

ERGOMETRIE KDY A PRO KOHO, DO JAKÉ MÍRY JSOU ZÁTĚŽOVÉ TESTY NAHRAZOVÁNY JINÝMI METODAMI NAPŘ. SPECT?



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NEMOCNICE V PRAZE

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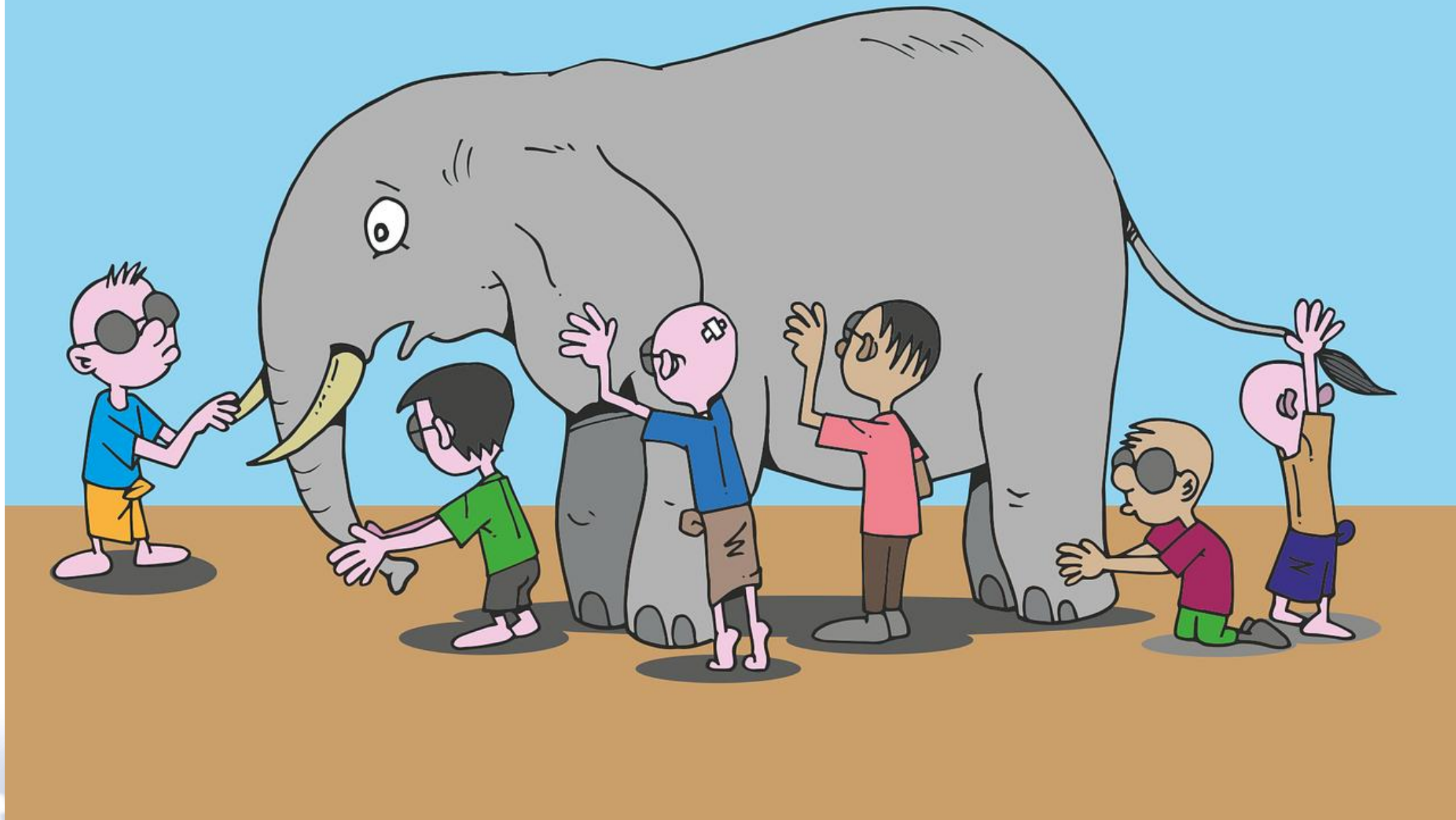


„Ergometry můžete zahodit, už je nepotřebujete“

=

„Echokardiografii už nepotřebujete, máte CT a MR
srdce“





Blind Men Elephant Story - Free vector graphic on Pixabay



Definice na začátek

- Ergon = práce (řecky)
- Ergometrie Jakékoli vyšetření v medicíně za použití ergometru (přístroj na aplikaci zevní práce, pacient musí použít příčně pruhované svaly)
- Zátěžové EKG ... Ergometrické vyšetření se snímáním povrchového EKG
- Spiroergometrie ... Ergometrické vyšetření s analýzou vydechovaných plynů
- Zátěžová..... echokardiografie, SPECT myokardu, MR srdce, pravostranná katetrizace,....





Ergometrie – minimum získaných dat

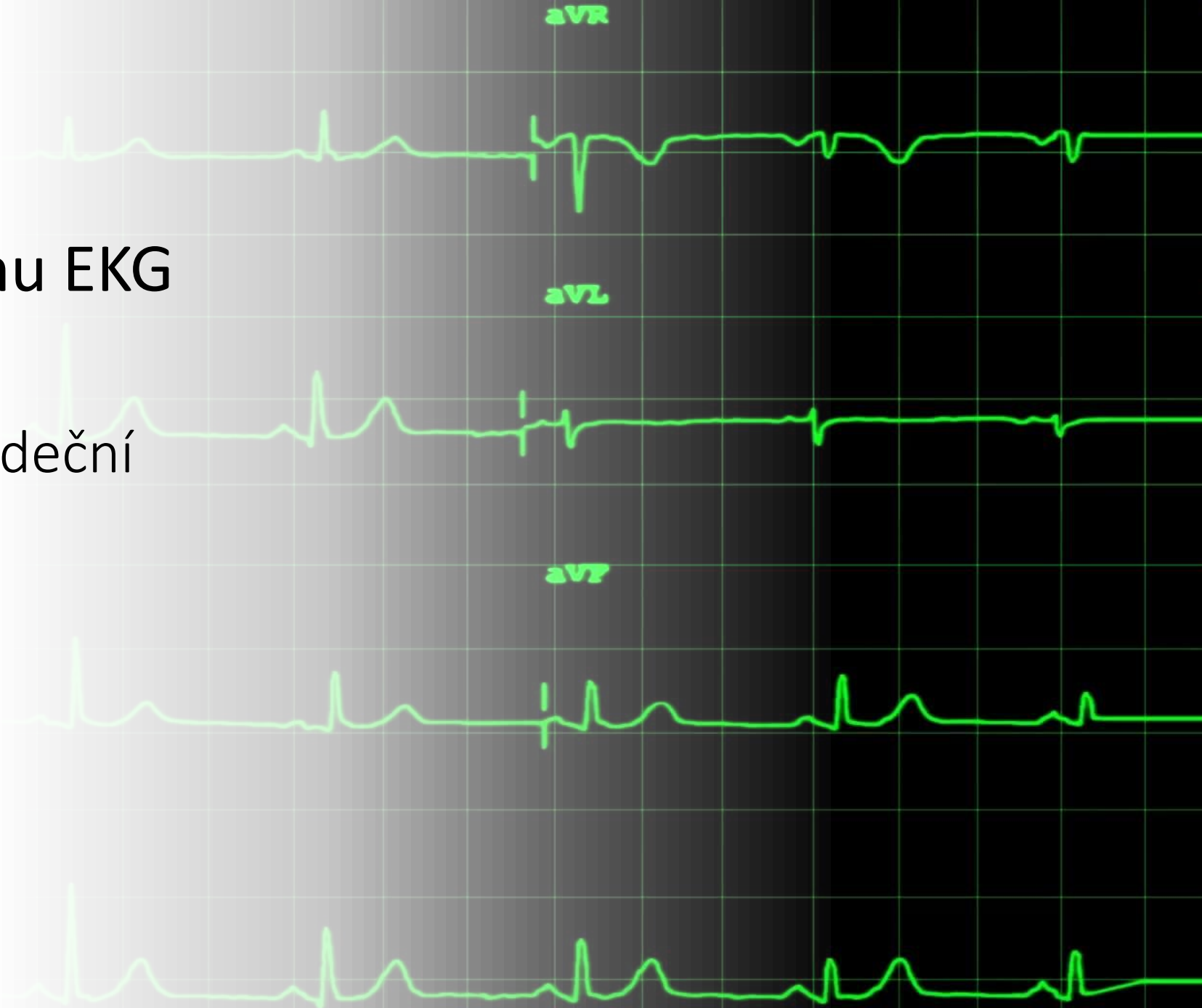
- Tolerance zátěže – Watt / sklon a rychlost na běhátku
- Elektrokardiografie
 - Srdeční frekvence, Extrasystoly, Repolarizační změny, blokády
- Krevní tlak

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- Saturace O₂
 - Subjektivně vnímaná intenzita zátěže – Borgova škála

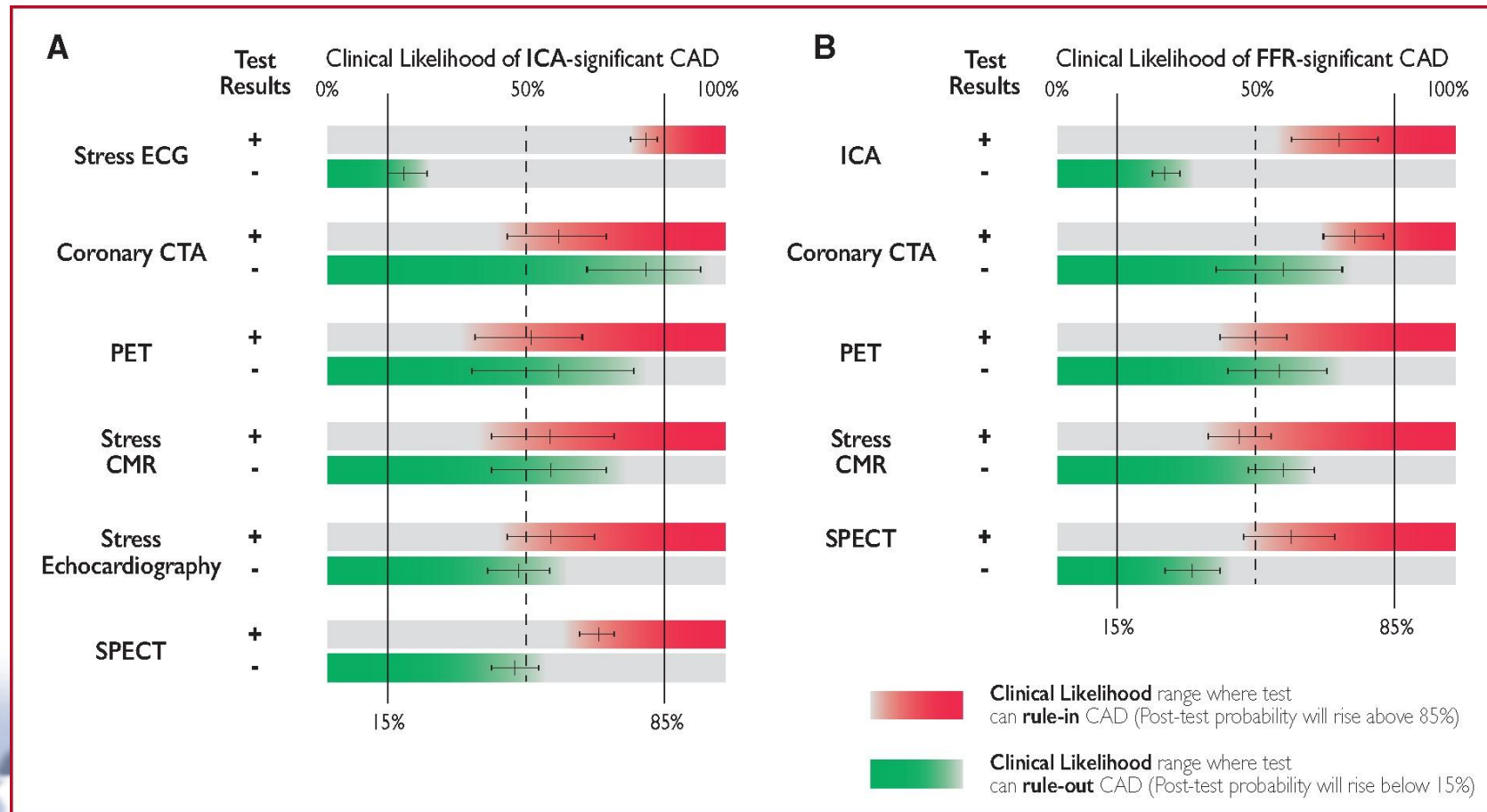


Indikace k zátěžovému EKG

- Ischemická choroba srdeční
- Chlopenní vady
- Srdeční selhání
- Arytmie
-



2019 ESC Guidelines for the diagnosis and management of chronic coronary syndromes



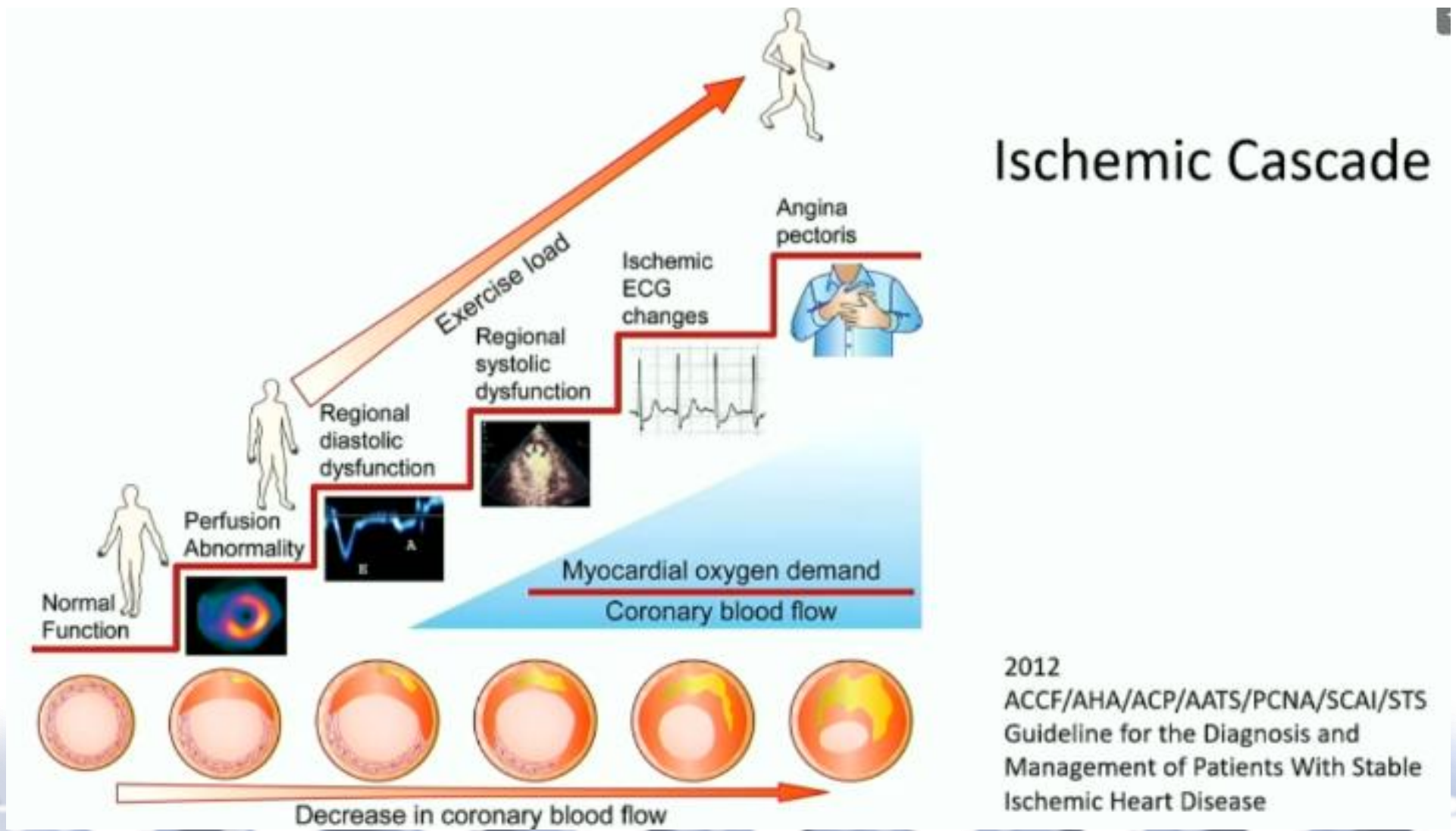
2019 ESC Guidelines for the diagnosis and management of chronic coronary syndromes

Changes in major recommendations

2013	Class ^a	2019	Class ^a
Exercise ECG is recommended as the initial test to establish a diagnosis of stable CAD in patients with symptoms of angina and intermediate PTP of CAD (15–65%), free of anti-ischaemic drugs, unless they cannot exercise or display ECG changes that make the ECG non-evaluable.	I	Exercise ECG is recommended for the assessment of <u>exercise tolerance, symptoms, arrhythmias, BP response, and event risk</u> in selected patients.	I
		Exercise ECG may be considered as an alternative test to rule-in or rule-out CAD when other non-invasive or invasive imaging methods are not available.	IIb
Exercise ECG should be considered in patients on treatment to evaluate control of symptoms and ischaemia.	IIa	Exercise ECG may be considered in patients on treatment to evaluate control of symptoms and ischaemia.	IIb



Ischemická kaskáda



Ischemic Cascade

2012
ACCF/AHA/ACP/AATS/PCNA/SCAI/STS
Guideline for the Diagnosis and
Management of Patients With Stable
Ischemic Heart Disease



Chlopenní vady – indikace zátěžových testů

- Objektivizovat / odhalit symptomy u pacientů, kteří tvrdí, že jsou asymptomatictí / mají nespecifické obtíže

- Z
- P
- P
- P

Ve zkratce:

Objektivizace symptomů

Hemodynamický dopad – TK, Tepový kyslík

Tolerance zátěže – vývoj v čase

- Zátěž

- A
- M
- Dif. Dg. dušnosti

- Dobutaminové echo

- Kontraktilní rezerva
- Významnost AoS (low-flow/low-gradient)
- Se srdečním selháním a funkční MiR – reversní remodelace LK





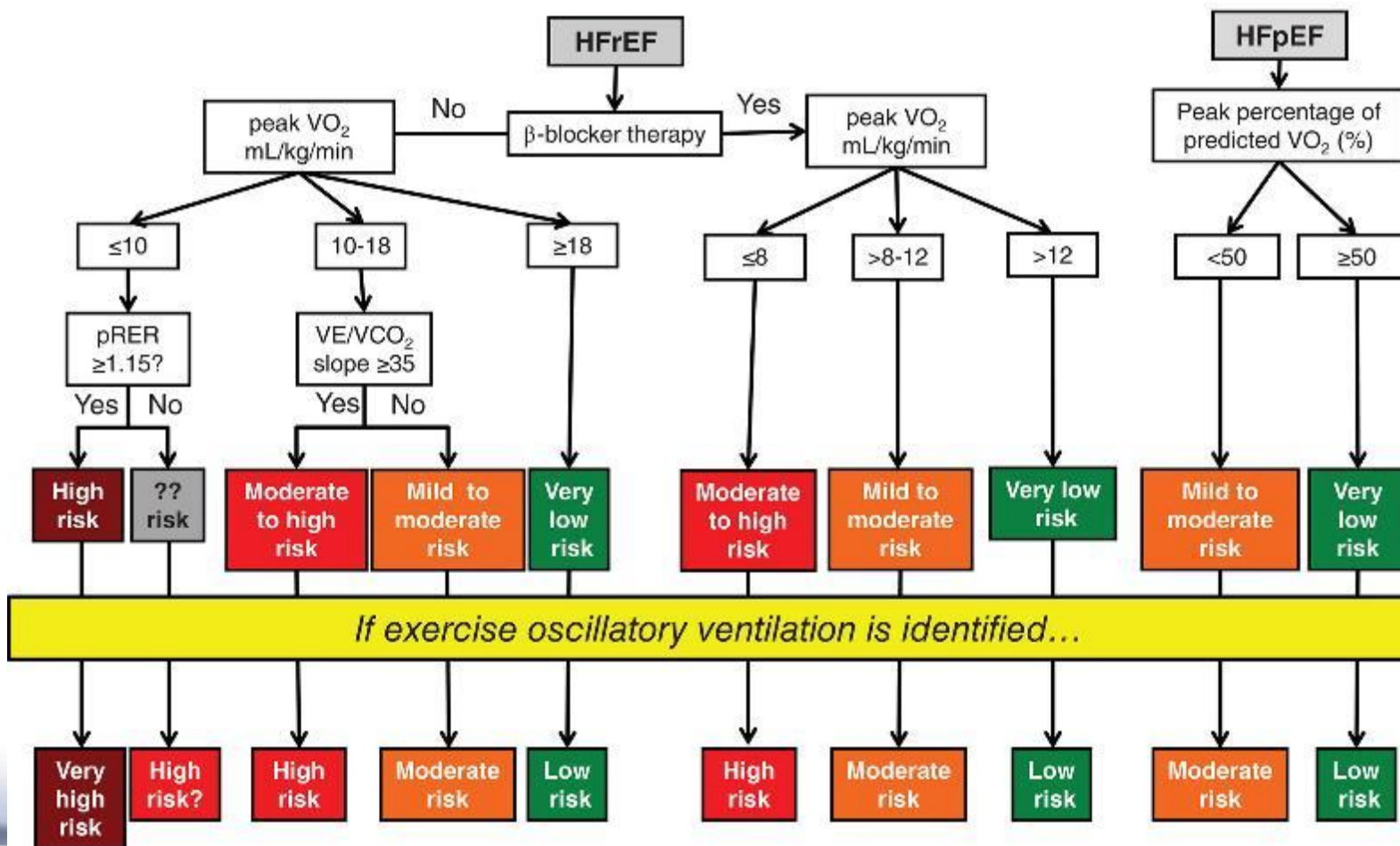
Arytmie a zátěžové testy

- Vyvolání arytmiie při zátěži (kontrolovaně do maxima)
 - CPVT, KES v zátěži, AV(N)RT
- QT intervalu při zátěži (prodlužování)
- Chronotropní kompetence, nastavení kardiostimulátorů (pohybových čidel)
- Palpitace při zátěži – sinusová tachykardie (psyché)
- **Modifikované protokoly**
 - Strmý začátek zátěže
 - Prudké ukončení bez zotavení
 - CAEP – Chronotropic Assessment Exercise Protocol

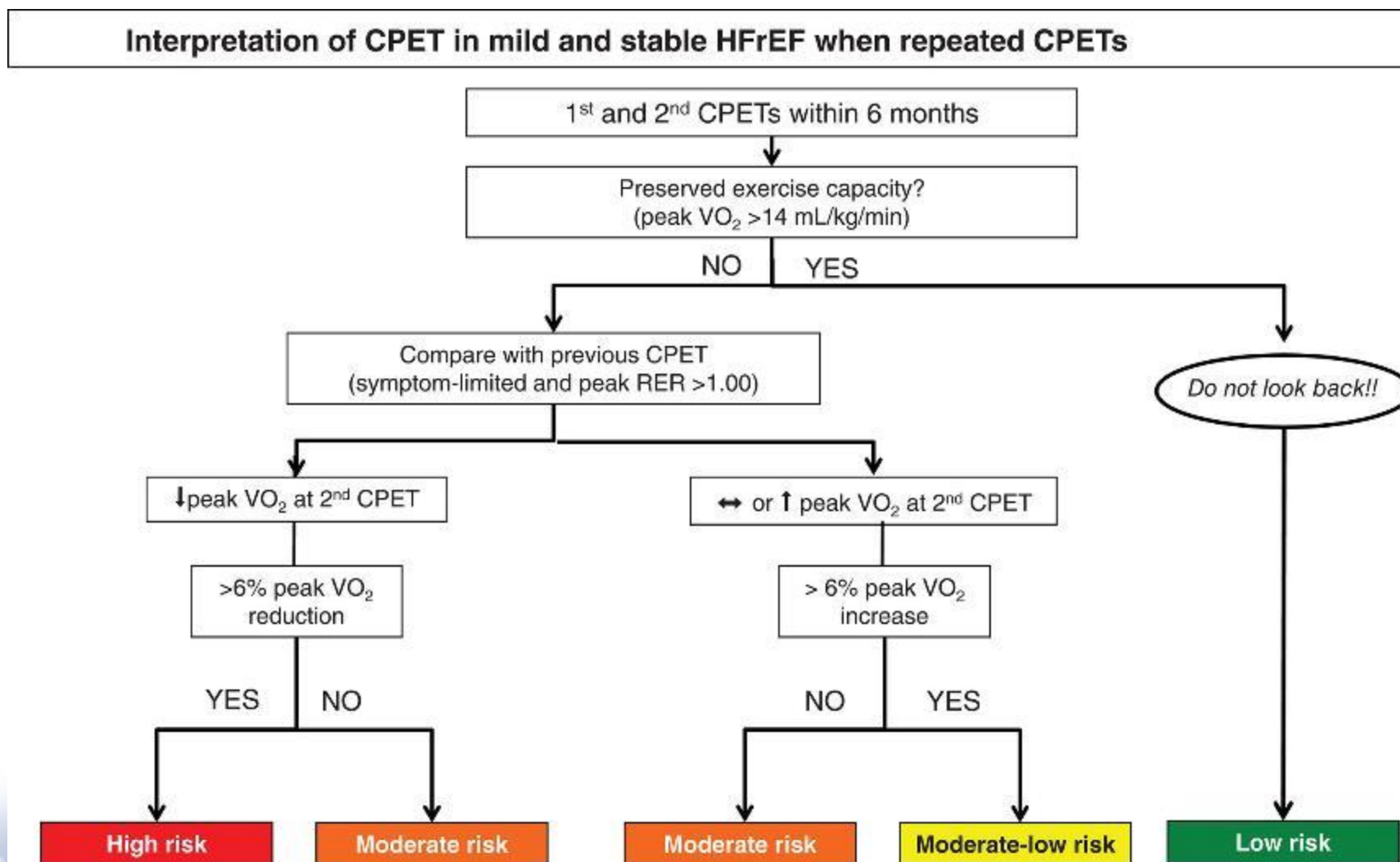


Chronické srdeční selhání – vstupní vyšetření

Risk estimation with CPET in patients with heart failure (2nd step)



Chronické srdeční selhání – opakované vyšetření



Francouzská doporučení

Table 5 Exercise test indications in the context of coronary artery disease.

Diagnosis of CAD	An ET is recommended to investigate CAD when the clinical pretest probability is intermediate (Table 1), the resting electrocardiogram is interpretable and the patient is able to perform physical exercise [3,6] If the patient is taking an antianginal agent, treatment should be maintained while performing the ET; when the test is normal, a second test should be considered after treatment withdrawal, given that safety measures are taken ^a When the pretest probability is high (Table 1), an ET should be performed to further define the degree of disease severity, providing an indication for medical treatment or coronary angiography When the clinical pretest probability is low (Table 1), an ET may be performed if the estimated cardiovascular risk is high or very high [4,5] An ET may be performed beyond 6 hours after symptom onset in a patient hospitalized for angina, provided that the clinical, biological and electrocardiographic variables remain normal [8]	I A IIa C IIa C
Evaluation of CAD	An ET or CPET is recommended to prescribe an adapted physical activity and cardiac rehabilitation programme [9] An ET should be performed after revascularization to assess the success of the intervention and serve as a reference for follow-up visits	I A IIa C

CAD: coronary artery disease; CPET: cardiopulmonary exercise test; ET: exercise test.

^a The patient must be told to use sublingual nitroglycerin if chest pain occurs during daily activities, in which case a prompt cardiological consultation is warranted.

Table 6 Exercise test indications in the context of rhythm or conduction disorders.

An ET is recommended for exercise-induced symptoms such as syncope, abnormal fatigue, palpitations	I C
An ET should be considered for the evaluation of antiarrhythmic treatment efficacy (medication or ablation)	IIa C
An ET should be considered for fine tuning of implanted cardiac stimulators or defibrillators	IIa C
An ET may be considered for the evaluation of ventricular response in patients with atrial fibrillation	IIb C
An ET may be considered for the evaluation of a pre-excitation electrocardiogram pattern	IIb C

ET: exercise test.

Table 7 Exercise test indications in the context of valvular diseases.

A CPET (or, if unavailable, an ET) should be considered in asymptomatic patients with severe aortic stenosis, to orient the therapeutic decision, given the occurrence of certain abnormalities (e.g. a reduction in VO ₂ peak, exercise angina, a reduction or < 20 mmHg increase in systolic BP or ventricular arrhythmia) [19–21]	IIa B
A CPET (or, if unavailable, an ET) should be considered when the clinical picture does not match echocardiographic findings in the context of valvular disease, other than aortic stenosis	IIa C
An ET is not recommended in symptomatic severe aortic stenosis [19]	III B

BP: blood pressure; CPET: cardiopulmonary exercise test; ET: exercise test.

Table 8 Exercise test indications in the context of chronic heart failure.

A CPET (or, if unavailable, an ET) is recommended to optimize exercise training programmes [9,23]	I A
A CPET (or, if unavailable, an ET) is recommended to assess functional capacity, and to establish the indication for ventricular device implantation or heart transplantation [22,26]	I C
A CPET (or, if unavailable, an ET) should be considered for assessment of unexplained dyspnea or myocardial ischemia in a patient with chronic heart failure	IIa C

CPET: cardiopulmonary exercise test; ET: exercise test.

Table 9 Exercise test indications in the context of other cardiovascular diseases.

Hypertrophic cardiomyopathy	A CPET (or, if unavailable, an ET) should be considered to assess functional capacity and prognostic markers, such as ventricular arrhythmia and BP response to exercise [27–29]	IIa B
	An ET should be considered every 1–2 years to follow up on BP response and evaluate treatment efficacy	IIa C
Pulmonary hypertension	In patients with pulmonary hypertension, a CPET is recommended at the time of diagnosis and at 6-month to 12-month intervals for follow-up; a CPET should also be performed in the presence of worsening symptoms; the VO ₂ peak and VE/VCO ₂ slope are used to further stratify the patient's risk [30]	I C
PAD	With the use of a treadmill ergometer, an ET is indicated to objectify claudication, to quantify the ischemia causing the symptoms and to assess functional capacity (the main prognostic marker) [31,32]	I B
	An ET is indicated to prescribe and properly guide a physical activity programme, adapted to the patient [33]	I B
Arterial hypertension	An ET is indicated in symptomatic hypertensive patients, presenting a normal resting electrocardiogram, to diagnose coronary artery disease [34]	I B
	An ET should be considered in all hypertensive patients to better define prognosis (functional capacity, BP response) or to prescribe an adapted physical activity programme (for leisure or professional purposes)	IIa C
Diabetes mellitus	An ET is indicated for diagnosis of CAD in symptomatic patients with diabetes whose resting electrocardiogram is normal and interpretable [39]	I B
	An ET should be considered in sedentary patients with diabetes to screen for symptoms triggered by moderate/vigorous exercise and/or to prescribe an adapted physical activity programme [40]	IIa B

BP: blood pressure; CAD: coronary artery disease; CPET: cardiopulmonary exercise test; ET: exercise test, PAD: peripheral artery disease; VE: volume of expired gas; VO₂: oxyg



Polská doporučení

Indications and contraindications Indications for CPET in cardiology are as follows^{1,2,5,11,24-27}:

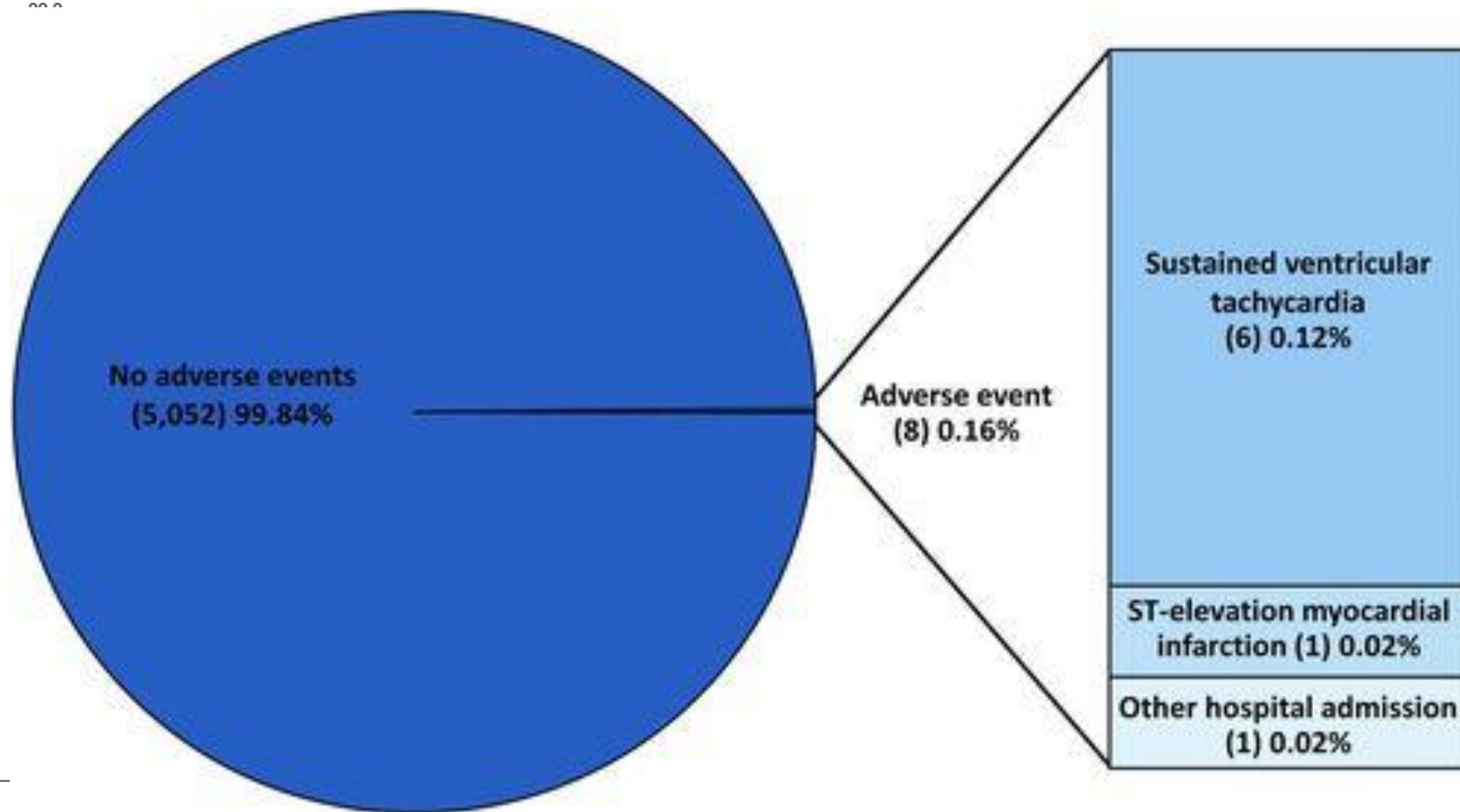
- 1 Identifying causes of exercise intolerance and dyspnea
- 2 Diagnostic workup as well as the evaluation of the disease progression, exercise capacity, and prognosis in: heart failure, hypertrophic cardiomyopathy (HCM), pulmonary hypertension (PH), suspected ischemic heart disease, suspected mitochondrial myopathy, unexplained exertional dyspnea, chronic obstructive pulmonary disease (COPD) or interstitial lung disease, pre- and postoperative evaluation and evaluation of long-term prognosis, valvular diseases
- 3 Evaluation of physical capacity in apparently healthy people
- 4 Choice of training, monitoring, and evaluation of results in cardiac rehabilitation
- 5 Evaluation of treatment effectiveness.

Indications for electrocardiographic exercise testing [1, 2, 3]:

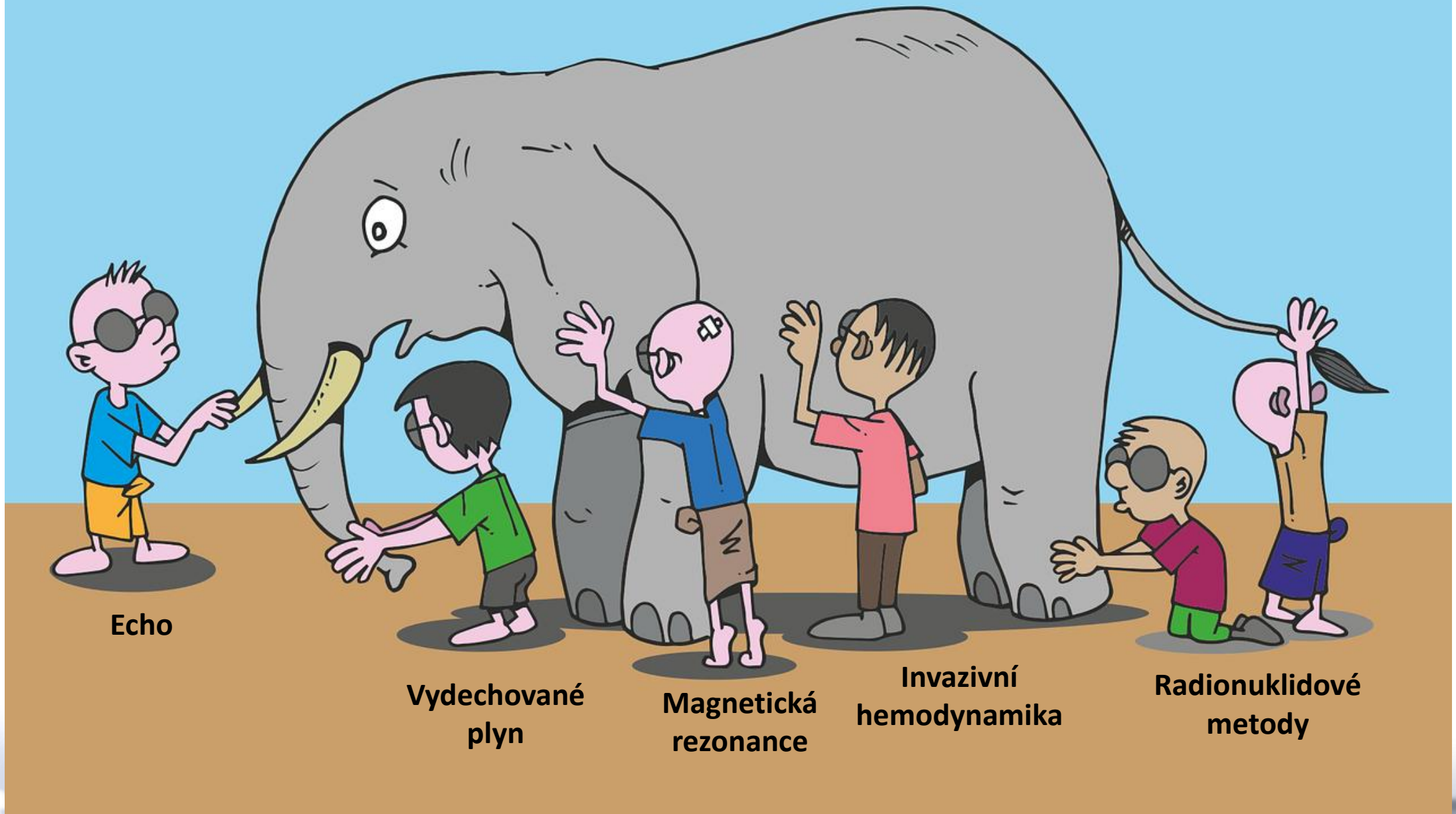
- As the initial test for establishing a diagnosis of stable coronary artery disease (CAD) in patients with symptoms of angina and intermediate pre-test probability of CAD (15%–65%) (Table 3)
- Evaluation of the functional severity of CAD (evaluation of coronary reserve)
- Risk stratification in patients with established CAD
- Evaluation of exercise capacity and exercise tolerance
- Patient evaluation prior to physical exercise/training
- Risk stratification prior to non-cardiac surgery (according to the ESC/ESA guidelines on non-cardiac surgery) [11]
- Evaluation of response to treatment (physical training, drug therapy, pacing)
- Assessment of exercise-induced symptoms (hypertensive response, chronotropic response, cardiac arrhythmias, symptoms related to valvular heart disease or cardiomyopathies)

Table 3. Patient Characteristics: Echocardiogram Data

	n	%*
Congestive heart failure	1289	
LV ejection fraction ≤25%	286	22.2
LV ejection fraction 26% to 35%	235	18.3
LV ejection fraction 36% to 50%	224	17.4
LV ejection fraction ≥51%	300	23.3
No recent echocardiogram	244	19.0
Aortic stenosis†	212	
Severe	90	42.5
Moderate	58	27.3
Mild	30	14.2
No recent echocardiogram	34	16.0
Pulmonary hypertension	194	
RV systolic pressure ≤30 mm Hg	18	9.3
RV systolic pressure 31 to 40 mm Hg	27	13.9
RV systolic pressure 41 to 70 mm Hg	86	44.1
RV systolic pressure ≥71 mm Hg	28	14.4
Right ventricular enlargement	81	41.8
Decreased RV systolic function	62	32.0
No recent echocardiogram	35	17.8
Hypertrophic cardiomyopathy†	598	
No obstruction	64	10.7
Labile obstruction	89	14.9
Basal obstruction	150	25.1
No recent echocardiogram with measurement of LV outflow tract gradient	295	49.3



LV indicates left ventricle; RV, right ventricle.
*The % refers to the percentage of patients within each disease category.
†See text for definitions.



Echo

Vydechované
plyn

Magnetická
rezonance

Invazivní
hemodynamika

Radionuklidové
metody

Děkuji za pozornost

