

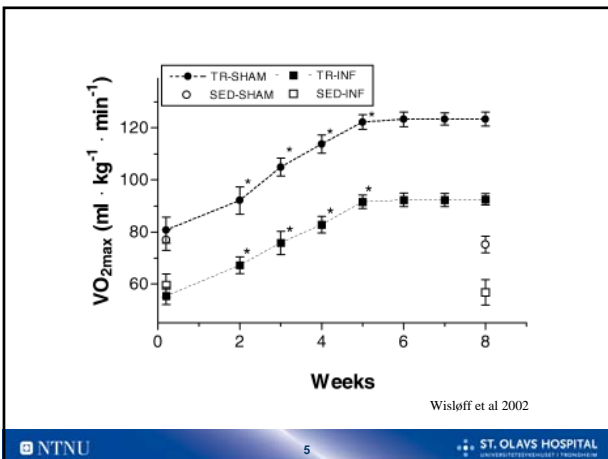
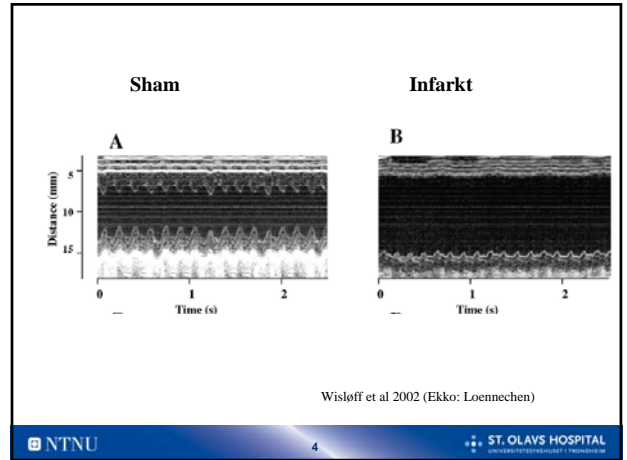
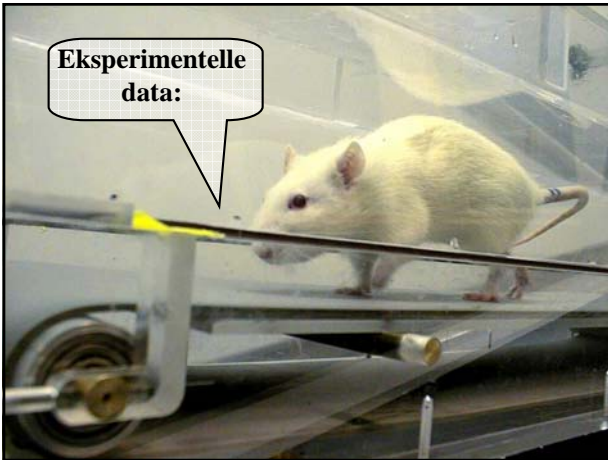
Trening og hjertesvikt

Asbjørn Støylen, Dr. Med.
ISB
NTNU

Trening og hjertesvikt

- Eksperimentelle data
- Kliniske data
- Hva sier guidelines?

- Hvordan skal man trene?



VO_2 :

Ficks formel:

$$CO = VO_2 / AV-O_2\text{-diff}$$

$$VO_2 = CO \times AV-O_2\text{-diff}$$

	SED-SHAM	TR-SHAM
Right ventricular mass (mg)	318.8±29.2	405.1±45.3**
Left ventricular mass (mg)	876.4±74.1	1097.6±84.5**
Left ventricular cell length (μm)	119.3±1.8	134.3±1.8**
Left ventricular cell width (μm)	25.50±1.0	25.43±1.1
Left ventricular infarction (%)	-	-

	SED-INF	TR-INF
Right ventricular mass (mg)	717.3±76.6	555.2±68.6**
Left ventricular mass (mg)	1575.1±67.0	1339.0±90.1**
Left ventricular cell length (μm)	156.0±1.5	138.7±1.2**
Left ventricular cell width (μm)	35.96±1.1	28.63±1.6**
Left ventricular infarction (%)	43.8±2.2	44.9±2.7

Wisloff et al 2002

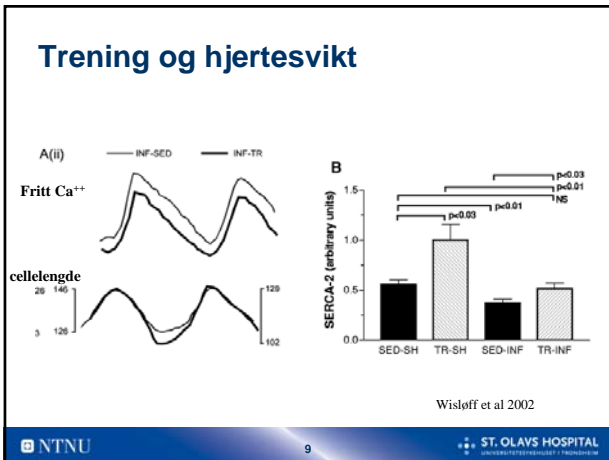
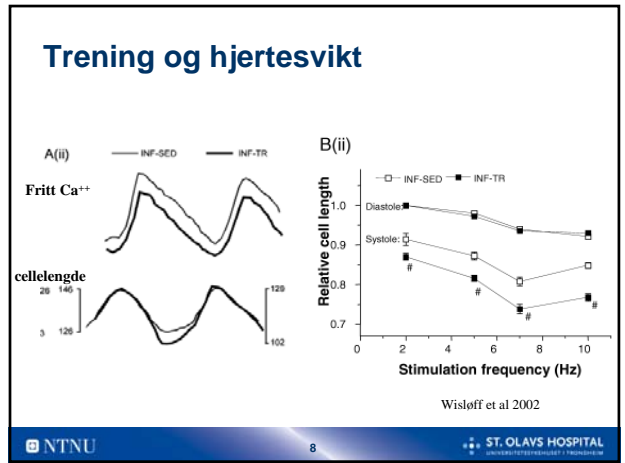


Table 1
Left ventricular echocardiographic and pressure measurements

	SED-INF	TR-INF
Left ventricular internal diameter diastole, mm	11.1±0.7**	11.3±0.4**
Left ventricular internal diameter systole, mm	10.1±1.1**	10.2±0.5**
Anterior wall thickness diastole, mm	0.5±0.2**	0.5±0.2**
Anterior wall thickness systole, mm	0.5±0.2**	0.5±0.2**
Posterior wall thickness diastole, mm	2.3±0.3	2.5±0.5
Posterior wall thickness systole, mm	3.1±0.9	3.1±0.6
Fractional shortening, %	9.0±5.9*	9.5±3.6**
Left atria diameter, mm	5.6±5.8*	5.6±6.1**
Right atria diameter, mm	4.7±6.5*	4.9±6.0*
E wave, peak velocity, cm·s ⁻¹	104±19*	112±11*
A wave, peak velocity, cm·s ⁻¹	17±8**	15±4**
E wave deceleration time, ms	30±5**	29±6**
Isovolumetric relaxation time, ms	22±4*	22±4*
Left ventricular end-diastolic pressure, mmHg	34.3±5.9*	34.5±4.6*
Left ventricular peak systolic pressure, mmHg	106.0±7.4*	113.8±7.9*
Aortic diastolic pressure, mmHg	79.9±7.7*	88.6±7.8*
Left ventricular +dP/dt _{max} , mmHg·ms ⁻¹	5.3±0.5**	5.6±0.7**
Left ventricular -dP/dt _{max} , mmHg·ms ⁻¹	3.4±0.4**	3.7±0.7**

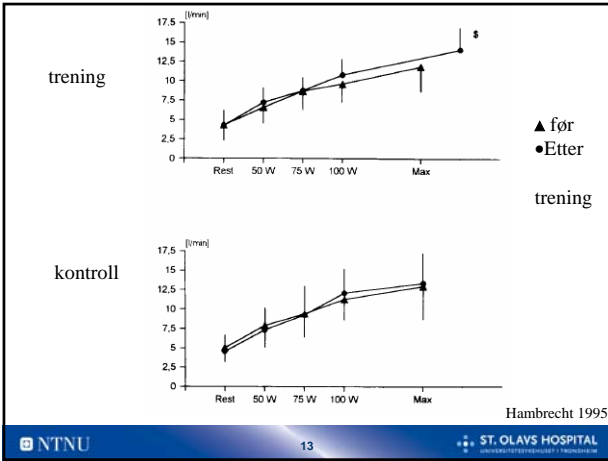
Wisloff et al 2002 (Ekko og kat: Loennechen)



Table 2 Summary of randomized exercise training studies in (LV) dysfunction and heart failure

Study	n pts	Clinical characteristics
Coats 1992 ^[18]	11	Stable CHF, IHD, sinus rhythm, NYHA II-III
Letti 1991 ^[19]	18	10 wk after the 1st anterior MI no previous history of
Koch 1992 ^[20]	25	Stable CHF, IHD or IDCM, NYHA II-III
Meyer 1991	12	Stable CHF, sinus rhythm, NYHA II-III
Coats 1992 ^[18]	17	Stable CHF, secondary to IHD sinus rhythm, NYHA
Dovey 1992	22	Stable CHF, NYHA II-III
EAMI Study, Giannuzzi 1993 ^[21]	31	5 wk after 1st anterior MI, NYHA II-III
Akzempodou 1993 ^[21]	12	Stable CHF, NYHA II-III
Belardinelli 1995 ^[21]	27	Mild CHF, IHD or IDCM, NYHA II-III
Belardinelli 1995 ^[21]	55	Stable CHF, IHD or IDCM, NYHA II-III
Hambrecht 1995 ^[21]	22	Stable CHF, IHD or IDCM, NYHA II-III
Kallavouri 1995 ^[21]	20	Stable CHF, IHD or IDCM, NYHA II-III
Kallavouri 1995 ^[21]	27	Stable CHF, IHD or IDCM, NYHA II-III
Meyer 1996 ^[21]	18	Stable CHF, IHD or IDCM, NYHA II-III
Meyer 1996 ^[21]	16	Stable CHF, IHD or IDCM, NYHA II-III
Piepoli 1996 ^[21]	12	Stable CHF, NYHA II-III
Magnusson 1996	11	Stable CHF, IHD or IDCM, NYHA II-IV (1 pt)
Hambrecht 1997 ^[21]	18	Stable CHF, IHD, NYHA II-III
ELVD Study, Giannuzzi 1997 ^[21]	77	3-4 wk after 1st MI, no history of HF
Willenheimer et al. 1998	49	Stable CHF, IHD or IDCM, 5 Boston points
Belardinelli 1999	99	Stable CHF, IHD or IDCM, NYHA II-III
CHANGE study, Wielenga et al. 1999	80	Stable CHF, IHD or IDCM, NYHA II-III
CHANGE study, Wielenga 1999 ^[21]	80	Stable CHF, IHD or IDCM, NYHA II-III
ELVD CHF just completed, Giannuzzi 1999	86	Stable CHF, IHD or IDCM, NYHA II-III

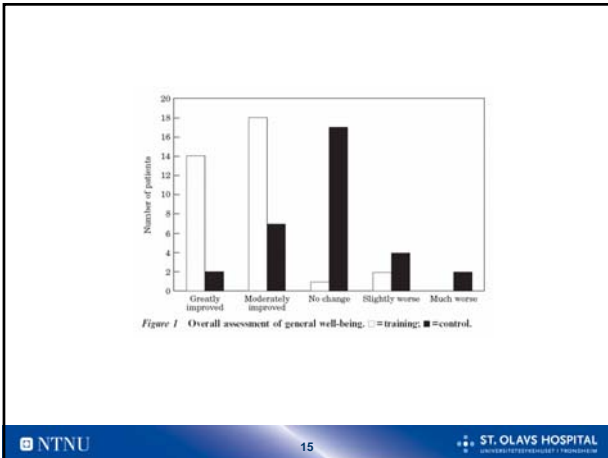
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CHANGE studien

- 80 pasienter, 41 randomisert til trening
- Trening 3g / uke
- Intensitet til 60% av differanse mellom resting og max på test.
- Økning i exercise time og anaerob terskel.
- Ingen økning i VO_{2max}
- Ingen adverse effects.
 - (Wielenga EIJ 1999)
- Leder: trening er nå mellom fase II og fase III i dokumentasjon
 - (Meyer EHJ 1999)

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Belardinelli 1999

- 99 pas, 50 trening, 49 kontroll. EF 28%
- Trening på 60% av VO_{2max} 3x/uke i 8 uker, deretter 2x i et år!!!!
- Økning i VO_{2max} og QoL med trening i startfasen.
- Ingen endring i vedlikeholdsperioden
- Ingen endring i EF
- Signifikant lavere mortalitet (9/50 18%) vs 20/49 (41%) og non fatale endepunkter (8 vs. 17).
- MEN: svært høy mortalitet sammenlignet med andre materialer med tilsvarende EF.
- Ingen pasienter på betablokker

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Styrketrening

	Rest	leg Press	Cycling
Systolic blood pressure [mm Hg]	157 ± 7	189 ± 8*	199 ± 13*
Diastolic blood pressure [mm Hg]	77 ± 2	98 ± 4*	86 ± 3**
Heart rate [beats/min]	66 ± 4	86 ± 5*	107 ± 4**
Rate-pressure product	103 ± 6	161 ± 7*	213 ± 17**
End-diastolic volume [ml]	257 ± 26	269 ± 27	268 ± 24
End-systolic volume [ml]	179 ± 22	188 ± 22	180 ± 23

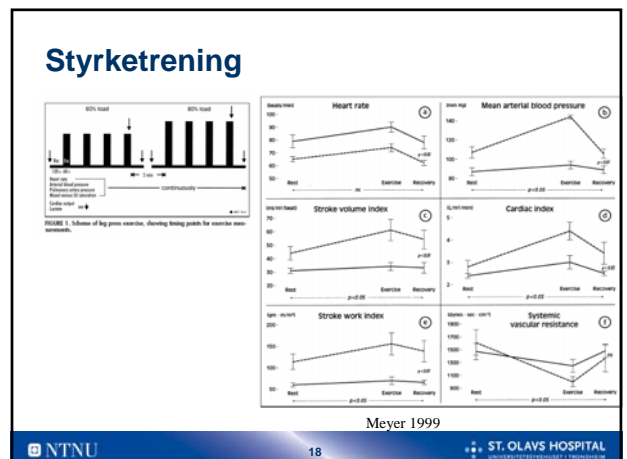
*p < 0.05 compared with rest; **p < 0.05 compared with leg press. Values are expressed as mean ± SEM.

	Rest	Leg Press	Cycling
Cardiac output [l/min]	5.2 ± 0.5	6.9 ± 0.5*	9.3 ± 0.7**
Stroke volume [ml]	77 ± 5	80 ± 4	87 ± 5*†
Total peripheral resistance [mm Hg·l ⁻¹ ·min ⁻¹]	23 ± 2	20 ± 2	14 ± 1*
Ejection fraction [%]	31 ± 2	32 ± 2	34 ± 2
Systolic BP/ESV ratio	0.9 ± 0.1	1.1 ± 0.1*	1.2 ± 0.2**†

*p < 0.05 compared with rest; †p < 0.05 compared with leg press. Values are expressed as mean ± SEM. BP = blood pressure; ESV = end-systolic volume.

McKelvie 1995

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ESC Guidelines

Guidelines for the diagnosis and treatment of chronic heart failure: executive summary (update 2005)

The Task Force for the Diagnosis and Treatment of Chronic Heart Failure of the European Society of Cardiology

Authors/Task Force Members: Karl Swedberg, Chairperson, * Göteborg (Sweden) *Writing Committee:* John Cleland, Hull (UK), Henry Dargie, Glasgow (UK), Helmut Drexler, Hannover (Germany), Ferenc Follath, Zurich (Switzerland), Michel Komajda, Paris (France), Luigi Tavazzi, Pavia (Italy), Otto A. Smiseth, Oslo (Norway).

Exercise

Exercise improves skeletal muscle function and therefore overall functional capacity. Patients should be encouraged and advised on how to carry out daily physical and leisure time activities that do not induce symptoms. Exercise training programs are encouraged in stable patients in NYHA class II-III. Standardized recommendations for exercise training in heart failure patients by the European Society of Cardiology have been published.⁴²

Working Group Report

Recommendations for exercise testing in chronic heart failure patients

Working Group on Cardiac Rehabilitation & Exercise Physiology and Working Group on Heart Failure of the European Society of Cardiology

EHJ 2001

Testing før trening

Table 2 Exercise testing in chronic heart failure: key points

1. Exercise testing in stable chronic heart failure only
2. Directly measured oxygen uptake is preferable to estimate of METs
3. Individualized protocol (ramp, Naughton)
4. Stage increments of 1 MET are recommended
5. Optimal test duration 8–12 min
6. Walking test for submaximal testing

EHJ 2001

Working Group Report

Recommendations for exercise training in chronic heart failure patients

Working Group on Cardiac Rehabilitation & Exercise Physiology and Working Group on Heart Failure of the European Society of Cardiology*

EHJ 2001

Relative and absolute contraindications to exercise training among patients with stable chronic heart failure

Absolute contraindications

1. Progressive worsening of exercise tolerance or dyspnoea at rest or on exertion over previous 3 to 5 days
2. Significant ischaemia at low rates (<2 METS, \approx 50 W)
3. Uncontrolled diabetes
4. Acute systemic illness or fever
5. Recent embolism
6. Thrombophlebitis
7. Active pericarditis or myocarditis
8. Moderate to severe aortic stenosis
9. Regurgitant valvular heart disease requiring surgery
10. Myocardial infarction within previous 3 weeks
11. New onset atrial fibrillation

Relative contraindications

1. ≥ 1.8 kg increase in body mass over previous 1 to 3 days
2. Concurrent continuous or intermittent dobutamine therapy
3. Decrease in systolic blood pressure with exercise
4. New York Heart Association Functional Class IV
5. Complex ventricular arrhythmia at rest or appearing with exertion
6. Supine resting heart rate ≥ 100 beats $\cdot \text{min}^{-1}$
7. Pre-existing comorbidities

Table 3 Relative criteria necessary for the initiation of an aerobic exercise training programme

- Compensated heart failure for at least 3 weeks
- Ability to speak without dyspnoea (with a respiratory rate of <30 breaths $\cdot \text{min}^{-1}$)
- Resting HR of <110 beats $\cdot \text{min}^{-1}$
- Less than moderate fatigue
- Cardiac index of ≥ 21 $\cdot \text{min}^{-1} \cdot \text{m}^{-2}$ (for invasively monitored patients)
- Central venous pressure of <12 mmHg (for invasively monitored patients)

Table 4 Relative criteria indicating the need to modify or terminate the training programme

- Marked dyspnoea or fatigue (≥ 14 on Borg scale)
- Respiratory rate of >40 breaths $\cdot \text{min}^{-1}$ during exercise
- Development of an S_3 or pulmonary rales
- Increase in pulmonary rales
- Increase in the second component of the second sound (P_2)
- Poor pulse pressure (<10 mmHg difference between systolic and diastolic BP)
- Decrease in BP (of >10 mmHg) during progressive exercise
- Increased supraventricular or ventricular ectopy during exercise
- Diaphoresis, pallor or confusion

Anbefalinger ESC

- Gå, sykle
- Intervalltrening: 30 s drag – 50% av max arbeid 40 – 80% av $\text{VO}_{2\text{max}}$, 60 sek hvile (10W).
- Gradvis økning i intensitet 40 til 80% forhold til symptomer og klinisk status
- Styrketrening? ”Promising”
- Safety: Trenger større studier

AHA position paper:

- Recommendations:
- The Committee on Exercise, Rehabilitation, and Prevention of the American Heart Association Council on Clinical Cardiology concludes that exercise training in patients with HF seems to be safe and beneficial overall in improving exercise capacity, as measured by peak $\dot{V} \text{O}_2$, peak workload, exercise duration, and parameters of submaximal exercise performance. In addition, QOL improves in parallel to the improvements in exercise capacity. Furthermore, benefits have been reported in muscle structure and physiological responses to exercise, such as improvements in endothelial function, catecholamine spillover, and oxygen extraction in the periphery, among others. In summary, this position statement will serve as guide to health professionals to better understand the exercise limitations of the patient with HF and aid in directing their patients to engage in physical activity. Therefore, insurers and third-party payers should support exercise training programs in patients with chronic HF that follow recommendations and patient selection as discussed in this position statement.

Piña et al Circulation 2003

Safety:

TABLE 2. Studies on Exercise Training in Chronic HF Due to Systolic Dysfunction: Adverse Events

Authors (Year of Publication)	Exercise Program			Adverse Events
	No. of Patients	Duration, % wk	Intensity (% Peak HR or $\dot{V} \text{O}_2$)	
(1) Coxe et al (1962) ¹⁰	10	5 to 8	70% to 80% HR	None during training
(2) Sullivan et al (1969) ¹¹	12	24	16 to 24	70% $\dot{V} \text{O}_2$ Worsened HF (n=1); exhaustion (n=1)
(3) Jettli et al (1969) ¹²	7	24	4	70% to 80% HR Worsened HF (n=3); ventricular arrhythmia (n=1)
(4) Meyer et al (1969) ¹³	12	23	6	70% to 80% HR Worsened congestive HF (n=1)
(5) Coats et al (1969) ¹⁴	17	19	8	70% to 80% HR None during training
(6) Koch et al (1969) ¹⁵	12	20	12	Individualized protocol None during training
(7) Belardinelli et al (1969) ¹⁶	16	31	8	40% $\dot{V} \text{O}_2$ None during training
(8) Belardinelli et al (1969) ¹⁷	26	20	8	60% $\dot{V} \text{O}_2$ Atrial fibrillation (n=1); hypertension (n=2)
(9) Hansbroeck et al (1969) ¹⁸	12	20	24	70% $\dot{V} \text{O}_2$ Atrial arrhythmia (n=1)
(10) Kellerman et al (1969) ¹⁹	15	21	24	60% to 80% HR None during training
(11) Kellerman et al (1969) ²⁰	15	22	32	50% to 60% $\dot{V} \text{O}_2$ None during training but worsened HF (n=5) after training
(12) Killian et al (1969) ²¹	12	24	24	50% to 60% $\dot{V} \text{O}_2$ Not reported
(13) Wilson et al (1969) ²²	32	33	12	60% to 70% HR Extreme exhaustion (n=3)
(14) Desnoes et al (1969) ²³	16	21	12	80% to 80% $\dot{V} \text{O}_2$ None during training
(15) Dubach et al (1969) ²⁴	12	32	8	70% to 80% $\dot{V} \text{O}_2$ None during training
(16) Meyer et al (1969) ²⁵	16	21	2	50% $\dot{V} \text{O}_2$ None during training
(17) European Heart Failure Training Group (1998) ²⁶	124	25	6 to 16	70% to 80% HR None during training
(18) Hansbroeck et al (1969) ²⁷	10	24	24	70% $\dot{V} \text{O}_2$ None during training
(19) Belardinelli et al (1969) ²⁸	10	20	32	60% $\dot{V} \text{O}_2$ None during training
(20) Hare et al (1969) ²⁹	9	20	11	Resistance training None during training

HR indicates heart rate (bpm).

Metaanalyser?

St. Elsewhere hospital
Avdeling for thoraskirurgi

Føds.nr: 300240 98765
Navn: Bertil Bypass
Adr: Graftveien 3
3300 Venestad

Epikrise

Pasienten ble innlagt for å få utført aortokoronar bypass, etter påvist hovedstammestenoze. Ukomplisert inngrep på hjerte-lungemaskin. Post-operativt forløp ukomplisert.

Han skrives ut med følgende medikamenter og råd:

Albyl-E: 75 til 500 mg daglig, etter eget ønske.

Selo-zok: 50 til 400 mg daglig, etter eget ønske

Pravachol: Doseres til LDL-kolesterol 1,5-4

Trening: Minimum ½ time tre ganger i uka, intensitet 50-90% av max hjertefrekvens.

Med vennlig hilsen


Gudo Guidelines
Assistentlege

Selve treningen varierer vilt!

Dokumentasjon:

• Safety

– Må anses rimelig dokumentert ved lav til moderat intensitet. Høy intensitet er ikke dokumentert.

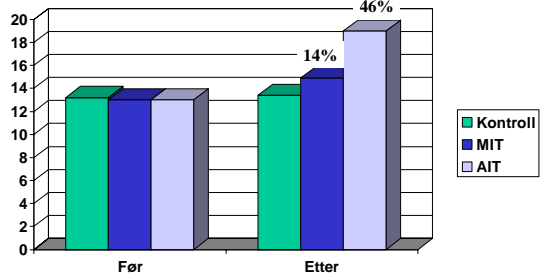
• Prognostisk gevinst

– Dokumentasjonen for svak foreløpig

Egne resultater:

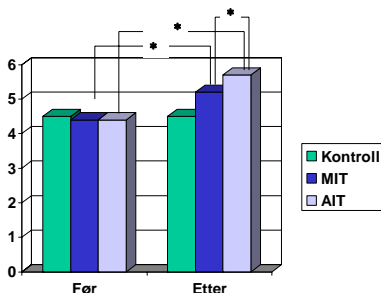
- 27 pasienter (20 menn, 7 kvinner), mean alder 75,5
- Alle på β -blokker og ACE-hemmer
- LVEF < 40%, NYHA "2,5"
- Randomisert til høy intensitet, moderat intensitet og kontroll.
- Trening 2 g/uke pluss en gang hjemme med tilsvarende intensitet i 12 uker.
 - AIT: Intervall 5 min oppvarming 60% av HRmax, 4 min drag på 90%, 3 min pauser på 70% og 3 min etter siste drag.
 - MIT: 70% av HR max justert for treningsmengde
 - Pulsstyrt med økende intensitet ettersom formen ble bedre

VO₂max



Tilsvarende for arbeidsøkonomi, aerob terskel og intensitet

Livskvalitet



	Kontroll		MIT		AIT	
	Pre	Post	Pre	Post	Pre	Post
LVDD	67.2 ± 8.1	67.8 ± 12.5	69.1 ± 8.6	68.2 ± 6.5	66.7 ± 6.8	59.0 ± 6.8
LVdV	250.5 ± 64.4	242.1 ± 62.3	245.5 ± 53.1	230.3 ± 41.0	248.1 ± 79.6	202.9 ± 72.0
EF	26.2 ± 8.0	26.6 ± 9.7	32.8 ± 4.8	33.5 ± 5.7	28.0 ± 7.3	38.0 ± 9.8
SV	53.4 ± 15.3	55.0 ± 13.7	63.5 ± 12.7	63.1 ± 15.7	57.1 ± 14.3	67.0 ± 19.9
HR	60 ± 11	59 ± 11	55 ± 10	54 ± 12	65 ± 14	61 ± 13
TVIs	4.73 ± 1.23	4.79 ± 1.34	4.80 ± 1.10	5.16 ± 0.96	4.79 ± 1.32	5.86 ± 1.53
E	0.6 ± 0.1	0.5 ± 0.2	0.7 ± 0.3	0.6 ± 0.1	0.7 ± 0.1	0.8 ± 0.2
Ea	4.0 ± 1.4	3.9 ± 1.9	4.6 ± 0.8	4.7 ± 1.6	4.5 ± 1.3	6.7 ± 1.6
E/Ea	15.1 ± 4.3	15.1 ± 6.4	15.1 ± 5.4	12.9 ± 3.8*	16.0 ± 3.5	11.8 ± 1.9
IVRT	110.2 ± 68.7	109.5 ± 64.8	112.4 ± 23.4	105.7 ± 25.6	100.7 ± 18.9	122.8 ± 41.4

Konklusjon:

- Høy intensitet ser ut til å gi vesentlig bedre effekt på hjertefunksjon. Signifikant:
 - Revers remodelering med red. volum
 - Økt EF, slagvolum og cardiac output
 - Bedret kontraktilitet og diastolisk relaksasjon
 - Redusert fylningstrykk
- Høyere hvile slagvolum tyder på delvis dekompensering før trening
- Dette burde gi forventet mortalitetseffekt

- Safety ved høy aerob intensitet ikke dokumentert