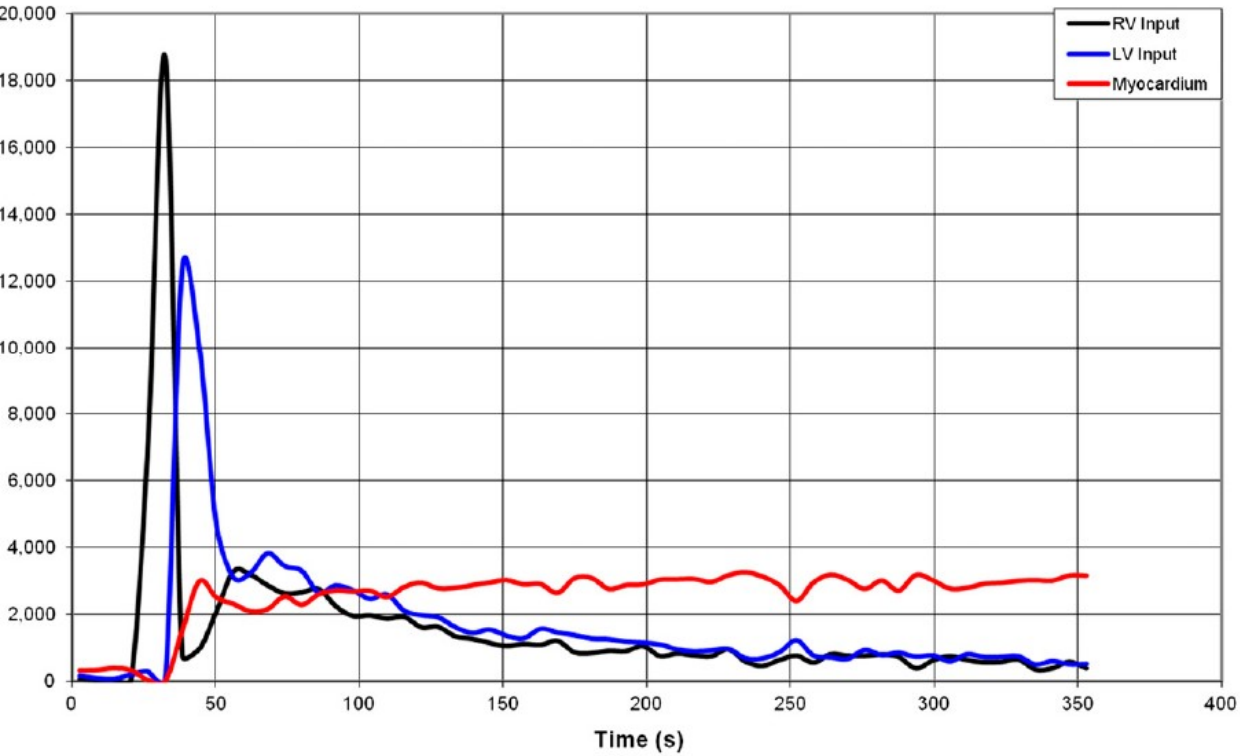


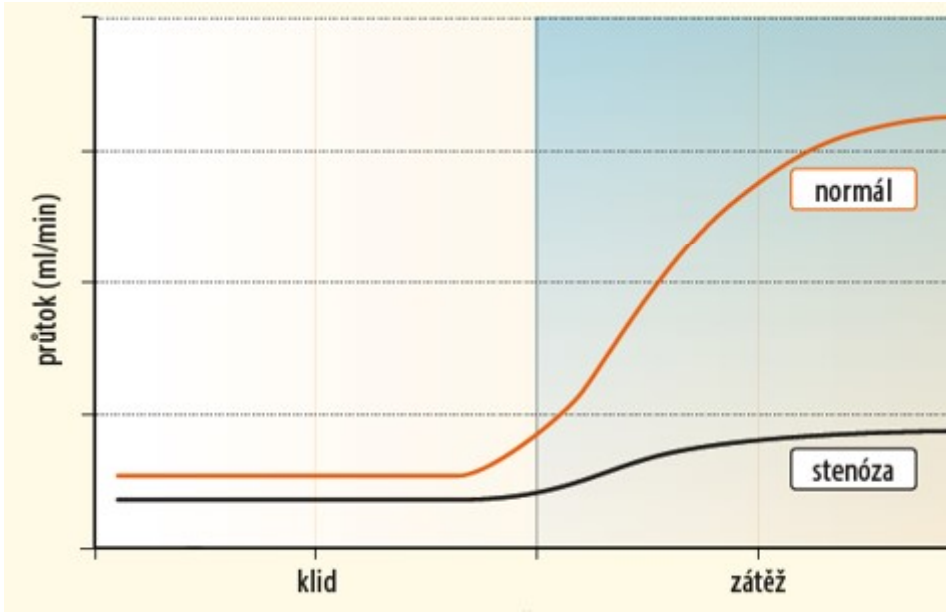
Herzog BA, et al. *Am J Cardiol 200*

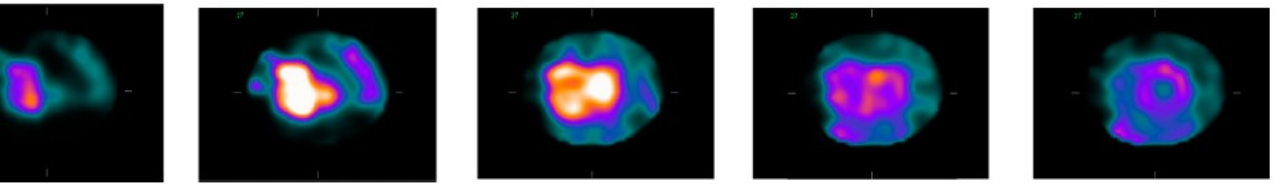
en-Haim S, et al.
IM 2013

Dynamic SPECT on CZT Came

Coronary Flow Reserve (CFR)





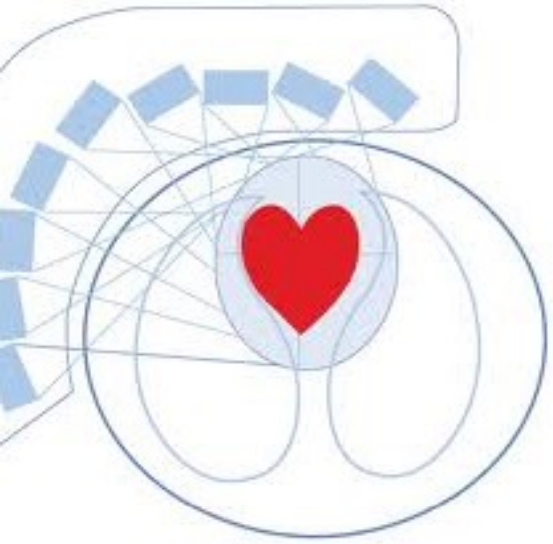


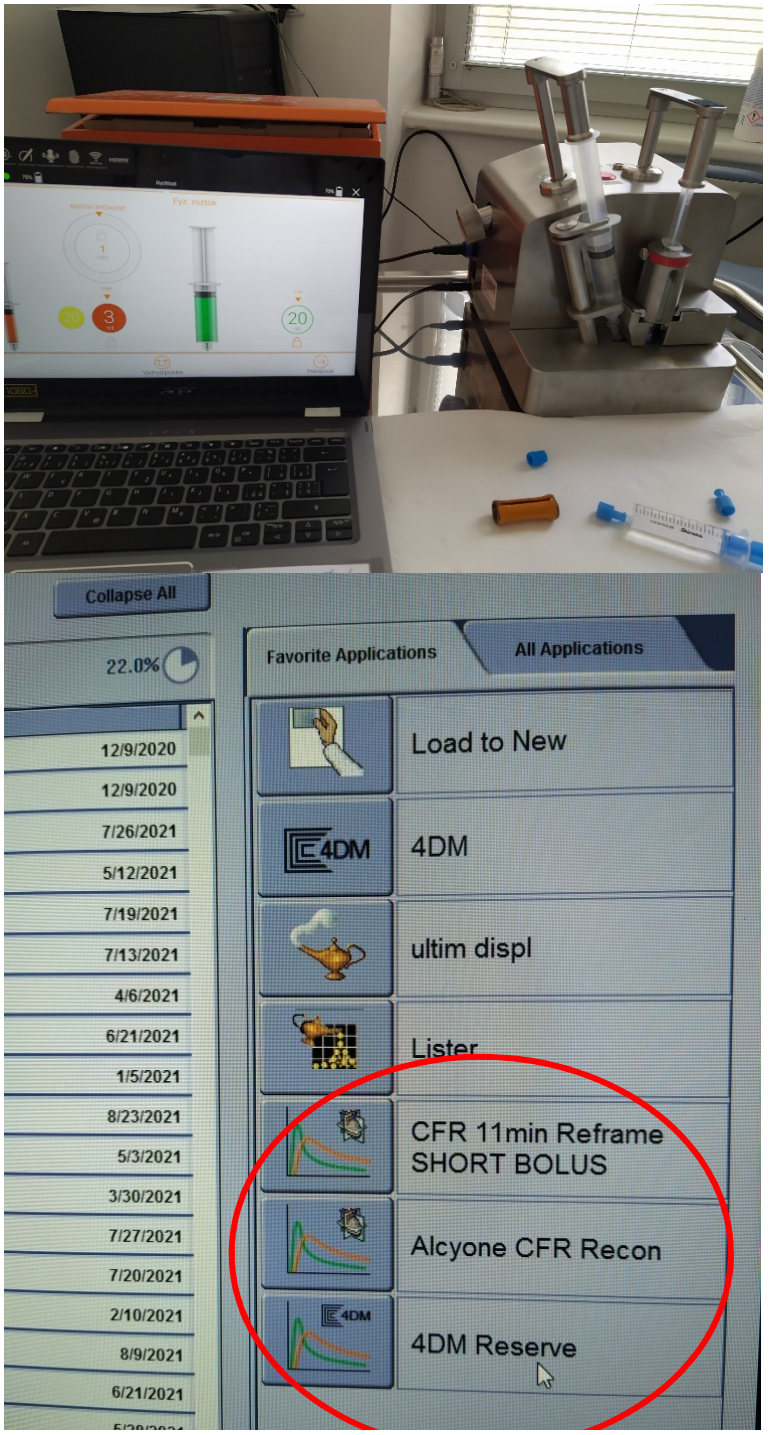
Corresponding 6-s SPECT images

Kvantifikace MBF a CRF

- Konverze PET programů pro použití na CZT SPECT kamerách s jednofotonovými zářiči
- Klinická validace porovnáním SPECT vs PET:
  - MIBI vs ^{15}O-H_2O (1)
  - tetrofosmin vs ^{13}N-NH_3 (2,3)

1. Agostini D, et al. EJNMMI 2018 (WATERDAY study)
2. Nkoulou R, et al. J Nucl Med. 2016
3. Giubbini R, et al. J Nucl Cardiol 2019



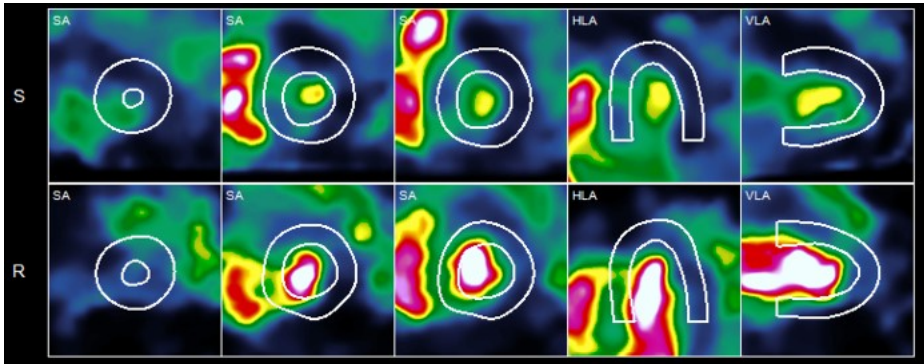


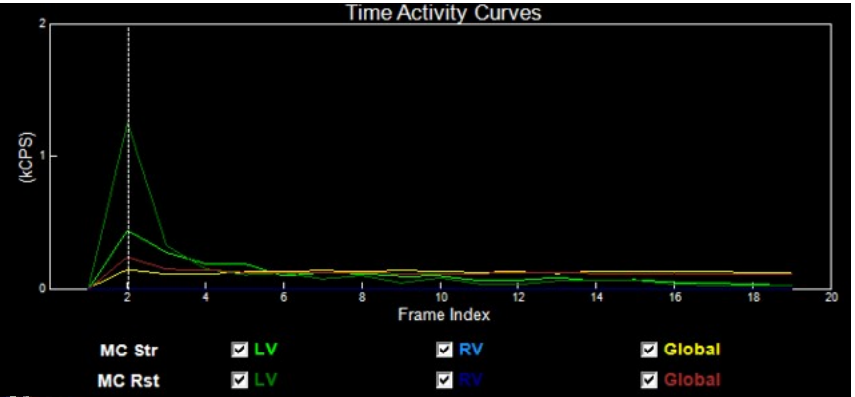
Dynamický SPECT

- CZT kamera
- Injektor (1 ml/sec)
- Licence na kvantitativní program

50letý muž. DM, námahová dušnost

Normal Coronary Flow Reserve (CFR) ≥ 2

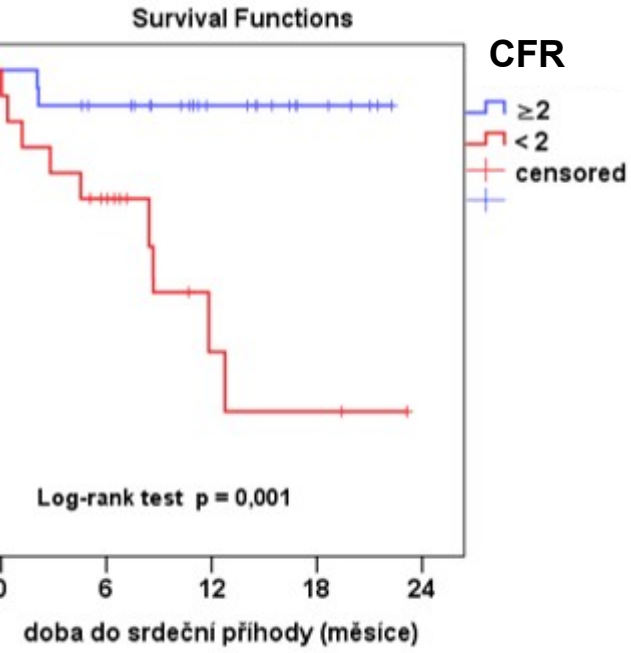


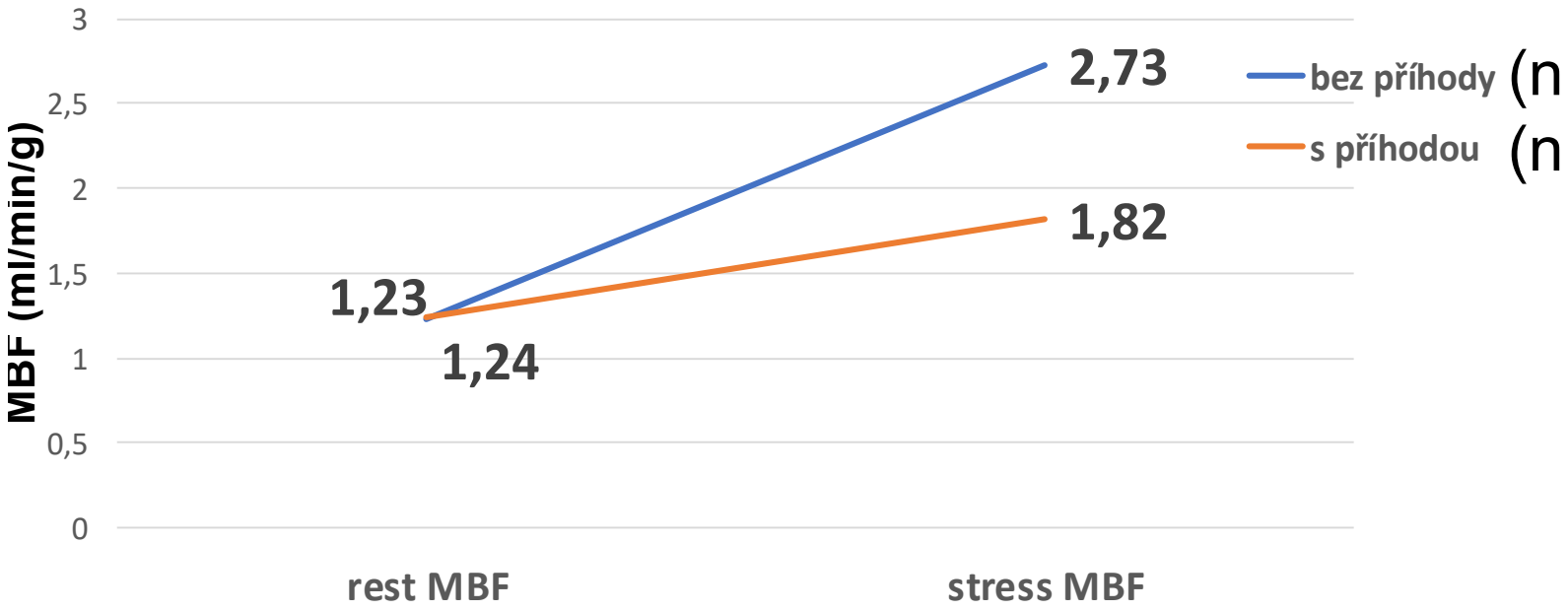


Global Results

Region	Mean Flow (ml/min/g) MC Str	MC Rst	MC Str	MC Rst	Reserve
LAD	87%	83%	2.72	1.16	2.35
LCX	89%	91%	3.53	1.37	2.57
RCA	73%	70%	3.20	1.01	3.17
TOT	84%	81%	3.04	1.13	2.69

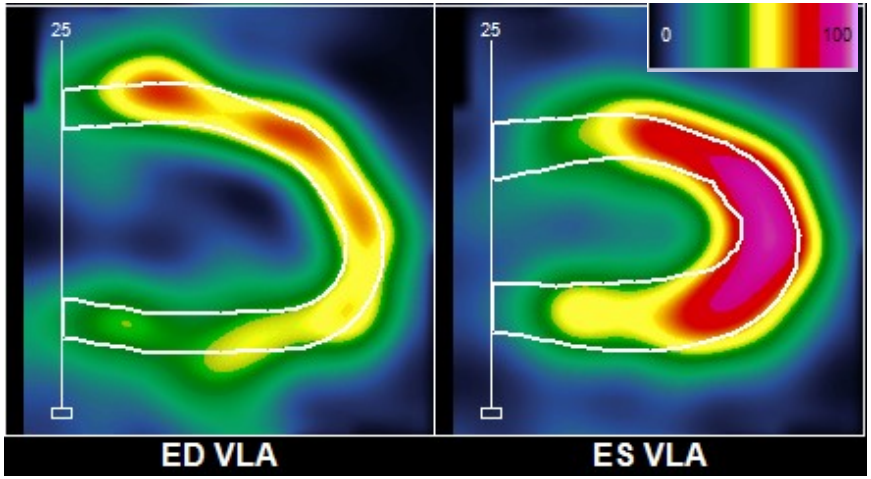
Coronary flow reserve (CFR)
Myocardial blood flow (MBF)

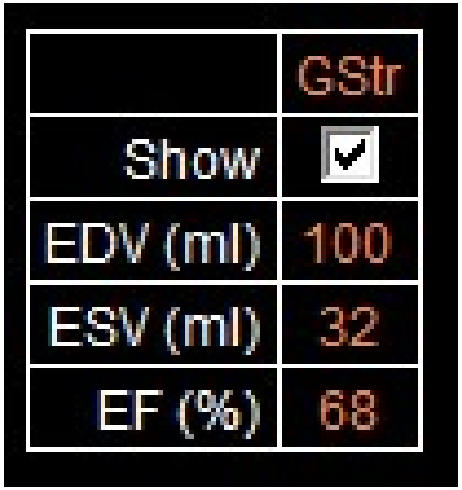


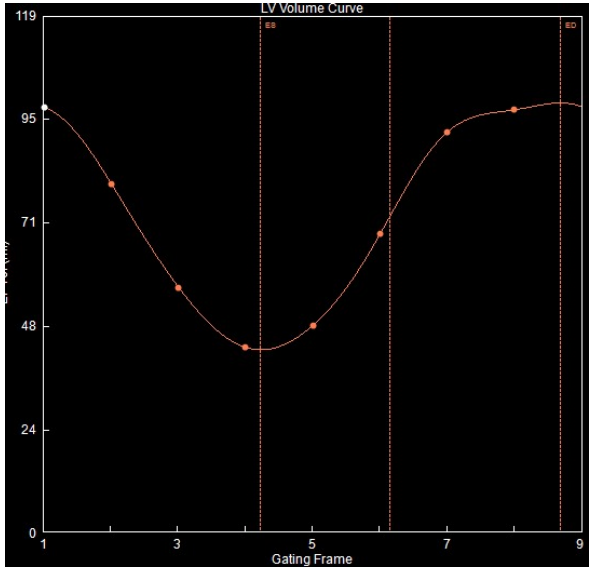


Kaminek M, et al. EJNMMI 20

Gated SPECT – sytolické ztlušťování jako nárůst impulsů

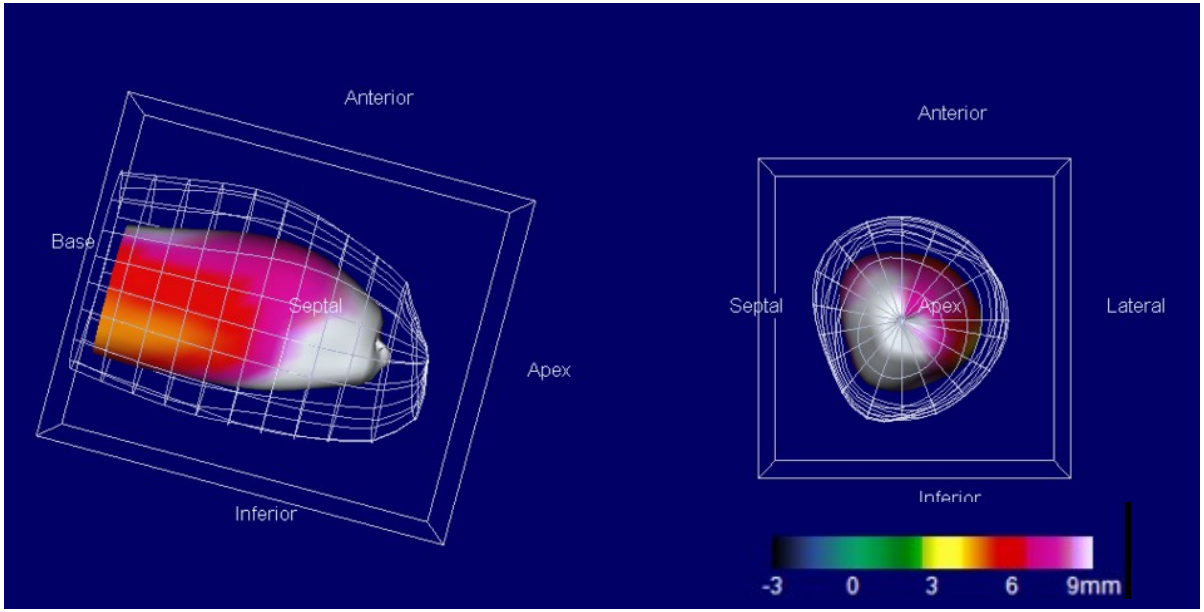




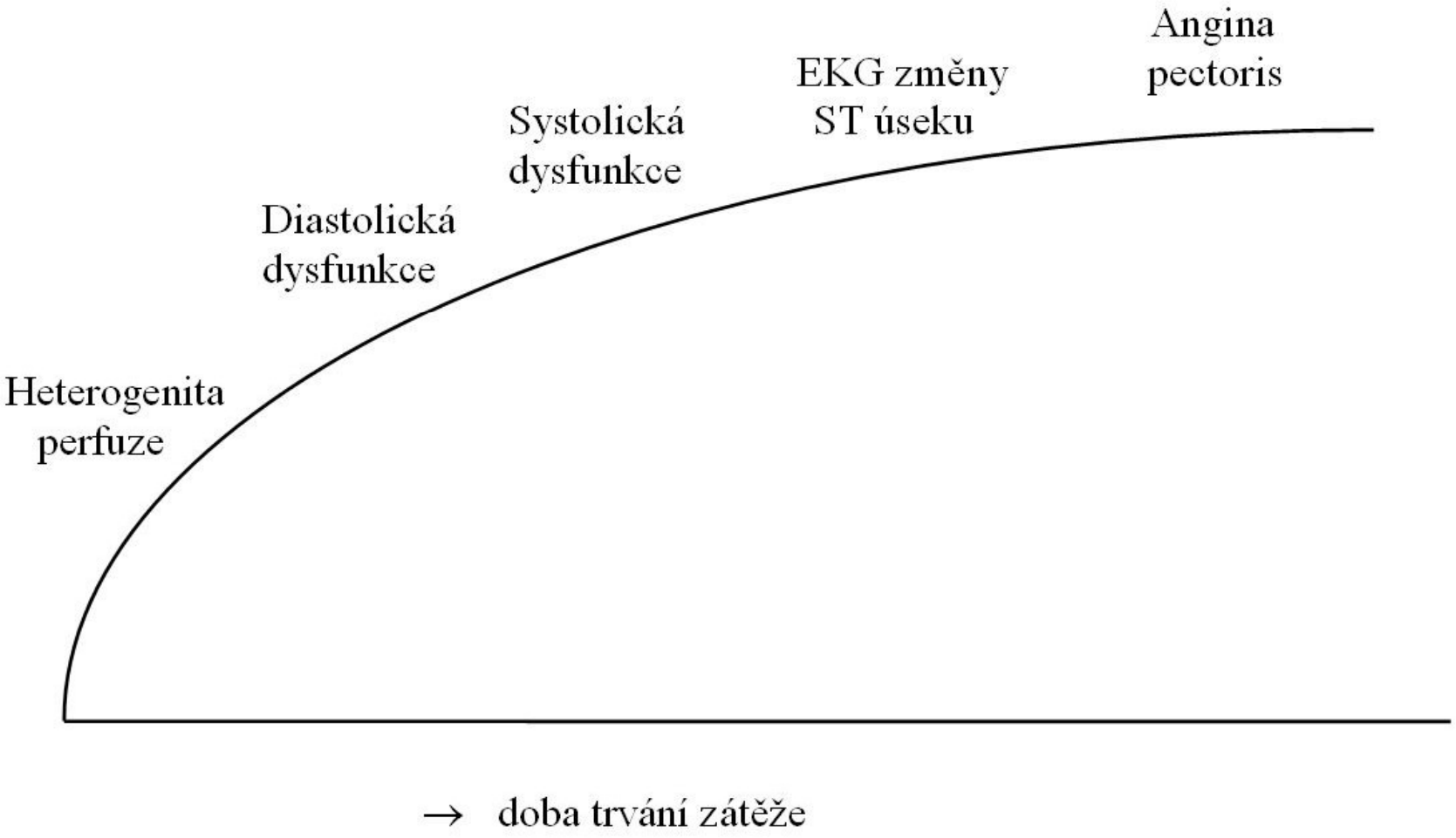


Pohyb endokardu v mm

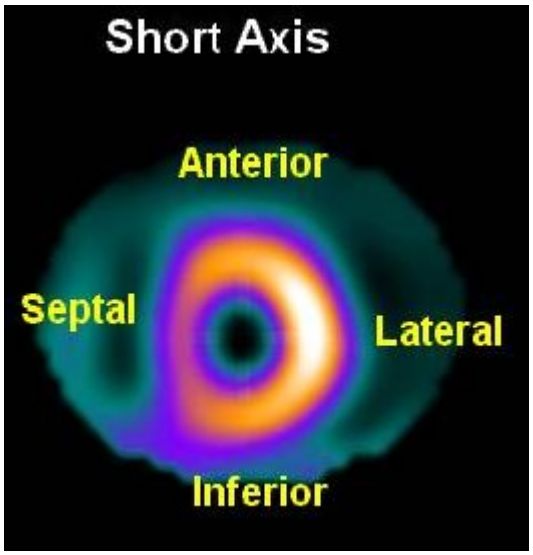
mřížka = endokard v ED, barevně v ES

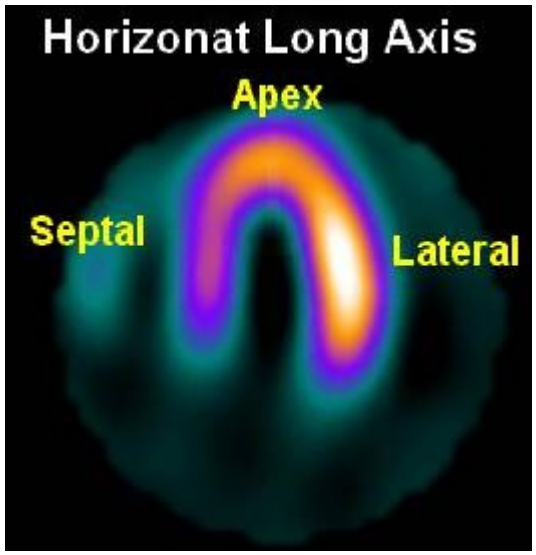


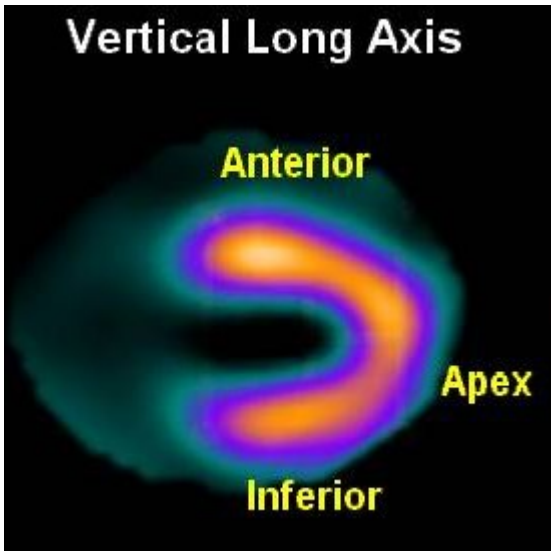
Ischemická kaskáda



Prognostický význam SPECT





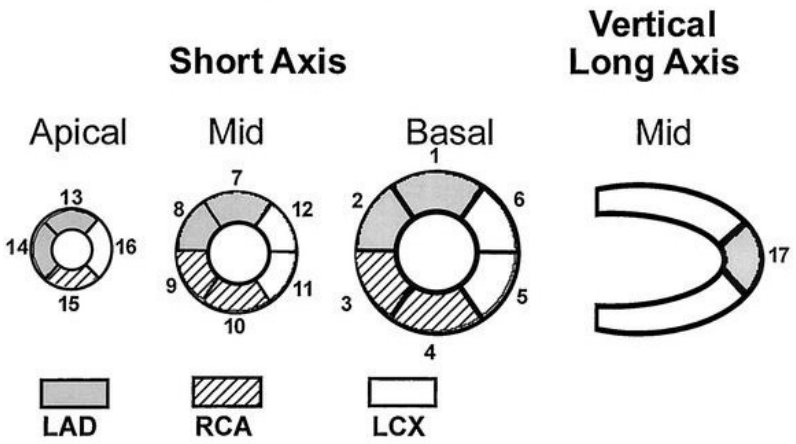


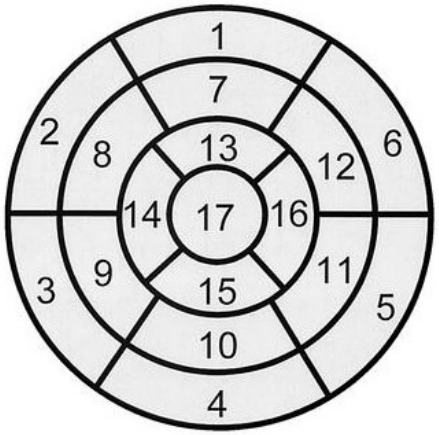
Normální zátěž. SPECT myokardu: nízké riziko

- srdeční smrt/infarkt myokardu < 1 % ročně
- i při koronarografickém nálezu stenózy > 50 %

Gibson PB, JACC 2002: 0,6% ročně
Kamínek M, BiomedPapers 2015: 0,7% ročně

Kvantitativní analýza perfuze





- 5ti stupňová škála (0 = normal, 4 = absent)
- sumační zátěžové skóre (SSS), sumační klidové skóre (SRS) a sumační rozdílové skóre (SDS)
- Hypoteticky nejhorší možné skóre = 68 (při postižení všech17ti segmentů levé komory x nejhorší perfuze, tj 4)

Přepočet na masu levé komory

$$score\ normalized\ to\ \%LV = \frac{\text{score (i. e., SSS, SDS or SDS)}}{68} * 100$$

SPECT - mírná ischemie (< 10 % z levé komory):

nízké riziko srdeční smrti (< 1 % ročně)

2018 ESC Guidelines on Revascularization

Indications for revascularization in patients with stable angina or silent ischaemia

Extent of CAD (anatomical and/or functional)		Class[a]	Level[b]
For prognosis	Left main disease with stenosis >50%.[c] [68–71]	I	A
	Proximal LAD stenosis >50%.[c] [62,68,70,72]	I	A
	Two- or three-vessel disease with stenosis >50% with impaired LV function (LVEF ≤35%).[c] [61,62,68,70,73–83]	I	A
	Large area of ischaemia detected by functional testing (>10% LV) or abnormal invasive FFR.[d] [24,59,84–90]	I	B
	Single remaining patent coronary artery with stenosis >50%.[c]	I	C
For symptoms	Haemodynamically significant coronary stenosis[c] in the presence of limiting angina or angina equivalent, with insufficient response to optimized medical therapy.[e] [24,63,91–97]	I	A

CAD = coronary artery disease; FFR = fractional flow reserve; iwFR = instantaneous wave-free ratio; LAD = left anterior descending coronary artery; LV = left ventricular; LVEF = left ventricular ejection fraction.

[a]Class of recommendation.

[b]Level of evidence.

[c]With documented ischaemia or a haemodynamically relevant lesion defined by FFR ≤0.80 or iwFR ≤0.89 (see section 3.2.1.1), or >90% stenosis in a major coronary vessel.

[d]Based on FFR <0.75 indicating a prognostically relevant lesion (see section 3.2.1.1).

[e]In consideration of patient compliance and wishes in relation to the intensity of anti-anginal therapy.

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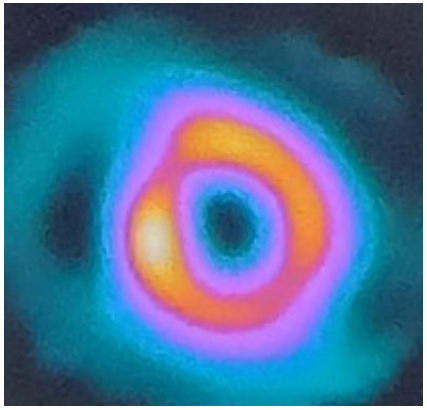
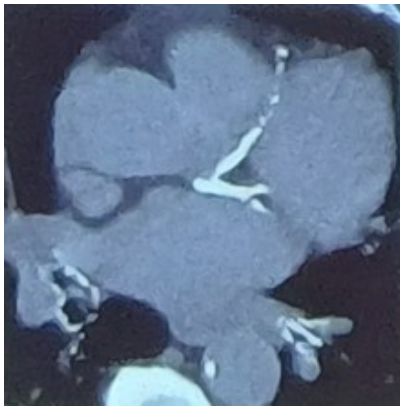
allah et al. J Nucl Cardiol 2022

HYBRID IMAGING GUIDELINE

2022 ASNC/AAPM/SCCT/SNMMI guideline for the use of CT in hybrid nuclear/CT cardiac imaging





MPI identified ischemia & defines need for revascularization

CACS reflects anatomic burden of atherosclerosis

MPI & CACS are independent & complementary predictors of cardiac even

Every pt without known CAD undergoing MPI, should have CACS (increase diagnostc acumen, enhances long term stratification, improves pt outcom by targeting aggressive risk factor modification in those with subclinical AS

No ischemia No atherosclerosis	No ischemia + atherosclerosis	Ischemia +/- atherosclerosi

PIS study: Prevalence of Silent Coronary Atherosclerosis by CCTA with CACS

Prevalence of Coronary Computed Tomography Angiography–Detected Atherosclerosis in SCAPIS Participants Established Coronary Heart Disease Who Underwent Both Successful Coronary Computed Tomography Angiography Scoring, for Whom PCE Could Be Calculated, and With 0 CAC (n=14 679), Divided by Sex and PCE Risk Group

ristic	Total	PCE risk category			
		Low (<5%)	Borderline (≥5 to <7.5%)	Intermediate (7.5 to <20%)	High (≥20%)
CAC = 0					
size	14 679	9780	2203	2543	153
erosclerosis	13 876 (94.5)	9350 (95.6)	2086 (94.7)	2310 (90.8)	130 (85.0)
m of atherosclerosis	803 (5.5)	430 (4.4)	117 (5.3)	233 (9.2)	23 (15.0)
nosis ≥50%	60 (0.4)	32 (0.3)	14 (0.6)	12 (0.5)	2 (1.3)
in, proximal LAD, or 3-vessel disease	22 (0.1)	11 (0.1)	8 (0.4)	3 (0.1)	0 (0.0)
CAC = 0					
size	5635	1998	1369	2126	142
erosclerosis	5228 (92.8)	1889 (94.5)	1288 (94.1)	1931 (90.8)	120 (84.5)
m of atherosclerosis	407 (7.2)	109 (5.5)	81 (5.9)	195 (9.2)	22 (15.5)
nosis ≥50%	25 (0.4)	7 (0.4)	8 (0.6)	8 (0.4)	2 (1.4)
in, proximal LAD, or 3-vessel disease	11 (0.2)	4 (0.2)	4 (0.3)	3 (0.1)	0 (0)
ith CAC = 0					
size	9044	7782	834	417	11
erosclerosis	8648 (95.6)	7461 (95.9)	798 (95.7)	379 (90.9)	10 (90.9)
m of atherosclerosis	396 (4.4)	321 (4.1)	36 (4.3)	38 (9.1)	1 (9.1)
nosis ≥50%	35 (0.4)	25 (0.3)	6 (0.7)	4 (1)	0 (0)
in, proximal LAD, or 3-vessel disease	11 (0.1)	7 (0.1)	4 (0.5)	0 (0)	0 (0)

n = 14 679

5.5 % atheroscleros

0.4 % stenosis ≥ 50

0.1 % LM, prox LAD

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Závěr

Nukleární kardiologie umožňuje efektivně zobrazit a kvantifikovat
schemii

Dobrá prognóza u pacientů bez ischemie nebo s limitovanou ischem
< 10 % z levé komory

Dynamický SPECT (event. PET) umožňuje přímou kvantifikaci
průtoků v ml/min/g (MBF) a jejich rezervu po vazodilataci (CFR)

U vybraných pacientů se susp. ICHS lze výhodně kombinovat
SPECT a CAC skóre (diabetici, dialyzovaní, dilatovaná levá komo