Contemporary Management of Chronic Obstructive Pulmonary Disease

Clinical Applications

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The presentation of chronic obstructive pulmonary disease (COPD) usually is insidious, and many patients are undiagnosed until the disease is far advanced. Therefore, the early use of spirometry is recommended for anyone who is suspected to have COPD. In the early stages of the disease, the patient is only mildly symptomatic (cough and sputum production). As COPD becomes more advanced, functional impairment in the form of chronic dyspnea occurs and acute exacerbations of symptoms become more frequent, contributing to overall morbidity and mortality. The single most important known causative factor of COPD is cigarette smoking. Smoking cessation remains, therefore, the mainstay of COPD therapy. In patients with advanced disease, symptomatic treatment with the regular use of either short- or long-acting sympathomimetic and/or anticholinergic bronchodilators, singly or in combination, should be added to smoking cessation and influenza and pneumococcal vaccination therapies. An inhaled corticosteroid, either alone or more commonly in combination with a long-acting bronchodilator, can further reduce exacerbations and improve the health status of these patients. Furthermore, patients with severe COPD, particularly those who are debilitated, should be considered for pulmonary rehabilitation because these programs have been proven useful in maintaining, or in some cases improving, health status for these patients. Finally, correction of resting arterial hypoxemia with oxygen therapy for more than 15 h/d prolongs survival of COPD patients for those with a resting PaO_2 lower than 55 to 60 mm Hg.

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DIAGNOSIS

The diagnosis of chronic obstructive pulmonary disease (COPD) requires attention to smoking and occupational history and documentation of symptoms such as cough, sputum production, and dyspnea.[1,2] The performance of spirometry provides the proper documentation of the presence and severity of airflow obstruction and should be done on every patient who is suspected to have COPD.[1,3-5] The ratio between forced expiratory volume in 1 second (FEV_1) to forced vital capacity (FVC) is used to determine airflow obstruction. Although spirometric thresholds remain controversial, most expert panels use FEV_1/FVC ratio of less than 70%[1,6] or less than 88% predicted in men or less than 89% predicted in women[7] of predicted to define airflow obstruction. Both spirometric evidence of airflow obstruction and clinical symptoms are necessary for the diagnosis of COPD. Once a clinical diagnosis of COPD is made, its severity can be determined, in part, by the patient's postbronchodilator FEV_1 values. In most settings, *mild COPD* is defined by a postbronchodilator FEV_1 of 70% to 80% or greater of predicted[1,6,7]; *moderate* as an FEV_1 of 50% to 80% of predicted[1,6,7]; *severe* as an FEV_1 of 30% to 49% of predicted[1,6,7]; and *very severe COPD* as an FEV_1 of less than 30% to 35% of predicted (FIGURE).[1,8] Irrespective of FEV_1 values, clinical evidence of right-sided heart failure generally indicates severe COPD[1] (BOX). Imaging of the thoracic cavity with plain chest radiographs also may provide potentially important information on the nature of the lung disease and helps to rule out (or in) important comorbid conditions and complications, such as congestive heart failure, pneumonia, pneumothorax, and lung tumors.[9] Among patients in whom the diagnosis remains uncertain despite the use of spirometry and plain chest radiographs, computed tomography (CT) provides incremental information that may have diagnostic and

See also p 2301 and Patient Page.

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prognostic value.[10] As an example, CT scans can demonstrate the presence, distribution, and extent of emphysema with a high degree of accuracy. As well, as a research tool, CT can yield objective measurements of airway wall thickness, an important and useful finding in chronic bronchitis.

MANAGEMENT STRATEGIES

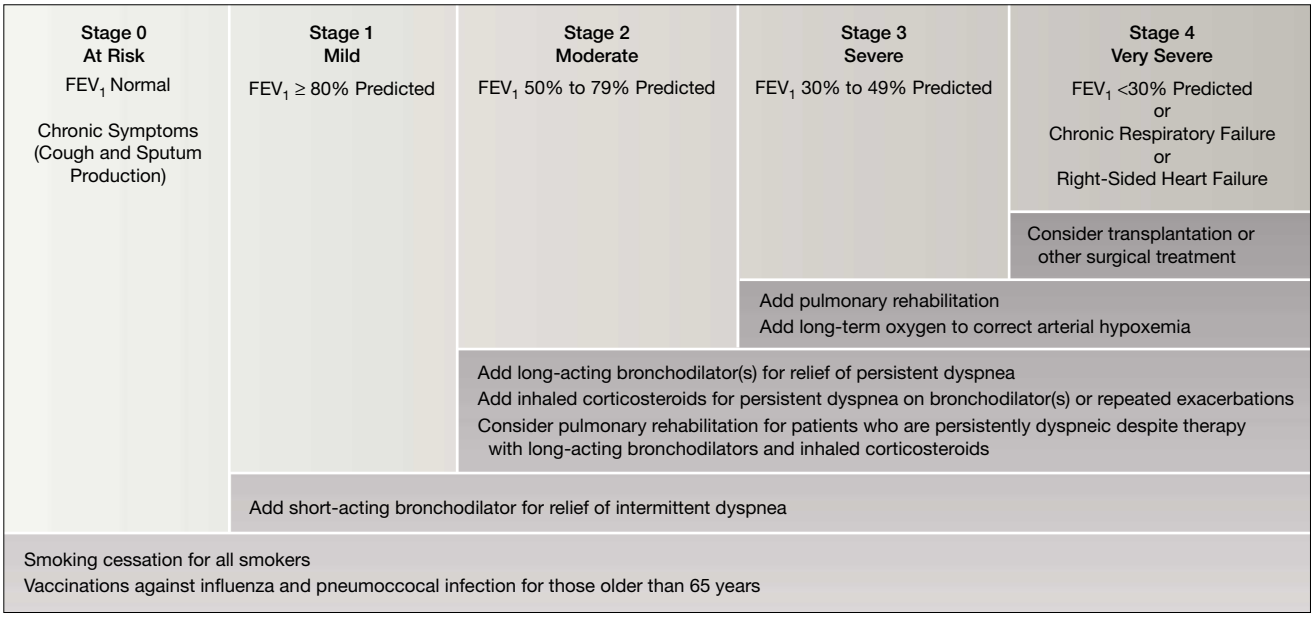
Clinical Context

Patient 1: Management of Mild COPD. A 65-year-old white man, who works as an office manager, presents to his family physician with a slight morning cough for the past 9 months. The cough at times is productive of mucoid sputum. No hemoptysis is present. He is a current smoker with a 23 pack-year smoking history. (He has smoked on average 10 cigarettes/day since 18 years of age. One pack-year is calculated by dividing the mean number of cigarettes consumed per day by 20 and then multiplying the quotient by the number of years the individual has smoked.) Although he admits that for the past 3 years he has been having more chest colds, which can last 2 to 3 weeks at a time, he states he feels well in general and has remained asymptomatic in his daily activities. He has no significant occupational history; no past history of allergy, asthma, sinusitis, or respiratory infection in his early childhood; and no family history of asthma or COPD. He has had no previous hospitalizations for any respiratory problems. He has no comorbid conditions. The findings from the physical examination were normal. How should this patient be managed?

Because this patient has a 23 pack-year history of smoking and symptoms of cough and sputum production, you suspect that he has COPD. The next step is to obtain lung function measurements to support your diagnosis and to assess the degree of severity of the airflow limitation, which is helpful in guiding treatment and for prognosis. Spirometry often can be performed in an office setting.

When spirometry is performed on this patient, his postbronchodilator FEV_1 is 3.0 L (or 87% of predicted) and his FVC is 4.41 L (or 94% of predicted). The FEV_1/FVC ratio is 0.68 (or 75% of predicted). Although both FEV_1 and FVC values are in the normal range, the reduced FEV_1/FVC ratio (in the presence of a smoking history and symptoms) confirms objectively a diagnosis of COPD. Since his postbronchodilator FEV_1 is greater than 80% of predicted, the patient has mild COPD (Box). A smoking cessation program should be offered to all current smokers, and influenza and pneumococcal vaccines to elderly patients. For most cases of mild COPD, only symptomatic treatment with short-acting bronchodilator(s) is needed (Figure). For this patient, smoking cessation is the single most important intervention. The US Public Health Service recommends a 5-step program for intervention to health care professionals to help their patients stop smoking.[11] The intervention consists of counseling and pharmacotherapy.[12-14] The counseling programs include practical counseling, social support, and behavior modification techniques. Pharmacotherapy, usually in the form of nicotine replacement products, is used adjunc-

Figure. Stages of Disease Severity and Recommended Treatments



For the National Heart, Lung, and Blood Institute/World Health Organization Global Initiative for Chronic Obstructive Lung Disease (GOLD) disease severity categories,[1] see Box. Treatment is stepwise; as an example, treatment for stage 4 includes all treatments recommended for stages 0 to 3. FEV_1 indicates forced expiratory volume in 1 second.

tively to increase long-term smoking abstinence rates. Nicotine replacement therapies, in general, increase quit rates by 1.5 to 2 fold, regardless of the setting.[12] Antidepressants, such as bupropion and nortriptyline, may be used in lieu of nicotine replacement therapies in certain settings.[13] It is uncertain whether the use of nicotine replacement therapies and antidepressants in combination can increase cessation rates beyond that achieved with monotherapy. Until further trials are performed, this practice cannot be recommended for most patients.

Self-help therapies, such as computer-generated feedback, telephone hotlines, and personalized booklets on smoking cessation, also may be of some value in assisting individuals to stop smoking.[14] Less conventional therapies, such as hypnosis and acupuncture, do not appear to be effective in fostering smoking cessation.[15,16] In general, the use of a multidisciplinary team approach consisting of cessation counseling, social support, behavior modification, pharmacotherapy with nicotine replacement products or antidepressants, and close follow-up appears to be the most effective means of promoting long-term abstinence among smokers. In mild COPD, this approach is associated with an approximate 25% long-term abstinence rate.[17]

If the patient in this scenario can successfully quit smoking, his expected rate of FEV_1 decline can be reduced by 50% from the rate expected if he remained an active smoker (from approximately 60 mL/y to approximately 30 mL/y).[4] Thus, smoking cessation counseling and pharmacotherapy should be offered to this patient. Moreover, although specific studies have not been done in patients with mild COPD, this individual is 65 years old and should be vaccinated for both influenza and pneumococcus. Influenza vaccination is associated with an approximate 20% to 30% reduction in hospitalizations from cardiac disease, and pneumonia or influenza, respectively, and an approximate 50% reduction in all-cause mortality.[18] Pneumococcal vaccination is associated with a 35% reduction in disseminated pneumococcal infections in COPD patients.[19] If this patient's cough continues months later despite smoking cessation, other differential diagnoses and further investigation and/or therapies should be considered.

Box. Classification Schemes for Chronic Obstructive Pulmonary Disease Severity

American Thoracic Society[8]

Stage 1 (mild): FEV_1 ≥50% of predicted
Stage 2 (moderate): FEV_1 of 35% to 49% of predicted
Stage 3 (severe): FEV_1 <35% of predicted

European Respiratory Society[7]

Mild: FEV_1 ≥70% of predicted
Moderate: FEV_1 of 50% to 69% of predicted
Severe: FEV_1 <50% of predicted
In the presence of FEV_1/FVC <88% of predicted in men and <89% in women

British Thoracic Society[6]

Mild: FEV_1 of 60% to 79% of predicted
Moderate: FEV_1 of 40% to 59% of predicted
Severe: FEV_1 <40% of predicted
In the presence of FEV_1/FVC ratio of <70%

NHLBI/WHO Global Initiative for Chronic Obstructive Lung Disease (GOLD) Criteria[1]

Stage 0: normal lung function
Stage 1 (mild): FEV_1 ≥80% of predicted
Stage 2 (moderate): 50% to 79% of predicted
Stage 3 (severe): 30% to 49% of predicted
Stage 4 (very severe): FEV_1 <30% of predicted or presence of respiratory failure or clinical signs of right-sided heart failure
In the presence of FEV_1/FVC ratio of <70%

Abbreviations: FEV_1, forced expiratory volume in 1 second; FVC, forced vital capacity; NHLBI/WHO, National Heart, Lung, and Blood Institute/World Health Organization.

Patient 2: When Should Supplemental Oxygen Be Used? A 69-year-old African American man has had severe COPD for 13 years. His FEV_1 is 0.9 L (approximately 30% of predicted). He is taking a number of medications, which include ipratropium bromide, a short-acting β_2-agonist, and an inhaled corticosteroid. He stopped smoking 2 years ago. He has dyspnea at rest. He asks about the use of long-term supplemental oxygen therapy in his situation. Findings from the physical examination show he has evidence of peripheral edema and an elevated jugular venous pressure, but the lung fields are relatively clear. He is believed to have mild right-sided heart dysfunction. An earlier echocardiogram showed no evidence of left ventricular failure. His resting arterial blood gases show a Pa_{O_2} of 60 mm Hg, Pa_{CO_2} of 30 mm Hg, an Sa_{O_2} of 92%, and a pH of 7.48. His venous blood hemoglobin concentration is 17 g/dL and hematocrit is 55%. Should this patient receive domiciliary oxygen therapy?

In general, long-term administration of oxygen should be reserved for individuals with COPD who have arterial hypoxemia (Pa_{O_2} ≤55 mm Hg), or a Pa_{O_2} between 55 and 60 mm Hg with evidence of pulmonary hypertension, cor pulmonale, or secondary erythrocytosis (hematocrit >55%). In these patients, continuous domiciliary oxygen therapy (for >15 h/d) sufficient to correct hypoxemia (Pa_{O_2} >60 mm Hg or Sa_{O_2} >90%) has been shown to improve survival.[20,21] On the basis of the arterial blood oxygen results, this patient would not appear to need long-term oxygen treatment. However, the arterial blood gas results show evidence of an acute respiratory alkalosis. If acute hyperventilation had not occurred, the arterial blood gases would have shown a Pa_{O_2} of 54 mm Hg,

Pa_{CO_2} of 40 mm Hg, and pH of 7.40, assuming the respiratory quotient was 0.8, and the alveolar-arterial oxygen gradient was unchanged with hyperventilation. As well, the relatively high hemoglobin concentration in this patient raises the suspicion that he usually is hypoxemic. Finally, the evidence of chronic right-sided heart failure probably indicates chronic pulmonary arterial hypertension. Therefore, this patient should be treated with long-term supplemental oxygen to raise the arterial oxygen saturation at rest to 90% to improve survival. (Medicare coverage criteria for oxygen therapy is provided on the author's Web site: http://www.mrl.ubc.ca/sin, which has been modified from reference 22.)

As it turns out, the family physician asks this patient to come back a week later so that arterial blood gases can be reassessed to satisfy the regulatory guidelines for the long-term administration of supplemental oxygen. On this occasion, the patient knows what to expect in the arterial puncture procedure and is less anxious. The results of the blood gas measurement show a Pa_{O_2} of 54 mm Hg, Pa_{CO_2} of 39 mm Hg, an Sa_{O_2} of 87%, and a pH of 7.40. This patient then starts domiciliary oxygen therapy to correct the hypoxemia.

Patient 3: Complicated Management for Severe COPD. A 72-year-old white woman has severe COPD, diagnosed 5 years ago. At present, her FEV_1 is 0.7 L or 25% of predicted. She has managed to stop smoking. Although she is taking combination bronchodilator therapy (albuterol and ipratropium), 2 puffs 4 times per day, she is still dyspneic while cleaning her apartment. What adjustments can the physician make to improve her symptoms?

In this patient, short-acting bronchodilators are no longer able to fully control her symptoms. The current available evidence indicates that long-acting β_2-agonists and long-acting anticholinergics improve respiratory symptoms and reduce the risk of acute exacerbations beyond that achieved by short-acting bronchodilators (see companion article). However, insufficient evidence is available to recommend one class of long-acting bronchodilators over another class (see companion article).

Besides long-acting bronchodilators for symptom control, a growing body of evidence shows that inhaled corticosteroids are beneficial for COPD patients who have an FEV_1 of less than 2.0 L (or <70% predicted normal) by reducing the rate of acute exacerbations. As well, the use of combination of inhaled corticosteroids and long-acting β_2-agonists has been shown to reduce the rate of acute exacerbations compared with monotherapy with these products (see companion article). The choice of therapy for this patient would be to change one or both short-acting bronchodilators to a long-acting preparation and to add an inhaled corticosteroid to further reduce the rate of acute exacerbation. Moreover, if she is physically well enough, this patient should be enrolled in a comprehensive, multidisciplinary pulmonary rehabilitation program, which includes individualized exercise training, nutrition counseling, and education. With such a program, she can expect improvements in exercise tolerance and a reduction in symptoms of dyspnea and fatigue (see companion article).

CONCLUSIONS

With the recent understanding of the pathogenesis of COPD, primary preventions should provide the best hope to control the rapid rise of this disease. Thus, smoking cessation and attention to control environmental and work-site pollution are key areas worthy of more attention. For patients who have developed COPD, a variety of treatment modalities (pharmacological and nonpharmacological) can make a difference in their health outcomes.

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