OBSTRUCTIVE PULMONARY CONDITIONS & ITS OCULAR IMPLICATIONS

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Course Description

- This course focuses on giving an introduction and review of common obstructive pulmonary diseases and conditions.
- This course will also highlight some ocular consequences of these pulmonary diseases and conditions.
Course Objective

• Briefly introduce and define obstructive pulmonary disease
• To review types of obstructive pulmonary diseases in detail: asthma, COPD, cystic fibrosis and obstructive sleep apnea
• To highlight how these pulmonary conditions relates to optometry and what ocular manifestations can result from these conditions
Outline

• Introduction
• Introduction of obstructive pulmonary disease

**Types of obstructive pulmonary disease:**
• 1. Chronic lower respiratory disease:
  • Asthma
  • COPD
    • Emphysema
    • Chronic bronchitis
  • Cystic fibrosis

• 2. Upper respiratory tract:
  • Sleep Apnea
Optometric considerations

• Pulmonary disease can increase the risk of ocular disease
• Dry Eye
• Glaucoma
• ARMD
• Retinal vascular changes
• Optic nerve head changes

• Pulmonary disease can contraindicate ocular medications
Optometric considerations

- **Medications** taken for pulmonary disease can cause ocular problems

- Optic atrophy
- Glaucoma
- Cataract
- Blurred vision
- Tear effects
- Conjunctivitis
Lung disease

• Top 4 causes of death in adults
• Every year, > 200,000 Americans die of lung disease in US

*CLRD: chronic lower respiratory disease

NOTES: Rates are age-adjusted. Cause of death is coded according to ICD–10.
SOURCE: CDC/NCHS, Health, United States, 2015, Figure 2 and Table 17. Data from the National Vital Statistics System (NVSS).
Lung disease is common

- Lung disease is not only a killer, most lung disease is **chronic**
- > 35 million Americans are living with chronic lung disease

- **Smoking** is directly responsible for 90% of lung cancer and causes most cases of **emphysema** and **chronic bronchitis**
Symptoms of Lung Disease

**TWO common** symptoms of lung disease

1. **Dyspnea**
   - Shortness of breath *(SOB)*
   - Can be caused by lung or heart disease

2. **Chronic cough**
   - Production of phlegm
   - Hemoptysis: *heme* (blood); *ptysis* (to spit) – coughing blood
Atypical symptom of Lung Disease

Chest pain is **not** a common symptom.
- Lung tissue has **no pain receptors**

- Pain is possible with:
  - Pleural disease
  - Pulmonary vascular disease
  - Musculoskeletal pain
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Introduction to Obstructive pulmonary disease

- **Definition**: Limitation of airflow *especially* on **exhalation** (*passive process*)
  - Makes breathing harder
  - Can be caused by:
    - **1. Change in lumen size**
      - Altered secretions in asthma or cystic fibrosis
    - **2. Thickening of airway wall**
      - Inflammation in bronchitis and remodeling in asthma
    - **3. Changes in supporting structure surrounding the airway**
      - Emphysema
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Asthma

- Common syndrome found in 1 in 12
- Genetic predisposition to type I hypersensitivity
- There are different asthma phenotypes
  - Some have ↑ IgE, some ↓ IgE
  - Treatment is all the same currently

**More likely to have asthma:**
- Children: can grow out of it
- Females: smaller pipes
- African American: genetically more susceptible
Asthma

- Characterized by **exacerbations** and **remissions**
- Initiating factors include:
  - Allergens, heat, stress, cold, dust, smoke, dander, pollen, fragrance, menstrual cycle, obesity, lack of sleep, alcohol, (exercise)

**Poor Control:**
- 93% of patients with inhalers **missed** at least **one important step** for correct use
- For example: exhaling fully or shaking inhaler before use
- 1 in 5 children with asthma go to ER for asthma each year
Signs and symptoms

- Intermittent (patients appear normal between attacks)
- Vary due to range in severity

Signs/Symptoms include:

- Chronic cough
- Wheezing (if severe, wheezing may not be present)
- Chronic episodic dyspnea (SOB)
- Sympathetic discharge (perspiration/flushing of skin)
- Tightness in chest
- Tachypnea
- Severe cases can have cyanosis of nail beds, confusion, agitation, nasal flaring, difficulty talking, no breath sounds

Most common symptoms

More severe symptoms
Asthma Therapy

**Goals:**
- Relieve symptoms
- Prevent recurrences of attacks

**Therapies:**
- Control triggers including smoking cessation
- Exercise and breathing exercises
- Bronchodilators: Adrenergic and Anticholinergics
- Anti-inflammatory agents
  - Steroid anti-inflammatory agents
  - Leukotriene inhibitors
  - Mast cell stabilizers
  - Monoclonal antibodies against IgE
  - Vitamin D?
- Thermoplasty – using radiowaves to change shape of airways
Glucocorticoids

**Most common adverse effects:**
- Osteoporosis
- Impaired wound healing
- Increased risk of infection
- Hypertension
- Decreased growth in children (oral >> than inhaled)
- Edema
- Ulcers
- Psychoses
- Cushing-like syndrome
- Oral candidiasis (Thrush) – use spacer to ↓ risk
- Glaucoma
- Cataracts
- ↑ risk of DM

Very little risk with inhaled
FDA guidelines:

**Use inhaled glucocorticoids with caution in patients with:**

- Parasitic infection (ex: histoplasmosis)
- Active or inactive TB
- Ocular herpes simplex
- **Increased IOP**

**use caution, but not absolute contraindication!**
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Chronic Obstructive Pulmonary Disease (COPD)

Includes two common diseases:

- Emphysema
- Chronic bronchitis

- Slowly, **progressive** airway obstruction
- Disease does **NOT** go away!
- Takes years to become clinically apparent
- **1st symptom**: SOB on exertion
- People tend to subconsciously avoid exertion tasks to mask symptoms
• About **15 million** US adults have COPD diagnosis
  • Probably more, just undiagnosed
  • **Smoking** is the #1 cause
    • 6 – 10% of adult pop but up to 50% of smokers
  • Lifetime risk is now estimated at ¼
  • COPD kills more than 120,000 Americans each year
  • 1 death every 4 minutes
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Emphysema

Aka: Type A COPD

- \( \approx 4 \text{ million} \) diagnosed patients in the U.S.
- Abnormal enlargement of the air spaces due to destruction of alveolar wall
- Repeated and prolonged inflammation causes release of proteolytic enzymes that digests alveolar septal walls
- Most common cause: cigarette smoking
  - Tobacco allows destructive enzymes to work over time and destroy alveoli walls
Typical emphysema patient

"Pink puffer"

- **Thin** (working to breath all the time)
  - Average person: 4-5% calories breathing
  - Pink puffer: ~30% calories breathing
- Pursed lips respiration
- Tripoding
- SOB and tachypnea (breath quickly)
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Chronic bronchitis

- ≈ 10 million diagnosed patients in the U.S.
- Chronic bronchitis is more common than emphysema: ~3/4 of patients with COPD
- Leading cause is cigarette smoking, also air pollution and infections

**Definition**: Persistent, productive cough on most days for at least 3 consecutive months in 2 consecutive years
- This defines CHRONIC
- Anyone with a cold has had chronicitis – but those are acute symptoms
Chronic bronchitis (Smoker's cough)

- **Inflammation of the airways*** with hypertrophy of large airway mucous glands and **hypersecretion of mucus***
- Airway size is **compromised** and **obstructed**

**Clinical manifestations:**

- **Wheeze**ng - Tremendous mucus production blocking airways
- **Crackles** - Caused by edema
- **Tachycardia** is common but not universal
  - Periphery not getting enough O2 $\rightarrow$ lungs will breath faster and heart will pump faster to get blood out
- **Polycythemia** - ↑ RBC to carry O2 $\rightarrow$ ↑ risk of clotting

* - makes tube obstruct
Typical chronic bronchitis patient

“Blue bloaters”
- Stereotypical chronic bronchitis patient
- Chronic cough and expectoration
- Obese, edematous due to right sided heart failure
  - Heart has to push against closed capillaries when there is poor oxygenation of the lungs
- Increased anterioposterior chest diameter – using accessory muscles
- Cyanotic
- CO$_2$ narcosis can cause decreased memory and info processing ability
Chronic bronchitis

Lack of O2 causes a lot of ocular problems!

Associated with:
- Decreased VA especially at night
- Decreased color vision
- Transient visual obscurations (different from TIA)
- 7% had swollen optic nerve heads
- 82% had decreased retinal function as determined by abnormal VEP
- Increased risk with increased PCO₂ and decreased pH in blood
Treatment for chronic bronchitis and emphysema

**No curative** therapies but treatment may **slow** progression

- **Goal:** control of symptoms and avoiding harmful environments
  - Smoking cessation including vaping
  - Many still smoke with diagnosis
  - Pharmaceutical treatment very similar to treatment for asthma
**Pharmaceutical Tx for chronic bronchitis and emphysema**

**Bronchodilators**
- Short acting or long acting Beta-2 agonists
- Anticholinergics

**Anti-inflammatory drugs**
- **Glucocorticoids**
  - Most useful during exacerbations
  - May decrease number of exacerbations

**Combination medications**
- Steroid & long acting beta agonists
- Long acting beta agonist/long acting muscarinic antagonist

*Note: Many of the same meds as asthma!*
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Cystic fibrosis (CF)

- Most common lethal genetic disease that affects Caucasians
  - 1 in 3700 live births in North America
- Autosomal recessive trait:
  - \( \approx 1 \) in 30 Caucasians are carriers
- Multi-system disease associated with abnormal chloride transport of epithelial cells
  - Either protein is in wrong place or it doesn’t function well
  - Increases chloride and sodium content in sweat
  - “Sweat test”: mother’s kissing salty child
Cystic fibrosis

**Pulmonary involvement:**
- Infection with normal floral bacteria
- Followed by infection with other bacteria
  - Cilia not working well, can’t cough it out!
- Persistent *infection* and *inflammation* cause damage to airway walls and obliteration of small airways*
- Most patients **die** of *pulmonary failure secondary to infection*
- Two CF patients cannot be in the same room!
Many other organ systems are involved in CF

Any organ system with a duct will likely be affected!

- ↑ thickness of secretions causes blockage
- Poor digestion of fats
- Malabsorption of proteins and carbohydrates
- Infertility (fertility ducts blocked)
- Cirrhosis of liver (liver ducts blocked)
- Increased incidence of sleep apnea (sinuses blocked)

http://www.patient.org.in/lung/cystic-fibrosis.htm
Ocular involvement in CF

**Abnormal chloride transfer in the eye**
- Aqueous deficient dry eye with epithelial staining
- Reduced endothelial cell density
- Increased corneal thickness (edema)
- Posterior sub capsular cataract
- Reduced contrast sensitivity (CI problems in retina)
- Diabetic retinopathy (diabetes more common → pancreas issue)
- Nutritional effects: decreased macular pigmentation; Xerophthalmia
Tx of cystic fibrosis

No cure, try to improve length and quality of life!

**Airway clearance techniques**

- **Goal**: remove mucus build up to prevent infection
- **Medicinal method**:
  - Can use **dornase alpha (Pulmozyme)**
    - Makes sputum less viscous and easier to clear
    - Can cause condition similar to **bacterial conjunctivitis**
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Sleep apnea

- **Apnea**: complete cessation of respiration 10 seconds
- 2 forms of sleep apnea
  - 1. Central:
    - **Not** an obstructive disease
    - *Cheyne-Stokes* respiration: dysfunction in brain respiratory control centers
      - Poor feedback loop: low O\textsubscript{2} gets to brain $\rightarrow$ breathe MORE $\rightarrow$ high O\textsubscript{2} $\rightarrow$ breathe less (stops breathing) $\rightarrow$ low O\textsubscript{2}......
    - Often due to **heart failure** (slow response due to poor blood flow)
  - 2. Obstructive: mechanical (MOST common)
Obstructive Sleep Apnea (OSA)

- Most common sleep disorder
- Prevalence depends on how defined
- Most agree that 3-7% of adults have mod to severe sleep apnea
- Found in up to 1/4 of males over 20 years of age if include mild forms
- Women less commonly affected (tend to be post menopausal)
- Often undiagnosed (80%)
- Can also occur in children (ex: CF or down syndrome)
Obstructive Sleep Apnea (OSA)

**Symptoms**
- Loud snoring (patient unaware)
- Chronically disturbed sleep (patient unaware)
- Excessive daytime sleepiness
- Irritability, depression, and personality changes
- Morning headaches
- Tired upon awakening
- Cognitive impairment (MRI scans on mammillary bodies)
OSA pathophysiology

- OSA is due to complete collapse of upper airway* in sleep
  - Upper airway: soft palate, uvula, the jaw
  - As patient enters deep sleep, upper airway closes
  - Thrashes, snorts, partially awakens and reopens airway with a gasp
  - Can occur **hundreds** of time per hour

* - makes tube obstruct

http://www.aafp.org/afp/991115ap/2279.html
OSA contributing factors

These factors ONLY ↑ risk of having OSA:

- Most patients are **obese** and have "thick" necks
  - Fat around neck helps occlude airways
- May have small or receding jaw
- May have increased size of **soft palate** and **tongue**
- Often a history of heavy drinking
  - Alcohol relaxes muscles and less likely to wake from sleep
- History of asthma

http://www.aafp.org/afp/991115ap/2279.html
Medical conditions associated with OSA

- HTN in 30 to 50% with OSA; often difficult to control
  - Treating HTN drops BP by 3-5mmHg ( = to a med)
- Obesity
- Multiple sclerosis (loss of muscle tone)
- Diabetes (3X) (1.7X even if control for obesity)
  - Increased risk of retinopathy, especially macular edema (lack of O2)
- Cardiovascular disease (lack of O2)
  - Ischemic heart disease, MI and angina (4-7X)
  - Nocturnal cardiac arrhythmias (2– 4X)
  - Stroke (3-8X)
  - Heart failure
Obstructive sleep apnea increases the incidence of some conditions

**Likely due to decrease in O2 supply!**

- Alzheimer disease/ Brain atrophy/ Cognitive decline
- Emotional problems
- Impotence
- Osteoporosis (2X)
- Glaucoma (7-8% vs 2%) especially normal tension glc
- Anterior ischemic optic neuropathy
- Motor vehicle accidents (MVA) (2 – 7X): falling asleep while driving
- With CPAP use: Corneal dryness, Corneal ulcers, Bacterial ocular infections
THANK YOU

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