Risiko ved testing og trening

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Typer test:

- Submaksimal test: Lite definert, alt som er mindre enn optimalt. Oftest tilsvarende vanlig trappegang (100 W). Eller til max HR 120 eller til 70% av Alderspredikert HR_{max}
- Symptombegrenset test. Begrenset av symptomer, tegn eller av oppnåd minst 85% av (alderspredikert) HR_{max}
- Makstest (VO_{2max})

Hvor farlig er testing?

TABLE 3. Complications Secondary to Exercise Tests

Cardiac
- Bradyarrhythmias
- Tachyarrhythmias
- Acute coronary syndromes
- Heart failure
- Hypotension, syncope, and shock
- Death

Noncardiac
- Musculoskeletal trauma
- Soft-tissue injury

Miscellaneous
- Severe fatigue (malaise), sometimes persisting for days; dizziness; fainting; body aches; delayed feelings of illness

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Hvor farlig er testing?

- Gibbons et al 1989:
  - 71 914 pasienter over 16 år ved et sykehus
  - 6 alvorlige komplikasjoner, 1 dødsfall.
  - 0,8 komplikasjoner / 10 000 tester
  - Ingen komplikasjoner over de siste 45 000 (10 år)

Kjent koronarsykdom:

- Oversikt: (8 studier)
- 0 – 5 dødsfall pr 100 000
- Estimat for koronarsyke: 10 dødsfall eller AMI / 10 000 tester (et dødsfall / 2500 tester)

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Testing etter PCI med stent.

- Kasuistiske rapporter om stenttrombose v/ tidlig fys. Anstrengelse
- Mange invasive kardiologer anbefaler fortsatt ingen testing første 14 dager etter stent
- Guidelines har ingen bemerkninger om testing etter stent.

TABLE 2. Absolute and Relative Contraindications to Exercise Testing

Absolute
- Acute myocardial infarction (within 2 d)
- High-risk unstable angina*
- Uncontrolled cardiac arrhythmias causing symptoms or hemodynamic compromise
- Symptomatic severe aortic stenosis
- Uncontrolled symptomatic heart failure
- Acute pulmonary embolus or pulmonary infarction
- Acute myocarditis or pericarditis
- Acute aortic dissection

Relative†
- Left main coronary stenosis
- Moderate stenotic valvular heart disease
- Electrolyte abnormalities
- Severe arterial hypertension‡
- Tachyarrhythmias or bradyarrhythmias
- Hypertrophic cardiomyopathy and other forms of outflow tract obstruction
- Mental or physical impairment leading to inability to exercise adequately
- High-degree atrioventricular block

Gibbons et al. ACC/AHA guidelines for exercise testing 2002

Randomiserte data test 1 dag etter stent:

Roffi JACC 2003

Resultater:

- 1000 pasienter, 498 randomisert til test, 502 kontroll
- Endepunkt: stenttromboser innen 14 dager

- 5 stenttromboser i testgruppen
- 5 stenttromboser i kontrollgruppen

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Totale komplikasjoner:

Table 2. Clinical Events at 14-Day Follow-Up

	Stress Test (n = 496)	Controls (n = 499)
Clinical stent thrombosis, no. (%)		
Acute thrombosis (≤12 h)	1 (0.2)	1 (0.2)
Subacute thrombosis (>12 h)	4 (0.8)	4 (0.8)
Any thrombosis	5 (1.0)	5 (1.0)
Access site complications, no. (%)		
Pseudoaneurysm	2 (0.4)	3 (0.6)
Arteriovenous fistula	0	1 (0.2)
Deep vein thrombosis/pulmonary embolism	1 (0.2)	1 (0.2)
Surgical repair	1 (0.2)	2 (0.4)
Blood transfusions	0	1 (0.2)
Hematoma	17 (3.4)	21 (4.3)
Any access site complication	20 (4.0)	26 (5.2)

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Exercise testing after myocardial infarction appears to be safe. The incidence of fatal cardiac events, including fatal myocardial infarction and cardiac rupture, is 0.03%, nonfatal myocardial infarction and successfully resuscitated cardiac arrest is 0.09%, and complex arrhythmias, including VT, is 1.4%. Symptom-limited protocols have an event rate that is 1.9 times that of submaximal tests, although the overall fatal event rate is quite low (130,131,135). The majority of the safety data are based on exercise testing performed more than 7 days after myocardial infarction. The number of patients reported at 4 to 7 days is more limited, and typically time is reported as a mean value or a range so that it is impossible to determine how many patients were studied at 4 days.

Hvor tidlig etter infarkt

- 300 pasienter med AMI
- Uten nitroglycerininfusjon, ukontrolert svikt, eller arrytmier.

- 216 testet innen 3 dager etter innkomst
- Symptombegrenset test
- Bruce protokoll

Senaratne MPJ JACC 2000

Number of Patients	Men 163	Women 53
Age (yrs)*	57.8 ± 0.9	63.2 ± 1.6
Day of Exercise Test		
Within 2 days	63 (38.7%)	10 (18.9%)
Third day	100 (61.3%)	43 (81.1%)
Exercise Duration (min)*	7.2 ± 0.2	5.0 ± 0.3
0–3 min	7 (4.3%)	10 (18.9%)
>3–6 min	56 (34.4%)	35 (66.0%)
>6–9 min	70 (42.9%)	5 (9.4%)
>9 min	30 (18.4%)	3 (5.7%)
Peak Heart Rate (beats/min)		
Achieved*	118 ± 2	111 ± 3
As % of predicted maximum	72.8 ± 0.9	70.7 ± 1.8
Exercise Test Results		
Positive	44 (27.0%)	12 (22.6%)
Negative	98 (60.2%)	26 (49.1%)
Indeterminate	21 (12.9%)	15 (28.3%)
Peak Creatine Kinase (u/l)	1492 ± 293	1176 ± 153
Duration of Hospital Stay (days)	3.9 ± 0.1	4.5 ± 0.4
Complications		
Prolonged pain/ST depression†	1 (0.6%)	0 (0.0%)
Drop in SBP	5 (3.1%)	2 (3.8%)
AMI/death/sustained VT	0 (0.0%)	0 (0.0%)
Nonsustained VT	1 (0.6%)	0 (0.0%)

Senaratne MPJ JACC 2000

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Gibbons et al. ACC/AHA guidelines for exercise testing 2002

Elektrolyttforstyrrelser

- 10 272 tester med K^+ målt < 48 t før test
  - 9 067 normokalemiske,
  - 309 hypokalemiske (3,4 ± 0,16)
  - 896 hyperkalemiske (5,1 ± 0,19)
- Ventrikulær og supraventrikulær ektopi
- 1 pas Sust. VT (K^+ 4,9)

Indications for Terminating Exercise Testing

Absolute Indications
- ST-segment elevation (>1.0 mm) in leads without Q waves (other than V_1 or aVR).
- Drop in systolic blood pressure >10 mm Hg (persistently below baseline), despite an increase in workload, when accompanied by any other evidence of ischemia.
- Moderate-to-severe angina (grade 3 to 4); Table 5 details descriptions and grades for angina scale.
- Central nervous system symptoms (eg, ataxia, dizziness, or near syncope).
- Signs of poor perfusion (cyanosis or pallor).

Relative Indications
- ST or QRS changes such as excessive ST displacement (horizontal or downsloping of >2 mm) or marked axis shift.
- Drop in systolic blood pressure >10 mm Hg (persistently below baseline), despite an increase in workload, in the absence of other evidence of ischemia.
- Increasing chest pain.
- Fatigue, shortness of breath, wheezing, leg cramps, or claudication.
- Arrhythmias other than sustained ventricular tachycardia, including multifocal ectopic, ventricular triplets, supraventricular tachycardia, heart block, or bradyarrhythmias.
- General appearance (see below).
- Hypertensive response (systolic blood pressure >250 mm Hg and/or diastolic blood pressure >115 mm Hg).
- Development of bundle-branch block that cannot be distinguished from ventricular tachycardia.

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Grad av sikkerhet

- **Ingen overvåkning**
- **Lege i umiddelbar nærhet**
  - **Takle evt. Komplikasjoner når de oppstår**
- **Kontinuerlig EKG overvåkning**
  - **Hindre komplikasjoner før de oppstår; Avbryte ved tegn på arytmi / iskemi / BT-fall**

Exercise testing should be conducted only by well-trained personnel with a sufficient knowledge of exercise physiology. Only technicians, physiologists, nurses, and physicians familiar with normal and abnormal responses during exercise can recognize or prevent adverse events. Equipment, medications, and personnel trained to provide advanced cardiopulmonary resuscitation (CPR) must be readily available. For details

AHA 2001

Exercise testing should be supervised by an appropriately trained physician. As indicated in the American College of Physicians/ACC/AHA task force statement on clinical competence in exercise testing (11), exercise testing in selected patients can be performed safely by properly trained nurses, exercise physiologists, physician assistants, physical therapists, or medical technicians working directly under the supervision of a physician, who should be in the immediate vicinity and available for emergencies. The electrocardio-

ACC 2002

Hvem er det aktuelt å teste?

- Friske
  - Idrettsfolk
  - Mindre aktive
- Pasienter med øket risiko for hjertesykdom før evt. trening
  - Hypertonikere
  - Overvektige
  - Metabolsk syndrom
- Pasienter med kjent hjertesykdom
  - Stabil angina
    - Post PCI
  - Gjennomgått infarkt
    - Nytt / gammelt
    - Stort / lite
  - Hjertesvikt
    - EF
    - NYHA
    - Elektrolytter

Grad av sikkerhet:

- Kontinuerlig EKG overvåkning
  - Hindre komplikasjoner før de oppstår; Avbryte ved tegn på arytmi / iskemi / BT-fall
- Rescusiteringsberedskap og lege i umiddelbar nærhet
  - Takle en stans, og vurdere pas. Som evt. Får symptomer
- Rescusiteringsberedskap og personell med trening i hjerte- lungeredning
  - Takle en stans
- Ingen beredskap

Risiko ved trening:

- 167 Hjerterehabili-teringsprogrammer
- 51 303 pasienter
- 2 351 916 treningstimer
- 21 hjertestans
  - 18 vellykket rescusitert
  - 3 døde
- 8 non fatale AMI
- 8,9 stans pr. million treningstimer
  - (1 pr. 111 996)
- 3,4 AMI pr. million treningstimer
  - (1 pr. 783 972)

Van Camp & Peterson, JAMA 1986

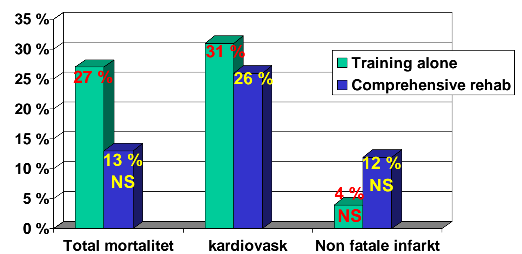
Risiko ved trening

- Single senter studie 1982 – 1998
- 3 335 pasienter, alder 61 ± 11,3 år, 70% menn
- Alle typer hjertesykdom
- 50 min aerobics (intervall / cirkel) 3x 7 uke I 4 – 8 uker, deretter mer intensiv trening med tredemøller, ergometersykler, etc 50 – 80% av maks puls fra test
- 292,254 treningstimer
- 3 non fatale infarkt, 1/ 97,418 treningstimer
- 2 hjertestans (1 død) 1/ 146,127 treningstimer

Table 2—*Summary of Contemporary Exercise-Based Cardiac Rehabilitation Complication Rates*

Investigator	Year	Patient Exercise Hours	Cardiac Arrest	MI	Fatal Events	Major Complications*
Van Camp and Peterson[2]	1980–1984	2,351,916	1/111,996†	1/293,990	1/783,972	1/81,101
Digenio et al[14]	1982–1988	480,000	1/120,000‡		1/160,000	1/120,000
Vongvanich et al[13]	1986–1995	268,503	1/89,501§	1/268,503§	0/268,503	1/67,126
Beaumont data	1982–1998	292,254	1/146,127§	1/97,418§	0/292,254	1/58,451

Risikoreduksjon ved hjerterehabilitering:



Joliffe et al syst. Cochrane review 2006

Risiko ved trening:

- Risikoen høyest under og første time etter fysisk aktivitet
- Risikoen under trening oppveies av risikoreduksjonen ved bedre form
- Risikoen lavere under fysisk aktivitet ved god kondisjon

The Exercise Prescription

CAD patients should undergo symptom-limited exercise testing before referral to an exercise program to establish a baseline, to determine maximal HR, and to exclude important ischemia, symptoms, or arrhythmia that would alter the therapeutic approach. This testing should be performed with patients on their usual medication to match the conditions likely to be encountered during the exercise sessions.