Post PCI Exercise Program in Cardiac Rehabilitation

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Cardiac Rehabilitation

The 2005 AHA/AACVPR Scientific Statement

“ CR refers to coordinated, multifaceted interventions designed to optimize cardiac patient’s physical, psychological and social functioning, in addition to stabilizing, slowing or even reversing the progression of the underlying atherosclerotic processes, there by reducing morbidity and mortality ”

Goals of CRP

- Primary Prevention
  - To reduce CAD morbidity by managing CAD risk factor.
- Secondary Prevention
  - To reduce the morbidity/mortality associated with recurrent MI
  - To slow or reverse the progression CAD lesions.

Indications to CR

- Risk Group
- MI / PCI
- CABG
- CHF
- Valve Disease
- PAD
- Cardiac Transplantation
- Etc.

Program Personnel

- Medical Director
- Program Director
- Clinical Exercise Specialist
- Nurse
- Dietitian
- Psychologist
- Etc.

AHA/AACVPR Core Components of Secondary Prevention /Cardiac Rehabilitation

- Nutritional counseling
- Weight management
- Lipid management
- Hypertension management
- Diabetes management
- Smoking management
- Psychosocial management
- Physical activity counseling
- Exercise training

Elements of the Exercise Prescription for Inpatient Cardiac Rehabilitation

Variable	Recommendation
Mode	Self care activities, ROM, postural changes, walking (hallway or treadmill), stationary cycling, stairclimbing
Intensity	Post-MI : HR<120bpm or, HRrest + 20bpm (arbitrary upper limit) Post surgery : HRrest + 30bpm (arbitrary upper limit) RPE<13(Borg 6-20 Scale) To tolerance if asymptomatic
Frequency	Early mobilization : 3 to 4 time per day (days 1~3) Later mobilization : 2 time per day (beginning on day 4)
Duration	Intermittent bouts lasting 3 to 5 min Rest periods at patient's discretion, last 1 to 2 min (shorter than exercise bout duration) Total duration of up to 20 min
Progression	Initially increase duration to 10 to 15 min, then increase intensity

Guidelines for progression to independent exercise

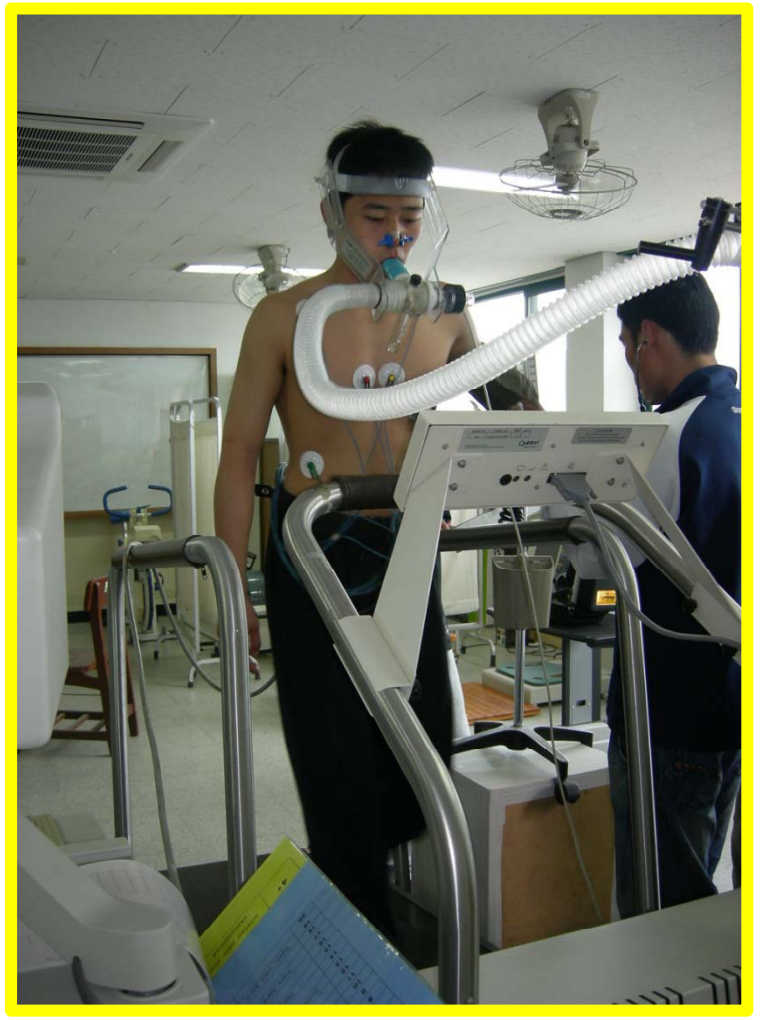
- FC ≥ 8METs (twice the level of occupational demand
- Appropriate hemodynamic response
- Appropriate ECG (< 1mm , ST-Depression)
- cardiac symptoms stable or absent
- independent and effective management of risk factors with changes in those factors
- knowledge of disease process, abnormal sign / symptoms, medication use

Goals for Outpatient Cardiac Rehabilitation

- Develop and assist the patient to implement a safe and effective formal exercise and lifestyle physical activity program
- Provide appropriate supervision and monitoring to detect deterioration in clinical status and provide ongoing surveillance data to the patient's healthcare providers to enhance medical management
- Return the patient to vocational and recreational activities or modify these activities contingent on the patient's clinical status.
- provide patient and family education to maximize secondary prevention (e.g., risk-factor modification) through aggressive lifestyle management and judicious use of cardioprotective medications

Exercise Training – Evaluation

- GXT
  - Post MI test
  - Diagnostic test
  - Prognostic test
  - Functional test
- Mode
  - Treadmill / Cycle / Arm ergometer
  - Field test (6 min walk)
- Protocol
  - Ramp protocol
- Variables
  - HR / BP / ECG
  - Gas exchange
  - Signs / Symptoms



Exercise Intervention
Cardiorespiratory Endurance Exercise

Type

- Arm ergometer
- Combination upper/lower extremity ergometer
- Upright and recumbent cycle ergometer
- Elliptical
- Rower
- Stair climber
- Treadmill for walking

Intensity

- RPE of 11 – 16

- 40% – 80% of the HRR or Karvonen method or percent oxygen uptake reserve (VO_2R or $\%VO_{2peak}$)

- Exercise intensity should be prescribed at a HR below the ischemic threshold if such a threshold has been determined for the patient

Frequency

- Exercise frequency should include participation in sessions most days of the week, i.e., 4~7 d·wk^{-1}

Time (Duration)

- Warm-up and cool-down : 5 to 10 minutes
  - Including static stretching range of motion, and low- intensity (<40%VO2R) aerobic activities
- The goal for the duration of the aerobic conditioning phase is generally 20 to 60 minutes per session
- After a cardiac event, many patients begin with 5- to10-minute sessions with a gradual progression in aerobic exercise time of 1 to 5 minutes per session or an increase in time per session of 10% to 20% per week

Exercise Intervention

Purposes of Resistance Training for Patients with Cardiac Disease

- Improve muscular strength and endurance
- Improve self-confidence
- Increase ability to perform activities of daily living
- Maintain independence
- Decrease cardiac demands of muscular work (i.e., reduced rate pressure product [RPP]) during daily activities
- Prevent and attenuate the development of other diseases and conditions, such as osteoporosis, type 2 diabetes mellitus, and obesity
- slow age- and disease-related declines in muscle strength and mass

Contraindication

- Unstable angina
- Uncontrolled arrhythmia
- left ventricular outflow obstruction
- symptomatic CHF
- severe valvular disease
- Uncontrolled hypertension
  (SBP>160mmHg, DBP>105mmHg)

ExRx for Resistance Exercise

❖ Beginning
- ◦ Post – MI : 4~6 weeks after event
- ◦ Post – Surgical : 8~12 weeks after event

❖ Mode
- ◦ Elastic band / ball / weight machine / free weight

❖ Intensity
- ◦ %1RM vs RM
- ◦ 12 – 15RM or RPE 11-13 (“light” to “somewhat hard”)

❖ Frequency : 2-3 times/week

• Progression : 1 ~ 2kg
(Increase loads by 5% increments when the patient can comfortably lift 12 to 15 repetitions

Lifestyle Physical Activity

- Walking for 30 min·d^{-1} equates to 3,000 to 4,000 steps, where as a 1 mile (1.6 km) walk equates to 1,500 to 2,000 steps.
- Minimum of 10,000 steps·d^{-1} is recommended

Exercise – Outcome

- Risk factor reduction
- Increase functional capacity
- Decrease mortality

Progression of Exercise

phase	week	frequency	intensity	duration
Initial	1	3	40-50	15-20
	2	3-4	40-50	20-25
	3	3-4	50-60	20-25
	4	3-4	50-60	25-30
Improvement	5-7	3-4	60-70	25-30
	8-10	3-4	60-70	30-35
	11-13	3-4	65-75	30-35
	14-16	3-5	65-75	30-35
	17-20	3-5	70-85	35-40
	21-24	3-5	70-85	35-40
Maintenance	24+	3-5	70-85	40-45

Case Study

Medical History

❖ 이름 : 조 ㅇ ㅇ

❖ 나이/성별 : 47y / M

- 내원 5년 전 사무업무 중 Chest pain 발생, 여 CV진료 권유 받았으나 증상 없어 refuse
- 20일 전부터 Resting 시 흉골 중앙 찌릿찌릿한 느낌이 있어 연고지 병원 방문, Coronary CT 상 coronary 좁아져 있다는 말 듣고 본원 외래 통해 방문

- Echo> hypokinesia LV apex (EF 59%)
- coronary CT> moderate stenosis LAD
- thalium> LAD territory ischemia
- 2010.09.06 CAG = mLAD CTO
- 2010.9.8 PTCA> successful stenting at mLAD
- PTCA at LAD 시행 후 급성 합병증 없이 퇴원

Medical History

❖ 이름 : 김 ㅇ ㅇ

❖ 나이/성별 : 60y / F

- 2010.04월 effort chest pain 주소로 CV 내원, 2010.05.10. TTE 및 Thallium SPECT 시행
- 2010.05.23 입원하여 CAG 예정
- 2010.05.22. 저녁 6시경 청소 중 substernal chest pain 발생
- NTG try 일시적으로 증상 호전 있으나 저녁 10시까지 chest discomfort 지속, AMC ER 내원
- ER 내원 당시chest pain 없음, EKG 특이 소견 없음.
- Echo> Normal (EF 63%)
- Thallium > Reversible large sized moderate-to-severly decreased perfusion in inferolateral wall
- 2010.05.20 TMT > ST depression in V4-6, at stage 2 with chest pain
- 2010.05.25 Successful stenting at p-dLCX 시행 후 급성 합병증 없이 퇴원

Case Study – Medical History

Case I

- 47yrs, male
- no prior cardiac history
- atypical chest pain
- midsternal 찌릿찌릿한 양상

Case II

- 60yrs, female
- no prior cardiac history
- effort chest pain
- substernal, 조이는 양상

Case Study – Treatment

Case I

PCI (Stent)

- 1.Isoket spray [15ml] 1.0 EA
- 2.Nitroglycerin tab [0.6mg] 1.0 TAB
- 3.Herben retard tab [90mg] 1.0 TAB
- 4.Selectol tab [200mg] 1.0 TAB
- 5.Vytorin tab 10mg/10mg [1TAB]1.0 TAB
- 6.Aspirin Protect tab [100mg] 1.0 TAB
- 7.Plavix tab [75mg] 1.0 TAB
- 8.Rivotril tab [0.5mg] 0.5 TAB

Referral to CRP
(Secondary prevention)

Case II

PCI (Stent)

- 1.Herben retard tab [90mg] 1.0 TAB
- 2.Concor tab [2.5mg] 1.0 TAB
- 3.Astrix cap [100mg] 1.0 CAP
- 4.Plavix tab [75mg] 1.0 TAB
- 5.Muteran cap[200mg] 3.0 CAP
- 6.(임상약) Rosuvastatin tab [10mg] 1.0 TAB
- 7. (임상약) Rosuvastatin tab [40mg] 1.0 TAB
- 8.Nitroglycerin tab [0.6mg] 1.0 TAB

Referral to CRP
(Secondary prevention)

Assessment

❖ Physiological Assessment

- Physique & Body Composition
- 6 Min Walking
- Symptom-limited GXT
  - Bruce Ramp Protocol
  - Stress ECG ,HR, BP, Gas Exchange, Angina & RPE Scale
  - Subjective Ratings

❖ Nutritional Assessment

- 3-day Food Record
- Nutrition Counseling (1/month)

❖ Psychological Assessment

- EQ-5D
- WHQOL
- BDI

Intervention

❖ Exercise

- ExRx
  - Individualized intensity
  - %VO_2R / HRR
  - Linear regression (HR vs VO_2)

- Exercise Training
  - Aerobic / Resistance/ Meditation
  - 3dyas / week (Mon. Wed. Fri. 2~4pm)
    1.5hour / session
    10 months (CASE 1)/ 6months (CASE 2)
  - Intermittent ECG & BP monitoring
  - CES-administered exercise log (BP, HR, RPE & Angina Scale)

Case Study I – Exercise prescription

Initial cardiorespiratory exercise prescription			
weeks	1-4	4-8	8-12
Modes	Walking/cycling	Walking/cycling	Walking/cycling
Intensity range(% of MHRR)	50 - 55	55-60	60-70
Target HR (bpm)	94-96	96-98	98-102
Target Vo_2(Mets)	5.1-5.5	5.5-5.9	5.9-6.7
Duration (min)	20-30	25-35	30-40
Frequency (day/week)	3 -5	3-5	3-5
Energy expenditure (kcal/min)	6.0-6.5	6.5-7.0	7.0-7.9
Initial musculoskeletal resistance exercise prescription			
Mode	None	Machines or free weight	Machines or free weight
Intensity	-	Resistance equal to 12-15 RM	Resistance equal to 12-15 RM
Duration	-	1 to 2 sets of 4-6 exercises / Major muscle groups	2 to 3 sets of 6-8 exercises / Major muscle groups
Frequency (day/week)	-	2-3X	2-3X

Case Study II – Exercise prescription

Initial cardiorespiratory exercise prescription			
weeks	1-4	4-8	8-12
Modes	Walking/cycling	Walking/cycling	Walking/cycling
Intensity range(% of MHRR)	50 - 55	55-60	60-70
Target HR (bpm)	85-87	87-89	89-94
Target Vo_2(Mets)	4.4-4.7	4.7-5.0	5.0-5.7
Duration (min)	20-30	25-35	30-40
Frequency (day/week)	3 -5	3-5	3-5
Energy expenditure (kcal/min)	4.5-4.8	4.8-5.2	5.2-5.9
Initial musculoskeletal resistance exercise prescription			
Mode	None	Machines or free weight	Machines or free weight
Intensity	-	Resistance equal to 12-15 RM	Resistance equal to 12-15 RM
Duration	-	1 to 2 sets of 4-6 exercises / Major muscle groups	2 to 3 sets of 6-8 exercises / Major muscle groups
Frequency (day/week)	-	2-3X	2-3X

Case Study – Symptom-limited GXT Data

	Case I		
	Initial f/u (2010.09.30)	Second f/u (2010.12.08)	Third f/u (2011.03.28)
Mode	Treadmill	Treadmill	Treadmill
Protocol	Bruce ramp	Bruce ramp	Bruce ramp
Test Time (min)	9'46''	12'52''	12'30''
Test WR	3.8mph / 14.8%	4.6mph / 16.8%	4.5mph / 16.6%
VO_2 peak (ml/kg/min)	32.1(9.2METs)	32.0(9.1METs)	45.6(13.0METs)
HRmax (bpm)	120 (resting HR 79)	139 (resting HR 70)	141 (resting HR 68)
BP (mmHg)	128/57(resting BP 108/44)	168/79(resting BP 110/83)	160/74(resting BP 96/64)
R (VO/ VCO_2)	1.13	1.20	1.28
RPE	15	17	13
Reason for termination	Dyspnea	Thirsty	Dyspnea

Case Study – Symptom-limited GXT Data

	Case II		
	Initial f/u (2010.06.18)	Second f/u (2010.09.03)	Third f/u (2010.12.10)
Mode	Treadmill	Treadmill	Treadmill
Protocol	Bruce ramp	Bruce ramp	Bruce ramp
Test Time (min)	10’04”	10’44”	13’13”
Test WR	3.9mph / 15.0%	4.1mph / 15.4%	4.7mph / 17.0%
VO_2 peak (ml/kg/min)	26.8(7.7METs)	30.1(8.6METs)	28.3(8.0METs)
HRmax (bpm)	114 (resting HR 59)	130 (resting HR 51)	126 (resting HR 54)
BP (mmHg)	196/90 (resting BP 138/77)	234/89(resting BP 129/97)	206/76(resting BP 133/69)
R (VO/VCO_2)	1.05	1.08	0.97
RPE	15	15	15
Reason for termination	Thirsty	Dyspnea	Dyspnea

Case Study I – Overall Outcomes

	Goals	1st f/u	2nd f/u	3rd f/u	Change Abs.	Change %	Achieve Goal (Yes or No)
Clinical Outcomes							
LDL (mg/dl)	<100	94	55	47	-47	Normal	Yes
Cholesterol (mg/dl)	<200	150	102	102	-48	Normal	Yes
HDL (mg/dl)	>40	33	33	42	+9	+27.2%	Yes
Triglyceride (mg/dl)	<150	162	83	102	-60	-37.0%	Yes
Rest Blood Pressure (mmHg)	<140/90	130/90	110/83	96/64	-44/26	-26.1/28.8%	Yes
METs (Measured/Estimated)	Add 1/.5 to baseline value	9.2	9.1	13.0	+3.8	+%	Yes

Case Study II – Overall Outcomes

	Goals	1st f/u	2nd f/u	3rd f/u	Change Abs.	Change %	Achieve Goal (Yes or No)
Clinical Outcomes							
LDL (mg/dl)	<100	30	28	22	-8	Normal	Yes
Cholesterol (mg/dl)	<200	76	74	77	+1	Normal	Yes
HDL (mg/dl)	>40	24	26	45	+21	+87.5%	Yes
Triglyceride (mg/dl)	<150	116	57	49	-67	Normal	Yes
Rest Blood Pressure (mmHg)	<140/90	138/77	129/97	133/69	-5/8	Normal	Yes
METs (Measured/Estimated)	Add 1/.5 to baseline value	7.7	8.6	8.0	+0.3	+3.8%	Not Yet

Case Study I – Overall Outcomes

	Goals	1st f/u	2nd f/u	3rd f/u	Change Abs.	Change %	Achieve Goal (Yes or No)
Health Outcomes							
Smoking (# per day)	0	30	0	0	******	******	Yes
Weight (kg)	61.7	67.4	63.2	63.5	-3.9	-5.7%	Not Yet
BMI(kg/㎡)	<23	23.8	22.4	22.4	-1.4	-5.8%	Yes
% Body fat	<23	26	23.1	19.9	-6.1	-6.1%	Yes
Relaxation Training	>2 per week	1/week	2/week	2/week	******	******	Yes
Ex. Attendance	>75%	80%	95%	85%	******	******	Yes
Activity Outside CRP	>2 days	1/days	2/days	2/days	******	******	Yes

Case Study II – Overall Outcomes

	Goals	1st f/u	2nd f/u	3rd f/u	Change Abs.	Change %	Achieve Goal (Yes or No)
Health Outcomes							
Smoking (# per day)	0	0	0	0	******	******	Yes
Weight (kg)	50.4	58.7	57.3	57.3	-1.4	-2.3%	Not Yet
BMI(kg/㎡)	<25	24.1	23.6	23.6	-0.5	-2.0%	Yes
% Body fat	<25	34.5	35.4	33.7	-0.8%	-0.8%	
Relaxation Training	>2 per week	1/week	2/week	2/week	******	******	Yes
Ex. Attendance	>75%	70%	80%	85%	******	******	Yes
Activity Outside CRP	>2 days	0/days	1/days	2/days	******	******	Yes