Chronic Obstructive Pulmonary Disease
Past and Present

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Classic Representations
Definition

• Chronic Obstructive Pulmonary Disease (COPD) is a common, preventable and treatable disease that is characterized by persistent respiratory symptoms and airflow limitation that is due to airway and/or alveolar abnormalities usually caused by significant exposure to noxious particles or gases.

• The airflow limitation is usually progressive and associated with an abnormal inflammatory response of the lung to noxious particles or gases.

Natural History of COPD

![Graph showing the natural history of COPD](image)
Epidemiology

- COPD is currently the fourth leading cause of death in the world.
- COPD is projected to be the 3rd leading cause of death by 2020.
- More than 3 million people died of COPD in 2012 accounting for 6% of all deaths globally.
- Globally, the COPD burden is projected to increase in coming decades because of continued exposure to COPD risk factors and aging of the population.

Economic and Social Burden

- COPD is associated with significant economic burden.
  - COPD exacerbations account for the greatest proportion of the total COPD burden.
- European Union:
  - Direct costs of respiratory disease ~6% of the total healthcare budget
  - COPD accounting for 56% (38.6 billion Euros) of the cost of respiratory disease.
- USA:
  - Direct costs of COPD are $32 billion
  - Indirect costs $20.4 billion.
Tobacco smoking is the main risk factor for COPD.

Pathophysiology

Normal COPD
Smoking Advertisement

Clinical Risk Factors

• Smoking!!!
  • Overwhelmingly the most important risk factor
  • Accounts for >80% of COPD
  • Increased responsiveness to allergens or other external triggers
  • Environmental exposures
    • Particulate matter, dusts, vapors, fumes, or organic antigens
  • Sex – F>M
  • Atopy – persistent asthma
  • Antioxidant deficiency – limited supporting data
  • Bronchopulmonary dysplasia – neonatal chronic lung disease
  • Premature birth with O2 dependence >28 days post-partum
  • Chronic pulmonary infections – Tuberculosis
Smoking Cessation

- Smoking cessation has the greatest capacity to influence the natural history of COPD.
- If effective resources and time are dedicated to smoking cessation, long-term quit success rates of up to 25% can be achieved.

### Brief Strategies to Help the Patient Willing to Quit

<table>
<thead>
<tr>
<th>Brief</th>
<th>Strategy</th>
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<tbody>
<tr>
<td><strong>1</strong></td>
<td>Understand the benefits of quitting smoking.</td>
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<tr>
<td><strong>2</strong></td>
<td>Set a quit date.</td>
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<td><strong>3</strong></td>
<td>Identify triggers and develop coping strategies.</td>
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<td><strong>4</strong></td>
<td>Join a support group.</td>
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<td><strong>5</strong></td>
<td>Use nicotine replacement therapy.</td>
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<td><strong>6</strong></td>
<td>Contact a smoking cessation counselor.</td>
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Smoking Cessation

- Smoking cessation is the single most clinically efficacious and cost effective way to prevent COPD, slow progression of established disease, improve survival.
Diagnosis

• Natural History of COPD
  • Prolonged preclinical period of 20-40 yrs.
  • Deterioration of lung function in marked excess of the normal age-related decline.
  • Nonsmokers → 25-30ml/yr after age of 35
  • Susceptible smokers → ≥60ml/yr
  • Exertional dyspnea → FEV1 40-55% of predicted
  • Disabling dyspnea → FEV1 < 1L, 5 year mortality 50%
History

* Risk factors
  * Family history
  * Smoking history
    * Age at initiation
    * Average amount smoked per day since initiation
    * Date when stopped smoking or a current smoker
  * Environmental history
    * The chronologically taken environmental history may disclose important risk factors for COPD
  * Asthma

Symptoms

* Dyspnea
  * Ask about the amount of effort required to induce uncomfortable breathing.
  * Many individuals will deny symptoms of dyspnea, but will have reduced their activity levels substantially.
  * Objective Dyspnea Assessment tools - COPD Assessment Test (CAT™) or Modified MRC dyspnea scale (see reference slides)
* Cough
  * Cough with or without sputum production should be an indication for spirometric testing.
  * chronic cough and sputum → chronic bronchitis.
* Wheezing
  * Suggests the presence of airflow obstruction
* Acute chest illnesses
  * Inquire about occurrence and frequency of episodes of increased cough and sputum with wheezing, dyspnea, or fever

Physical Findings

* Physical examination
  * All physical findings are generally present only with severe disease
  * Chest
    * Overdistention of the lungs - chest held near full inspiratory position at end of normal expiration, low diaphragmatic position, decreased intensity of breath and heart sounds, and prolonged expiratory phase
    * Evidence of airflow obstruction - wheezes during auscultation on slow or forced breathing and prolongation of forced expiratory time
    * pursed-lip breathing, use of accessory respiratory muscles, flattening of intercostal spaces
  * Other
    * Unusual positions to relieve dyspnea at rest
    * Digital clubbing is NOT typical in COPD (even with associated hypoxemia) and suggests other diagnoses (eg, lung cancer, bronchiectasis, pulmonary fibrosis)
    * Mild dependent edema may be seen in the absence of right heart failure
Management

• **Smoking cessation** is key!!
• Pharmacologic therapy can reduce COPD symptoms, reduce the frequency and severity of exacerbations, improve health status and exercise tolerance.
• Pharmacologic treatment regimens should be individualized and guided by the severity of symptoms, risk of exacerbations, side-effects, comorbidities, drug availability and cost, and the patient’s response, preference and ability to use various drug delivery devices.

Management

• **Influenza vaccination** decreases the incidence of lower respiratory tract infections.
• **Pneumococcal vaccination** decreases lower respiratory tract infections.
• **Pulmonary rehabilitation** improves symptoms, quality of life, and physical and emotional participation in everyday activities.
• In patients with severe resting chronic hypoxemia, long-term oxygen therapy improves survival.

Management

• In patients with severe chronic hypercapnia and a history of hospitalization for acute respiratory failure, long-term non-invasive ventilation may decrease mortality and prevent re-hospitalization.
• In select patients with advanced emphysema refractory to optimized medical care, surgical or bronchoscopic interventional treatments may be beneficial.
• **Lung transplantation** can improve QOL and functional capacity is select patients with very severe COPD.
• **Palliative** approaches are effective in controlling symptoms in advanced COPD.
• **Inhaler technique** needs to be assessed regularly.
GOLD 2017: Pharmacologic Treatment Algorithms by GOLD Group (Preferred Pathways)

C: LAMA + LABA
- Further macrolide(s)

D: LABA + LABA + ICS
- Further macrolide(s)

A: LABA

B: A bronchodilator
- A long-acting bronchodilator (LAMA or LABA)

**ANTI-INFLAMMATORY THERAPY IN STABLE COPD**

- Initial treatment with a macrolide is supported by the inclusion of macrolides in the long-term therapy of moderate to severe stable COPD (Category 1, Level A).
- Higher treatment with a macrolide increases the risk of pneumonia in those with severe disease (Category 2b, Level B).
- Use of macrolides with LABA in COPD improves lung function, quality of life, and health-related quality of life (Category 2b, Level B).

**ICS TREATMENT**

- Use of inhaled corticosteroids is supported as an add-on to LABA (Category 1, Level A).

**COMBINATION THERAPY**

- Treatment with a macrolide in combination with an additional bronchodilator (Category 1, Level A)

**SECONDARY SURVIVAL OUTCOMES**

- Use of inhaled corticosteroids is supported as an add-on to LABA (Category 1, Level A).
COPD EXACERBATIONS

• Acute increase in symptoms beyond normal day-to-day variation
  • Cough increases in frequency and severity
  • Sputum increases in volume or character
  • Dyspnea increases

• Causes of exacerbations
  • 50-60% - Respiratory infections (bacterial/viral)
  • 30% - Unknown (MI, CHF, Aspiration, PE)
  • 10% - Environmental pollution

COPD EXACERBATIONS

• 14% of pts admitted with a COPD exacerbation die within 3 months
• 43% mortality at 12 months in pts with an acute exacerbation and PaCO2 ≥ 50
• In hospital early mortality → pneumonia, cardiac failure, pulmonary embolus
• High prevalence of PE ~ 20% overall and 25% in those patients requiring admission

COPD EXACERBATIONS

SEVERITY

• Mild (treated with short acting bronchodilators only, SABDs)
• Moderate (treated with SABDs plus antibiotics and/or oral corticosteroids) or
• Severe (patient requires hospitalization or visits the emergency room). Severe exacerbations may also be associated with acute respiratory failure.

  • No respiratory failure: Respiratory rate: 20-30 breaths per minute; no use of accessory respiratory muscles; no changes in mental status; hypoxemia improved with supplemental oxygen given via Venturi mask 28-35% inspired oxygen (FiO2); no increase in PaCO2.
  • Acute respiratory failure — non-life-threatening: Respiratory rate: > 30 breaths per minute; using accessory respiratory muscles; no change in mental status; hypoxemia improved with supplemental oxygen via Venturi mask 25-30% FiO2; hypercarbia i.e., PaCO2 increased compared with baseline or elevated 50-60 mmHg.
Acute respiratory failure — life-threatening:

- Respiratory rate: > 30 breaths per minute; using accessory respiratory muscles; acute changes in mental status; hypoxemia not improved with supplemental oxygen via Venturi mask or requiring FiO\textsubscript{2} > 40%; hypercarbia i.e., PaCO\textsubscript{2} increased compared with baseline or elevated > 80 mmHg or the presence of acidosis (pH ≤ 7.25).

Management of severe but not life-threatening exacerbations:

- Assess severity of symptoms, blood gases, chest radiograph.
- Administer supplemental oxygen therapy, obtain arterial or capillary gases and pulse oximetry measurements.
- Bronchodilators:
  - Increase dose and/or frequency of short-acting bronchodilators.
  - Consider long-acting bronchodilators when patient becomes stable.
  - Use spacers or inhalers-rehabilitators when appropriate.
- Consider steroid treatment.
- Consider antibiotics (and) when signs of bacterial infection are present.
- Consider noninvasive mechanical ventilation (NIV).
- As an alternative:
  - Monitor fluid balance.
  - Consider subcutaneous heparin or low molecular weight heparin for thromboembolism prophylaxis.
  - Identify and treat associated conditions (e.g., heart failure, anemia, pulmonary embolism etc.).

Indications for noninvasive mechanical ventilation (NIV):

At least one of the following:

- Respiratory acidosis (PaCO\textsubscript{2} ≥ 8.0 kPa or > 65 mmHg and arterial pH ≤ 7.35).
- Severe dyspnea with clinical signs suggestive of respiratory muscle fatigue, increased work of breathing, or both, such as use of accessory respiratory muscles, paradoxical motion of the abdomen, or retraction of the intercostal spaces.
- Persistent hypoxemia despite supplemental oxygen therapy.
Noninvasive Mechanical Ventilation

- Very Effective – proven in randomized trials and meta-analyses (Cochrane Database Syst Rev 2004)
  - Meta-analysis (14 trials, 758 patients)
    - Compared standard therapy alone to NPPV + standard therapy in COPD exacerbations complicated by hypercapnia (PaCO2 > 45)
    - NPPV decreased mortality (11 vs 21%)
    - NPPV decreased intubation rate (16 vs 33%)
    - NPPV decreased treatment failure (20 vs 42%)
    - LOS and complications related to treatment were also reduced
Case Study: 53 year old male presents for office evaluation regarding suspected COPD, longstanding dyspnea, and chronic cough. Patient has a 20 pack/year smoking history and continues to smoke. Strong family history of emphysema (mother, father, and one brother).
Alpha-1 Antitrypsin Deficiency

- It is the most common genetic disease in the U.S. and Europe
  - 100,000 people in the U.S. with severe deficiency
  - 25 million Americans are carriers of Alpha-1
- AAT is produced in the liver
- AAT Deficiency is caused by a defect in the AAT gene
  - This defect can cause AAT to be manufactured poorly, function poorly, or poorly released from liver cells
- AAT can affect the lungs, liver, skin, and vasculature

Alpha-1 Antitrypsin Deficiency

- Severity of AAT Deficiency is related to the type and number of abnormal AAT genes inherited and to environmental exposures
- Numerous AAT genes have been identified and are classified under the Pi-typing system
  - M gene is normal
  - Z and Null genes often lead to severe deficiency
Diagnosing Alpha-1
Who Should Be Tested?

- Family history of Alpha-1
- Family history of emphysema, bronchiectasis, liver disease, or panniculitis
- Early onset emphysema (age < 45 years)
- Emphysema in the absence of, or out of proportion to a recognized risk factor, such as smoking, occupational exposure, etc.
- Emphysema with a prominent basal hyperlucency (worse disease at the bases of the lungs)
- **All individuals with a diagnosis of chronic obstructive pulmonary disease (COPD)**
  - Bronchiectasis
  - Chronic asthma in adolescents and adults
  - Recurrent pneumonia or bronchitis
  - Unexplained liver disease
  - Wegener’s granulomatosis (C-ANCA positive vasculitis)
  - Necrotizing panniculitis

Alpha-1 Augmentation Therapy

- Basic goal of therapy is to increase the level of AAT protein and to restore the balance between the AAT and mediators of inflammation including neutrophil elastase
- Recommended for individuals with Alpha-1 and COPD
- Typically with severe Alpha-1 deficiency
Case Challenges
“All that wheezes is not asthma (or COPD)!”

Case Study

- 61 y.o. WF with PMHx sig for COPD, obesity, anxiety, and depression who was transferred to our hospital due to persistent wheeze, SOB, and ?stridor.
- Bronchoscopy...

Vocal Cord Dysfunction Syndrome

Relaxation
Inhalation with posterior chink
Exhalation
Inhalation with posterior chink
Case Study

• 37 y.o. WF with only Hx of childhood asthma and tobacco use presented to ER with SOB, wheezing, and worsening right-sided face/neck swelling.

• No other pertinent history
Left vocal cord paralyzed in adduction

Right upper lobe with tumor mucosal invasion

- Dx: Endobronchial biopsies and brushings from RUL orifice confirmed small cell lung carcinoma which was complicated by SVC syndrome and paralyzed L vocal cord.

Case Study

- 27 y.o. WF with longstanding RA (since the age of 4) and asthma, and moderate OSA presented with complaints of longstanding DOE, wheezing, and nocturnal awakenings with SOB/gasping (despite CPAP). Pt was hypoxic in office with walking 300 feet.
- PMHx – RA, GERD, OSA, blindness, anxiety
FEV1/FVC = 80%
Post Bronchodilator FEV1 = 1.93L (68% of predicted)
TLC = 76% of predicted
DLCO = 90% of predicted

Cricoarytenoid Arthritis
Case Study

• 65 y.o. WF presents for evaluation of a left pleural effusion, subcentimeter pulmonary nodules, and mild shortness of breath. She has also experienced a nonproductive nocturnal cough.

• PFT – moderate fixed obstruction

• SocHx – lifelong nonsmoker, no significant second smoke exposure.
Thank You!

Additional References

- 2019 Global Initiative for Chronic Obstructive Lung Disease.
COPD Assessment Test (CAT™)

### Modified MRC Dyspnea Scale

**MRC Grade 0:** Can get breathless with strenuous exercise.

**MRC Grade 1:** Get short of breath when hurrying or walking up a steep hill.

**MRC Grade 2:** Walk slower than people of the same age on the level because of breathlessness, or have to stop and catch my breath when walking up my own stairs.

**MRC Grade 3:** Can’t walk two flights of stairs without having to stop and catch my breath.

**MRC Grade 4:** Can’t leave the house or can’t breathe when dressing or undressing.

*Further details can be found in Table 2.5.*

**Interventional Bronchoscopies and Surgical Treatments for COPD**

- Empiric pulmonary artery vasodilator therapy
- Measuring pulmonary edema
- Lung transplantation

**Advanced COPD**

- Empiric pulmonary artery vasodilator therapy
- Measuring pulmonary edema
- Lung transplantation

**Definitions:**
- *All terms are not explained in this context.*