<table>
<thead>
<tr>
<th>Module 2</th>
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<tbody>
<tr>
<td>11. Clinical syndromes and symptoms of respiratory system affection</td>
<td>2</td>
<td>5.12.16</td>
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<tr>
<td>(obstructive syndrome).</td>
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<td>(pulmonary insufficiency syndrome, dry and exudative pleuritis.)</td>
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Obstructive Syndrome

SIGNS AND SYMPTOMS OF RESPIRATORY SYSTEM DISEASES

LECTURE IN INTERNAL MEDICINE PROPAEDEUTICS

M. Yabluchansky, L. Bogun, L. Martymianova, O. Bychkova, N. Lysenko, N. Makienko
V.N. Karazin National University Medical School’ Internal Medicine Dept.
Preamble: the importance of the respiratory system

• Since our childhood we all are aware that food, water and oxygen are the basic necessities of life and we cannot survive without them
• An average person can live without food for 3-4 weeks
• We cannot survive without water for more than 3-5 days
• Oxygen is crucial to sustain life, and 3 minutes is the maximum time where person can stay alive without breathing

http://www.justforhearts.org/2013/08/for-how-long-a-person-can-survive-without-oxygen-water-food/
http://assets-s3.mensjournal.com/img/article/you-re-breathing-all-wrong/298_298_you-re-breathing-all-wrong.jpg
Obstructive lung syndrome: definition, diseases 1

- Obstructive syndrome is characterized by airway obstruction
- Many obstructive diseases of the lung result from narrowing of the smaller bronchi and larger bronchioles, often because of excessive contraction of the smooth muscle itself

Obstructive lung syndrome: definition, diseases 2

- Obstructive syndrome is generally characterized by inflamed and easily collapsible airways, obstruction to airflow, problems with exhaling and frequent medical clinic visits and hospitalizations.
- Obstructive syndrome lays in the basis of asthma, bronchiectasis, bronchitis, chronic obstructive pulmonary disease (COPD), cystic fibrosis, etc.

Obstructive lung syndrome: accent on causes

- Smoking including passive smoking (Chronic Obstructive Pulmonary Disease (COPD))
- Frequent chest infections, particularly in winter
- Serious asthma symptoms with frequent exacerbations for a long time, which have not been improving with treatment
- Long-term exposure to lung irritants (air pollution (industrial dust, chemical fumes, etc.))

Obstructive lung syndrome: accent on causes 2

- Preterm birth that leads to lung damage (neonatal chronic lung disease).
- A family history of emphysema
- Inherited factors (genes), including alpha-1 antitrypsin deficiency

Obstructive lung syndrome: the United States III surveys from 1988 to 1994

- Asthma: 5.1%
- Chronic Bronchitis: 5.8%
- Emphysema: 5.0%
- Airflow Obstruction Int: 4.7%
- Airflow Obstruction Ext: 9.3%
Obstructive lung syndrome: symptoms 1

- Shortness of breath (in early stages occurs only with exertion)
- Tightness in chest
- Cough (dry or productive of white or colored sputum)
- A flare-up (an exacerbation), often worse in winter with wheezing
- Depression and anxiety

Obstructive lung syndrome: symptoms 2

- Weight loss
- Tiredness and fatigue
- Swollen ankles
- Limitations in activity and lifestyle
Obstructive lung syndrome:
History 1

• Most patients seek medical attention late in the course of their disease
• Patients often ignore the symptoms because they start gradually and progress over the course of years
• Patients often modify their lifestyle to minimize dyspnea and ignore cough and sputum production
• With retroactive questioning, a multiyear history can be elicited
• Patients typically present with a combination of signs and symptoms of chronic bronchitis, emphysema, and reactive airway disease
• Systemic manifestations (decreased fat-free mass, impaired systemic muscle function, osteoporosis, anemia, depression, pulmonary hypertension, cor pulmonale, left-sided heart failure)

Obstructive lung syndrome: History 2

• A productive cough or an acute chest illness is common
• The cough usually is worse in the mornings and produces a small amount of colorless sputum
• Breathlessness is the most significant symptom, but it usually does not occur until the sixth decade of life (although it may occur much earlier)
• By the time the FEV$_1$ has fallen to 50% of predicted, the patient is usually breathless upon minimal exertion
• Wheezing may occur in some patients, particularly during exertion and exacerbations
• A history of more than 40 pack-years of smoking was the best single predictor of airflow obstruction
Obstructive lung syndrome: History 3

• With disease progression, intervals between acute exacerbations become shorter, and each exacerbation may be more severe.

• In addition, obstructive lung syndrome appears to increase the risk for mild cognitive impairment.

• Some important clinical and historical differences may help distinguish between the types of obstructive lung syndrome.

• Classic findings for patients with chronic bronchitis include productive cough with gradual progression to intermittent dyspnea; frequent and recurrent pulmonary infections; and progressive cardiac/respiratory failure with edema and weight gain.

• Classic findings for patients with emphysema include a long history of progressive dyspnea with late onset of nonproductive cough; occasional mucopurulent relapses; and eventual cachexia and respiratory failure.
Obstructive lung syndrome: Physical Examination 1

• The sensitivity of a physical examination is relatively poor; however, physical signs are quite specific and sensitive for severe disease.

• Patients with severe disease experience tachypnea and respiratory distress with simple activities.

• Use of accessory respiratory muscles and paradoxical indrawing of lower intercostal spaces is evident (known as the Hoover sign).

• In advanced disease, cyanosis, elevated jugular venous pulse, and peripheral edema can be observed.

http://emedicine.medscape.com/article/297664-clinical#b3
Obstructive lung syndrome: Physical Examination 2

Thoracic examination reveals the following:

- Hyperinflation (barrel chest)
- Wheezing – Frequently heard on forced and unforced expiration
- Diffusely decreased breath sounds
- Hyperresonance on percussion
- Prolonged expiration
- In addition, coarse crackles beginning with inspiration may be heard

http://emedicine.medscape.com/article/297664-clinical#b3
Obstructive lung syndrome: Physical Examination 3

• Patients may have signs of right heart failure (cor pulmonale), such as edema and cyanosis.
• Patients may be very thin with a barrel chest.
• Patients typically have little or no cough or expectoration.
• Breathing may be assisted by pursed lips and use of accessory respiratory muscles.
• The chest may be hyperresonant, and wheezing may be heard.
• Heart sounds are very distant.

http://emedicine.medscape.com/article/297664-clinical#b3
Obstructive lung syndrome: conditions and nature

<table>
<thead>
<tr>
<th>Condition</th>
<th>Main site</th>
<th>Major changes</th>
<th>Causes</th>
<th>Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chronic bronchitis</td>
<td>Bronchus</td>
<td>Hyperplasia and hypersecretion of mucus glands</td>
<td>Tobacco smoking and air pollutants</td>
<td>Productive cough</td>
</tr>
<tr>
<td>Bronchiectasis</td>
<td>Bronchus</td>
<td>Dilation and scarring of airways</td>
<td>Persistent severe infections</td>
<td>Cough, purulent sputum and fever</td>
</tr>
<tr>
<td>Asthma</td>
<td>Bronchus</td>
<td>Smooth muscle hyperplasia, excessive mucus, inflammation, constriction</td>
<td>Immunologic or idiopathic</td>
<td>Episodic wheezing, cough and dyspnea</td>
</tr>
<tr>
<td>Bronchiolitis (subgroup of chronic bronchitis)</td>
<td>Bronchiole</td>
<td>Inflammatory scarring and bronchiole obliteration</td>
<td>Tobacco smoking and air pollutants</td>
<td>Cough, dyspnea</td>
</tr>
</tbody>
</table>

Obstructive lung syndrome: spot the difference 1

- In asthma the bronchial tubes (airways) are hyperresponsive and usually triggered by breathing in things in the air such as dust, pollen, etc. with recurring episodes of wheezing, breathlessness, chest tightness, and coughing, particularly at night or in the early morning.

- Bronchiectasis refers to the abnormal, irreversible dilatation of the bronchi caused by destructive and inflammatory changes in the airway walls.

Obstructive lung syndrome: spot the difference 2

- Chronic obstructive pulmonary disease (COPD) is characterized by airflow limitation that is not fully reversible.

Obstructive lung syndrome: spot the difference

**ASTHMA**
- More intermittent airflow obstruction
- Improvement in airways obstruction with bronchodilators and steroids
- Cellular inflammation with eosinophils, mast cells, T-lymphocytes, and neutrophils in more severe disease
- Broad inflammatory mediator response
- Airways remodeling

**COPD**
- Progressively worsening airflow obstruction
- Often presents in 6th decade of life or later in patients
- More permanent airflow obstruction; less reversibility and less normalization of airflow obstruction
- Cellular inflammation: neutrophils, macrophages, eosinophils and mast cells may occur
- Emphysema frequently found
Obstructive lung syndrome: lung function tests

FVC = forced vital capacity, FEV₁ = forced expiratory volume in the first second of expiration
Obstructive lung syndrome: lung function tests 1

The obstructive defect is reversible because at least one of the two measurements (FVC or FEV₁) increased by at least 0.2 L and by at least 12%
Obstructive lung syndrome: lung function tests 2

\( \text{FEF}_{25\% - 75\%} = \text{forced expiratory flow at } 25\% \text{ to } 75\% \text{ of FVC; } \)
\( \text{FEV}_1 = \text{forced expiratory volume in one second; } \)
\( \text{FVC} = \text{forced vital capacity; } \)
\( \text{LLN} = \text{lower limit of normal} \)
**Obstructive lung syndrome:**

**lung function tests**

<table>
<thead>
<tr>
<th>Classification of COPD by impairment of lung function</th>
</tr>
</thead>
<tbody>
<tr>
<td>COPD stage</td>
</tr>
<tr>
<td>------------</td>
</tr>
<tr>
<td>GOLD 1</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>GOLD 2</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>GOLD 3</td>
</tr>
<tr>
<td></td>
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<tr>
<td>GOLD 4</td>
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</tr>
</tbody>
</table>

**FEV\(_1\):** Forced expiratory volume in 1 second; **FVC:** Forced vital capacity; **GOLD:** Global Initiative for Chronic Obstructive Lung Disease

Classification of COPD severity should be undertaken with care in patients with comorbid diseases or other possible contributors to shortness of breath. Postbronchodilator forced expiratory volume in 1 s (FEV\(_1\)) to forced vital capacity (FVC) ratio less than 0.7 is required for the diagnosis of COPD to be established.

**Reference:** Modified from GOLD Global strategies for the diagnosis, management, and prevention of chronic obstructive pulmonary disease updated 2014.
Obstructive lung syndrome: spirometric measures in asthma, COPD and ACOS

<table>
<thead>
<tr>
<th>Spirometric variable</th>
<th>Asthma</th>
<th>COPD</th>
<th>ACOS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal FEV&lt;sub&gt;1&lt;/sub&gt;/FVC pre- or post BD</td>
<td>Compatible with diagnosis</td>
<td>Not compatible with diagnosis</td>
<td>Not compatible unless other evidence of chronic airflow limitation</td>
</tr>
<tr>
<td>Post-BD FEV&lt;sub&gt;1&lt;/sub&gt;/FVC &lt;0.7</td>
<td>Indicates airflow limitation but may improve spontaneously or on treatment</td>
<td>Required for diagnosis (GOLD)</td>
<td>Usually present</td>
</tr>
<tr>
<td>FEV&lt;sub&gt;1&lt;/sub&gt; ≥80% predicted</td>
<td>Compatible with diagnosis (good asthma control or interval between symptoms)</td>
<td>Compatible with GOLD classification of mild airflow limitation (categories A or B) if post- BD FEV&lt;sub&gt;1&lt;/sub&gt;/FVC &lt;0.7</td>
<td>Compatible with diagnosis of mild ACOS</td>
</tr>
<tr>
<td>FEV&lt;sub&gt;1&lt;/sub&gt; &lt;80% predicted</td>
<td>Compatible with diagnosis. Risk factor for asthma exacerbations</td>
<td>An indicator of severity of airflow limitation and risk of future events (e.g. mortality and COPD exacerbations)</td>
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</tr>
<tr>
<td>Post-BD increase in FEV&lt;sub&gt;1&lt;/sub&gt; &gt;12% and 200 ml from baseline (reversible airflow limitation)</td>
<td>Usual at some time in course of asthma, but may not be present when well-controlled or on controllers</td>
<td>Common and more likely when FEV&lt;sub&gt;1&lt;/sub&gt; is low, but ACOS should also be considered</td>
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</tr>
<tr>
<td>Post-BD increase in FEV&lt;sub&gt;1&lt;/sub&gt; &gt;12% and 400 ml from baseline (marked reversibility)</td>
<td>High probability of asthma</td>
<td>Unusual in COPD. Consider ACOS</td>
<td>Compatible with diagnosis of ACOS</td>
</tr>
</tbody>
</table>

ACOS: asthma-COPD overlap syndrome; BD: bronchodilator; FEV1: forced expiratory volume in 1 second; FVC: forced vital capacity; GOLD: Global Initiative for Obstructive Lung Disease.

Obstructive lung syndrome: lung function tests

<table>
<thead>
<tr>
<th>Small airway obstruction</th>
<th>Upper airway obstruction</th>
</tr>
</thead>
<tbody>
<tr>
<td>COPD</td>
<td>Asthma attack</td>
</tr>
<tr>
<td>FVC</td>
<td>N to ↓</td>
</tr>
<tr>
<td>FEV₁</td>
<td>↓</td>
</tr>
<tr>
<td>FEV₁/FVC</td>
<td>↓</td>
</tr>
</tbody>
</table>

Typical findings in patients with lower airway and upper airway obstruction. COPD = chronic obstructive pulmonary disease, FVC = forced vital capacity, FEV₁ = forced expiratory volume in the 1 second of expiration.
Smokers who are susceptible to lung injury experience an increase in the rate of age-related loss in FEV$_1$ compared with nonsmokers (red, green, and blue lines).

$\text{FEV}_1 = \text{forced expiratory volume in 1 second}$
Obstructive lung syndrome: lung function decline in smokers and nonsmokers

After lung function declines to threshold levels, clinical symptoms develop (black dotted lines)

When a smoker stops smoking, the rate of FEV\(_1\) loss again approximates to that of a nonsmoker (blue dotted line)

FEV\(_1\) = forced expiratory volume in 1 second
Obstructive lung syndrome: chest X-ray 1

- A chest X-ray may show signs of obstructive lung syndromes and can be used to help exclude other serious conditions (including lung cancer)

A pneumothorax on the left side. On the right side multiple large apical bullae which are also at risk of rupture.
Obstructive lung syndrome: chest X-ray 2

• The X-ray may show:
  – Flattening of the diaphragm, the large muscle that separates the lungs and heart from the abdominal cavity
  – Increased size of the chest, as measured from front to back
  – A long narrow heart
  – Abnormal air collections within the lung (focal bullae)

A pneumothorax on the left side. On the right side multiple large apical bullae which are also at risk of rupture.

https://emcow.files.wordpress.com/2013/10/copd-and-px.jpg?w=540&h=444
http://www.webmd.com/lung/copd/chest-x-rays-for-chronic-obstructive-pulmonary-disease-copd
Obstructive lung syndrome: chest X-ray 3

A normal chest X-ray does not mean patient do not have COPD

A pneumothorax on the left side. On the right side multiple large apical bullae which are also at risk of rupture.
Obstructive lung syndrome: arterial blood gas test 1

<table>
<thead>
<tr>
<th>pH result</th>
<th>Bicarbonate result</th>
<th>PaCO₂ result</th>
<th>Condition</th>
<th>Common causes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 7.35</td>
<td>Low</td>
<td>Low</td>
<td>Metabolic acidosis</td>
<td>Kidney failure, shock, diabetic ketoacidosis, intoxication with methanol, salicylate, ethanol</td>
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<tr>
<td>Greater than 7.45</td>
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• Arterial blood gas analysis is used to measure the pH and the partial pressures of oxygen and carbon dioxide in arterial blood

[Links]
https://labtestsonline.org/understanding/analytes/blood-gases/tab/test/
http://www.australianprescriber.com/magazine/33/4/124/9
Obstructive lung syndrome: arterial blood gas test 2

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- Interpretation of an arterial blood gas result should not be done without considering the clinical findings

Obstructive lung syndrome: arterial blood gas test 3

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- Factors relating to sampling technique, specimen processing and environment may also influence the results

Obstructive lung syndrome: oximetry 1

- The test measures the oxygen saturation in the blood.

- An SpO₂ of greater than 95% is generally considered to be normal.
- An SpO₂ of 92% or less (at sea level) suggests hypoxemia.
  - In a patient with acute respiratory illness (e.g., influenza) or breathing difficulty (e.g., an asthma attack), an SpO₂ of 92% or less may indicate a need for oxygen supplementation.
  - In a patient with stable chronic disease (e.g., COPD), an SpO₂ of 92% or less should prompt referral for further investigation of the need for long-term oxygen therapy [5, 6].

Obstructive lung syndrome: oximetry

The test can be useful in finding out whether oxygen treatment is needed, but it provides less information than the arterial blood gas test.

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[Image showing pulse oximeter and graph]

Obstructive lung syndrome: electrocardiogram 1

ECG changes occur in obstructive lung syndromes due to:

- The presence of hyperexpanded emphysematous lungs within the chest

The ECG demonstrates many of the features of chronic pulmonary disease: rightward QRS axis; peaked P waves in the inferior leads; Clockwise rotation of the heart
Obstructive lung syndrome: electrocardiogram 2

- The long-term effects of hypoxic pulmonary vasoconstriction upon the right side of the heart, causing pulmonary hypertension and subsequent right atrial and right ventricular hypertrophy (i.e. cor pulmonale).

  The ECG demonstrates many of the features of chronic pulmonary disease: rightward QRS axis; peaked P waves in the inferior leads; Clockwise rotation of the heart.

http://lifeinthefastlane.com/ecg-library/copd/
Obstructive lung syndrome: transfer factor for carbon monoxide

- $D_{LCO}$ or $T_{LCO}$ (diffusing capacity or transfer factor of the lung for carbon monoxide (CO),) is the extent to which oxygen passes from the air sacs of the lungs into the blood.
Obstructive lung syndrome:
transfer factor for carbon monoxide 2

• The test looks at whether lungs have been damaged and if so, how much damage there is
Obstructive lung syndrome: tests rarely done

- Alpha-1 antitrypsin (AAT) test for recognizing emphysema
- A CT scan for detailed picture of the lungs

Computed tomography of the lung showing emphysema and bullae in the lower lung lobes of a subject with type ZZ alpha-1-antitrypsin deficiency

Obstructive lung syndrome: specialized investigations sometimes used in distinguishing asthma and COPD

<table>
<thead>
<tr>
<th>Inflammatory biomarkers</th>
<th>Asthma</th>
<th>COPD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test for atopy (specific IgE and/or skin prick tests)</td>
<td>Modestly increases probability of asthma; not essential for diagnosis</td>
<td>Conforms to background prevalence; does not rule out COPD</td>
</tr>
<tr>
<td>FENO</td>
<td>A high level (&gt;50 ppb) in non-smokers supports a diagnosis of eosinophilic airway inflammation</td>
<td>Usually normal. Low in current smokers.</td>
</tr>
<tr>
<td>Blood eosinophilia</td>
<td>Supports asthma diagnosis</td>
<td>May be present during exacerbations</td>
</tr>
<tr>
<td>Sputum inflammatory cell analysis</td>
<td>Role in differential diagnosis is not established in large populations</td>
<td></td>
</tr>
</tbody>
</table>
Obstructive lung syndrome: regular checkups

- Spirometry
- Arterial blood gas test
- X-rays or ECGs

I quit smoking 30 years ago, not soon enough, I have COPD
The graph illustrates the difference between normal respiratory flow and flow with obstructive disease. The black line represents normal flow, while the red line shows the reduced flow typical of obstructive disease. The red arrow labeled 'RV' points to the region of reduced volume and flow, indicating a restrictive ventilatory defect.