

Utredning av kroniskt koronart syndrom - Arbetsprovets roll

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Disposition

- Vad säger våra europeiska riktlinjer
- Diagnostik
 - ST-T-reaktionen - sensitivitet och specificitet
- Prognostik
 - Arbetsförmåga
 - Hjärtfrekvensreaktionen
 - Arytmi
 - LBBB



European Society
of Cardiology

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ESC GUIDELINES

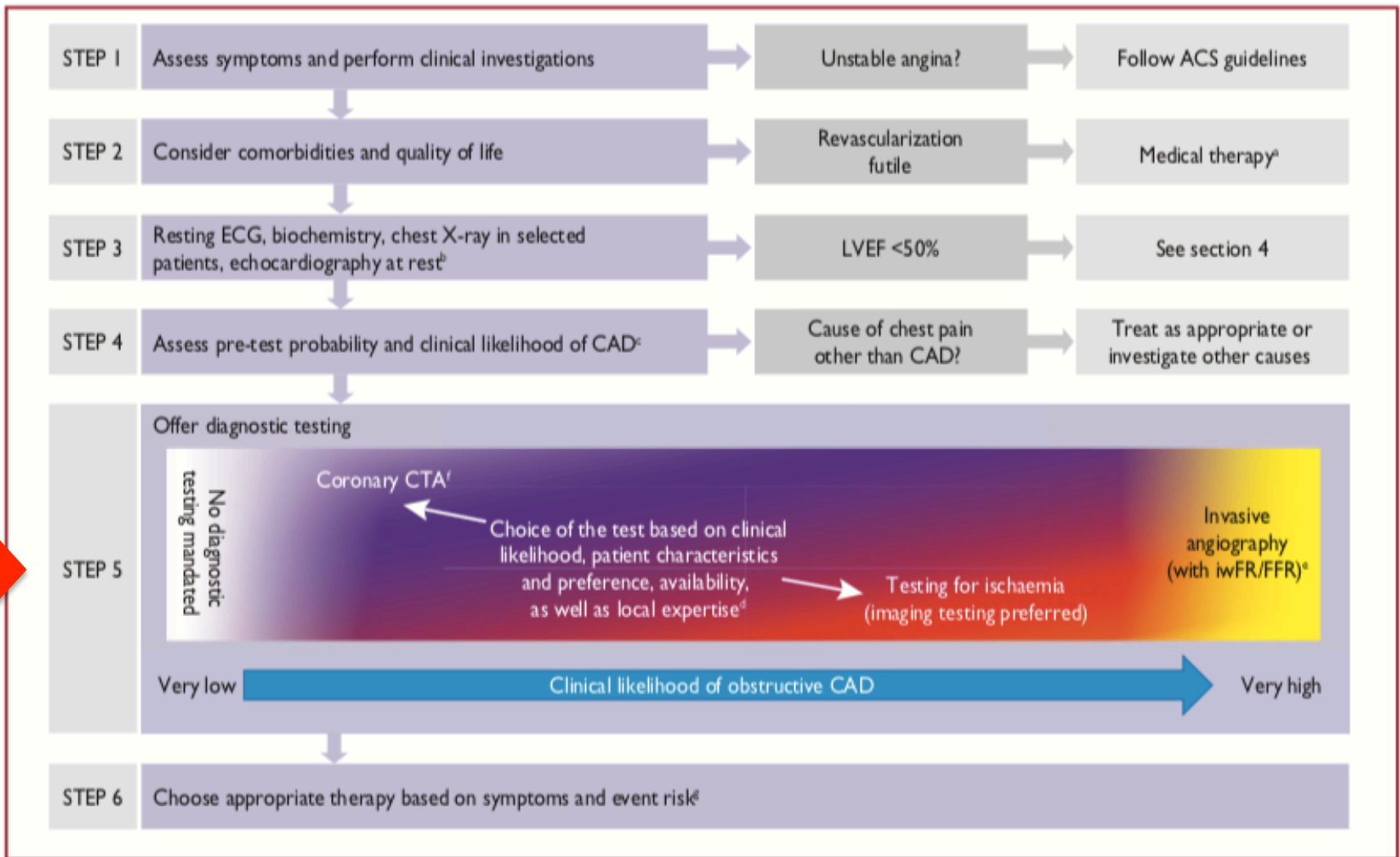


2019 ESC Guidelines for the diagnosis and management of chronic coronary syndromes

The Task Force for the diagnosis and management of chronic coronary syndromes of the European Society of Cardiology (ESC)

Authors/Task Force Members: Juhani Knuuti* (Finland) (Chairperson), **William Wijns*** (Ireland) (Chairperson), **Antti Saraste** (Finland), **Davide Capodanno** (Italy), **Emanuele Barbato** (Italy), **Christian Funck-Brentano** (France), **Eva Prescott** (Denmark), **Robert F. Storey** (United Kingdom), **Christi Deaton** (United Kingdom), **Thomas Cuisset** (France), **Stefan Agewall** (Norway), **Kenneth Dickstein** (Norway), **Thor Edvardsen** (Norway), **Javier Escaned** (Spain), **Bernard J. Gersh** (United States of America), **Pavel Svtil** (Czech Republic), **Martine Gilard** (France), **David Hasdai** (Israel), **Robert Hatala** (Slovak Republic), **Felix Mahfoud** (Germany), **Josep Masip** (Spain), **Claudio Muneretto** (Italy), **Marco Valgimigli** (Switzerland), **Stephan Achenbach** (Germany), **Jeroen J. Bax** (Netherlands)

Flödesschema ESC 2019



PTP based on sex, age and nature of symptoms (Table 5)

Decreases likelihood

- Normal exercise ECG^a
- No coronary calcium by CT (Agatston score = 0)^a

Increases likelihood

- Risk factors for CVD (dyslipidaemia, diabetes, hypertension, smoking, family history of CVD)
- Resting ECG changes (Q-wave or ST-segment/T-wave changes)
- LV dysfunction suggestive of CAD
- Abnormal exercise ECG^a
- Coronary calcium by CT^a

Clinical likelihood of CAD

2013	Class ^a
<p>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.</p>	I



2019	Class ^a
<p>Exercise ECG is recommended for the assessment of exercise tolerance, symptoms, arrhythmias, BP response, and event risk in selected patients.</p>	I
<p>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.</p>	IIb
<p>Exercise ECG may be considered in patients on treatment to evaluate control of symptoms and ischaemia.</p>	IIb

Diagnostisk tillförlitlighet

- *arbetsprovet*

- 1 mm ST-sänkning
 - Horisontell eller nedåtsluttande
- Sensitivitet – 68%
- Specificitet - 77%
- Work up bias
 - Sensitivitet 45-50%
 - Specificitet 85-90%
- Sensitivitet
 - En-kärl 39%
 - Två-kärl 72%
 - Tre-kärl 83%
- Ingen studie gjord mot FFR

Gianrossi et al Circulation 1989

Froelicher et al Ann Intern Med 1998

The performance of non-invasive tests to rule-in and rule-out significant coronary artery stenosis in patients with stable angina: a meta-analysis focused on post-test disease probability

Juhani Knuuti^{1*}, Haitham Ballo^{1†}, Luis Eduardo Juarez-Orozco^{1†}, Antti Saraste¹, Philippe Kolh², Anne Wilhelmina Saskia Rutjes³, Peter Jüni⁴, Stephan Windecker⁵, Jeroen J. Bax⁶, and William Wijns⁷

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See page 3331 for the editorial comment on this article (doi: 10.1093/eurheartj/ehy364)

Aims

To determine the ranges of pre-test probability (PTP) of coronary artery disease (CAD) in which stress electrocardiogram (ECG), stress echocardiography, coronary computed tomography angiography (CCTA), single-photon emission computed tomography (SPECT), positron emission tomography (PET), and cardiac magnetic resonance (CMR) can reclassify patients into a post-test probability that defines (>85%) or excludes (<15%) anatomically (defined by visual evaluation of invasive coronary angiography [ICA]) and functionally (defined by a fractional flow reserve [FFR] ≤ 0.8) significant CAD.

Methods and results

A broad search in electronic databases until August 2017 was performed. Studies on the aforementioned techniques in >100 patients with stable CAD that utilized either ICA or ICA with FFR measurement as reference, were included. Study-level data was pooled using a hierarchical bivariate random-effects model and likelihood ratios were obtained for each technique. The PTP ranges for each technique to rule-in or rule-out significant CAD were defined. A total of 28 664 patients from 132 studies that used ICA as reference and 4131 from 23 studies using FFR, were analysed.

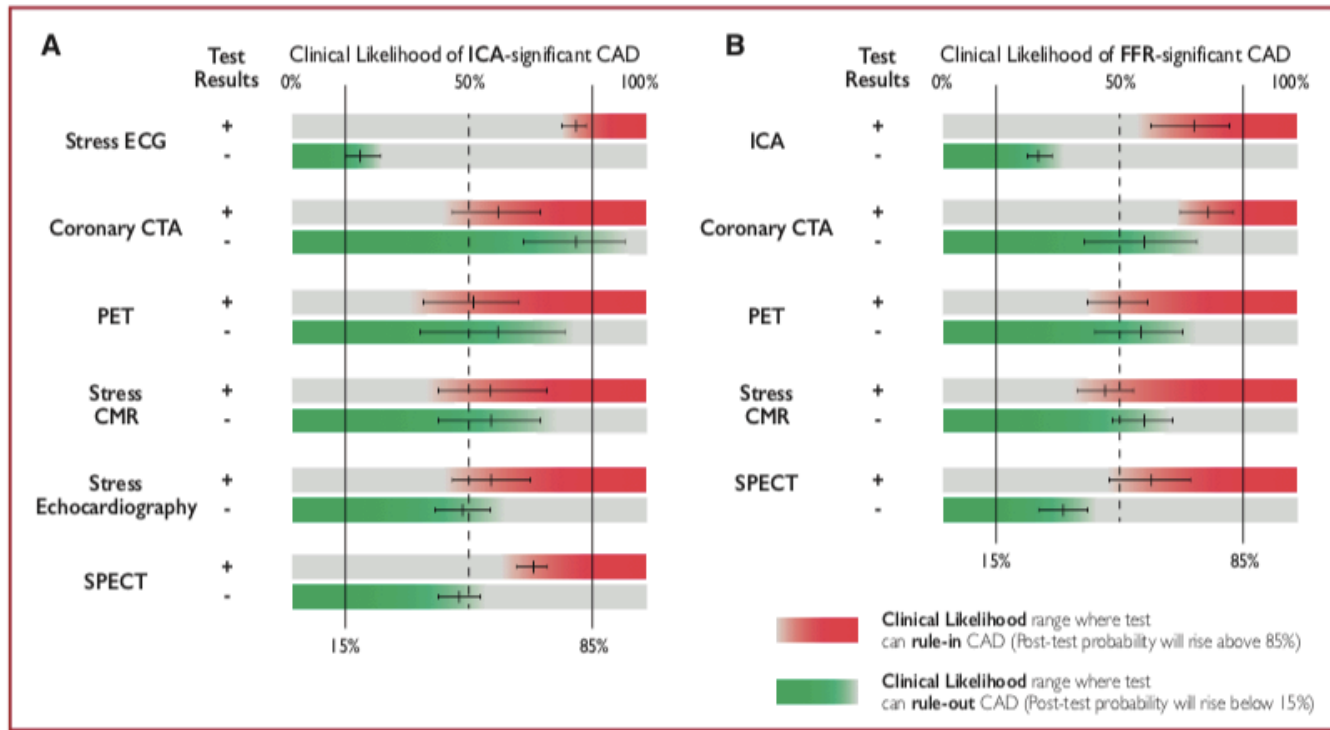
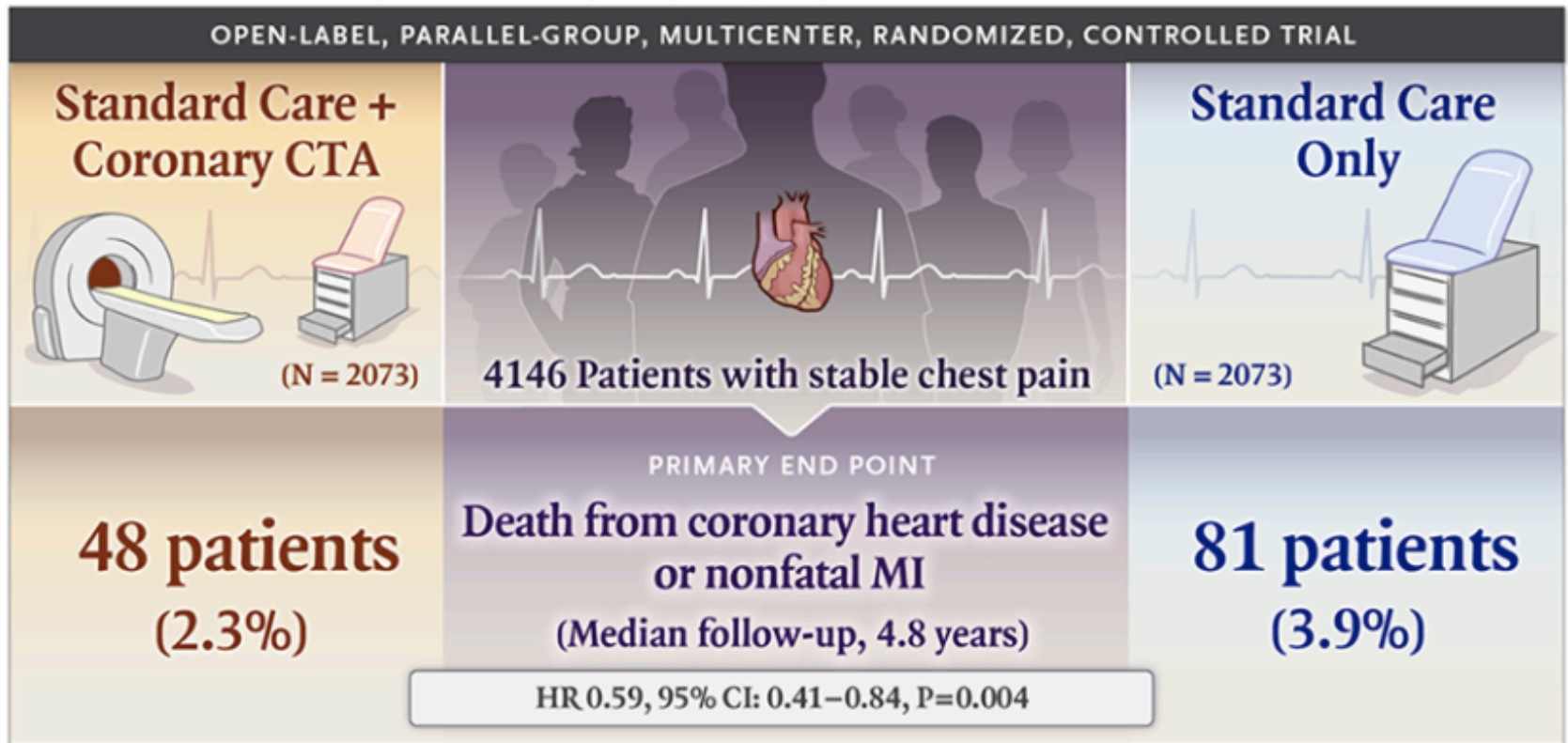


Figure 5 Ranges of clinical likelihood of coronary artery disease in which a given test can rule-in (red) or rule-out (green) obstructive coronary artery disease. (A) Reference standard is anatomical assessment using invasive coronary angiography. (B) Reference standard is functional assessment using fractional flow reserve. Note in (B) that the data with stress echocardiography and single-photon emission computed tomography are more limited than with the other techniques.⁷³ The crosshairs mark the mean values and their 95% confidence intervals. Figure adapted from Knuuti *et al.*⁷³ CAD = coronary artery disease; CMR = cardiac magnetic resonance; CTA = computed tomography angiography; ECG = electrocardiogram; FFR = fractional flow reserve; ICA = invasive coronary angiography; PET = positron emission tomography; SPECT = single-photon emission computed tomography.

SCOT HEART

Coronary CT Angiography and 5-Year Risk of MI

OPEN-LABEL, PARALLEL-GROUP, MULTICENTER, RANDOMIZED, CONTROLLED TRIAL



Men är arbetsprovet en dålig undersökning?

- Arbets-EKG kan utgå, men länge leve **arbetsprovet!**
- Billig undersökning
- Hög tillgänglighet
- Relativt enkel, ingen dyr utrustning
- Ger massor av prognostisk information om patienten
- Ingen strålning
- **Se till att ha en bra undersökning**

Optimalt a-prov

- ✓ Normalt vilo-EKG
- ✓ >85% av beräknad maxpuls
- ✓ 8-10 minuters duration
- ✓ Ansträningsgrad >16 på Borg-skalan
- ✓ Hög dubbelprodukt (syst bltr x HF),
hjärtarbete

ST-T-reaktionen

Sekundära ST-T-förändringar

- Retledningshinder
 - LBBB
 - LAH – kan maskera LAD-ischemi
 - RBBB (obs! V4-V6) – titta på QRS/ST i vila
- ST-T-förändringar på vilo-ekg
- Preexcitation - WPW
- Digoxin
- Pacemaker med kammarpacing - kardiellt minne

Diagnostisk tillförlitlighet

- *arbetsprovet*

- 1 mm ST-sänkning
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- Sensitivitet – 68%
- Specificitet - 77%
- Work up bias
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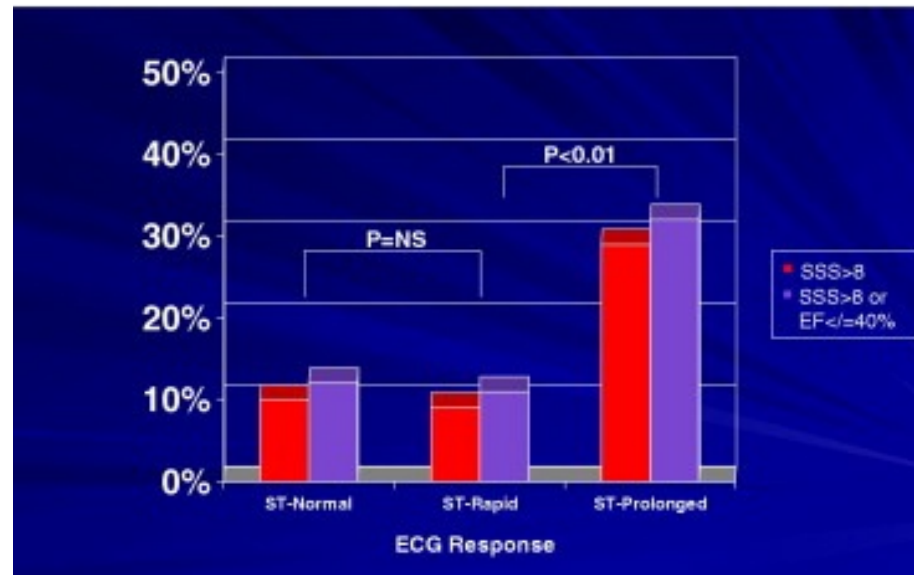
Gianrossi et al Circulation 1989

Froelicher et al Ann Intern Med 1998

ST-T reaktion efter arbete I

Comparison of High Risk Stress Myocardial Perfusion Imaging Findings in Men With Rapid Versus Prolonged Recovery of ST-Segment Depression After Exercise Stress Testing

Jonathan D. Rich, MD^{a,b}, Stuart Chen, MD^{a,b}, and R. Parker Ward, MD^{a,b,*}



ST-T-reaktion efter arbete II

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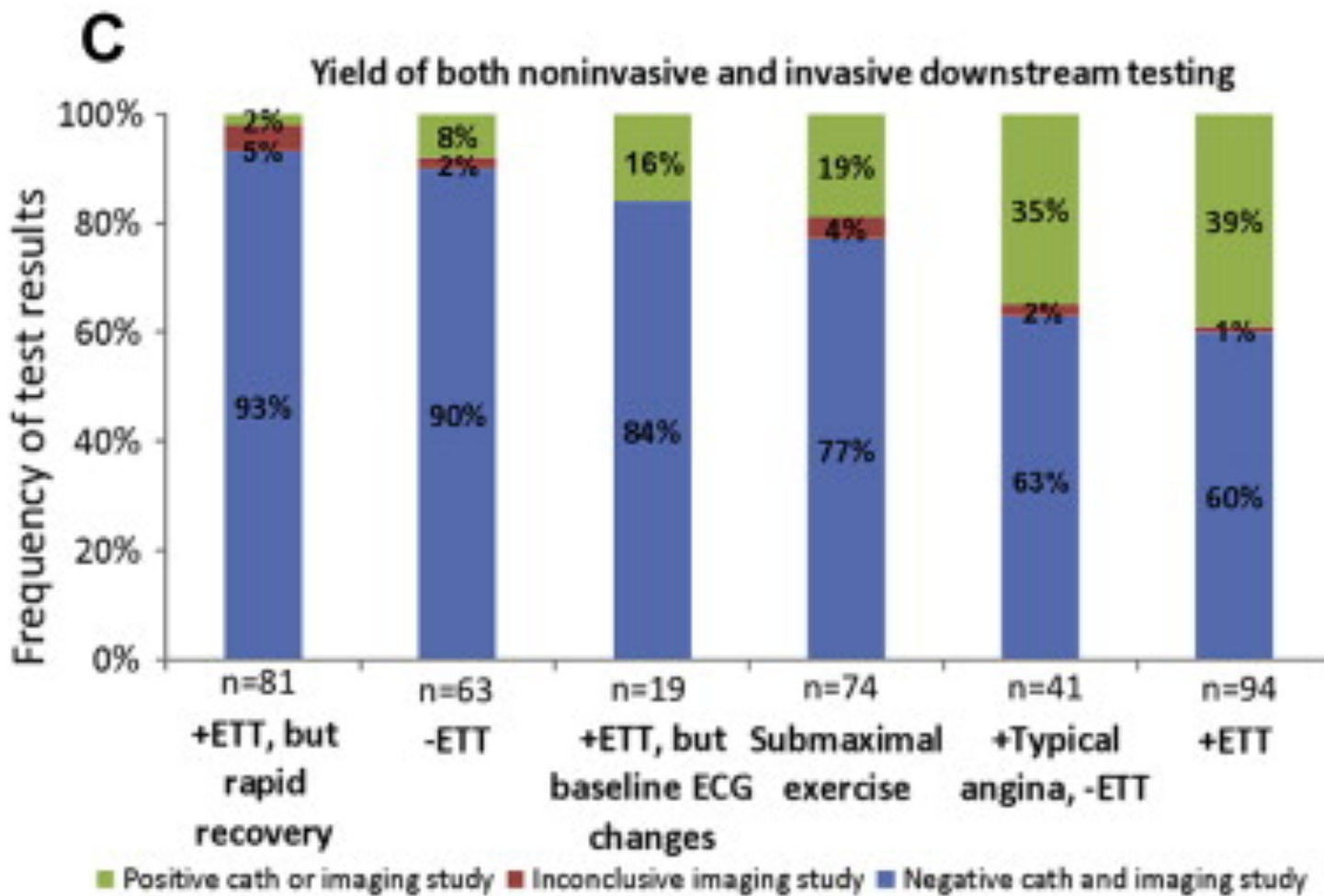
Yield of Downstream Tests After Exercise Treadmill Testing

A Prospective Cohort Study

Mitalee P. Christman,* Marcio Sommer Bittencourt, MD, MPH,† Edward Hulten, MD, MPH,†
Ekta Saksena, BA,‡ Jon Hainer, BSc,† Hicham Skali, MD,† Raymond Y. Kwong, MD,§
Daniel E. Forman, MD,§ Sharmila Dorbala, MD,† Patrick T. O’Gara, MD,§ Marcelo F. Di Carli, MD,†
Ron Blankstein, MD†

Boston, Massachusetts

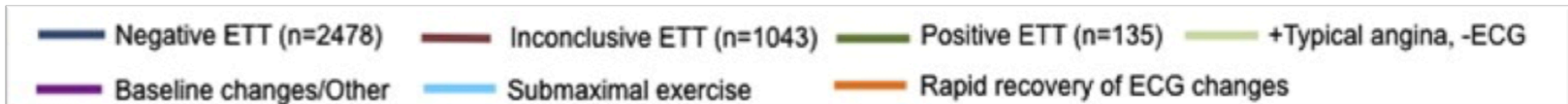
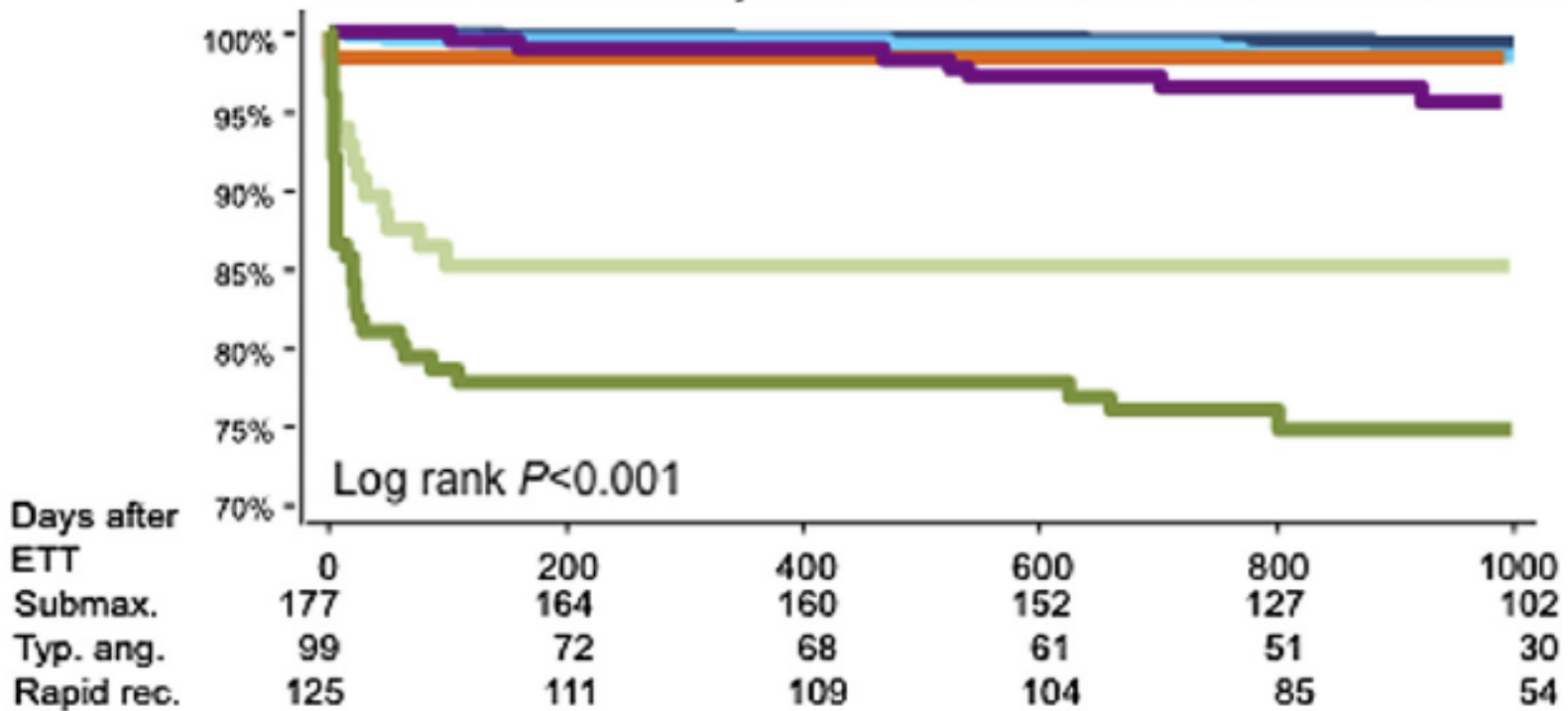




ST-T-reaktion efter arbete III

C

Survival free from MI, revascularization or cardiovascular death



Arbetsförmåga

Comparison of two commonly used reference materials for exercise bicycle tests with a Swedish clinical database of patients with normal outcome

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Summary

- ”Kalmarmaterialet” sedan hösten 2014
- Retrospektivt 1790 unika arbetsprov
 - Bedömda som normala
 - 1043 män
 - 747 kvinnor
- Korrigerar mot längd (tidigare vikt)
- Kritik – inkl mycket vältränade personer

Gradering av arbetsförmåga

Gradering enligt Equalis rekommendation från 2019:

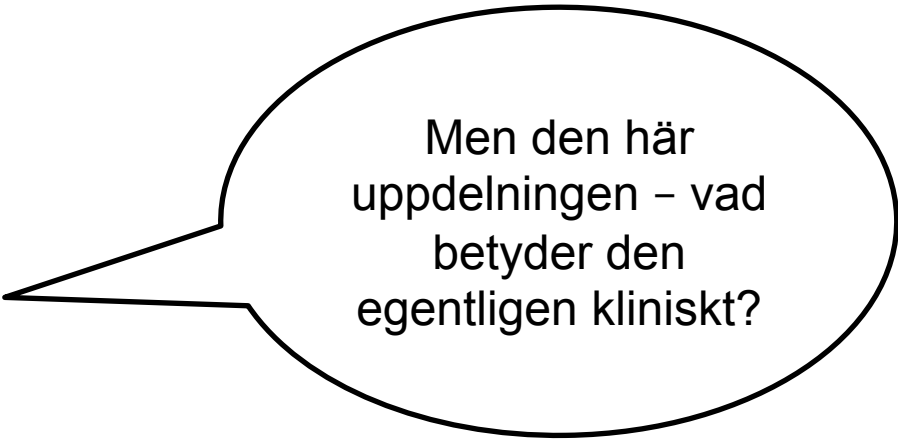
God >120%

Normal 75-120%

Lätt sänkt 70-74%

Måttligt sänkt 69-50%

Uttalat sänkt <50%



Men den här
uppdelningen - vad
betyder den
egentligen kliniskt?

Long-term follow-up of patients undergoing standardized bicycle exercise stress testing: new recommendations for grading of exercise capacity are clinically relevant

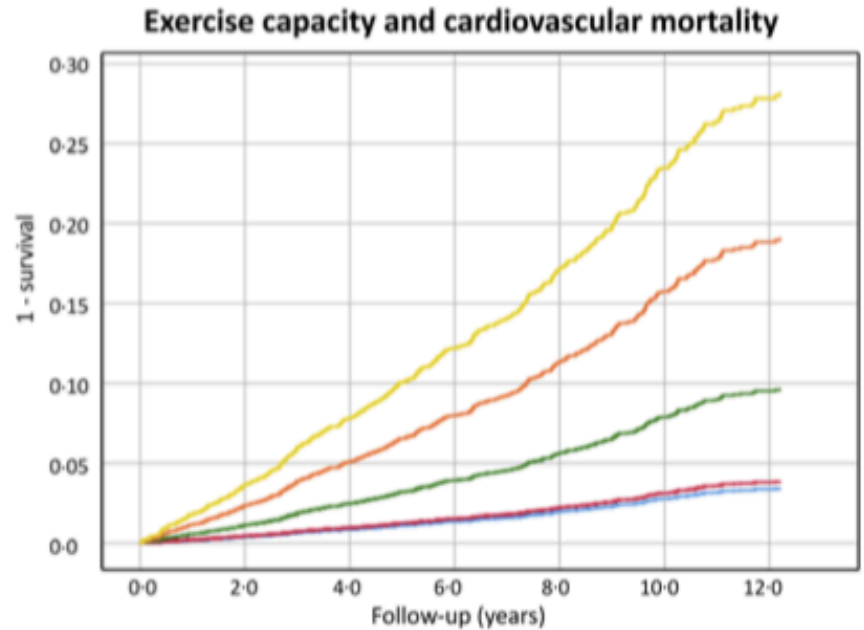
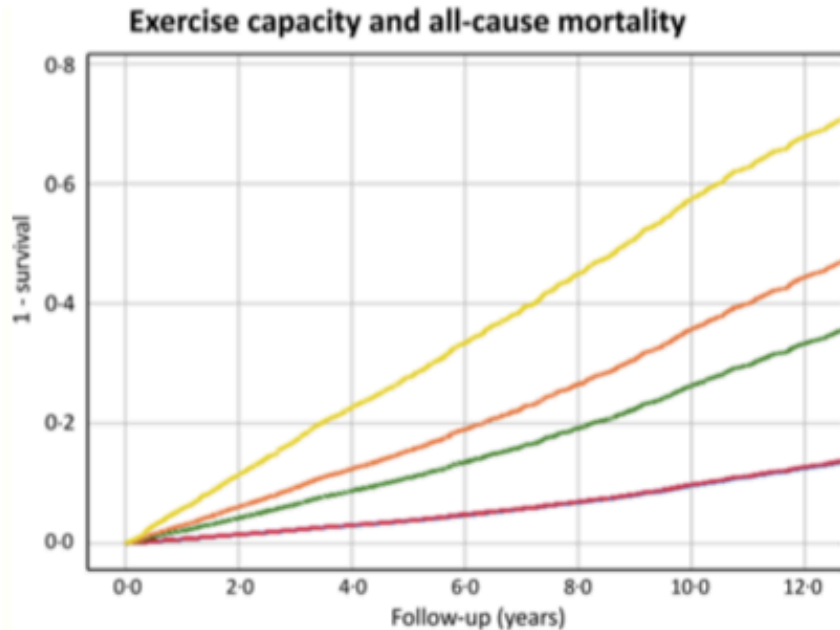
Thomas Lindow^{1,2,3} , Lars Brudin⁴, Viktor Elmberg⁵ and Magnus Ekström⁶

¹Department of Clinical Physiology, Växjö Central Hospital, Växjö, ²Clinical Sciences, Clinical Physiology, Lund University, Lund,, ³Department of Research and Development, Region Kronoberg, Växjö, ⁴Department of Clinical Physiology, Kalmar County Hospital, Kalmar, ⁵Department of Clinical Physiology, Blekinge Hospital, Karlskrona, and ⁶Faculty of Medicine, Department of Clinical Sciences Lund, Respiratory Medicine and Allergology, Lund University, Lund, Sweden

Summary

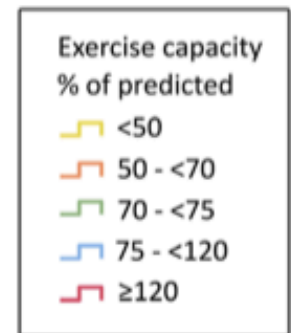
- Ca 14 000 patienter
- Arbetsprov 2005 till 2016
- Uppföljning median 7,7 år (IQ 5,0-10,8 år)
- Nationellt patientregister
- Dödsorsaksregister
- Totalt 1809 dödsfall, varav 546 kardiovaskulärt relaterade

Gradering arbetsförmåga och mortalitet



Number of patients at risk at 2-year follow-up intervals

Group	Follow-up intervals (time from exercise test, years)						
	0	2	4	6	8	10	12
All patients	13887	12748	10571	8059	5591	3350	1142
<50%	373	317	239	158	97	55	21
50 - <70%	2012	1871	1506	1139	787	511	243
70 - <75%	987	947	790	600	443	273	133
75 - <120%	9656	9546	8314	6707	4863	3226	1703
≥120%	859	859	758	615	422	238	126



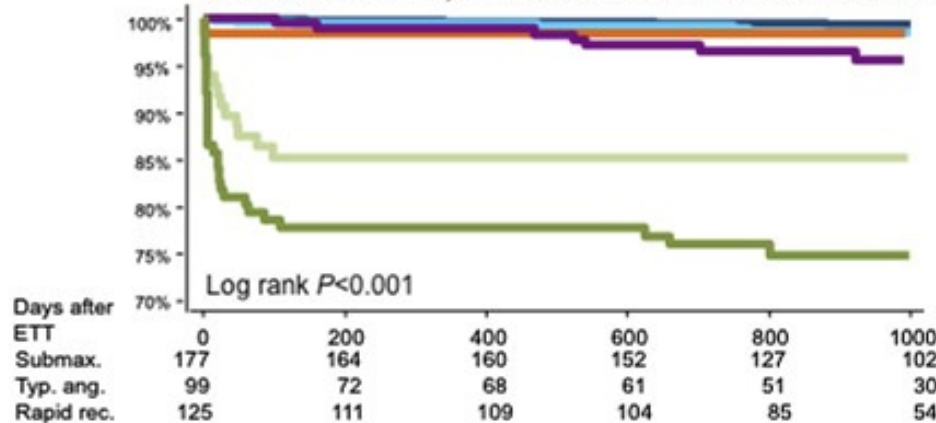
Arbetsförmåga II

- Likvärdig med perfusionsdefekt på scint avseende mortalitet
Snader JACC 1997
- Starkare prediktor för mortalitet än koronarangio och ST-sänkning
Myers et al NEJM 2002
- >10 METs och intermediär risk eller känd CAD – låg risk för >10% ischemi vid scint
Bourque et al J Nucl Cardiol 2010
- Patologiskt a-prov och >10 METs – god prognos, 7% tecken på ischemi vid stress-EKO
Bath et al Am J Cardiol 2008

Angina

Angina under a-prov är ett observandum och oavsett EKG-reaktion är vidare utredning värdefull

C Survival free from MI, revascularization or cardiovascular death



- Negative ETT (n=2478)
- Inconclusive ETT (n=1043)
- Positive ETT (n=135)
- +Typical angina, -ECG
- Baseline changes/Other
- Submaximal exercise
- Rapid recovery of ECG changes

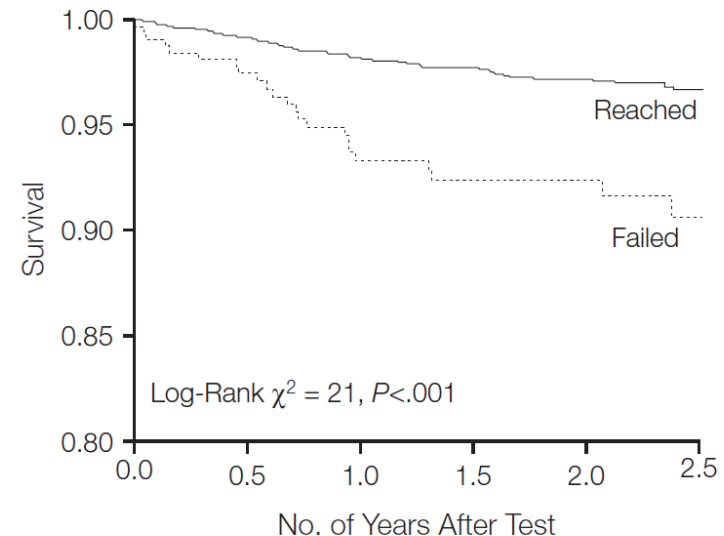
Hjärtfrekvensen

- **HF i vila** - förhöjd - sämre prognos
- **Heart rate recovery (HRR)** - HF vila
 - sänkning av hjärtfrekvensen under den första minuten efter arbete
 - Parasympatikus reaktivering
 - Patologiskt:
 - stående $>12/\text{min}$
 - liggande $>18/\text{min}$
 - Om patologisk rel till mortalitet

Kronotrop inkompetens

- Definition: <85% av predikterad HR_{max}
- Minskad känslighet hos sinusknutan för sympatikusstimulering
- Farmakologiskt (betablockad), koronarinsufficiens, del av sjuk sinusknuta
- Predikterar för ökad risk av hjärtkärlhändelser och total mortalitet
- <85% HR_{max} adjusted RR 1.8 (95%CI 1.1-3.0, P=0.01)

Figure 2. Survival According to Ability to Reach 85% of the Age-Predicted Maximum Heart Rate



Lauer et al JAMA 1999

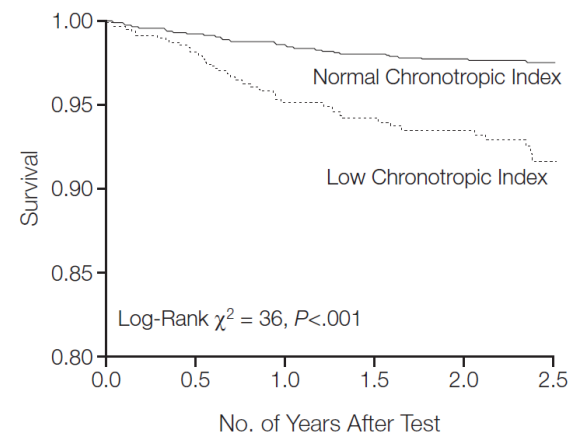
Kronotropt index = HR reserve

- Normalt 1.0 (95%CI 0.8-1.3)
 - Sänkt <0.8 (inte betablockad)
 - Betablockad <0.62
 - Tar hänsyn till ålder, hjärtats vilofrekvens
- Kronotrop index justerad RR 2.2 (95%CI 1.4-3.4, p>0.001)
- Lågt kronotropt index medför risk för mortalitet likvärdig med defekt på scint.

*Laurer et al JAMA 1999,
Azarbal et al JACC 2004*

$$\frac{HF_{\max} - HF_{\text{vila}}}{\text{Beräknad } HF_{\max} - HF_{\text{vila}}}$$

Figure 3. Survival According to Chronotropic Index



Ventrikulära arytmier

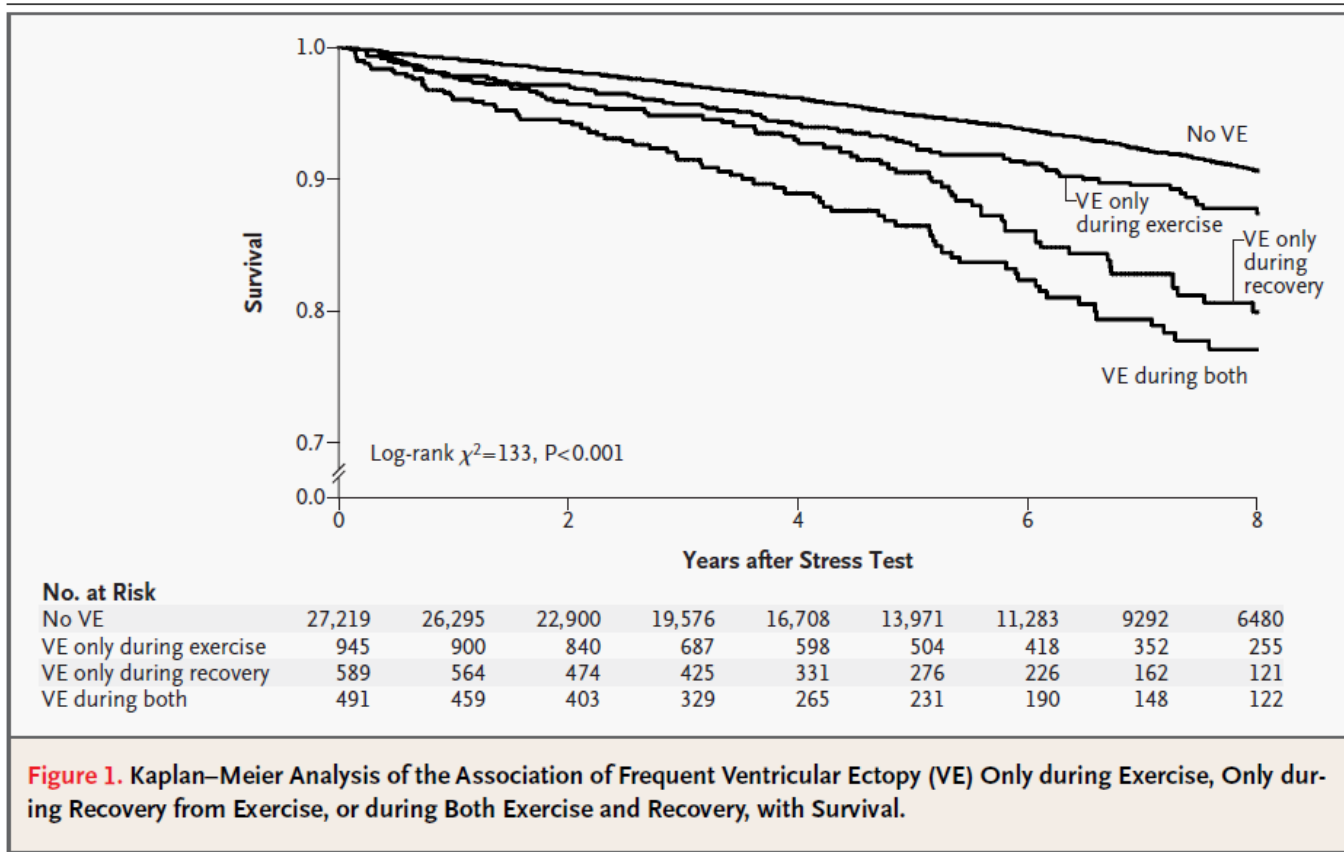
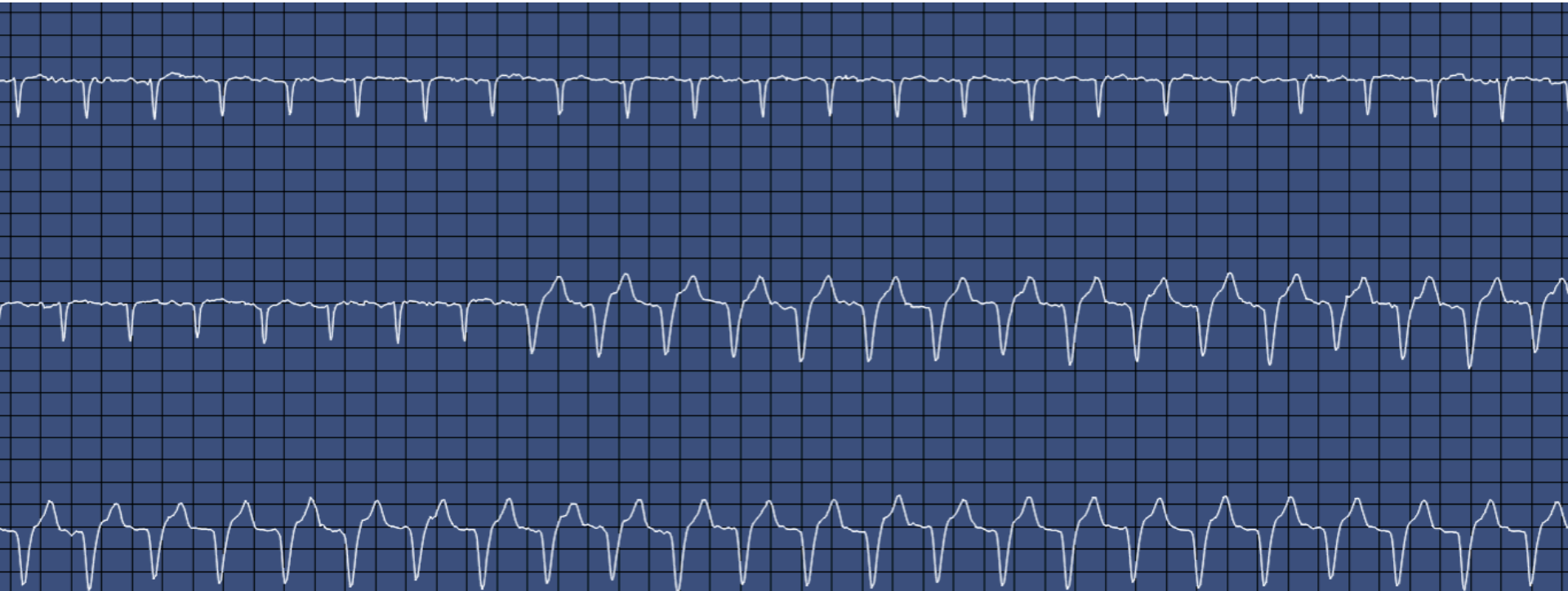


Figure 1. Kaplan–Meier Analysis of the Association of Frequent Ventricular Ectopy (VE) Only during Exercise, Only during Recovery from Exercise, or during Both Exercise and Recovery, with Survival.

LBBB

- Arbetsinducerat vänstersidigt skänkelblock
- Ökad mortalitet/morbiditet oberoende av tidigare känd CAD
 - RR 2.8 (1.2-6.7, p=0.02)

Grady et al Clin Cardiol 1998



Sammanfattning

- Arbetsprov ej förstahandsundersökning för **diagnostik** vid misstänkt kronisk koronart syndrom med intermediär sannolikhet
 - Men om annan undersökning ej finns att tillgå...
- Men ger mycket viktig **prognostisk** information!
”Hur mår min patient?” ”Event risk”
 - Arbetsförmåga, ST-T-reaktion, bröstsmärta, arytmier, hjärtfrekvens, blodtrycksreaktion