호흡재활 대상환자의 선정과 평가

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1. Comprehensive pulmonary rehabilitation (PR) program

- Developed for the individual patient with chronic respiratory disease
- Definition: a comprehensive intervention based on a thourough patient assessment followed by patient-talored therapies, which include, but are not limited to, exercise training, education and behavior change, designed to improve the physical and psychological condition of people with chronic respiratory disease and to promote the long-term adherence of health-enhancing behaviors

2. Patient selection

Restrictive Diseases	Obstructive Diseases
Loss of inspiratory reserve	Increase in residual volume
Intrinsic loss of inspiratory	Intrinsic increase in residual volume
reserve	
	 Bronchial obstruction (acute asthma)
 Lung fibrosis 	 Airways collapse (chronic obstructive lung
 Pulmonary hypertension 	disease/emphysema)
 Pulmonary edema 	 Bronchial obstruction (bronchiectasis, cystic
Extrinsic loss of inspiratory	fibrosis)
reserve	Extrinsic increase in the residual volume
 Chest wall rigidity 	 Neck obesity
 Neurologic (central) 	 Tracheomalacia
weakness	
 Neurologic (peripheral) 	
weakness	
 Chest wall restriction 	
from bracing	

(1) Chronic lung diseases

- 1 COPD
- 2 Asthma
- 3 Cystic fibrosis
- (4) Non-cystic fibrosis bronchiectasis
- (5) Interstitial lung disease (ILD)
- 6 Pulmonary hypertension
- ⑦ Lung transplantation
- 8 Lung volume reduction surgery
- (9) Lung cancer

(2) Neuromuscular disease

Rapidly progressive	Variable progression	Slowly progressive or nonprogressive
Motor neuron diseases/ALS	Limb girdle MD	Previous poliomyelitis
DMD (in teenage years)	Myopathies	Facioscapulohumeral MD
	Nemaline	Type III SMA
	Metabolic	Central hypoventilation
	Merosin negative congenital	Spinal cord injury
	muscular dystrophy	

(3) Chest wall restrictive lung disease

Contraindication of Pulmonary Rehabilitation

- 절대적 금기증
 - ① 불안정한 심혈관 질환 (불안정 협십증, 급성심근경색, 심한 대동맥판협착증)
 - ② 치료하지 않은 심한 폐동맥 고혈압
- 프로그램 수정이 필요한 경우
 - ① 안정화된 심장질환이나 폐동맥 고혈압
 - ② 심한 정형외과적인 문제 (knee pain, back pain, foot pain, etc.)
 - ③ 진행된 간질환
 - ④ 뇌졸중
 - ⑤ 인지장애 ④ 저시진화
 - ⑥ 정신질환

□ Other considerations in patient selection

- ① Smoking
- ② Motivation and adherence
- ③ Finantial considerations
- (4) Transportation

3. Patient assessment

(1) Medical history

- Respiratory history
- Comorbidities (especially coronary artery disease, diabetes, osteoporosis, sleep apnea, orthopedic issues, etc.)
- Other medical and surgical history
- Family history of respiratory disease
- Use of medical resources (hospitalization, urgent care or ER visits, physician visits, exacerbations, etc.)
- All current medication (including OTC drugs and herbal supplements; includes dose, route, and frequency)
- Oxygen: how it is prescribed and how the patient actually utilizes it
- Allergies and drug intolerance
- Smoking history
- Occupational, environmental, and recreational exposures
- Alcohol and other substance abuse history
- Social support

(2) Physical assessment

- Vital signs: BP, PR, RR, Oxygen saturation, BT
- Height, weight, BMI
- Use of accessory muscles of respiration
- Chest exam: inspection, palpation, percussion, symmetry, diaphragm position, breath sounds, duration of expiratory phase
- Cardiac exam: cardiac rate and rhythm, murmur, gallops, jugular venous distension
- Presence of digital clubbing
- Upper- & lower-extrimity evaluation: joint disease, musculoskeletal dysfunction, range of motion, muscle atrophy, edema

(3) Diagnostic tests

- Complete pulmonary function test (spirometry, lung volumes, diffusing capacity)

FVC (Forced vital capacity, mL): represents the active ROM of respiratory muscles, chest wall, and lung

Measures	Obstructive disorders	Restrictive disorders	Mixed disorders
FEV/1/EV/C	Decreased	Normal or increased	Decreased
	Decreased		Decreased
FEV1	Decreased	Decreased, normal, or	Decreased
		increased	
FVC	Decreased or	Decreased	Decreased or normal
	normal		
TLC	Normal or	Decreased	Decreased, normal, or
	increased		increased
RV	Normal or	Decreased	Decreased, normal, or
	increased		increased

Characteristic physicologic changes associated with pulmonary disorders

LUNG VOLUMES





3



- Maximal inspiratory and expiratory pressure (MIP & MEP)

- \Box cmH₂O
- □ Respiratory muscle strength
- □ More sensitive than FVC

Maximal insufflation capacity (MIC)

- □ The passive ROM of respiratory muscle, chest wall, land lung
- Pulmonary compliance and oropharyngeal and laryngeal muscle
- □ Attained by the patient taking a deep breath and holding it and then air stacking consecutively delivered volumes using a manual resuscitation bag

Peak cough flow (PCF)

- Unassisted PCF: having the patient cough as forcibly as possible through a peak flow meter
- □ Assisted PCF: patients were first insufflated to the MIC and then asked to cough forcefully through a peak flow meter as an abdominal thrust was timed to glottic opening
- \square PCF should be \ge 160L/min in order to clear secretions from the airway
- Sleep study
- Chest X-ray
- Bone densitometry
- Cardiac testing: Holter monitor, echocardiogram, thallium exercise stress test
- Alpha-1 antitrypsin level in patients with COPD
- HbA1c for diabetic patients
- Thyroid panel
- Complete blood count
- Comprehensive metabolic profile

(4) Symptom assessment

- Dyspnea
 - □ Primary symptom in patients with respiratory disease
 - Onset, quality, quantity (intensity), frequency, and duration
 - □ Aggravating / relieving factors
 - □ Modified Medical Research Council Dyspnea Scale (mMRC)

0	힘든 운동을 할 때만 숨이 차다		
1	평지를 빨리 걷거나, 약간 오르막길을 걸을 때 숨이 차다		
2	평지를 걸을 때 숨이 차서 동년배보다 천천히 걷거나, 자신의 속도로 걸어도 숨이 차서 멈		
	추어 쉬어야 한다		
3	평지를 약 100미터 정도 걷거나, 몇 분 동안 걸으면 숨이 차서 멈추어 쉬어야 한다		
4	숨이 너무 차서 집을 나설 수 없거나, 옷을 입거나 벗을 때도 숨이 차다		

– Fatigue

- □ Fatigue Severity Scale, the Identity-Consequences Fatigue Scale (ICFS), and the Chronic Respiratory Questionnaire (CRQ)
- Cough
- Sputum production
- Wheeze
- Hemoptysis
- Edema
- Sleep disorders: Epworth Sleepiness Scale (ESS) and the Pittsburgh Sleep Quality Index Assessment (PSQI)
- Sinus disease postnasal drainage
- Chest pain
- Gastroesophageal reflux
- Dysphagia
- Extremity pain or weakness
- Feelings of anxiety, panic, fear, isolation
- Depressive symptoms

(5) Musculoskeletal and exercise assessment

- Pain assessment: location, duration, intensity (usually rated on a 0 to 10 scale), character, and aggravating/ relieving factors
- Frailty and grip strength
 - Fried phenotype model: weight loss (> 10 pounds unintentional over the prior year), exhaustion (self-report to questions asked), slowness (15-foot walk time), low activity (patient's physical activity for one week ≤ 270 kcal), and weakness (measured by grip strength)
 - Grip strength: simple to perform and measures overall muscle strength, being a biomarker of aging process, a predictor of all-cause mortality in middle age and the elderly, a predictor of health-related prognosis including functional limitation, functional decline, ADL dependence, and mortality
- ADL assessment
 - Basic ADLs, such as dressing, bathing, walking, eating
 - Household chores
 - Leisure activitie
 - Job-related activities
 - Sexual activity

(6) Nutrition assessment

Weight/ body composition

(7) Supplemental oxygen assessment

(8) Multicomponent assessment of COPD

- BODE index

Variables	Points of BODE index			
	0	1	2	3
FEV1 % or predicted	≥ 65	50-64	36-49	≤ 35
6MWD (m)	≥ 350	250-349	150-249	≤ 149
mMRC	0-1	2	3	4
BMI	> 21	≤ 21		

- GOLD classification of airflow limitation severity in COPD

GOLD 1	Mild	FEV1 \geq 80% predicted
GOLD 2	Moderate	$50\% \leq \text{FEV1} < 80\%$ predicted
GOLD 3	Severe	$30\% \leq \text{FEV1} < 50\%$ predicted
GOLD 4	Very severe	FEV1 < 30% predicted

The ABCD assessment tool



- **호흡재활 대상 환자의 평가 항목** (대한결핵및호흡기학회, 호흡재활지침서 2015)

필수 평가 항목	가능하다면 시행하는 평가 항목
병력 신체검사 폐기능검사(Pulmonary Function Test) 흉부 방사선 촬영 심전도 전혈구계산(CBC) 산소포화도(안정시, 보행시) 증상 평가(호흡곤란 정도, 피로감) 운동 능력 평가(6분보행검사)	심폐운동부하검사, 셔틀보행검사 호흡근 근력(최대흡기압, 최대호기압) 평가 사지 근력 평가 일상생활동작 수행 평가 삶의 질 평가 정신의학적 평가 심장초음파, 홀터 검사 영양평가

4. Exercise assessment

- To optimize effectiveness, the training load must exceed that normally encountered in daily life to improve fitness and muscle strength (i.e., the training threshold)

- Exercise levels should progress throughout pulmonary rehabilitation based on ongoing comprehensive assessment

- Prior to exercise assessment, patient history and physical examination should be carefully reviewed with a focus on disorders that may potentially worsen or become unstable during exercise, including

- Cardiovascular disease (coronary artery disease, previous MI, chest pain, arrhythmia, Afib with resting rate > 100 bpm, VT, second- or third-degree AV block, T-wave inversion or ST elevation)
 Moderate to severe valve disease
- Symptomatic or new onset heart failure
- Large patent foramen ovale causing shunt physiology

(1) Six-minute walk test (6MWT)

- Measures the maximum distance walked in 6 minutes
- Advantages: safe, easy to administer, involves the use of minimal technical resources, well-telerated, accurately reflects a familiar ADL (walking)
- Standardization of the test procedure is important
 - staff, configuration of track, patient instruction, verbal reinforcement during testing, type, use and

flow rate of supplemental oxygen, and use of walking aid, etc.

(2) Shuttle walk test

Two types of shuttle walk test

- 1 Incremental shuttle walk test (ISWT)
 - Measures a symptom-limited <u>walking distance</u> over a marked walking course of 10 meter
 The distance walked correlates well with maximal oxygen uptake
- 2 Endurance shuttle walk test (ESWT)
 - □ Standardized, externally controlled, constant-paced walking test for the assessment of endurance capacity
 - □ The ISWT should be initially performed to determine exercise capacity
 - □ Then a paced walk speed corresponding to 85% of walking speed on the ISWT is used to determine the walking speed for the ESWT
 - □ The primary outcome is <u>time</u>
- Advantages (ISWT): less influenced by motivation or pacing; correlate better with exercise capacity in
 patients with chronic lung disease; might be a more sensitive indicator of functional change with
 rehabilitation or other therapy; correlates strongly to direct measures of peak VO2 as well as easier to
 administer, less expensive, and incorporates an acitivity that patients perform on a daily basis

(3) Cardiopulmonary exercise test

- Measures maximal exercise tolerance using either a treadmill or stationary cycle ergometer
- In most clinical circumstances, cycle ergometry is the preferred mode of exercise
- Physical responses including HR, ECG, BP, SpO2, and ratings of perceived exertion and dyspnea are recorded
- Absolute and relative contraindications for CPET including ISWT

절대적 금기증	상대적 금기증
급성심근경색(3~5일) 불안정 협심증 증상이 있거나 혈역학적으로 불안정한 부정맥 급성심내막염 급성심근염 또는 심낭염 증상이 있는 심한 대동맥협착증 조절되지 않은 심부전 급성 폐색전증 또는 폐경색 하지의 혈전증 박리동맥류 의증 조절되지 않은 천식 폐부종 안정시 대기중 산소포화도≤85% 호흡부전 운동 능력에 영향을 미치는 기타 급성 질환 (감염증, 신부전, 갑상샘중독증 등) 협조가 되지 않는 정신적 장애	좌주관상동맥 협착증 중등도 심장판막협착증 치료받지 않은 중증 고혈압(안정시 수축기>200 mmHg, 이완기>120 mmHg) 빠른부정맥 또는 느린부정맥 고도 방실차단 비후성 심근병증 현저한 폐고혈압 진행된 임신 또는 복잡 임신 전해질 이상 운동 능력에 영향을 미치는 정형외과적 장애