# Doporučení pro provedení SPECT a SPECT/CT myokardu

Milan Kamínek. LF UP a FN Olomouc

Verbene HJ, et al.

Eur J Nucl Med Mol Imaging (2015) 42:1929–1940
DOI 10.1007/s00259-015-3139-x

11 stran

GUIDELINES

# EANM procedural guidelines for radionuclide myocardial perfusion imaging with SPECT and SPECT/CT: 2015 revision

A large number of minor changes have been described in more detail in the fully revised version available at:

http://eanm.org/publications/guidelines/index.php?navId=37

105 stran

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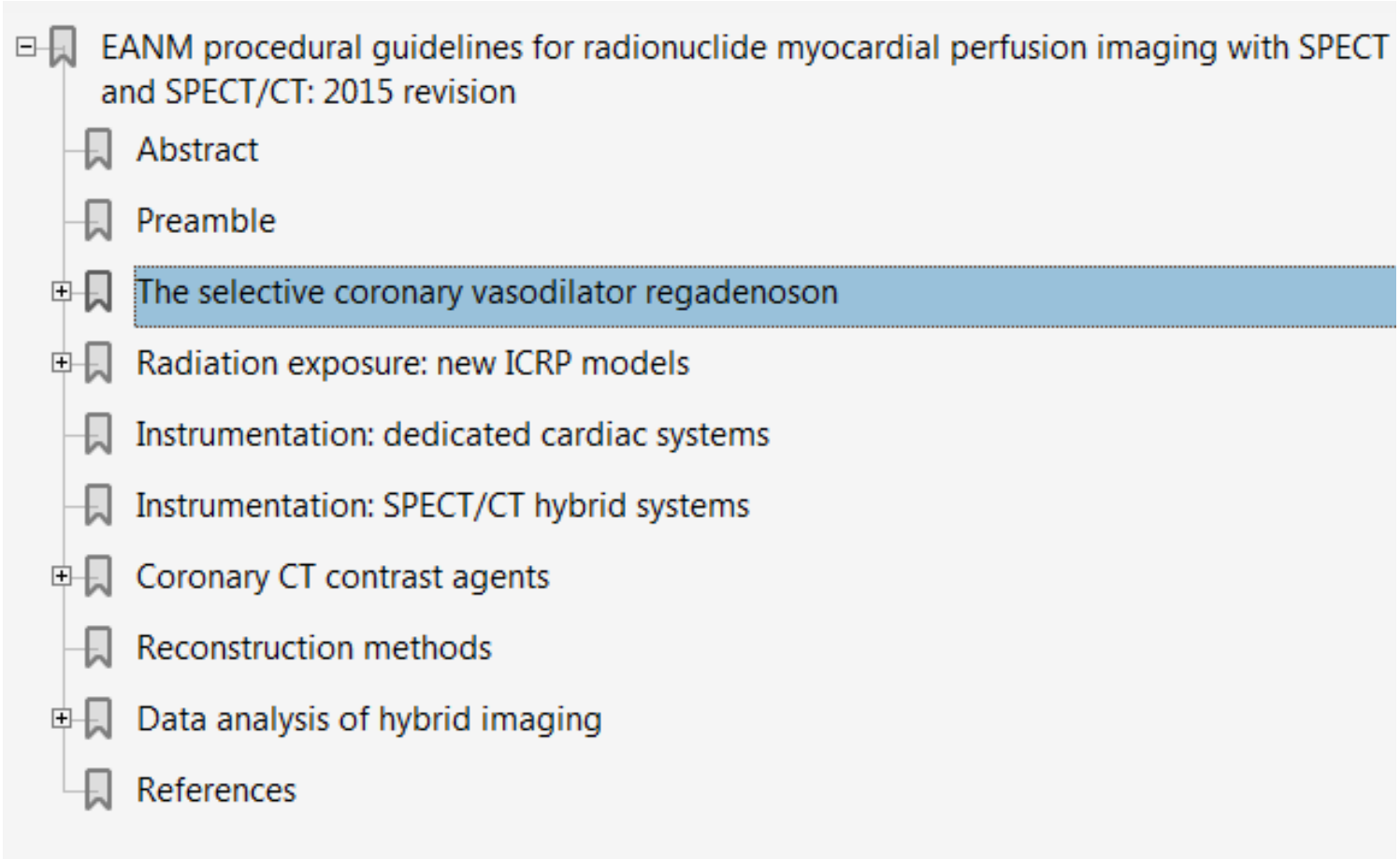
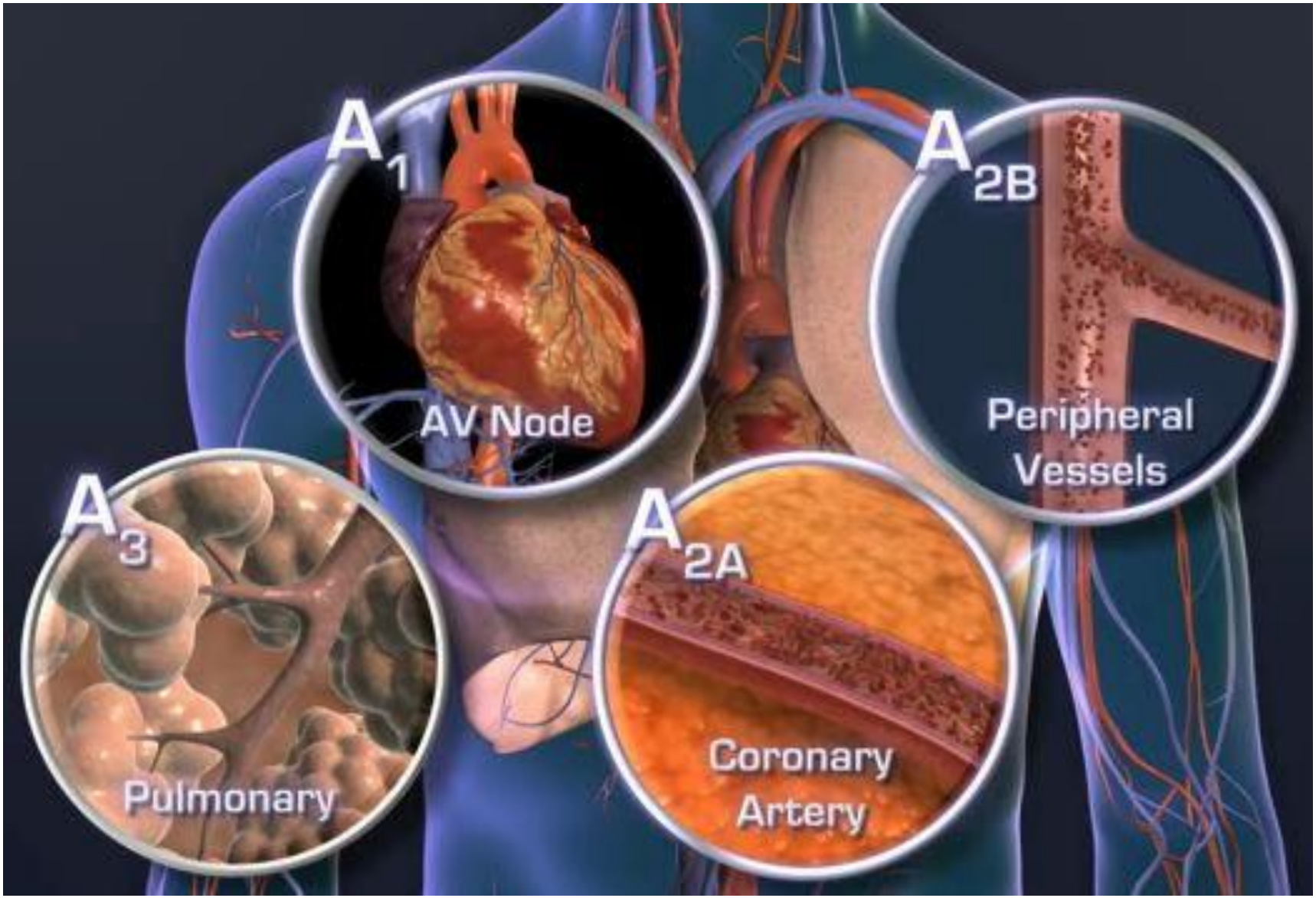
Hesse B, et al. 2005 → Verbene HJ, et al. 2015



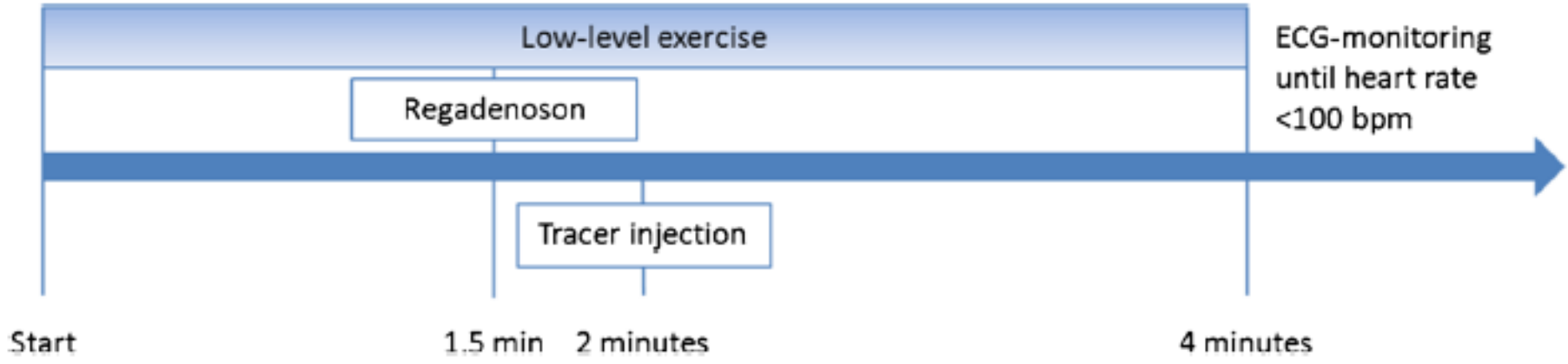
# Regadenoson: selektivní $A_{2A}$ adenosin



# Kombinace farmakologické a nízké úrovně fyzické zátěže

**LBBB: Yes** → Vasodilator without low level ergometry

**LBBB: No** → Vasodilator with low level ergometry



## Radiation exposure: new ICRP models

The International Commission on Radiological Protection (ICRP) má nové fantomy pro výpočet absorbované dávky, nové váhové faktory a nový biokinetický model, současné efektivní dávky pro dospělé jsou:

- $^{99m}$Tc-tetrofosmin (stress and rest): 0.0058 and 0.0063 mSv/MBq, respectively
- $^{99m}$Tc-sestamibi (stress and rest): 0.0066 and 0.0070 mSv/MBq, respectively
- $^{201}$Tl-chloride (redistribution): 0.102 mSv/MBq.

Tyto hodnoty jsou přibližně o 20% nižší než při kalkulaci předchozími metodami

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- Preamble
- The selective coronary vasodilator regadenoson
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- Instrumentation: dedicated cardiac systems
- Instrumentation: SPECT/CT hybrid systems
- Coronary CT contrast agents
- Reconstruction methods
- Data analysis of hybrid imaging
- References

# Instrumentation

1. Dual-detector variable camera in a 90° configuration
2. Dedicated cardiac systems: Cadmium zinc telluride (CZT)

The D-SPECT® (Spectrum Dynamics) utilises nine small rectangular detectors placed along a 90° arc. Each detector rotates around its own axis. All detectors together register photons from an area comparable to a traditional 180° acquisition.

Discovery NM530c (GE Healthcare) uses a stationary, multiplepinhole design with 19 holes, each with its own CZT detector. The collimators are arranged such that the area of the chest including the heart can be imaged.

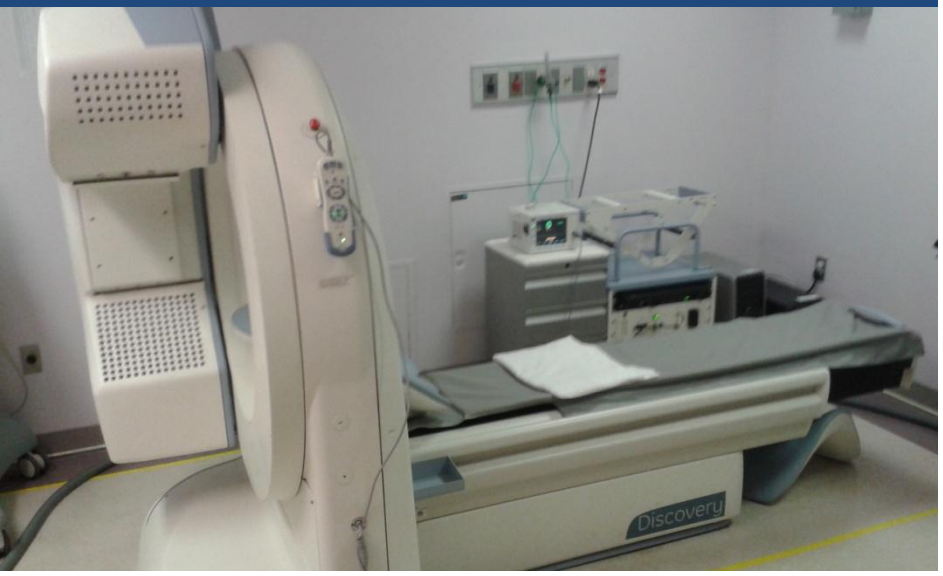
Clinical evaluations of both systems have demonstrated performance similar to that of traditional systems, but with shorter imaging times or lower administered activities.

## D-SPECT™ Cardiac Scanner

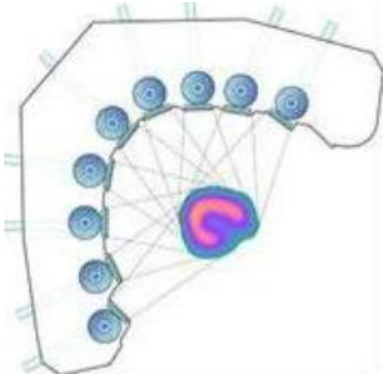
Dynamic SPECT (D-SPECT)

Spectrum-Dynamics Haifa, Israel

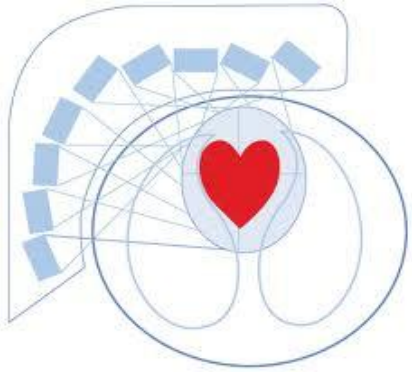
## GE Discovery *NM 530c*




CZT technologie



9 detektorů



19 detektorů

Výrazná redukce aplikovaných aktivit: efekt.dávka pod 1 mSv


Discovery

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# Instrumentation: SPECT/CT hybrid systems

- For **calcium scoring (CACS)**, at least 4-slice CT is required, but **≥ 6-slice** is recommended

- For **coronary CT angiography (CCTA)**, at least a 16-slice scanner is required, but a **≥ 64-slice** multidetector-row CT is recommended, with an imaging capability for slice width of 0.4–0.6 mm and temporal resolution of 500 ms or less; ≤ 350 ms is preferred

SPECT


SPECT/CT

SmartScore - Gated 0.5 sec

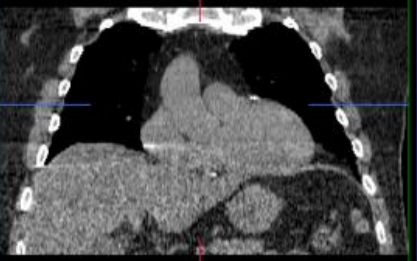
02-May-2016 10:29:53
0.75 x 0.75 x 2.50

kV: 120
eff.mAs: Unknown

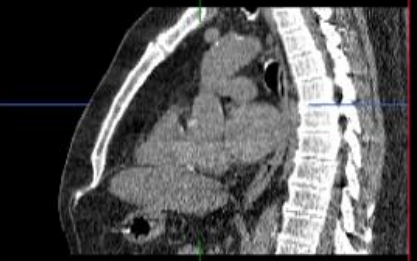
Filter: Unknown
Heart Rate: --

Transverse
MPR

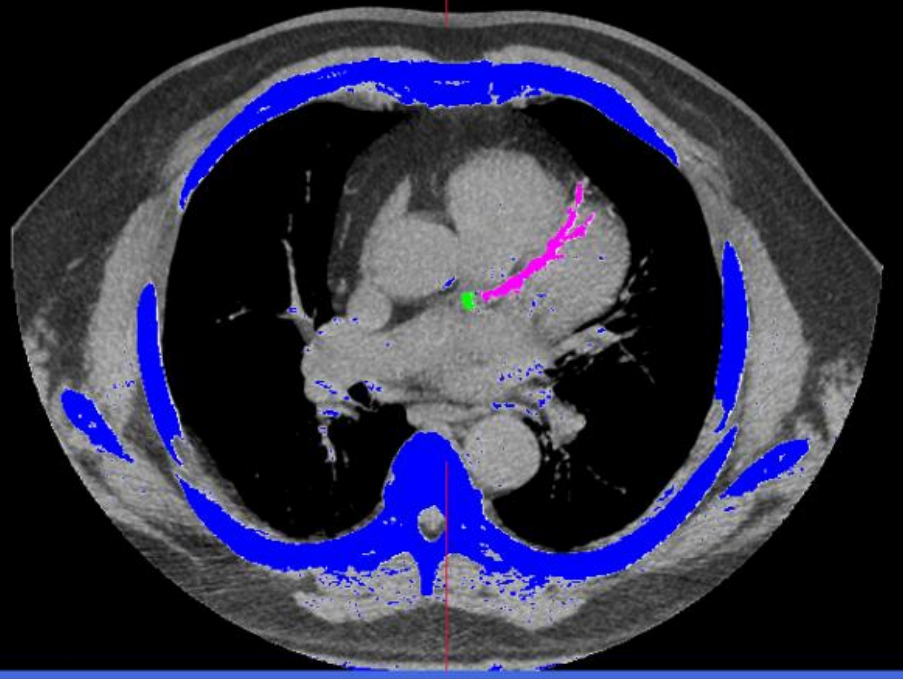
Coronal
MPR



Sagittal
MPR



Transverse
Thin MIP
5 Slices



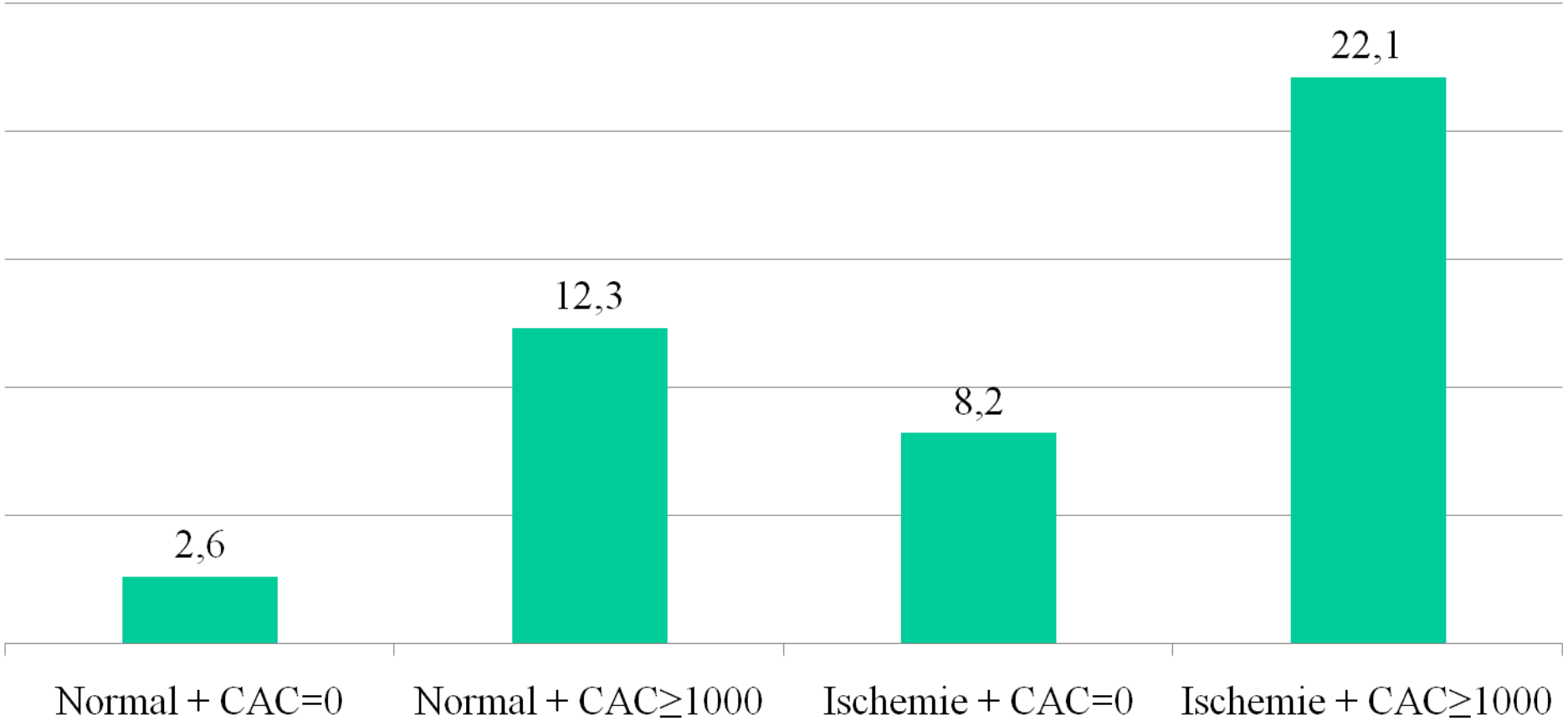
130 HU

| Vessel | Lesions | Volume (mm³) | Agatston Sc |
|---|---|---|---|
| LM | 1 | 191.3 | 255 |
| LAD | 10 | 1227.7 | 1595 |
| LCX | 9 | 188.4 | 194 |
| RCA | 14 | 611.7 | 754 |
| Total | 34 | 2219.1 | 2798 |

No Calciu

# SPECT + CAC vs. SPECT alone

- 695 pacientů, kardiální příhody (%)/rok




*Schenker MP et al. Circulation 2008*

Verbene HJ, et al.

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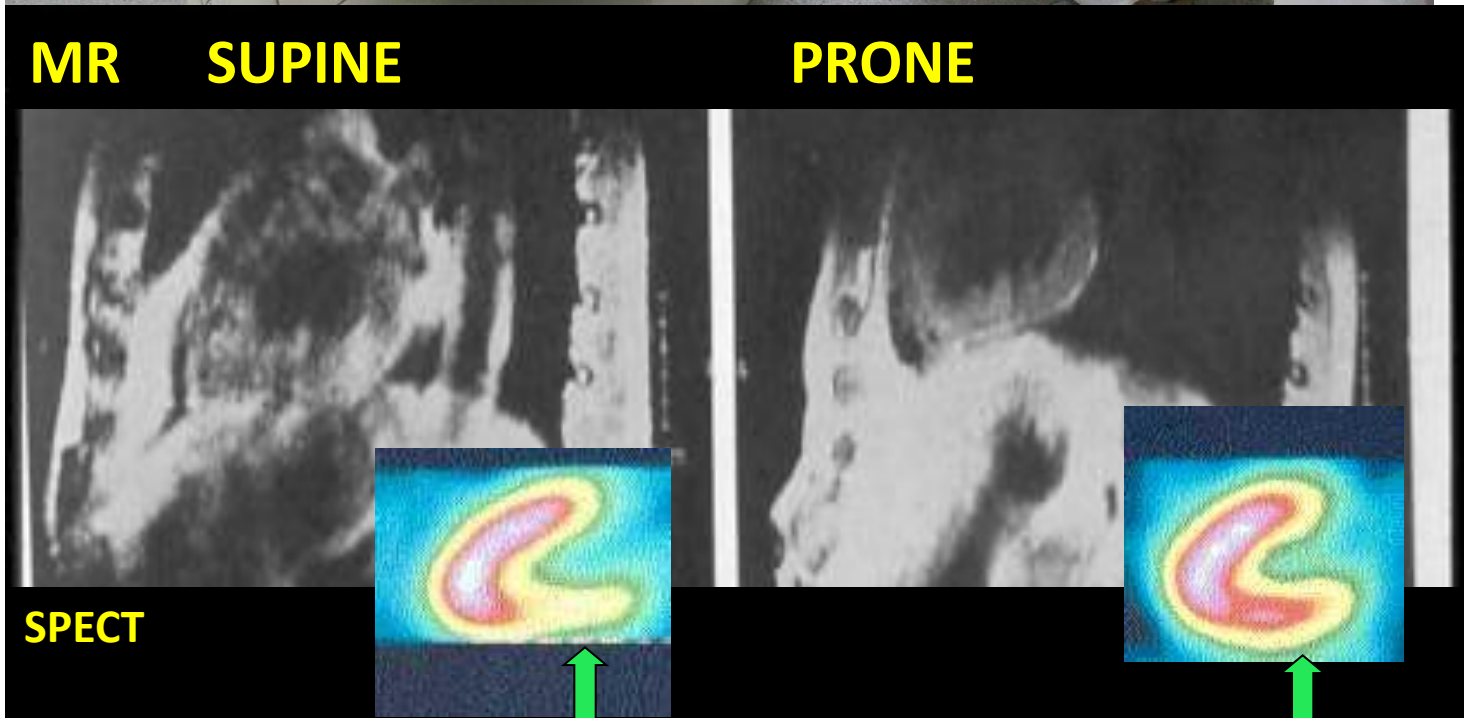
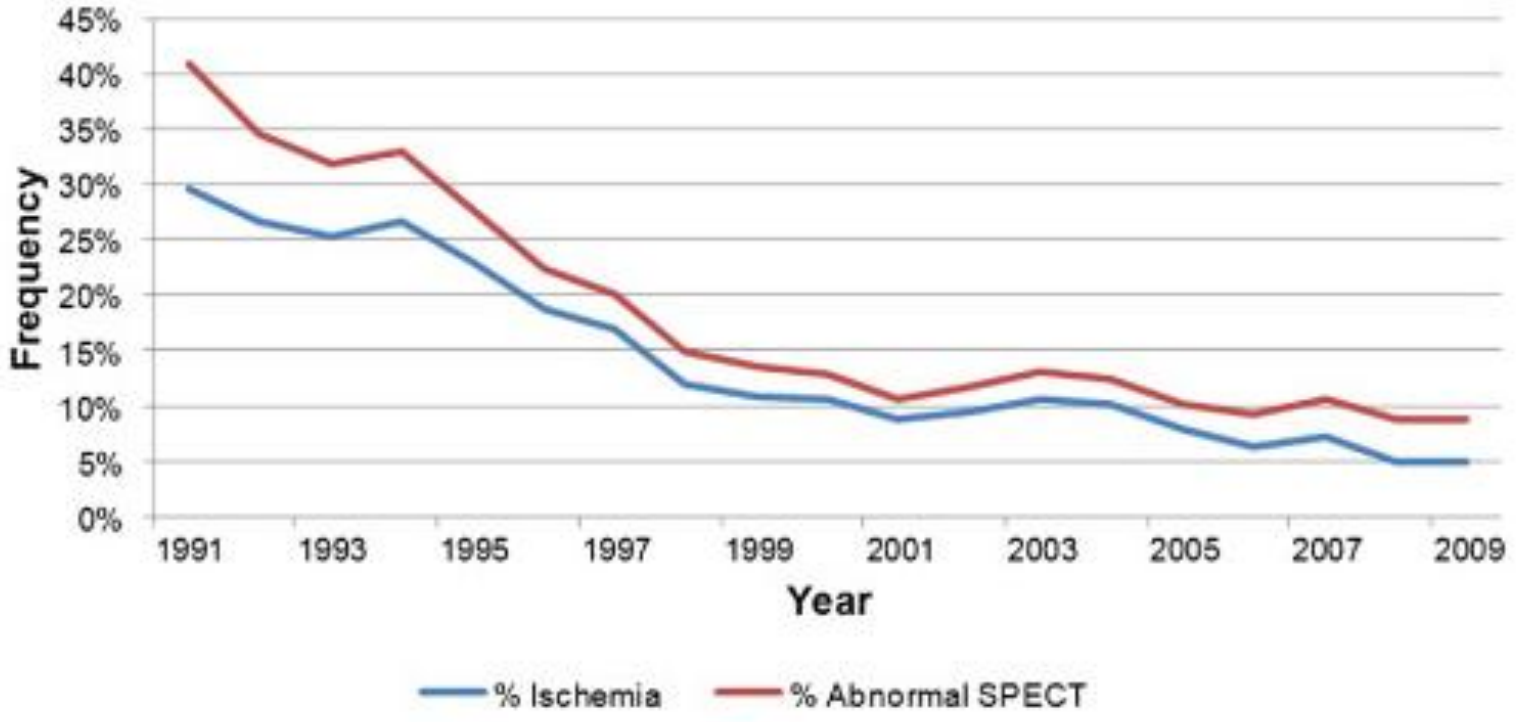
# Prone pozice



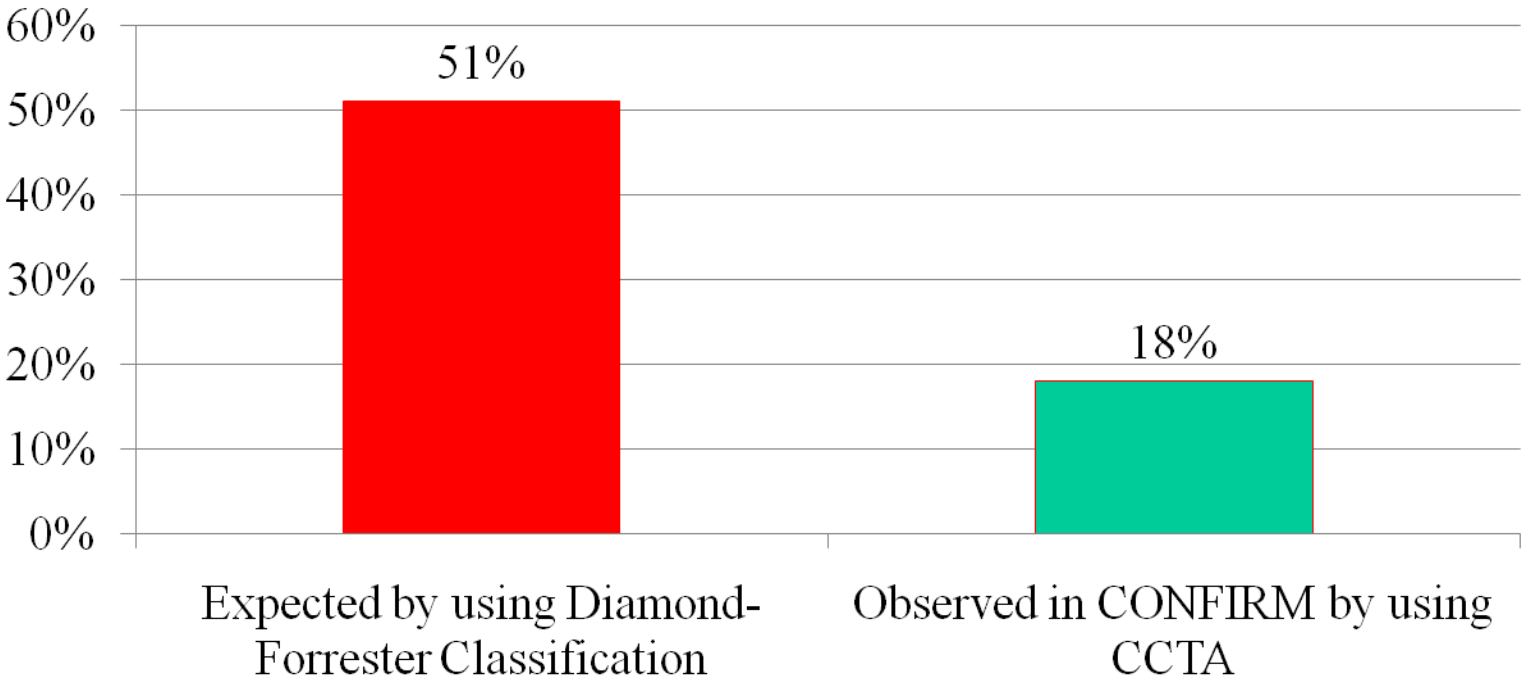
**Rozanski A, et. Al. Temporal Trends in the Frequency of Inducible Myocardial Ischemia During Cardiac Stress Testing : 1991 to 2009**




JACC 2013

# Diamond-Forrester Classification overestimates likelihood of angiographically “significant CAD“

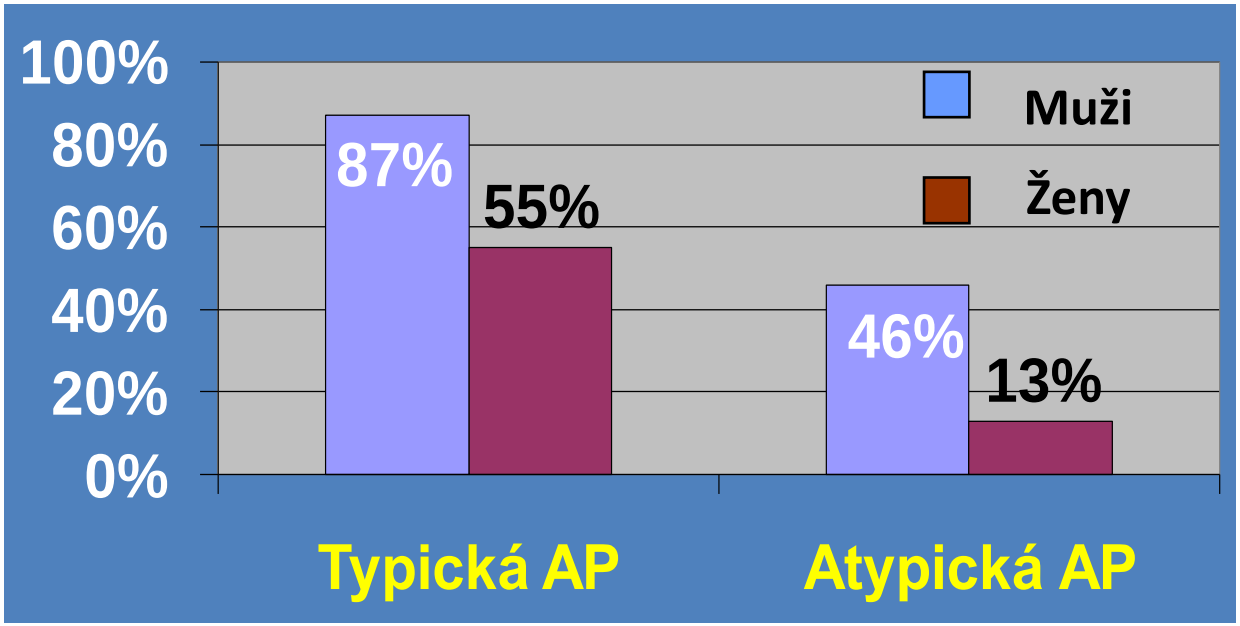
## Overall Obstructive CAD prevalence in patients with NonAng, AtypAng, and TypAng (n= 8106)




Cheng et al. CONFIRM. Circulation 2011

# Předtestová pravděpodobnost ICHS
# Věk: 40-49 let

*Diamond GA, Forrester JS. N Engl J Med 1979*



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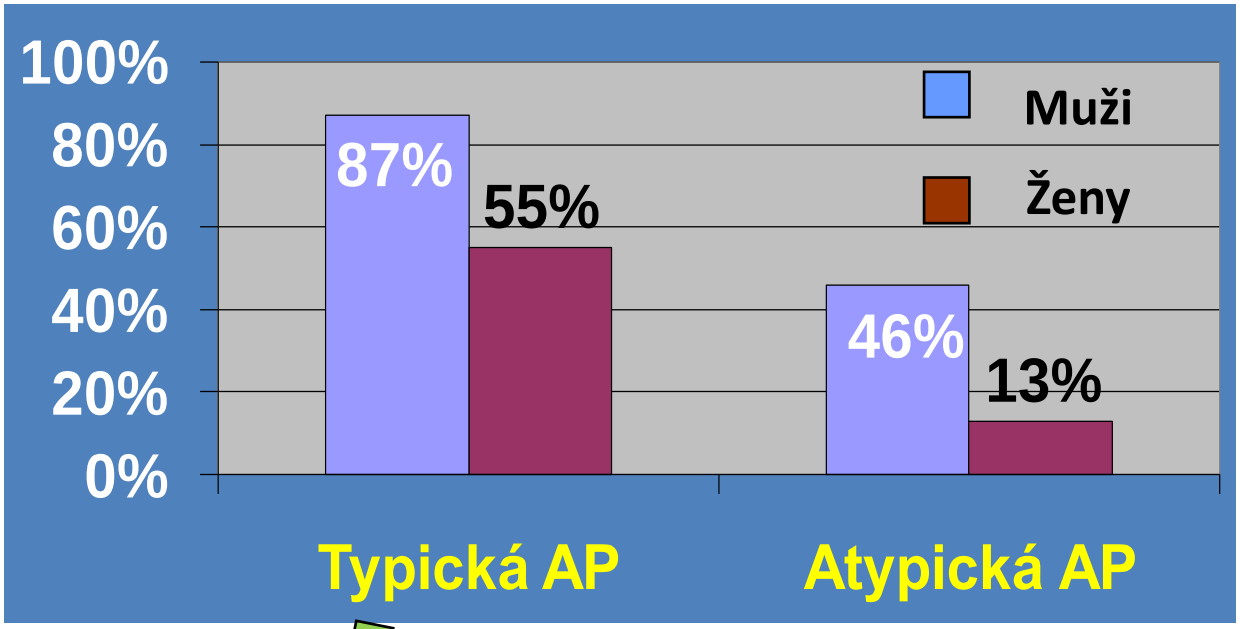


**Souhrn Doporučených postupů ESC pro diagnostiku a léčbu stabilní ischemické choroby srdeční – 2013.**

Cor et Vasa

http://www.kardio-cz.cz/doporucene-postupy-ceske-kardiologicke-spolecnosti-460/

| | Typická angina | | Atypická angina | | Neanginózní bolest na hrudi | |
|---|---|---|---|---|---|---|
| Věk | Muži | Ženy | Muži | Ženy | Muži | Ženy |
| 30–39 | 59 | 28 | 29 | 10 | 18 | 5 |
| 40–49 | 69 | 37 | 38 | 14 | 25 | 8 |
| 50–59 | 77 | 47 | 49 | 20 | 34 | 12 |
| 60–69 | 84 | 58 | 59 | 28 | 44 | 17 |
| 70–79 | 89 | 68 | 69 | 37 | 54 | 24 |
| > 80 | 93 | 76 | 78 | 47 | 65 | 32 |

*Berman DS, ICNC12, Madrid 2015*

**<10% pacientů se susp. ICHS má pomocí SPECT zobrazenu ischemii**

Př.: Pacienti s 50% pravděpodobností ICHS *(Diamond-Forrester)*

- 20% z nich má ≥50% stenózu na CT koronarografii*
- 90% z nich má ≥50% stenózu na invazivní koronarografii**
- 57% z nich má abnormální FFR***
- 77% z nich má ischemii na SPECT (kolateralizace)****
- **0.20 x 0.90 x 0.57 x 0.77 = 8%**

* *Cheng (CONFIRM) Circulation 2011*

** *Budoff et al (ACCURACY) JACC 2008*

*** *Tonono et al (FAME) JACC 2010*

**** *Zhou et al EJR 2014 (Meta anylysis)*

Verbene HJ, et al.

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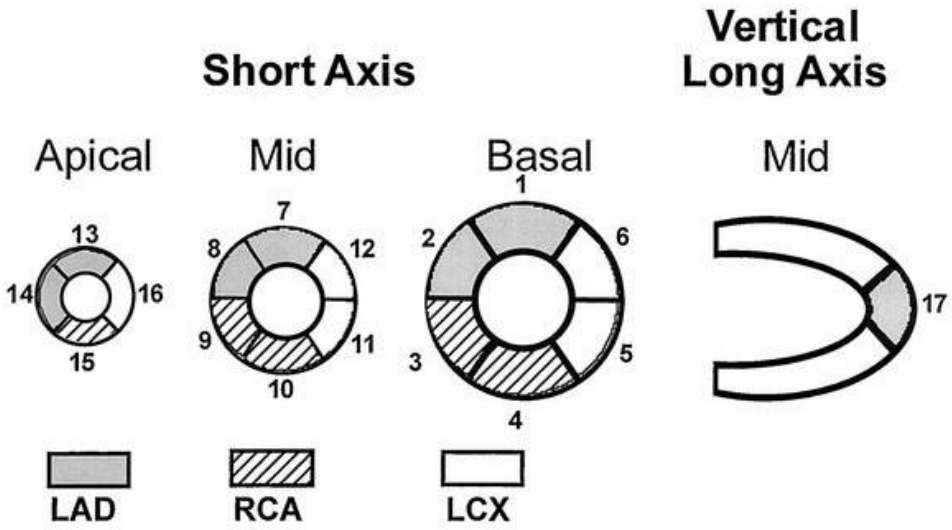
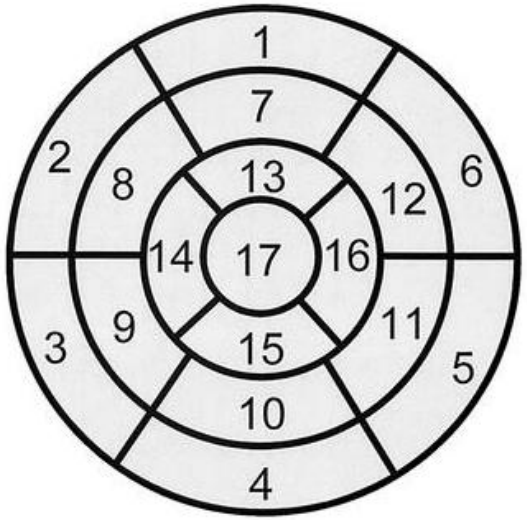
# Kvantitativní analýza perfuze

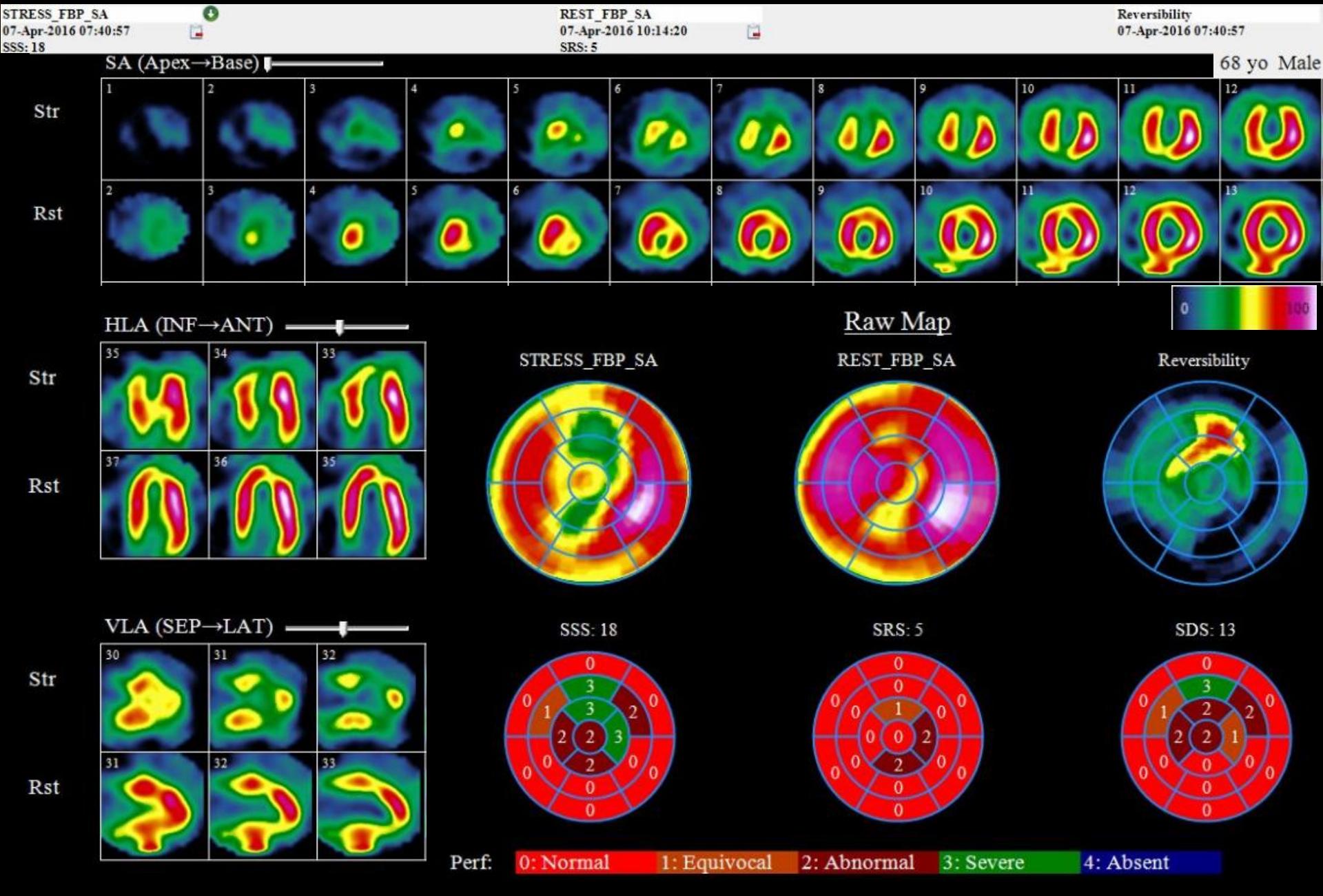


- 5ti stupňová škála (0 = normal, 4 = absent)
- sumační zátěžové skóre (SSS), sumační klidové skóre (SRS) a sumační rozdílové skóre (SDS)

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

# 68letý muž, námahová AP, RBBB. SKG: 90% stenóza RIA a RD, multi PCI



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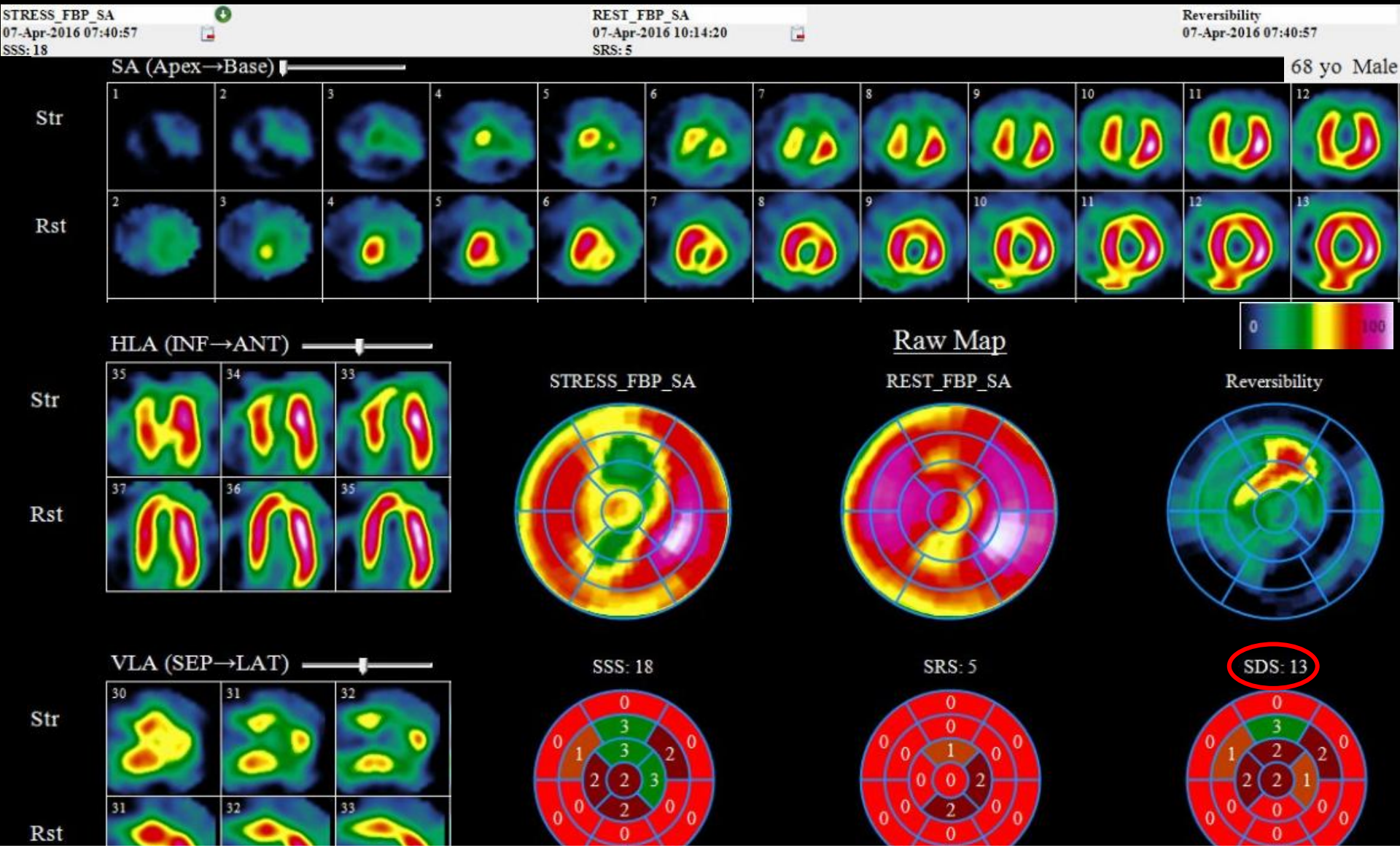


SDS 13: 13/68 = 19% ischemického myokardu

# Závěr

- Doporučené postupy EANM pro SPECT myokardu **2005 vs. 2015: výrazná evoluce v zobrazování**

- 2015 Updated procedural guidelines for SPECT and SPECT/CT:

  **- Regadenoson**

  **- Dedikované kardiologické CZT kamery**

  **- Hybridní SPECT/CT**

http://www.asnc.org/guidelinesandstandards

- SPECT: Stress, Protocols, and Tracers - 2016

ASNC IMAGING GUIDELINES

# ASNC imaging guidelines for SPECT nuclear cardiology procedures: Stress, protocols, and tracers

Milena J. Henzlova, MD,[a] W. Lane Duvall, MD,[b] Andrew J. Einstein, MD,[c] Mark I. Travin, MD,[d] and Hein J. Verberne, MD[e]

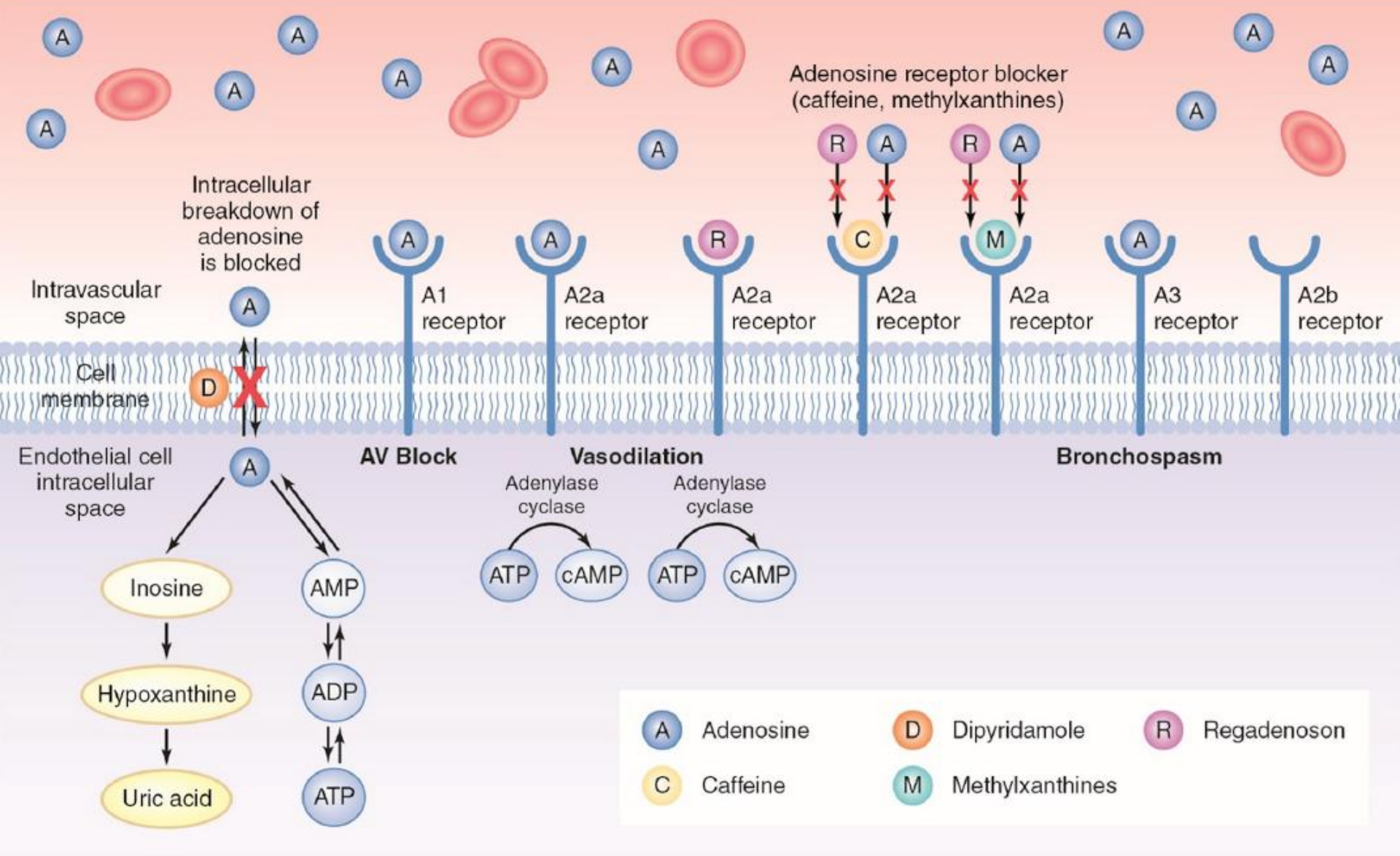


Figure 1. Mechanism of action of coronary vasodilators. *ADP,* Adenosine diphosphate; *AMP,* adenosine monophosphate; *ATP,* adenosine triphosphate; *AV,* atrioventricular; and *cAMP,* cyclic adenosine monophosphate.

*Henzlova M, ASNC imaging guidelines*

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- First-Pass Radionuclide Angiography (FPRNA) - 2009 - Extended through 2015
- Equilibrium Radionuclide Angiocardiography (ERNA) - 2009- Extended through 2015
- Single Photon Emission Computed Tomography - 2010