Pulmonology

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Part I:
Infectious Disorders

- Influenza
- Acute Bronchitis
- Pneumonia
- Tuberculosis
- Epiglottitis
- Pertussis

Influenza

Background:

- occurs as epidemics or pandemics (type A)
- most frequently in fall / winter

Etiology:

- orthomyxovirus
- three antigenic subtypes
  - A & B (A & B are similar clinically)
  - C (milder)
- transmitted via large resp droplets; incubation 1-4d

Influenza

Clinical Findings:

epithelial necrosis leading to bacterial superinfection (esp. with pneumococcus or *S. aureus)*

abrupt onset, fever, chills, headache, coryza, myalgias (esp. back and legs), sore throat, proteinuria, leukopenia, cervical lymphadenopathy

Diagnosis:

usually clinical (aka presumptive)

rapid Ag tests (nasal/pharyngeal)

fever and cough in areas of epidemic:

positive predictive value of 80%

Influenza

	Prophylaxis	Treatment (w/i 48 hrs)	Ages
amantadine	**A**	**not recommended**	**≥ 1**
rimantadine	**A**	**not recommended**	**≥ 1**
oseltamivir (Tamiflu)	**A/B**	**A/B**	**> 1***
zanamivir (Relenza)	**A/B**	**A/B**	**> 7***

Influenza

Prevention (85% with annual vaccines)

- Influenza A/B vaccine for:
  - over >50
  - any adult or child with chronic medical problems (esp. cardiac & respiratory)
  - nursing home residents
  - healthcare workers
  - pregnant women
  - children 6-59 months
  - household contacts of those above
  - contraindications to vaccines: allergy to eggs, acute febrile illness, thrombocytopenia

Influenza

Watch For…. **<u>Reye's syndrome</u>:**

children with A/B and VZV treated with salicylates

presents with hepatic and CNS complications

Acute Bronchitis (aka tracheobronchitis)

Etiology:

>90% are viral (rhino, corona, RSV, etc)

inflammation of airways (trachea, bronchi, bronchioles) characterized by cough

Clinical Findings:

cough *with or without* sputum (color not predictive of bacteria), fever, or substernal discomfort

expiratory rhonchi or wheezes

Labs/Diagnosis:

CXR: absence of markings

but…..true bronchitis difficult to distinguish from pneumonia…get a CXR!

Acute Bronchitis (*aka tracheobronchitis*)

Treatment:

antibiotics are only indicated for the following:

- elderly
- cardiopulm diseases + cough > 7-10 d
- immunocompromised

What is appropriate?

- treat symptoms (OTC meds +/-)
- bronchodilators if airflow obstruction

cough can persist

- 3 weeks in 50% of patients
- >1 month in 25%

Community Acquired Pneumonia (CAP)

Background:

- #1 infectious cause of death in US; #6 overall
- generally acquired via aspiration of previously colonized upper airway
- acquired in the home or non-hospital environment

Etiology:

- bacteria isolated more than viruses (e.g. influenza, RSV, adenovirus, parainfluenza)
- *S. pneumo* (m.c. bacterial) >*H. influenza* > *M. cat*
- Atypicals: *Legionella, Mycoplasma*, & *Chlamydia*

Community Acquired Pneumonia (CAP)

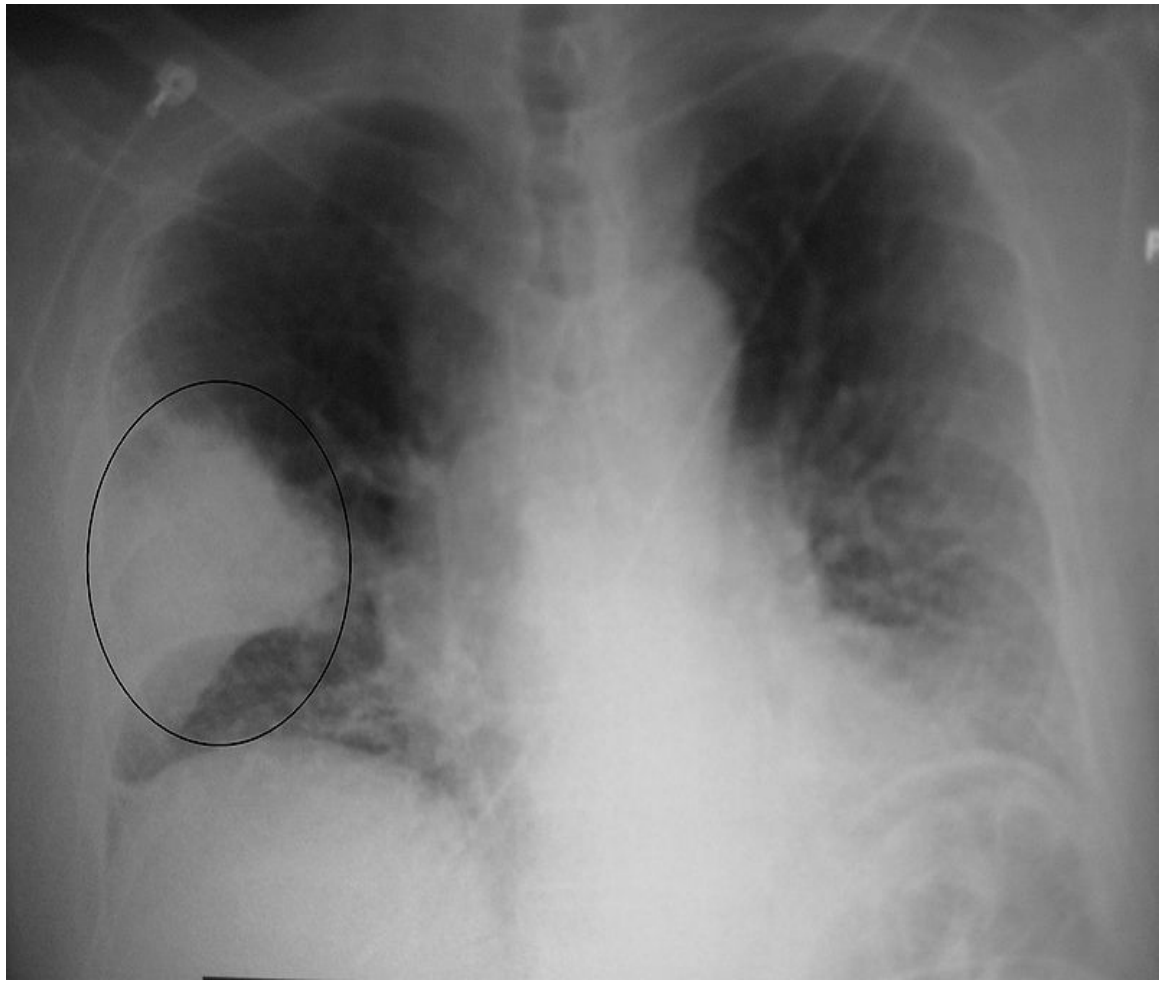
Clinical Findings:

- most common signs are tachycardia/tachypnea
- fever/hypothermia; rigor/sweats;
- new cough + / ─ sputum, dyspnea
- altered breath sounds/rales
- dullness to percussion with effusion
- *but*.....chest exam alone not accurate to confirm/exclude diagnosis

Community Acquired Pneumonia (CAP)

Labs/Diagnosis: ***clinical diagnosis!***

- sputum gram stain
- sputum C&S (less sensitive and specific)
- CXR: patchy, segmental lobar, multi lobar consolidation
  - no pattern is pathognomonic
- Ag studies (*Legionella, Pneumococcus*, respiratory viruses)
- blood cultures x 2 (if hospitalized)



A very prominent pneumonia of the middle lobe of the right lung

Source: http://en.wikipedia.org/wiki/File:PneumonisWedge09.JPG

Community Acquired Pneumonia (CAP)

Treatment:

- outpatient:
  - doxycycline, erythromycin
  - macrolides (clarithro >> azithro)
  - respiratory fluoroquinolones
- inpatient:
  - coverage of *S. pneumo* and *Legionella*
    - ceftriaxone (cefotaxime) plus macrolide
    - respiratory fluoroquinolones
- hospitalization for CAP?
  - clinical judgment
  - PORT classification
  - consider if: age > 50 with co-morbidities, altered mental status, or hemodynamically unstable

Community Acquired Pneumonia (CAP)

Prevention: pneumococcal vaccine
age > 65 or co-morbid conditions

Remember…

- Expect improvement in 48 -72 hrs with the right antibiotic
- CXR may worsen but patient improves clinically
- Fever can last 2-5d with pneumococcus; longer with others
- Rales can persist > 7 days in up to 40% of patients
- CXR may not clear for several weeks
- If patient not responding to initial therapy…

consider: virus, TB, resistant organism, *Pneumocystis* or non- infectious illness

Community Acquired Pneumonia (CAP)

M. pneumoniae -low grade fever -cough -bullous myringitis -cold agglutinins ***P. jiroveci (PCP)*** -slow onset -increased LDH -more hypoxemic than CXR seems -"ground glass" infiltrates **rats** *-Y. pestis*	***L. pneumophila*** -hyponatremia -diarrhea ***C. psittaci*** -psittacine birds -Zoonotic disease ***S. pneumoniae*** -single rigor -rust colored sputum **COPD** *-H. flu*	**alcoholics** *-K. pneumoniae:* currant jelly sputum (dark red mucoid) **cystic fibrosis** *-Pseudomonas* **college student** *-Mycoplasma* *-Chlamydia* **air conditioning / aerosolized water** *-Legionella* **HIV/AIDS** *- P. jiroveci*	**rabbits** *-F. tularensis* **post splenectomy** -encapsulated organism *-S. pneumo* *-H. flu* **leukemia** -fungus **children < 1 year** *-RSV* **children 2-5 years** *-parainfluenza*

Pneumonia: Nosocomial (HCAP)

Background:

onset of pneumonia > 72 hours after admission

highest risk: ICU patients on ventilation

#2 cause of hospital acquired infection

mortality from 20-50%

Etiology:

variable geographically

based on patient risk factors

Pseudomonas, *S. aureus,* Klebsiella*, E. coli, Enterobacter*

Pneumonia: Nosocomial (HCAP)

Clinical Findings (same as CAP):

- most common signs are tachycardia/tachypnea
- fever/hypothermia; rigor/sweats; new cough + / — sputum, dyspnea
- altered breath sounds/rales; dullness to percussion with effusion

Diagnosis (CDC use for epidemiology):

- onset in 72 hours
- PE with rales/dullness or infiltrate on CXR
- one of following:
  - purulent sputum
  - isolated pathogen
  - Ab titers
  - histopathologic evidence of pneumonia

Pneumonia: Nosocomial (HCAP)

Labs/Diagnosis:

- blood culture
- sputum +/-
- CXR evidence of new infiltrate if VAP

Treatment:

- varies with organism, CXR findings, and Abx sensitivities
- empirical initially with broad coverage
  - cefepime
  - ticarcillin/clavulanic acid
  - piperacillin/tazobactam
  - meropenem

Pneumonia: HIV Related

Background:

Pneumocystis jiroveci (formerly PCP)

Etiology:

most common opportunistic infection assoc. with AIDS (CD4 < 200)

also occurs in patients with CA, malnourished, immunosuppressed

Clinical Findings:

typically sub acute in presentation

fever, tachypnea, SOB, non-productive cough

Pneumonia: HIV Related

Labs/Diagnosis:

difficult to diagnose due to non-specific symptoms (fever, cough, SOB)

CXR: cornerstone of diagnosis with diffuse or peri-hilar infiltrates

no effusions seen

lymphopenia with low CD4 count

sputum if possible to isolate the organism

bronchoalveolar lavage

Treatment: TMP/SMX (or pentamidine, atovaquone, others)

Other: extremely high mortality (near 100%) if not tx

primary prophylaxis

TMP/SMX

all AIDS patients with CD4 < 200

Tuberculosis

Background:

- overall, 10% infected with TB will develop the disease
- Primary TB
  - 95 % become Latent TB Infection (LTBI)
    - not considered infectious
    - cannot spread TB
    - asymptomatic
    - *but* have inactive TB in their body
  - 5% become Progressive Primary TB (PPTB)
- Secondary
  - usually reactivation TB develops from LTBI

Etiology: *M. tuberculosis:* transmitted by resp. droplets

Tuberculosis

Clinical Findings:

- may be asymptomatic
- ***cough is most common symptom***
- classic symptom complex: fever, drenching night sweats, anorexia, weight loss
- common pulmonary symptoms
  - cough, pleuritic chest pain, SOB, hemoptysis
  - ***post-tussive rales are classic***

Diagnosis:

- CXR, sputum culture, acid fast stain of sputum smear
  - **organism necessary to obtain susceptibilities*

Tuberculosis

Labs: Sputum: AFB

PPD: measure induration, *not erythema*

positive indicates exposure not necessarily active ds

CXR: Primary:

homogeneous infiltrates

hilar/paratracheal lymph node enlargement

segmental atelectasis

cavitations with progressive disease (PPTB)

Reactivation:

fibrocavitary apical ds., nodules, infiltrates

posterior and apical segments of RUL

apical-posterior segments of LUL

superior segments of LL

miliary pattern in hematogenous dissemination

Tuberculosis

Ghon/Ranke complexes: healed primary infection

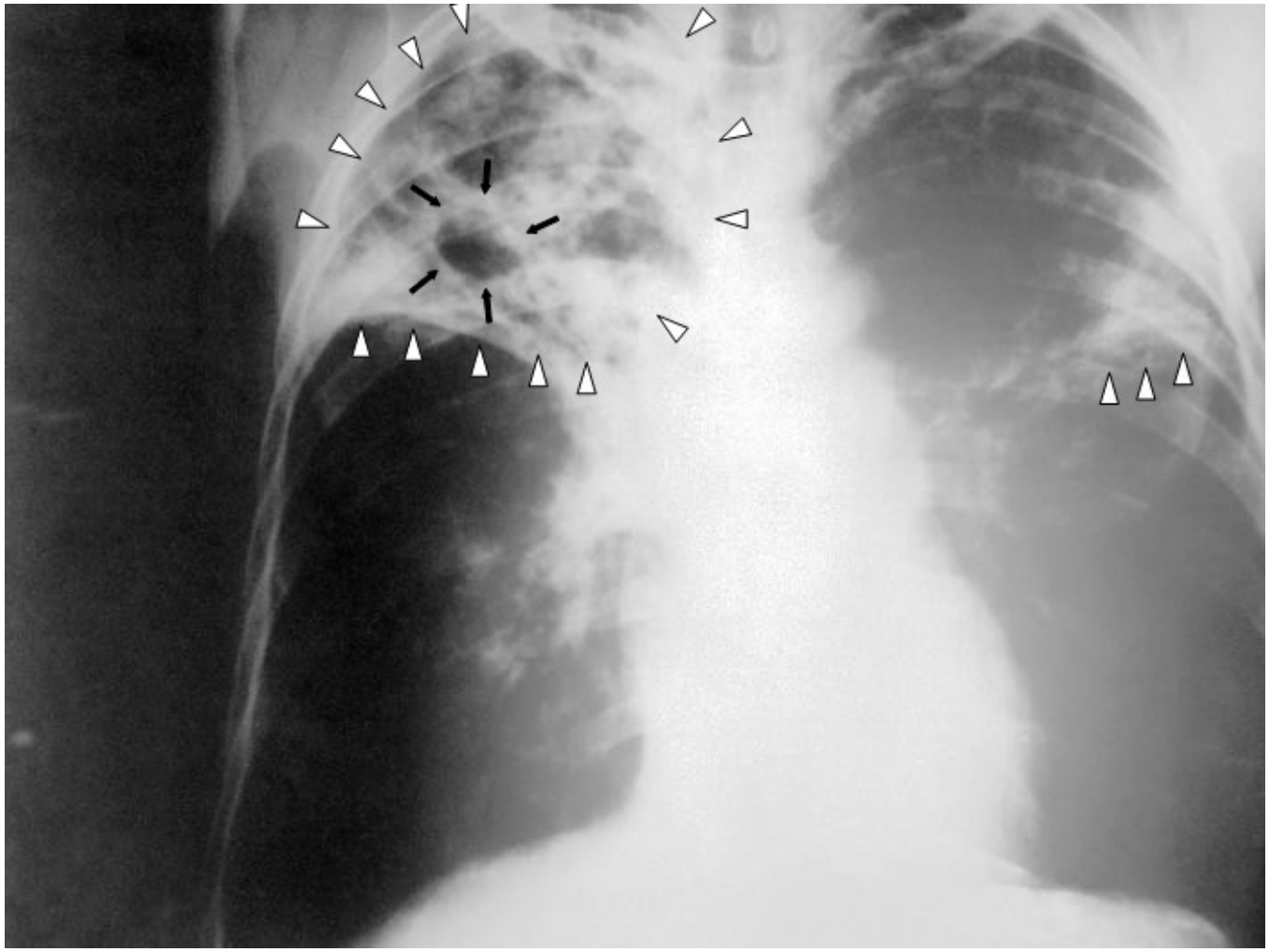
Biopsy:

caseating granulomas (aka necrotizing granulomas) is the histologic hallmark

Miscellaneous:

Pott's Disease: extrapulmonary TB (tuberculous spondylitis)

m.c. in thoracic spine



An AP CXR of a patient with advanced bilateral pulmonary tuberculosis. It reveals the presence of bilateral pulmonary infiltrate (white triangles), and "caving formation" (black arrows) present in the right apical region.

Source: http://phil.cdc.gov/phil/home.asp ID#: 2543 US Department of Health and Human Services

Tuberculosis

Classification Of Positive Tuberculin Skin Test Reactions	
Reaction Size	**Group**
≥ 5 mm	1. HIV positive persons 2. Recent contacts of those with active TB 3. Persons with evidence of TB on CXR 4. Immunosuppressed patients on steroids
≥ 10 mm	1. Recent immigrants from countries with high rate of TB infection 2. HIV negative injection drug users 3. Mycobacteriology lab personnel 4. Residents/Employees of high risk congregate settings 5. Persons with certain medical conditions: DM, silicosis, CRF, etc. 6. Children < 4 years of age 7. Infants, children, adolescents exposed to adults at high risk
≥ 15 mm	1. Persons with no risk factors for TB

Measure induration (not erythema) at 48-72 hours

http://en.wikipedia.org/wiki/File:Mantoux_test.jpg

Tuberculosis

Treatment:

LTBI: (treat only after active TB is ruled out!)

INH x 9 months *or*

PZA and RIF x 2 months *or*

RIF x 4 months (only if in contact with TB resistant persons)

Active TB:

INH/RIF/PZA/EMB x 2 months…then, INH/RIF x 4 months (if sensitive)

Tuberculosis

Anti-tuberculous class specific side effects

INH	→	hepatitis, peripheral neuropathy co-administer Vitamin B6 (pyridoxine)
RIF	→	hepatitis, flu syndrome, orange body fluids
EMB	→	optic neuritis, red-green vision loss

Tuberculosis

Treatment Considerations

- Multiple drugs are necessary
- Sensitivity testing is important
- Single daily dose is effective
- Prolonged treatment may be necessary
- Ensure compliance

Epiglottitis (supraglottitis)

Etiology: viral or bacterial

Signs/Symptoms:
- rapidly developing sore throat ***or*** odynophagia is out of proportion to clinical findings

Labs: laryngoscopy, lateral films (thumb print sign)

Treatment: ceftizoxime or cefuroxime; dexamethasone

Pertussis

Background:
- usually affects infants and young children
- incidence increasing in adults (27% of all cases)
- protection from childhood vaccines wears off

Etiology:
- *Bordatella pertussis*
- transmitted via respiratory droplets
- incubation 6-20 days (most often 7 days)

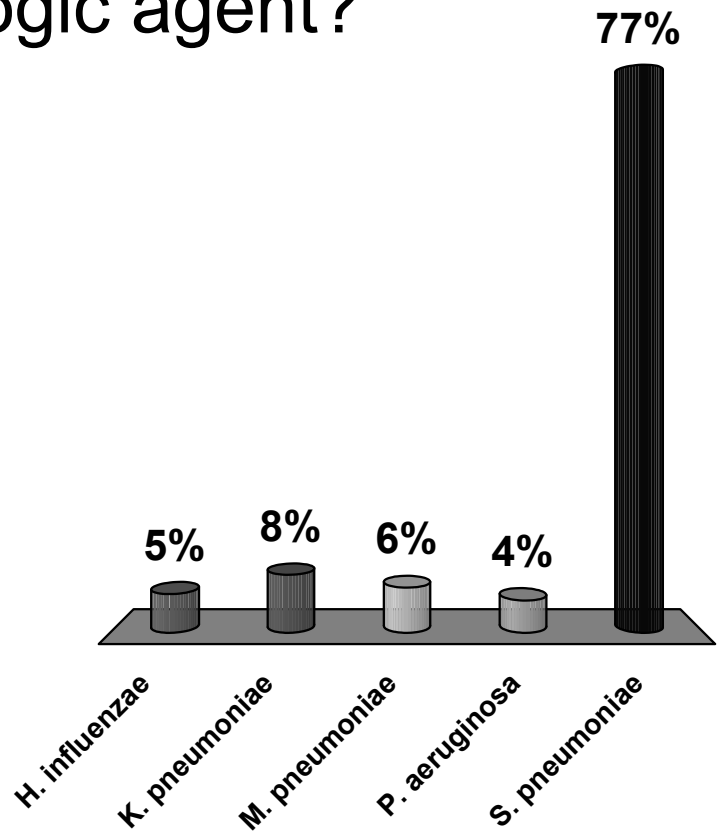
Clinical Findings:
- resembles common cold/bronchitis
- “whoop” rare in adults

Pertussis

Labs:	• PCR is current diagnostic standard
	• more sensitive then culture
Treatment:	• antibiotics to eradicate organism *but does not alter course of illness*
	• erythromycin, azithromycin, clarithromycin or TMP-SMX
Prevention:	vaccination with Tdap (instead of Td)
Prophylaxis:	same as treatment when given within 3 weeks of onset of cough in index case

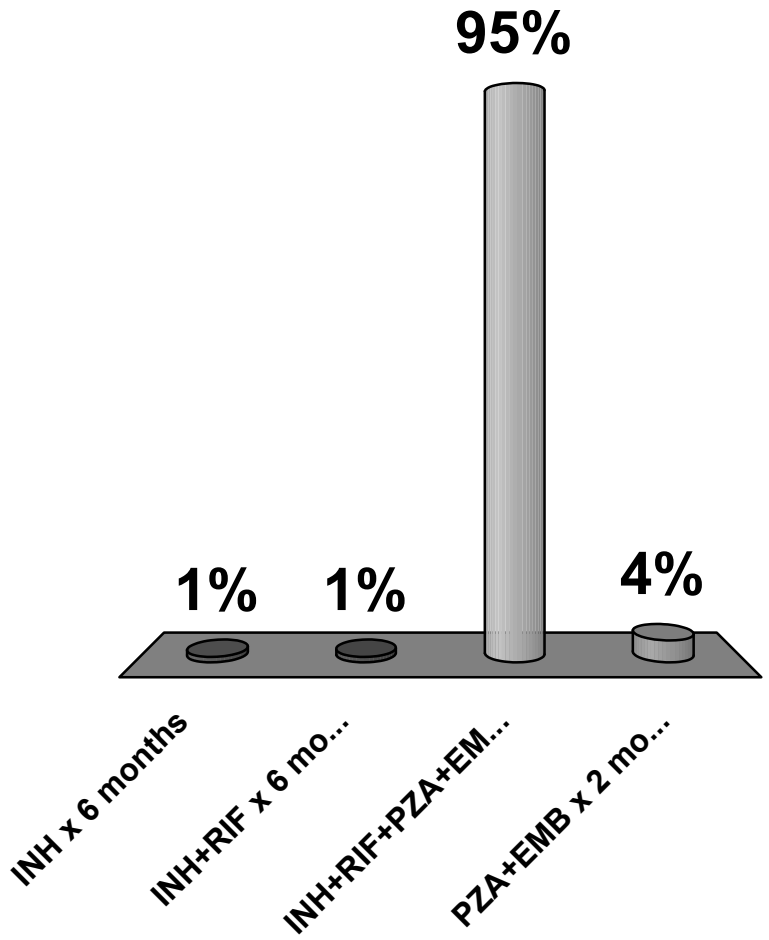
A 72 year-old male patient presents c/o acute onset of fever, with pleuritic chest pain, a single rigor, and rust colored sputum. CXR is normal. What is the most likely etiologic agent?

A. *H. influenzae*
B. *K. pneumoniae*
C. *M. pneumoniae*
D. *P. aeruginosa*
E. *S. pneumoniae*



Which of the following regimens is most appropriate for the treatment of active TB in immunocompetent patients?

A. INH x 6 months
B. INH+RIF x 6 months
C. INH+RIF+PZA+EMB x 2 months then INH+RIF x 4 months
D. PZA+EMB x 2 months then INH+RIF x 4 months



Part II:
Neoplastic Diseases

- Pulmonary Nodules
- Bronchogenic Carcinoma
- Carcinoid Tumors
- Metastatic (Secondary) Tumors

Solitary Pulmonary Nodule

Background:

a.k.a. coin lesion, lung nodule

lesion < 3cm (if > 3cm = “mass”)

40% are malignant

Etiology:

most are infectious granulomas: (old or active TB, fungal infection, foreign body reaction)

carcinoma

hamartoma

metastasis (usually multiple)

bronchial adenoma (95% are carcinoid tumors)

Solitary Pulmonary Nodule

Clinical Findings: most are asymptomatic

Labs/Diagnosis:

CXR: lesion < 3 cm, isolated, rounded opacity surrounded by normal lung

old radiographs for comparison?

compare size (doubling time)

larger → malignancy

rapid growth → infection

no growth → benign

Solitary Pulmonary Nodule

Labs/Diagnosis:

CT: determine nature, location, progression, extent evaluate with CT and biopsy for diagnosis

smooth, well defined	→	often benign
ill defined/lobular	→	suggests CA
spiculated/peripheral halo	→	often CA

Solitary Pulmonary Nodule

Solitary Nodule Comparison		
	malignant	***benign***
age	> 45-50	< 35
calcifications	absent to irregular calcifications	central/uniform/laminated or popcorn like
size	>2cm	<2cm
old films	new or larger	no change
margins	irregular	regular

Solitary Pulmonary Nodule

Treatment:

- >35 years old: resect unless no change in 2 years
- <35 years old, lesion is unchanged, can repeat study in 3-6 months

Bronchogenic CA

Background

- 90% of lung CA is bronchogenic
- leading cause of cancer deaths in men ***and*** women
- *more deaths from lung cancer then colon, breast, and prostate combined!*
- 5-year survival is 15%
- cigarette smoking is #1 risk factor

Bronchogenic CA

Classification Scheme

SCLC: early mets & aggressive clinical course
assumes micro metastases at presentation

NSCLC: (adeno, squamous, large cell)
slower spreading
more amenable to treatment (i.e., surgery)

Clinical Findings

often presents in 50s-70s
cough, dyspnea, hemoptysis, anorexia, weight loss

Bronchogenic CA

Main histological types

- Squamous (25-35% of cases)
  - keratinization w/ keratin "pearl" formation
  - centrally located, intraluminal mass
  - hemoptysis is common
- **Adenocarcinoma** (***m. c. with 35-40% of cases***)
  - peripheral mass or nodules
- Large Cell (5-10% of cases)
  - heterogeneous group of undifferentiated tumors w/ large cells usually peripherally
  - doesn't fit in other groups
  - fast doubling rates
- Small Cell (15-20% of cases)
  - bronchial origin begins centrally, infiltrating to cause bronchial narrowing/obstruction without a discreet luminal mass

Bronchogenic CA

Labs/Diagnosis:

- cytology & biopsy
- TNM classification only applies to NSCLC

Treatment:

- depends on type/extent of disease
- surgery, chemo, radiation

Other:

- common sites of metastases:
  - bone, brain, adrenal glands, liver

Bronchogenic CA

S.P.H.E.R.E. of Lung CA Complications	
SVC Syndrome	compression of SVC: plethora, H/A, mental status changes
Pancoasts Tumor	tumor of the lung apex causes Horner's syndrome and shoulder pain affects brachial plexus & cervical sympathetic n.
Horner's Syndrome	unilateral facial anhidrosis, ptosis, miosis
Endocrine	Carcinoid syndrome: flushing, diarrhea, telangiectasias
Recurrent Laryngeal Symptoms	hoarseness
Effusions	exudative

Bronchogenic CA

Paraneoplastic Syndromes		
Classification	**Syndrome**	**Histological Type**
Endocrine/Metabolic	Cushing's Syndrome SIADH Hypercalcemia Gynecomastia	Small Cell Small Cell Squamous Cell Large Cell
Neuromuscular	Peripheral neuropathy Myesthenia (Eaton-Lambert) Cerebellar Degeneration	Small Cell Small Cell Small Cell
Cardiovascular	Thrombophlebitis	Adenocarcinoma
Hematologic	Anemia DIC Eosinophilia Thrombocytosis	All All All All
Cutaneous	Acanthosis nigricans	All

Carcinoid Tumor

Background:

- aka “carcinoid adenomas”, “bronchial gland tumors”
- well-differentiated neuroendocrine tumors
- men=women; usually under age 60
- *m.c. location: GI tract; also lung*

Etiology:

- low-grade malignant neoplasms
- pedunculated / sessile growth in the central bronchi

Carcinoid Tumor

Clinical Findings:

- usually asymptomatic
- localized bronchial obstruction
- hemoptysis, cough, focal wheezing, recurrent pneumonia
- carcinoid syndrome
  - flushing, diarrhea, wheezing, hypotension
  - occurs in 10% of patients

Labs/Diagnosis:

- CT and octreotide scintigraphy for localization
- Bronch / CT → surgery

Treatment:

- surgical excision
- octreotide for symptoms
- most are resistant to radiation and chemotherapy

Mesothelioma

Background:

primary tumors from pleural lining (80%) or peritoneum (20%)

Etiology: *history of asbestos exposure*

Clinical Findings:

insidious onset of SOB, non-pleuritic chest pain, weight loss; dullness to percussion, decreased breath sounds, digital clubbing

Mesothelioma

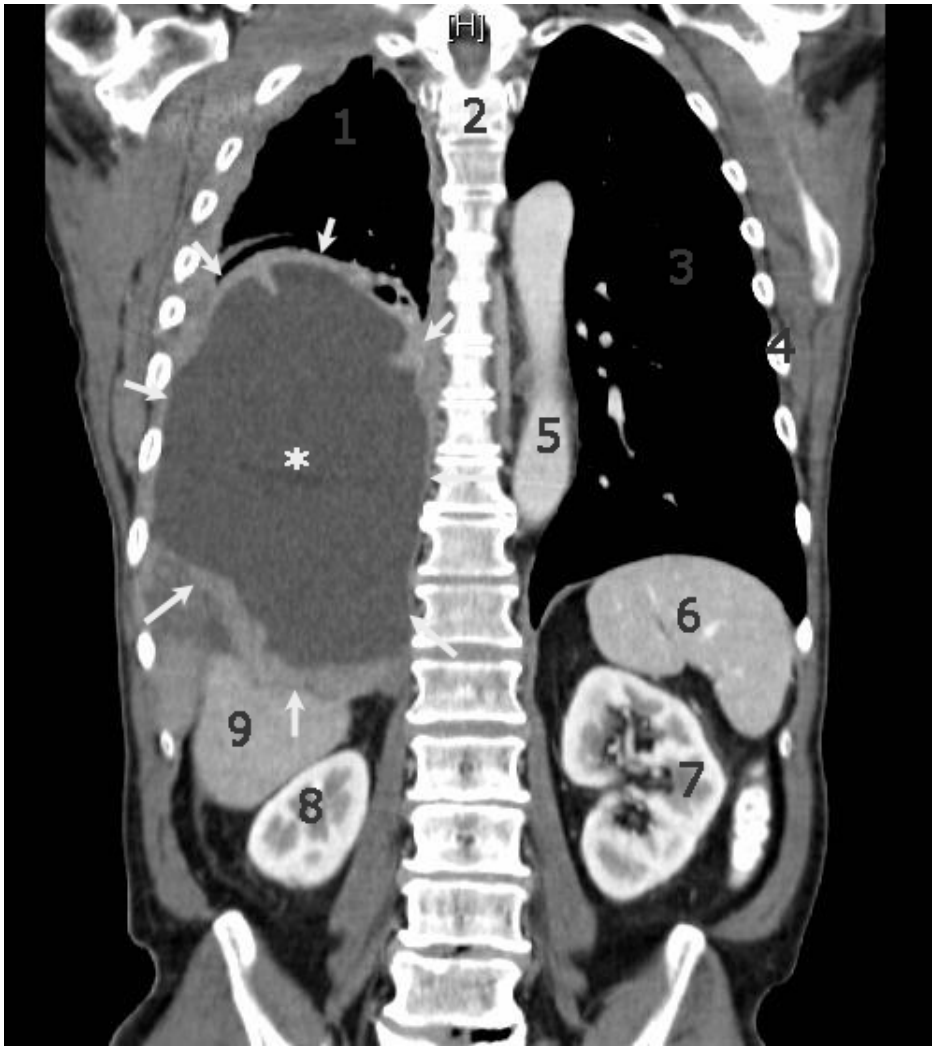
Labs/Diagnosis:

- pleural fluid is exudative and hemorrhagic
- CXR reveals nodular, irregular, unilateral pleural thickening, and effusion
- video assisted thoracic surgery (VATS): biopsy

Treatment:

- none that are effective
- some do chemo/radiation

Other: five year survival is less than 5%



Malignant mesothelioma marked by yellow arrows

Source: http://commons.wikimedia.org/wiki/File:Tumor_Mesothelioma2_legend.jpg

Secondary Lung Cancer

represents extra-pulmonary metastases

most frequently primary's that mets to lung:

breast, liver, colon

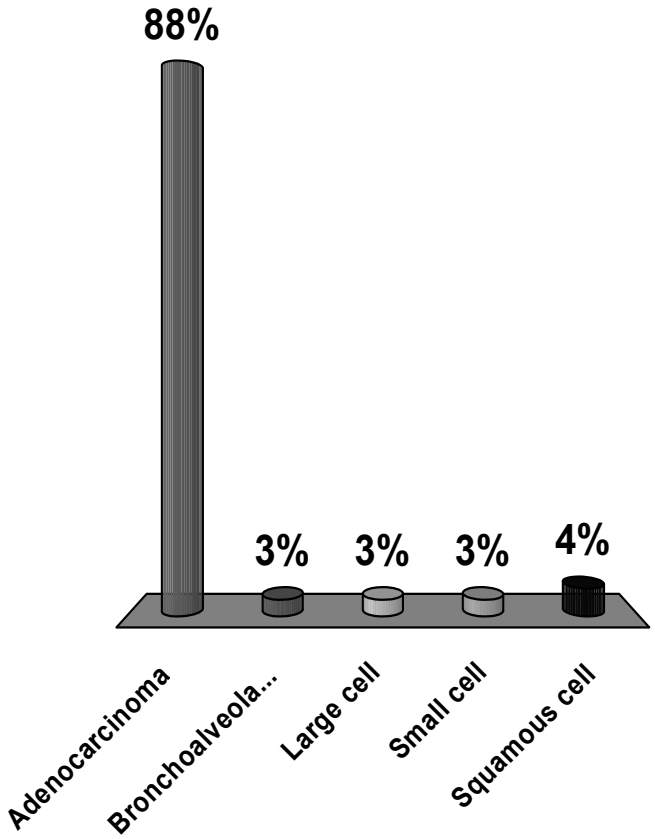
almost any CA can spread to lungs

imaging reveals multiple nodules/masses

diagnose and treat the primary tumor

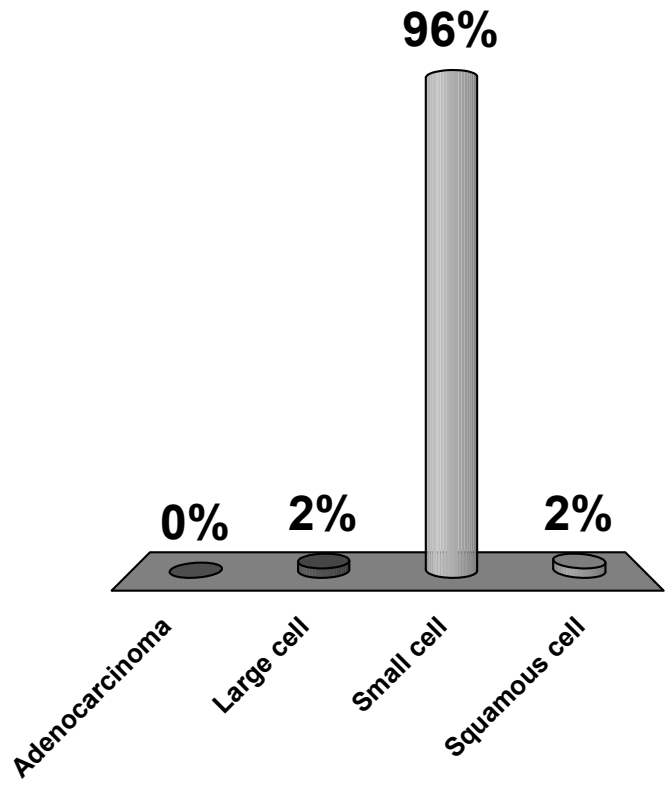
Which of the following is the most common type of lung cancer in non-smokers?

A. Adenocarcinoma
B. Bronchoalveolar
C. Large cell
D. Small cell
E. Squamous cell



For which of the following types of lung cancer is surgery generally not indicated?

A. Adenocarcinoma
B. Large cell
C. Small cell
D. Squamous cell



Part III:
Obstructive Pulmonary Disease

- Asthma
- Bronchiectasis
- Chronic Bronchitis
- Emphysema

Obstructive Pulmonary Disease

↓ FEV/FVC

Normal / ↑ TLC

Asthma

Background:

- "reversible" airway condition
- characterized by:
  - acute inflammation
  - bronchial hyper reactivity
  - mucus plugging
  - smooth muscle hypertrophy
- **Atopy** is the strongest identifiable factor:
- Atopic "triad": *wheeze, eczema, seasonal rhinitis*

Asthma

Etiology:

Precipitants: allergens (esp. dust and dust mites), exercise, URI, post nasal drip, GERD, meds (**beta blocker**, ACEI, **ASA**, NSAIDS), stress, cold air

Clinical Findings:

episodic/chronic symptoms of airway obstruction

breathlessness, cough, wheeze

1/3 of children have no wheeze

prolonged expiration/diffuse wheeze

Asthma

Classification Of Severity			
	Symptoms	**Nighttime Symptoms**	**Lung Function**
Intermittent	≤ 2x/week	≤2x/month	FEV1 > 80% predicted FEV1/FVC normal
Mild Persistent	>2x/week but not daily	3-4x/month	FEV1 > 80% predicted FEV1/FVC normal
Moderate Persistent	Daily Daily use of beta agonist	>1x/week but not nightly	FEV1 > 60% but < 80% pred. FEV1/FVC reduced 5%
Severe Persistent	Throughout the day	Often 7x/week	FEV1 < 60% pred. FEV1/FVC reduced > 5%

Asthma

Labs/Diagnosis:

ABGs: mild hypoxia and respiratory alkalosis

Peak Flow: diminished

CBC: eosinophilia

CXR: hyperinflation

spirometry (pre and post therapy)

decreased FEV1/FVC (<75%)

definitive test: metacholine challenge test

(aka bronchial provocation test)

FEV1 decreases by > 20%

$\geq$ 10% ↑ FEV with bronchodilator therapy

Asthma

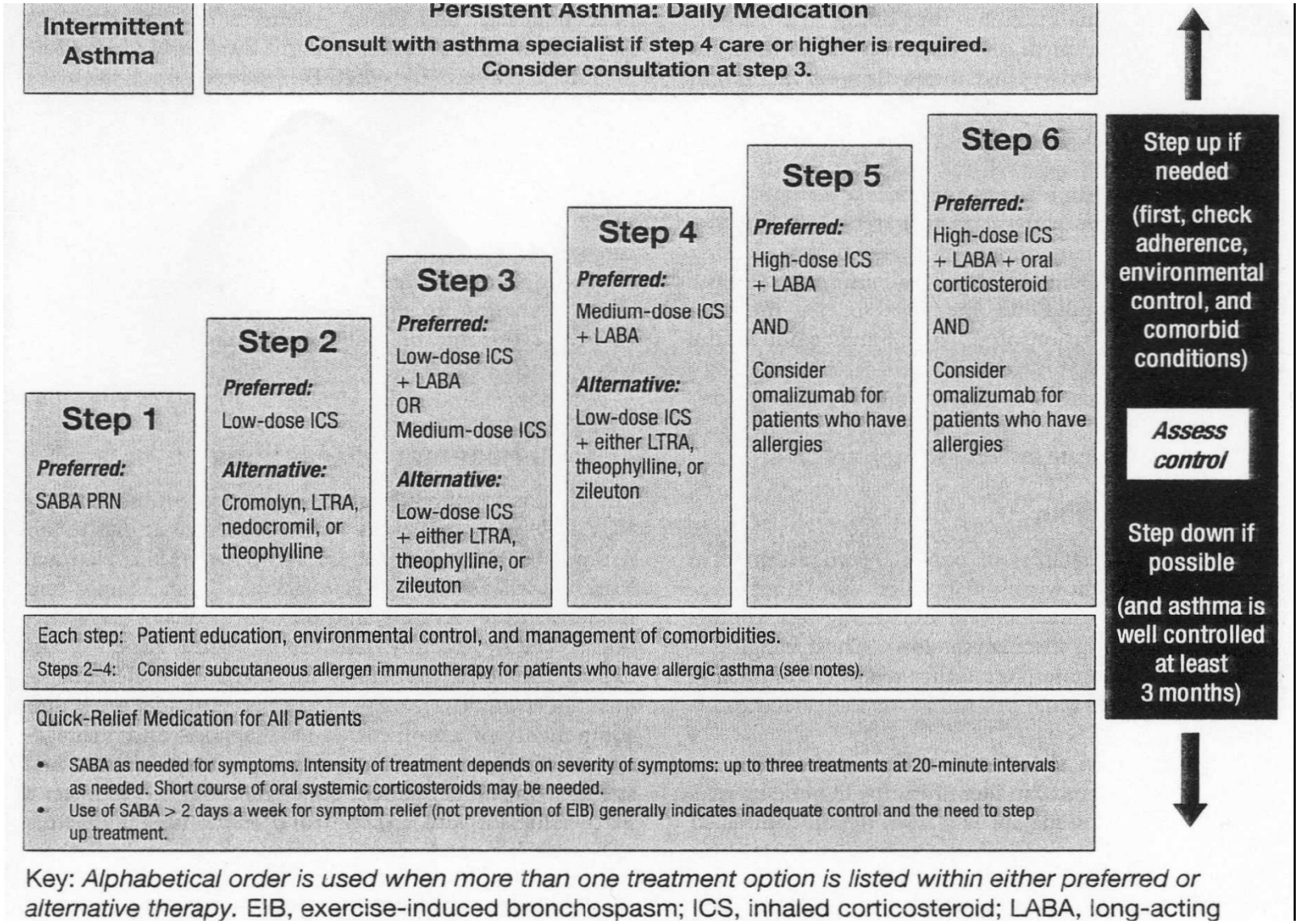
Treatment:

- General
  - remove irritants
  - education on peak flow measurements
  - desensitization
  - oxygen
- Pharmacological
  - Quick relief meds
    - INH beta 2 agonists (e.g. albuterol)
    - glucocorticoids (e.g. prednisone)
    - anticholinergics (e.g. ipratropium)

Asthma

Long-term control therapy

- INH steroids (e.g. fluticasone, budesonide)
  - mainstay for **persistent** asthma
- Long acting bronchodilators
  - INH mast cell stabilizers (e.g. cromolyn)
  - INH beta 2 agonists (e.g. salmeterol):
    - good for mild persistent or EI asthma
  - leukotriene inhibitors (e.g. montelukast (Singulair))
- phosphodiesterase inhibitors (e.g. theophylline)



National Asthma Education and Prevention Program, Expert Panel Report 3: Guidelines for the Diagnosis and Management of Asthma, NIH Pub No 08-4051, 2007

Bronchiectasis

Background:

permanent dilation/destruction of the bronchial walls

Etiology:

congenital: Cystic Fibrosis

acquired: recurrent infections (TB, fungal infection, lung abscess) obstruction (tumor)

Clinical Findings:

foul breath, chronic cough with purulent sputum, hemoptysis, recurrent pneumonia, weight loss, anemia, persistent basilar crackles

Bronchiectasis

Labs/Diagnosis:

Sputum smear/culture

CXR: ***tram track lung markings***

honeycombing

atelectasis

CT (HRCT): diagnostic test of choice

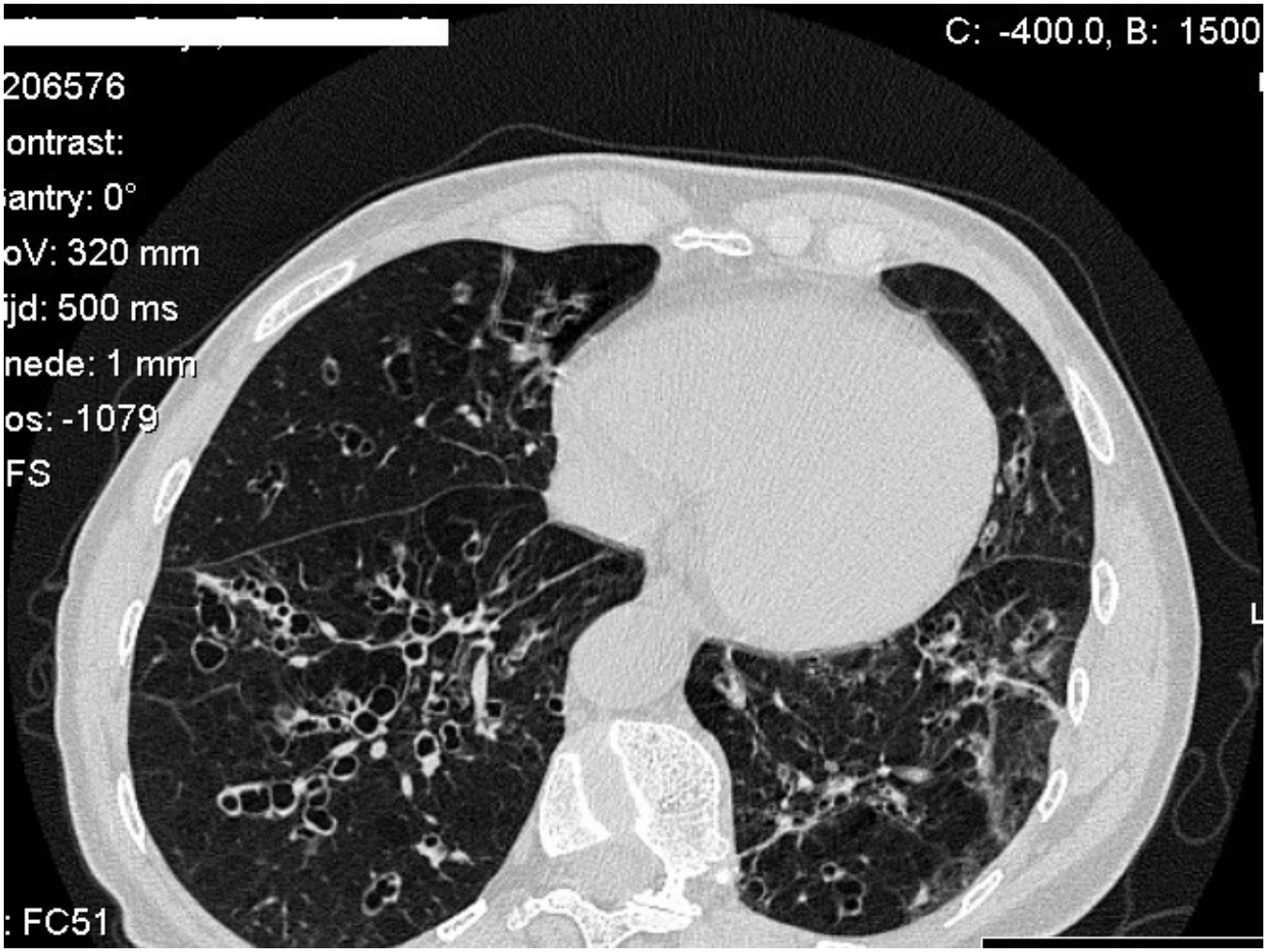
thickened bronchial walls with dilated airways

Clinical diagnosis with radiological support

Bronchiectasis

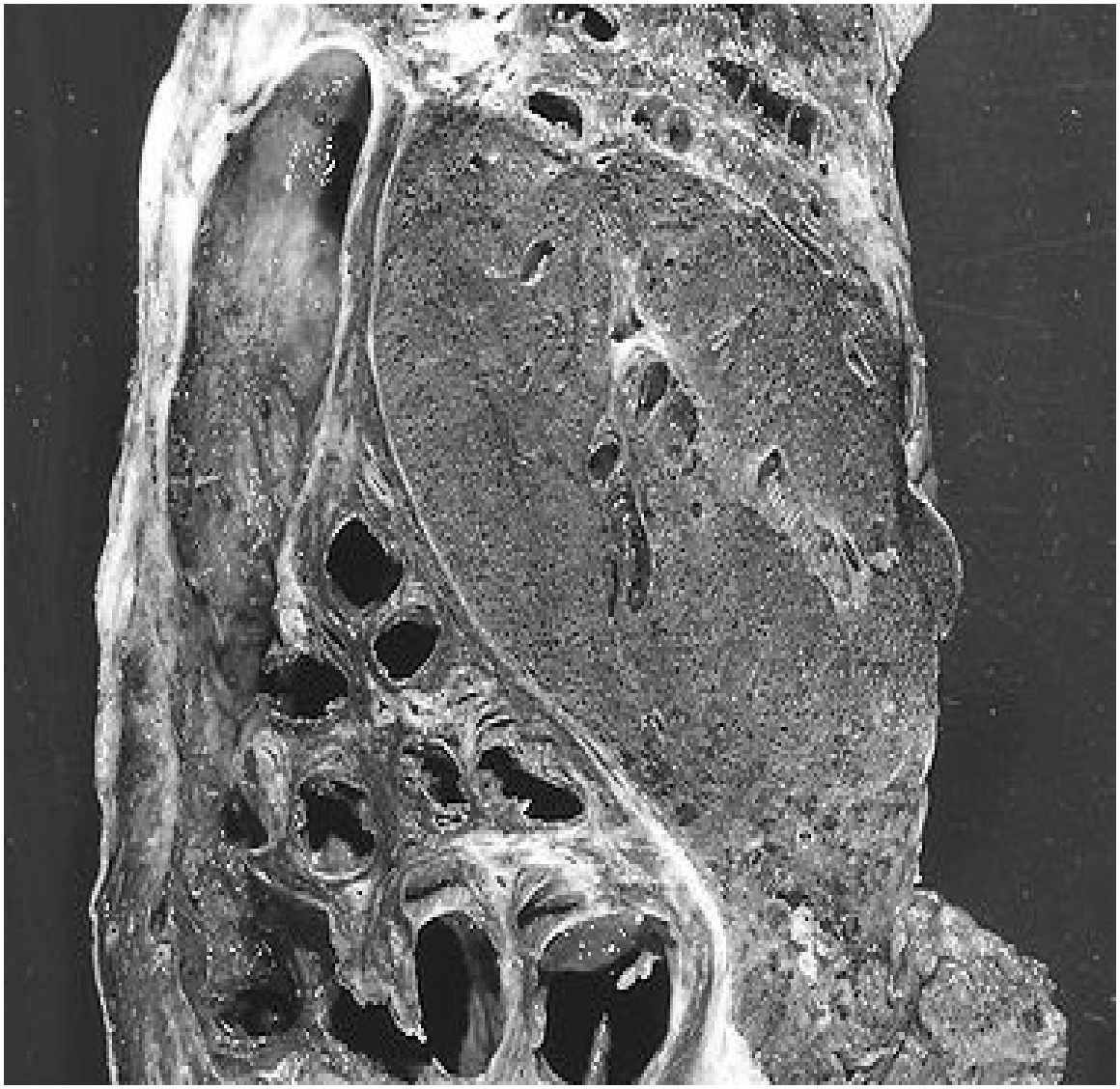
Treatment:

- ambulatory oxygen
- aggressive antibiotics (10-14 days):
  - amoxicillin
  - Augmentin
  - Bactrim (TMP/SMX)
- INH bronchodilators for maintenance and acute exacerbations
- lung transplantation



Lung CT with thin slices (1 mm) showing bronchiectasis in the lower lung lobes of a subject with type ZZ alpha-1-antitrypsin deficiency. There are no signs of emphysema.

Source: Fregonese L, Stolk J. Hereditary alpha-1-antitrypsin deficiency and its clinical consequences. Orphanet J Rare Dis. 3, 1, 16. 2008. doi:10.1186/1750-1172-3-16. PMID 18565211.



Source: http://www.flickr.com/photos/pulmonary_pathology/3791074491/ |Date= |Author=Yale Rosen |Permission=[http://creativecommons.org/licenses/by-sa/2.0/ CC-BY-SA 2.0] |other versions= }}
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COPD: Chronic Bronchitis/Emphysema

Background:

airflow obstruction due to chronic bronchitis or emphysema

most patients have features of both

<u>Emphysema</u>:

permanent air space enlargement distal to terminal bronchiole with alveolar wall destruction

<u>Chronic Bronchitis</u>:

increased bronchial secretions

cough for > 3 months over at least 2 years

COPD: Chronic Bronchitis/Emphysema

Etiology

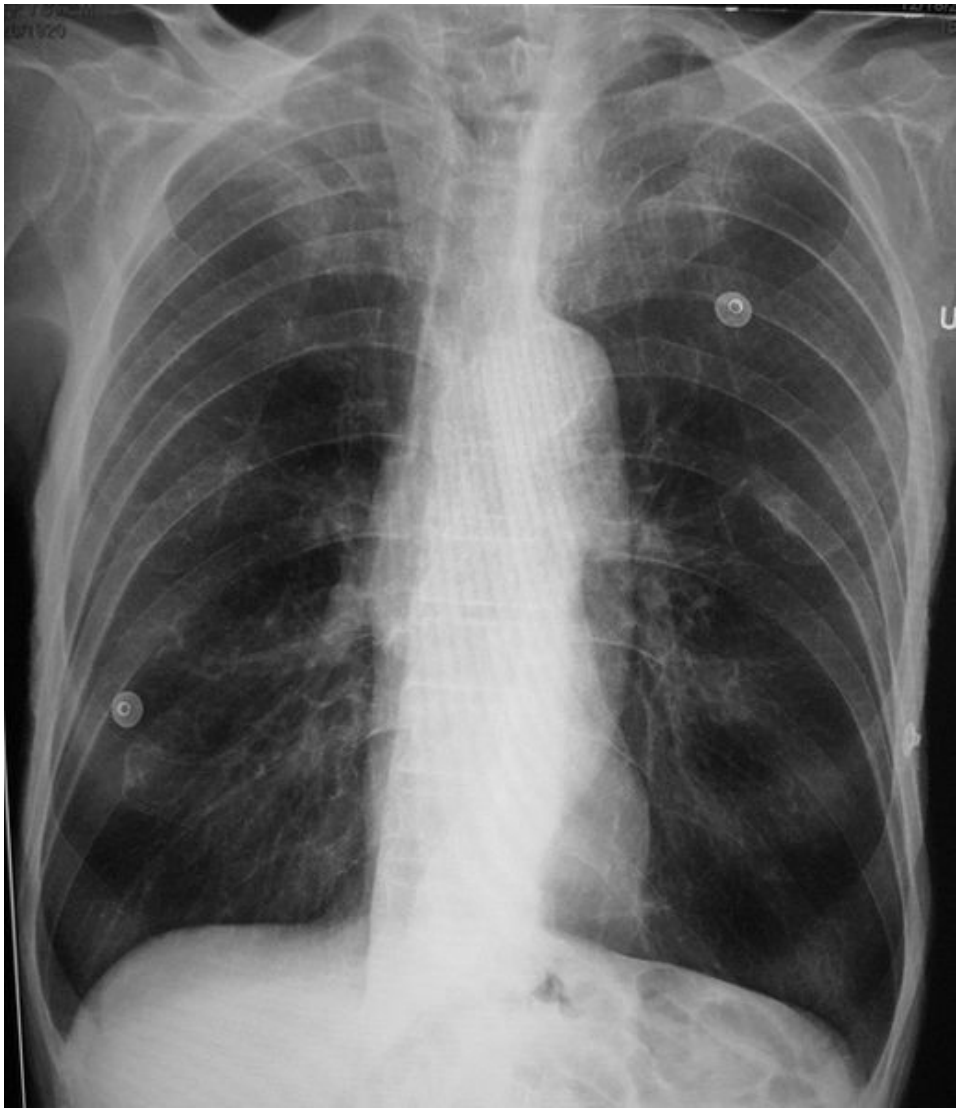
- ***smoking/exposure to tobacco (80%)***
- environmental pollutants
- recurrent URI's
- eosinophilia
- bronchial hyper responsiveness

Labs/Diagnosis:

PFT:
- normal early in the disease
- decreased FEV1/FVC occur later
- increased RV and TLC
- confirmed by biopsy
- ↑ Reid index: gland layer is > 50% of total bronchial wall

COPD: Chronic Bronchitis/Emphysema

COPD Comparisons		
	Emphysema Predominant	**Bronchitis Predominant**
Patient type	"pink puffers"	"blue bloaters"
Clinical Findings	***Hallmark: exertional dyspnea*** cough is rare quiet lungs no peripheral edema thin; recent weight loss barrel chest pursed lips breathing hyperventilation	mild dyspnea ***chronic productive cough*** noisy lungs: rhonchi and wheeze peripheral edema overweight and cyanotic
CXR	decreased lung markings at apices flattened diaphragms hyperinflation ***parenchymal bullae and blebs*** small, thin appearing heart	increased interstitial markings at bases diaphragms not flattened



CXR of patient with severe emphysema.

Source: http://commons.wikimedia.org/wiki/File:Emphysema2008.jpg

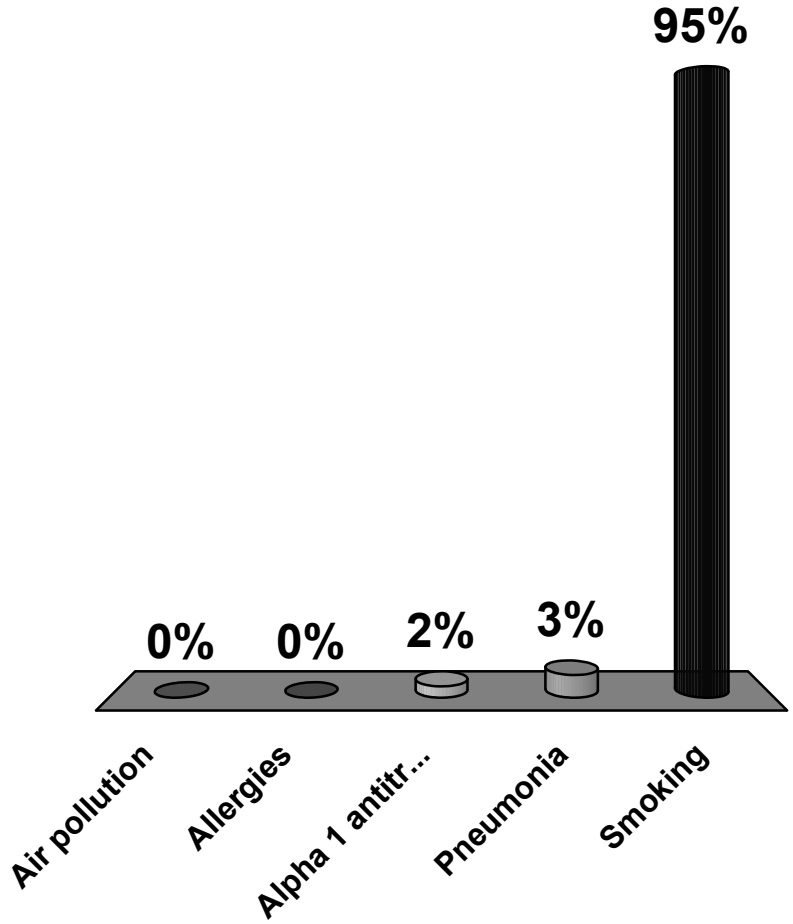
COPD: Chronic Bronchitis/Emphysema

Treatment:

- ***smoking cessation***
- ***oxygen*** *improves the natural history of the disease*
- bronchodilators
  - ***#1: ipatropium***
  - #2: short acting beta agonists: albuterol
  - #3: theophylline
- INH steroids?
- antibiotic: for AECB and acute bronchitis
  - TMP/SMX; augmentin/clavulanate, doxycycline
- influenza and pneumococcal vaccines
- Surgery: transplant, LVRS, bullectomy

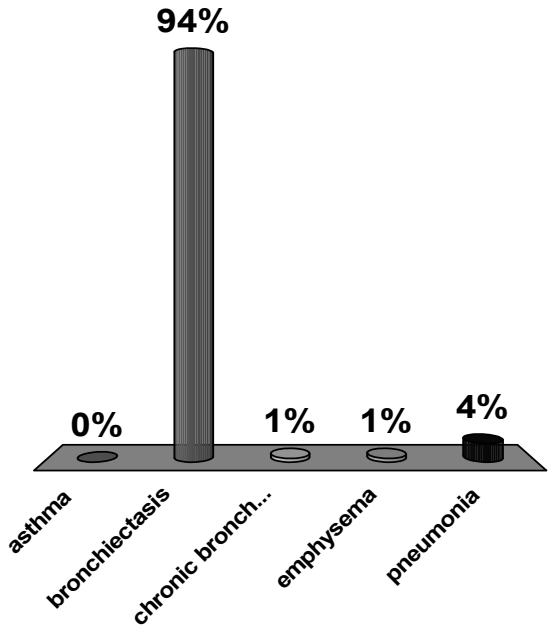
Which of the following is the most common cause of chronic bronchitis?

A. Air pollution
B. Allergies
C. Alpha 1 antitrypsin deficiency
D. Pneumonia
E. Smoking



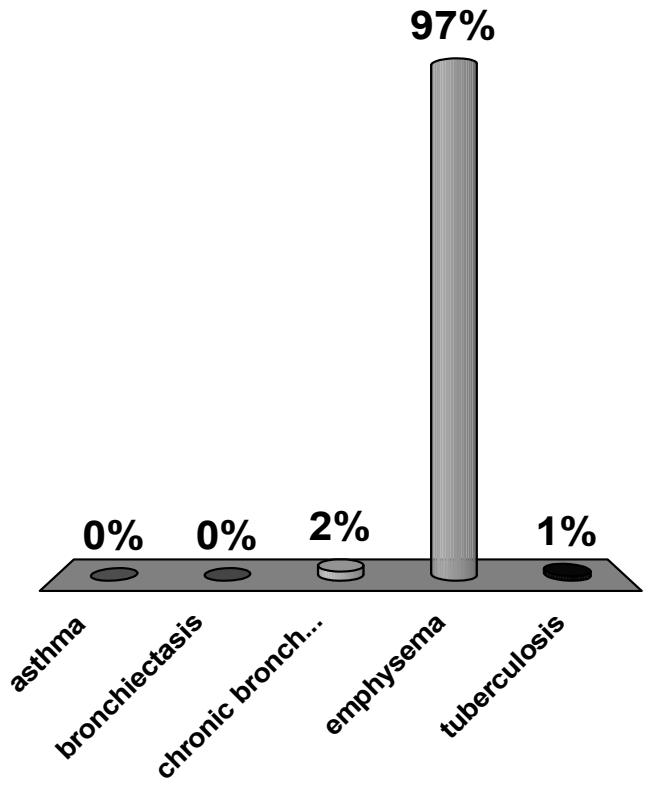
A 12 year-old girl with cystic fibrosis since age 3 presents c/o purulent foul smelling sputum. CXR demonstrates tubular, air-filled structures that extend to near the end of the lung fields. The remainder of the lung fields appear normal. Which of the following is the most likely diagnosis?

A. asthma
B. bronchiectasis
C. chronic bronchitis
D. emphysema
E. pneumonia



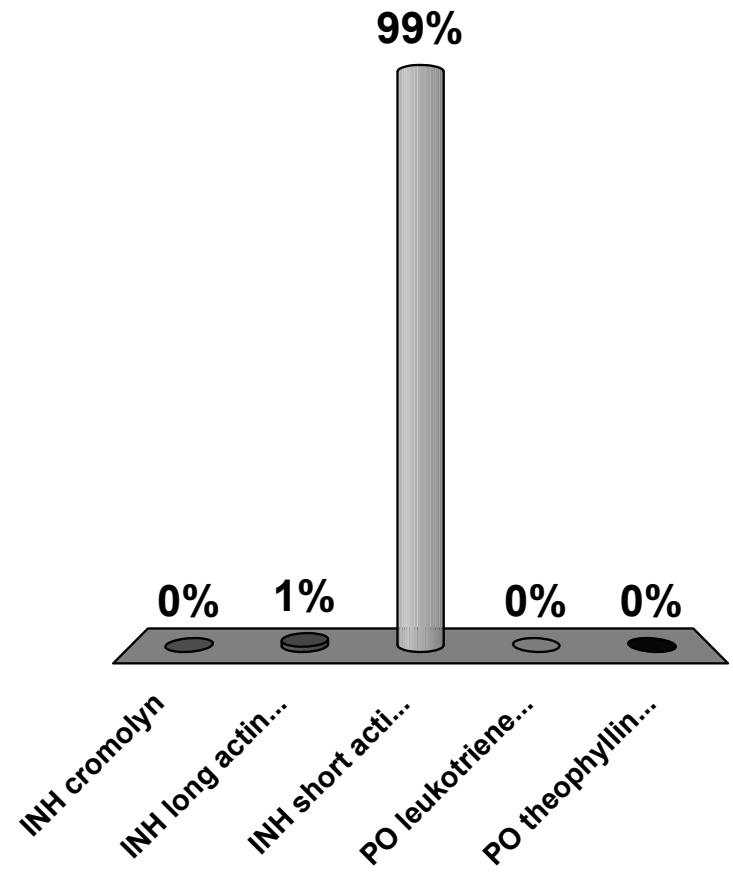
A 60 year-old male smoker presents c/o SOB with mild exertion. He denies cough or chest pain. Exam reveals a thin male with an increased chest A:P diameter and use of accessory muscles. On auscultation, the chest is very quiet with no adventitious sounds. Which of the following is the most likely diagnosis?

A. asthma
B. bronchiectasis
C. chronic bronchitis
D. emphysema
E. tuberculosis



A 24 year old woman is having an acute asthma exacerbation. Which of the following medications would be most appropriate to administer?

A. INH cromolyn
B. INH long acting beta-2 agonist
C. INH short acting beta-2 agonist
D. PO leukotriene modifier
E. PO theophylline



Part IV:
Restrictive Pulmonary Diseases

- Idiopathic Pulmonary Fibrosis
- Pneumoconioses
- Sarcoidosis

Restrictive Pulmonary Diseases

Normal / ↑ FEV/FVC

↓ TLC

Idiopathic Pulmonary Fibrosis

Background:

- most common dx among pts with interstitial lung disease
- includes group of distinct histopathologic features
- ensure its truly idiopathic as most ILD are due to infection, drugs, environmental/occupational exposures

Etiology: unknown

Clinical Findings:

- insidious dry cough
- exertional dyspnea
- diffuse, fine, end insp. crackles/rales ("velcro" at bases)
- clubbing

Idiopathic Pulmonary Fibrosis

Labs/Diagnosis:

- CXR/HRCT:
  - low lung volumes
  - patchy, diffuse fibrosis
  - pleural honeycombing
  - biopsy helps to exclude other causes

Treatment:

- *controversial*
- corticosteroids
- interferon

Pneumoconioses

Chronic lung diseases

Differentiated by origin of the precipitating agent

Etiology:

- generally industrial
- inhalation of mineral or metal dusts
- fibrotic lung develops progressively from ingestion of the agents by macrophages leading to cell injury and death

Treatment:

- generally supportive

Pneumoconioses

Comparison of Pneumoconioses			
Disease	**Occupation**	**Diagnosis**	**Complications**
asbestosis	insulation, demolition, construction,	BX: asbestos bodies CXR: linear opacities at bases and pleural plaques	increased risk of lung CA and ***mesothelioma***, esp. if smoker
CWP	coal miner	CXR: nodular opacities at upper lung fields	progressive massive fibrosis
silicosis	miners, sand blasters, quarry workers, stone workers,	CXR: nodular opacities at upper lung fields	increased risk of ***TB***; progressive massive fibrosis
berryliosis	high technology fields: aerospace, nuclear power, ceramics, foundries, tool & die manufacturing	CXR: diffuse infiltrates and hilar adenopathy	needs chronic steroids

Sarcoidosis

Background:

↑ incidence in North American blacks & Northern European whites

Etiology:

systemic disease of unknown etiology

Clinical Findings:

malaise, fever, slowly progressing dyspnea, cough

pulmonary findings are limited

extra-pulmonary findings common:

erythema nodosum

parotid gland enlargement

Sarcoidosis

Labs: ACE levels elevated
CXR → bilateral hilar adenopathy
hypercalcemia

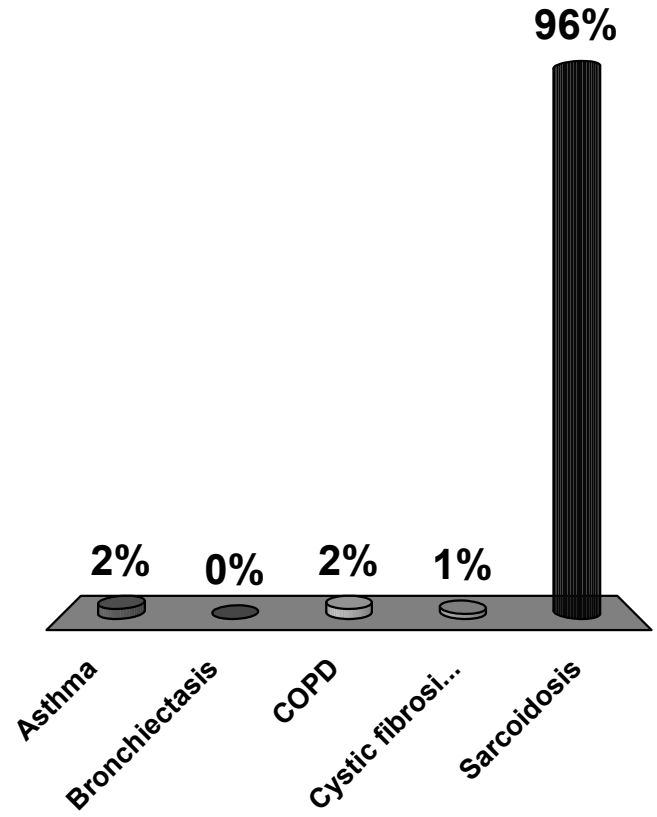
Diagnosis: biopsy shows non-caseating granulomas

Treatment: prednisone

Other: "**GRUELING**"
Granulomas
RA
Uveitis
Erythema nodosum
Lymphadenopathy
Interstitial fibrosis
Negative TB test
Gammaglobulinemia

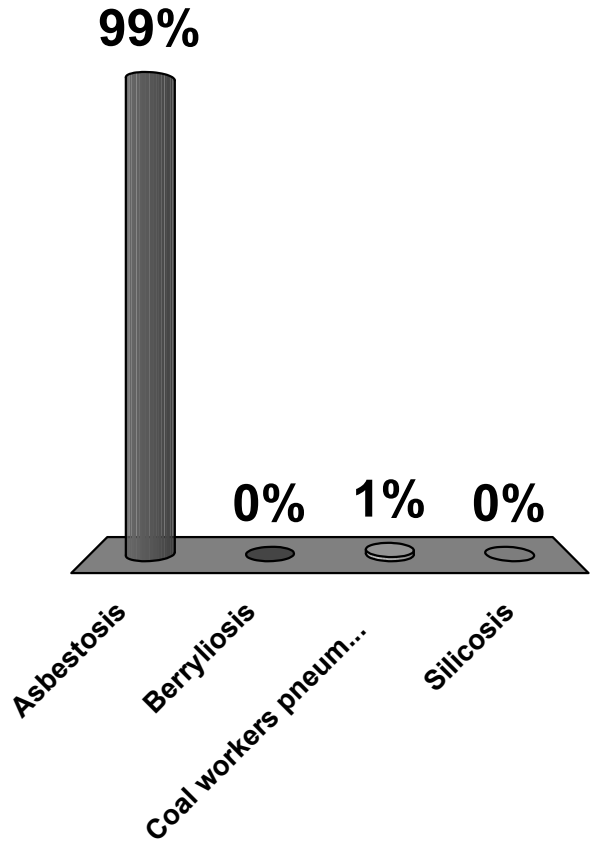
Which of the following is an example of a restrictive lung disease?

A. Asthma
B. Bronchiectasis
C. COPD
D. Cystic fibrosis
E. Sarcoidosis



Which of the following restrictive lung diseases has an increased risk of mesothelioma if the patient is a smoker?

1. Asbestosis
2. Berryliosis
3. Coal workers pneumoconiosis
4. Silicosis



Part V:
Pleural Diseases

- Pleural Effusion
- Pneumothorax

Pleural Effusions

Background

abnormal fluid collection in the pleural space

25% of effusions are associated with malignancy

Important to distinguish transudate from exudate

Pleural Effusions

Etiology: 5 types of effusions

- exudates: **"*leaky capillaries*"**
  - these three cause 80%
    - para-pneumonic
    - malignancy
    - PE (but 20% as transudate)
  - infection (TB), malignancy, trauma
- transudates: **"*intact capillaries*"**
  - CHF (90%), atelectasis, renal/liver ds. (cirrhosis)
- empyemas: direct infection of an exudate
- hemothorax: trauma
- chylothorax: TB

Pleural Effusions

Clinical Findings:

- often asymptomatic
  - *progressive dyspnea on exertion and pleuritic chest pain*
- presentation is variable
  - asymptomatic → small effusion
  - dyspnea/cough → large effusion
- percussion dullness
- decreased tactile fremitus
- diminished/absent breath sounds
- b/l (transudates) vs. unilateral (exudates)

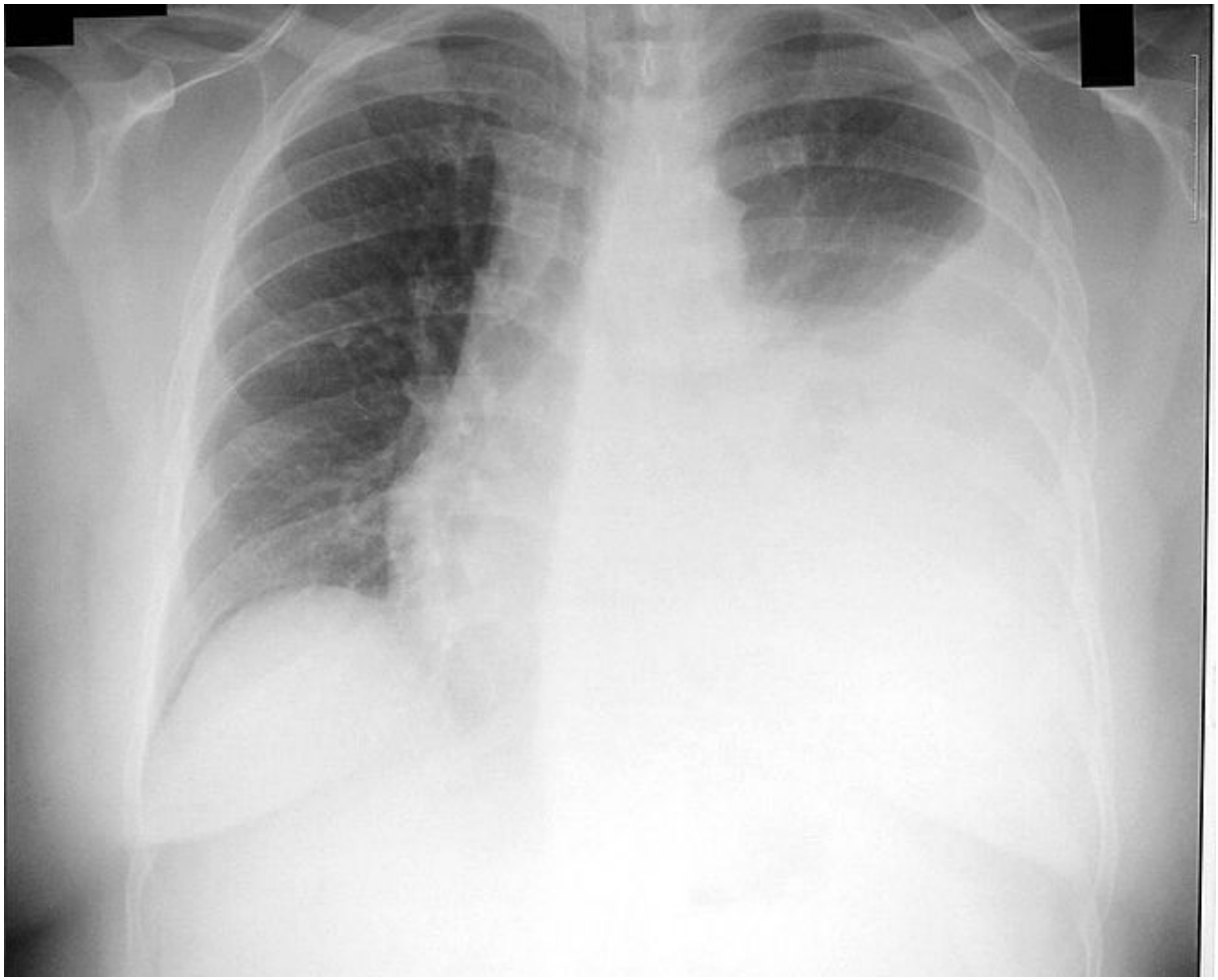
Pleural Effusions

Labs:

- imaging helps define extent of effusion
  - lateral decubitus (free flowing vs. loculated fluid)
  - upright (blunting of costophrenic sulcus)
  - CT scan for small effusions

Diagnosis:

- **thoracentesis is the gold standard**
  - send for protein, LDH, pH, total & cell counts, glucose
    - cytology?
    - Gram stain with C & S?



Massive Left-Sided Pleural Effusion

Source: http://en.wikipedia.org/wiki/Image:Left-sided_Pleural_Effusion.jpg

Pleural Effusions

Treatment:

- Transudates:
  - correct underlying condition
  - therapeutic thoracentesis if severe dyspnea
- Exudates:
  - drainage for empyemas
  - pleurodesis for malignant pleural effusions

Pleural Effusions

Other:

transudates vs. exudates **(Light's criteria)**

exudate if meets any *one* of the following:

- pleural fluid protein/serum protein ratio > 0.5
- pleural fluid LDH / serum LDH ratio > 0.6
- pleural fluid LDH > 2/3 upper limit of normal for serum LDH (a cut-off value of 200 IU/L was used previously)

Pneumothorax

Background: accumulation of air in pleural space

Etiology/Classifications:

- Spontaneous (1° or 2°)
  - Primary: (PSP) occurs in absence of underlying ds.
    - tall, thin males (rupture of apical blebs)
  - Secondary: (SSP) underlying ds.
    - *COPD*, asthma, CF, ILD
- Traumatic: penetrating/blunt trauma (incl. iatrogenic)
- Tension pneumothorax: ***medical emergency!***
  - penetrating trauma, CPR, pos pressure ventilation:
    - lung collapse
    - → contra lateral mediastinal shift
    - → hypotension 2° impaired v. return

Pneumothorax

Clinical Findings:

- Spontaneous:
  - ipsilateral, unilateral chest pain, sudden and pleuritic, dyspnea, cough
  - absent/diminished breath sounds
  - hyper resonance
  - decreased tactile fremitus
  - if small, exam is unimpressive
- Tension: (in addition to above…)
  - respiratory distress, falling SaO2, hypotension, distended neck veins, tracheal deviation

Pneumothorax

Labs/Diagnosis:

e***nd expiratory chest film reveals visceral pleural air***

Tension: air on affected side with contralateral mediastinal shift

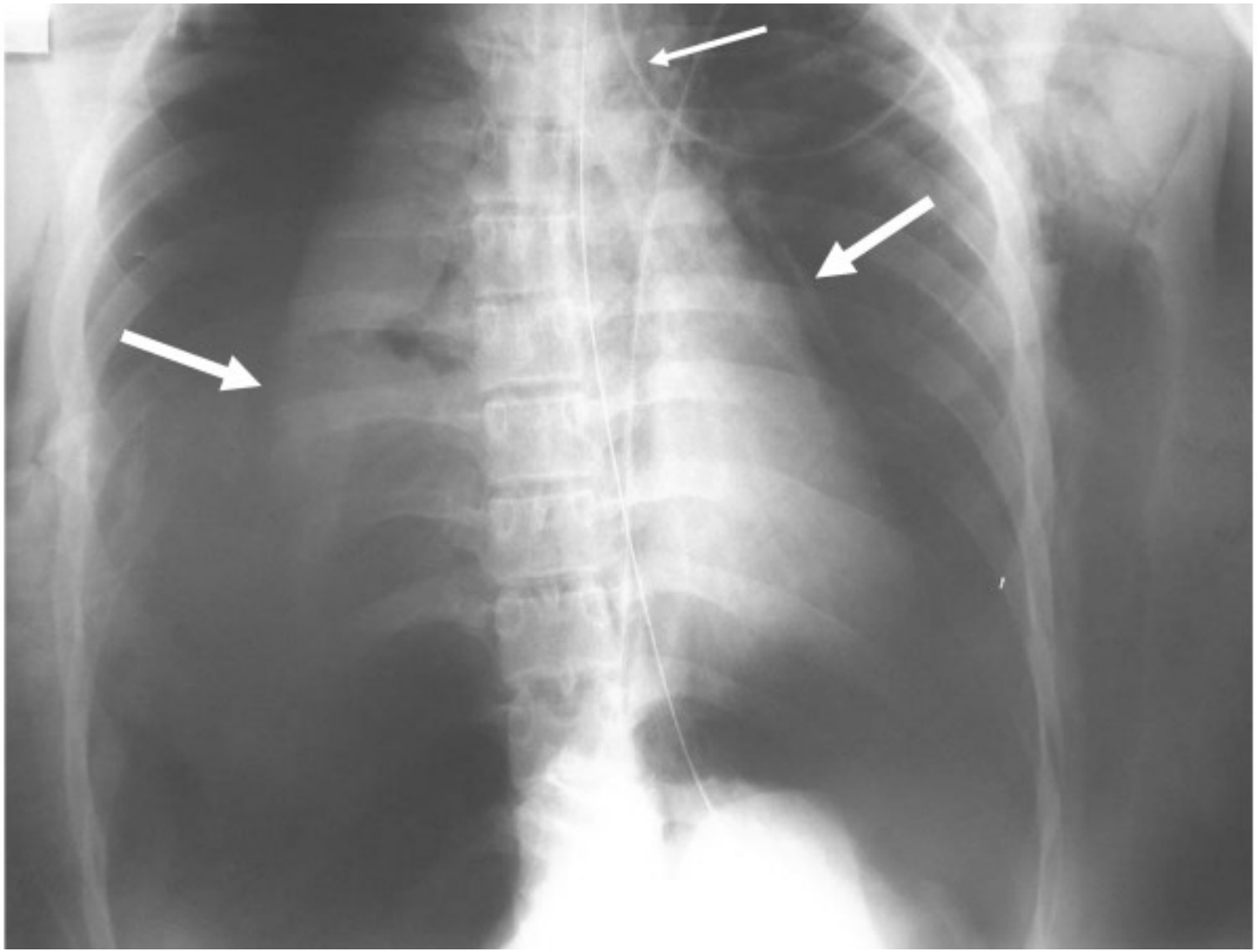
Treatment:

Primary spontaneous/secondary:

<15% diameter of hemithorax on CXR: rest, cough, chest pain relief, serial CXRs

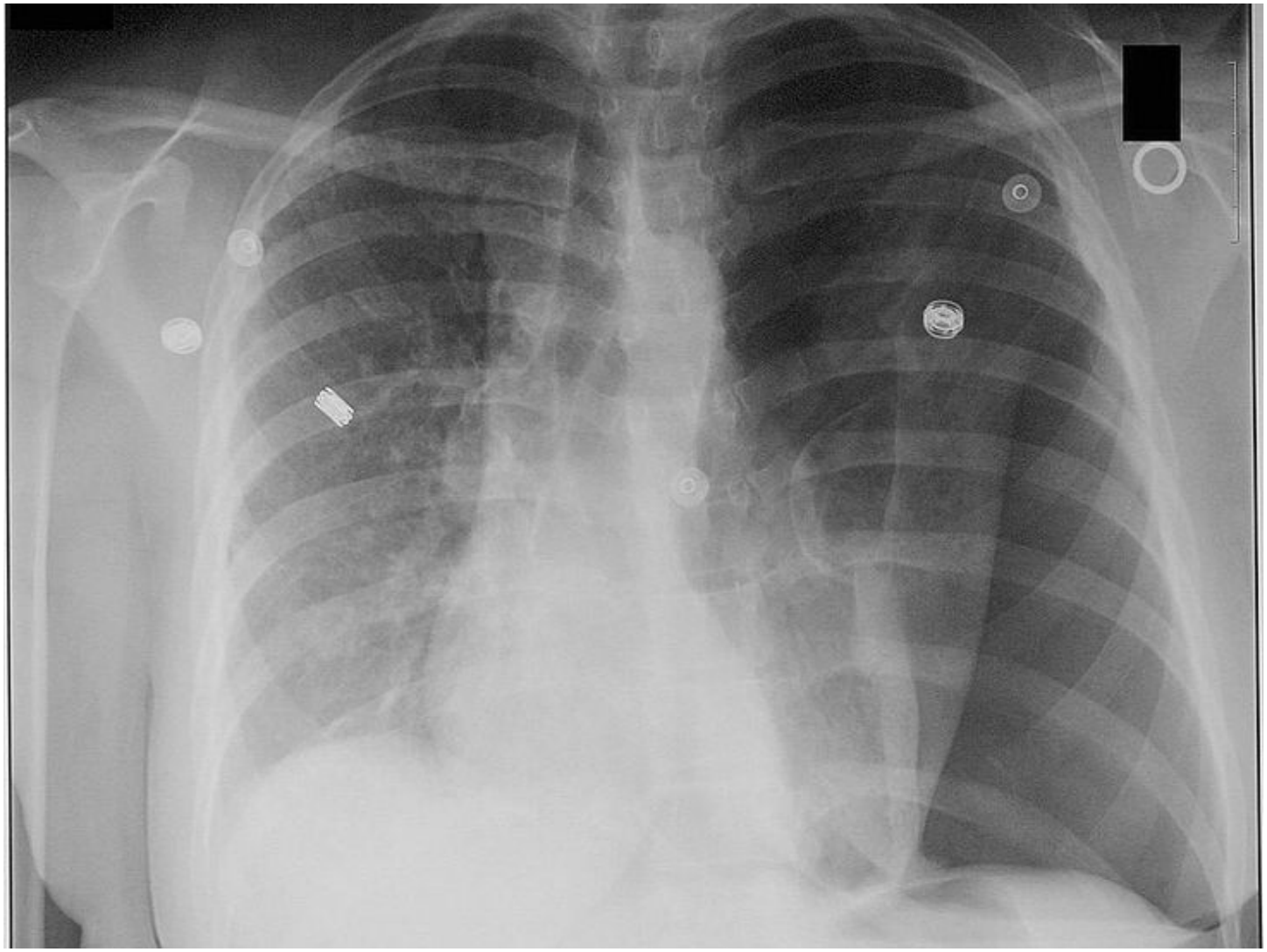
>15%: chest tube plus above measures

Tension: immediate needle decompression 2nd ICS at MCL



Bilateral pneumothorax (larger arrows)

Source: Le Guen et al. Critical Care 2007 11:R94 doi:10.1186/cc6109 http://ccforum.com/content/11/5/R94

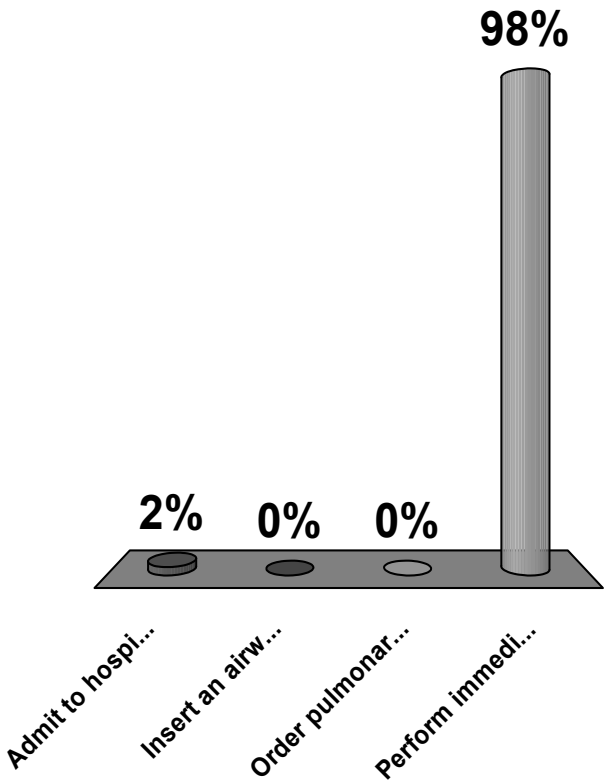


Left tension pneumothorax

Source: http://clinicalcases.blogspot.com/2004/02/tension-pneumothorax.html

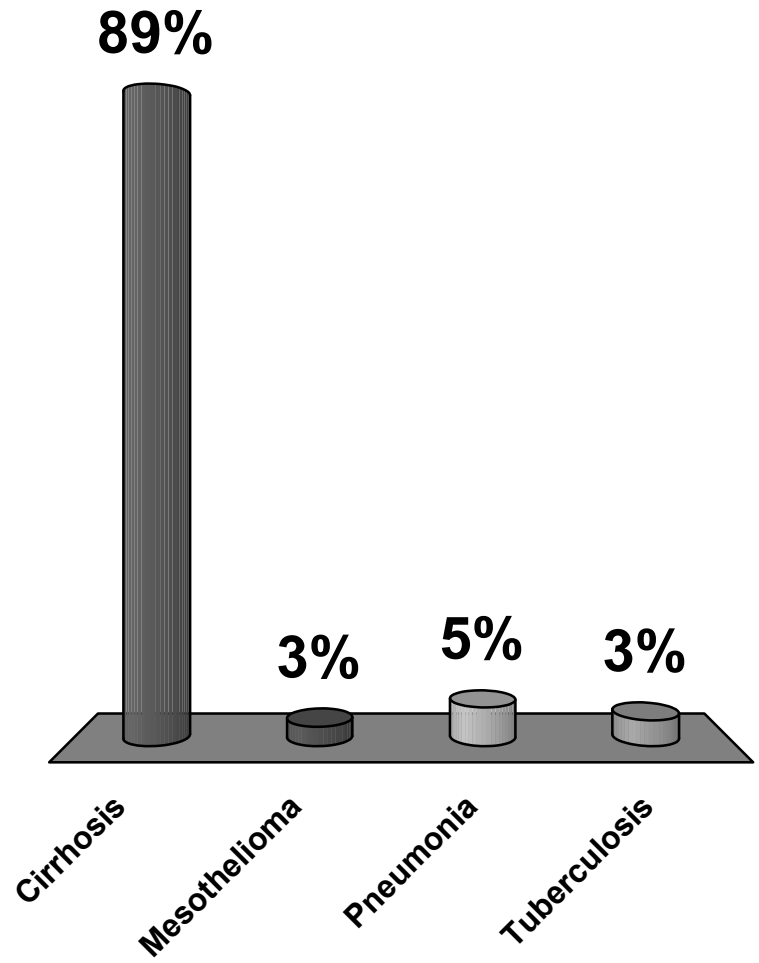
A 54 year-old patient presents with acute onset of chest pain, SOB and hypotension. CXR reveals a mediastinal shift to the right. Which of the following is the most appropriate next step?

A. Admit to hospital for observation
B. Insert an airway
C. Order pulmonary consult
D. Perform immediate needle decompression



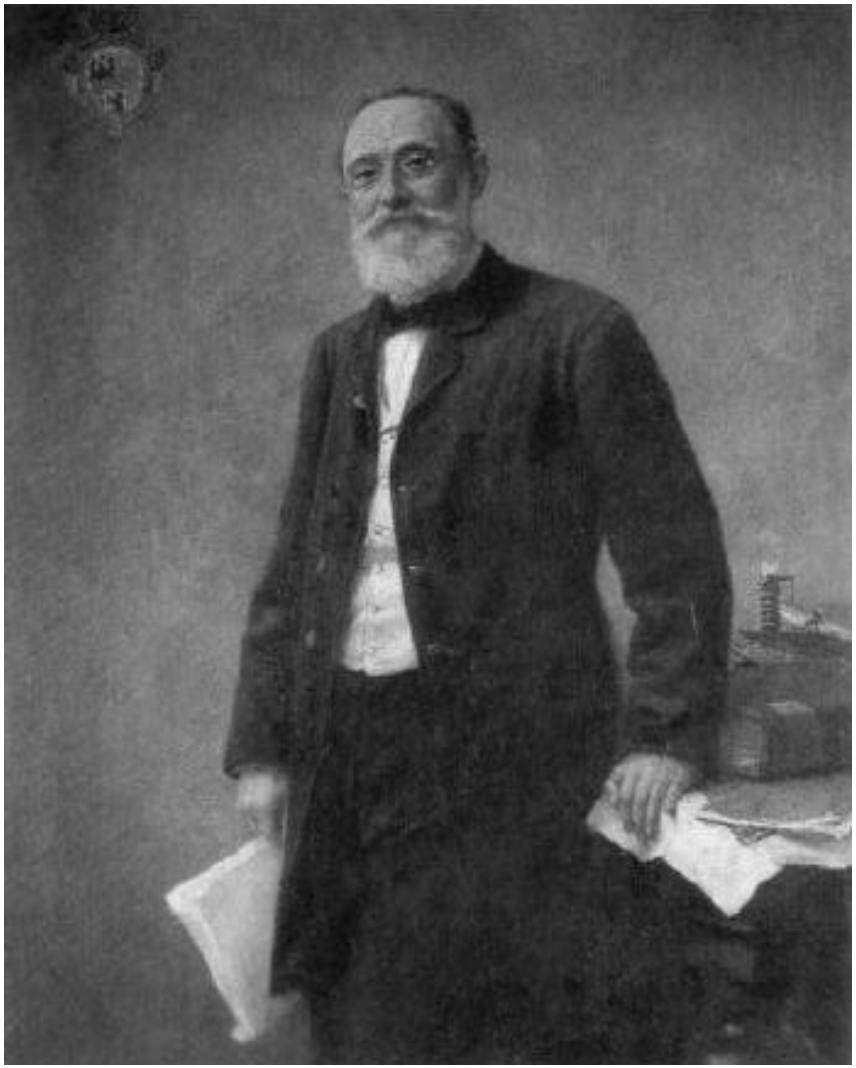
Which of the following is the most likely cause of an transudative effusion?

A. Cirrhosis
B. Mesothelioma
C. Pneumonia
D. Tuberculosis



Part VI:
Pulmonary Circulation

- Pulmonary Thromboembolism
- Pulmonary Hypertension
- Cor Pulmonale
- ARDS



Rudolf Virchow by Hugo Vogel, 1861

Source: http://www.kunsttexte.de/download/bwt/werner.pdf

Pulmonary Embolism (PE)

Background

occlusion of pulmonary arterial circulation from an embolized substance

#3 leading cause of death in hospitalized pts.

Risk Factors: (Dr. Rudolf Virchow's triad)

- hypercoagulable state: (e.g. CA)
- venous stasis (e.g. prolonged rest/cast)
- vascular intimal inflammation / injury (e.g. surgery/trauma)

surgical procedures: orthopedic, pelvic, abdominal CA, OCPs, pregnancy

Pulmonary Embolism (PE)

Etiology: most are from thrombus

- 95% deep calf veins that propagate proximal to popliteal / ileofemoral veins
- risk of PE greater with proximal thrombus
- others:?
  - air → central lines
  - amniotic fluid → active labor
  - fat → long bone (femur) fx
- negative workup in 25-50% patients for VTE

Pulmonary Embolism (PE)

Clinical Findings:

Homans' sign: low sensitivity/specificity

calf pain with passive, forcible, dorsiflexion of foot with knee flexed

variable, signs and symptoms are non-specific but <3% chance of PE in absence of dyspnea with tachypnea or pleuritic chest pain)

most emboli are clinically silent

most common symptom: dyspnea (sudden; 85% with RR>16) / pain on inspiration

(*consider PE in any hospitalized patient with acute SOB)

most common sign: tachycardia (60% with P > 100)

Pulmonary Embolism (PE)

Labs/Diagnostic Evaluation:

ECG: *not diagnostic!*

sinus tachycardia (most common)

atrial dysrhythmias, PEA

S1-Q3-T3 (inverted T wave) is rare (20%)

ABGs: hypoxemia (but 15% have PaO2 > 80)

Elevated D-Dimer

Plasma levels of degraded fibrinogen

negative D-Dimer (with low clinical suspicion) → strong evidence against DVT

Pulmonary Embolism (PE)

CXR (abnormalities may be subtle / absent)

m.c. abnormality is atelectasis at bases

Westermark's Sign: focal oligemia (vasoconstriction) in the embolized zone

Hampton's Hump: (**classic finding**)

wedge shaped infarct

VQ scans:

"normal" practically rules out PE

"abnormal" is non specific

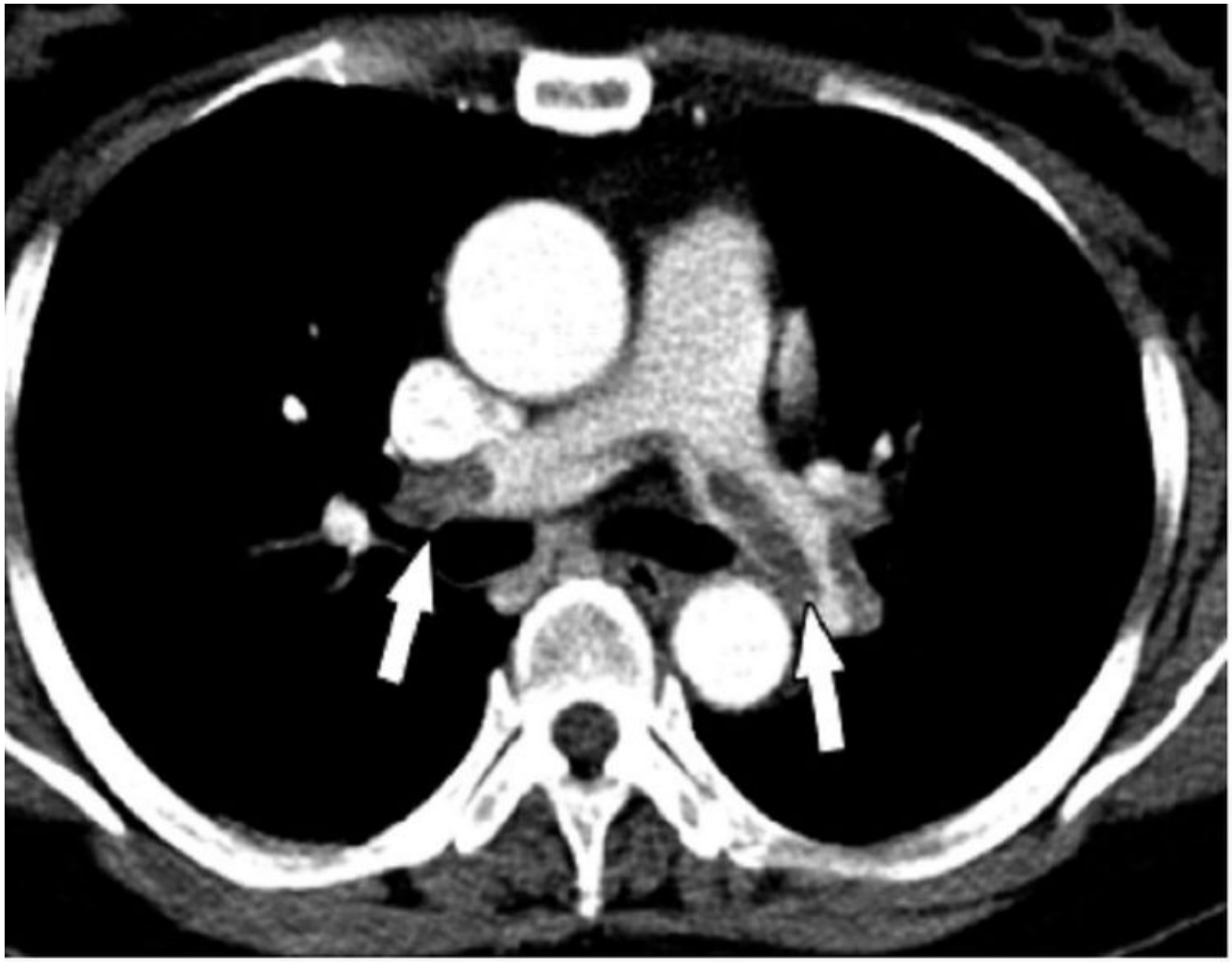
categorized along with CXR

normal/very low

low

intermediate

high probability



Chest Spiral CT (with and without contrast agent) showing multiple filling defects of principal branches, due to acute and chronic pulmonary embolism

Source: Cardiovascular Ultrasound 2007, 5:26. doi:10.1186/1476-7120-5-26

Pulmonary Embolism (PE)

Spiral CT (helical) angiography
- more sensitive then VQ, but less than pulmonary arteriography
- less sensitive in the distal segmental arteries

Pulmonary Arteriography
- shows intraluminal filling defect
- "**Gold Standard**"

LE Venous Doppler (not good for dx of PE)
- most commonly used
- incompressible veins (absence of "wink")
- 90-94% sensitivity in proximal (less in distal)

Venography
- "**Gold Standard**" for diagnosis of LE DVT

Pulmonary Embolism (PE)

Treatment:

- anticoagulation: generally 3-6 months
  - heparin (UFH: sig is TID) → coumadin (INR 2-3x normal)
  - LMWH (sig is QD)
- thrombolytic therapy (streptokinase, alteplase, urokinase):
  - only for stable patient
  - not generally recommended
- IVC filter
- surgery: only for saddle emboli

Pulmonary Embolism (PE)

Other:

Prevention:

combination of mechanical & pharmacological measures

early ambulation

intermittent pneumatic compression

low dose heparin

LMWH

Pulmonary Hypertension

Background:

- pulmonary artery pressure rises to a level inappropriate for a given cardiac output
- self-perpetuating once initiated
- women > men
- 30-50 yo

Pulmonary Hypertension

Etiology:

- primary (idiopathic) hypertension (PPH) is rare
- ***most frequently: secondary pulmonary HTN***
  - (COPD, connective tissue disorder esp. scleroderma)
  - increased pulmonary venous pressure
  - constrictive pericarditis, LV failure, mitral stenosis, mediastinal disease compressing pulmonary veins
  - decreased area of pulmonary arterial bed
  - vasoconstriction
  - loss of vessels
  - lung resection, emphysema, ILD, CVD
  - vessel obstruction

Pulmonary Hypertension

Clinical Findings:

dull/retrosternal chest pain (angina-like), dyspnea, fatigue, effort syncope

difficult to diagnose early

signs/symptoms are often related to underlying cause

Labs: polycythemia

EKG: right axis deviation, RVH, RAE, right ventricular strain

Pulmonary Hypertension

Diagnosis: Multifactorial

Work-up:

- CXR/CT: increased vasculature
- PFTs: underlying airflow obstruction or restricted lung volumes
- ECHO: RVH, estimated pulmonary artery pressure
- catheterization to determine degree of HTN
- others

Pulmonary Hypertension

Treatment:

- underlying cause
  - oxygen if from COPD
  - anticoagulants if from emboli
  - diuretics/salt restriction for cor pulmonale
  - vasodilators?
    - epoprostenol (PGI2)
    - prostacyclin

Cor Pulmonale

Background:

- Failure of the right side of the heart caused by prolonged high blood pressure in the pulmonary artery (pulmonary HTN) and right ventricle of the heart.
- RV enlargement leads to RV failure

Etiology:

- *if acute think P.E.; if chronic think COPD*
- pulmonary vascular disease (PE, vasculitis, ARDS)
- respiratory disease
  - obstructive (asthma, COPD)
  - restrictive (ILD, lung resection)

Cor Pulmonale

Clinical Findings:

- fatigue, exertional dyspnea, and syncope with exertion
- increase in chest diameter
- labored respiratory efforts with retractions of the chest wall
- hyper resonance to percussion
  - diminished breath sounds
  - wheezing
  - distant heart sounds
  - cyanosis (rarely)

Cor Pulmonale

Labs/Diagnosis:

- CXR
- EKG: RAD > 30°; flat, inverted T waves in RV precordial leads

Treatment:

- oxygen
- decrease PVR and pulmonary HTN
- treat underlying disorder

Acute Respiratory Distress Syndrome

Clinical Definition:

acute (12-18hours) hypoxemic respiratory failure after a systemic or pulmonary insult **without** heart failure

Physiological Definition

bilateral diffuse pulmonary infiltrates

normal PCWP ($\leq$18 mmHg)

PaO2/FiO2 < 200

Etiology:

most common (one-third of patients): ***sepsis***

others: toxic inhalation, near drowning, aspiration, etc.

Acute Respiratory Distress Syndrome

Clinical Findings:

respiratory distress, tachypnea, fever, crackles, rhonchi

Labs:

CXR: diffuse pulmonary infiltrates *that spares the costophrenic angles*

air bronchograms in 80%

normal heart size

Diagnosis: no biochemical tests to define ARDS

clinical dx that excludes cardiogenic pulmonary edema

Acute Respiratory Distress Syndrome

Treatment:

underlying cause *plus* supportive care

support cardiac output with inotropes, cautious fluids

mechanical ventilation

PEEP: lowest levels to recruit atelectic alveoli

PaO2 > 60

FIO2: < 60%

SaO2 ≥ 90%

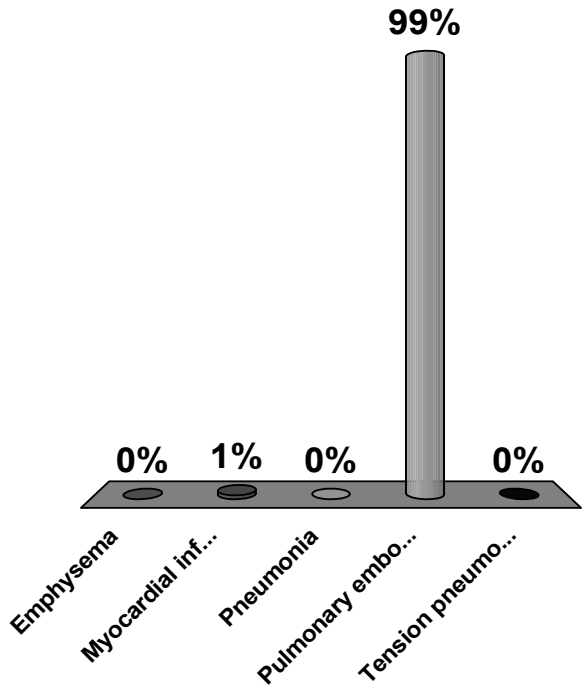
Other:

ARDS mortality: 30-40%

ARDS *plus* sepsis mortality: 90%

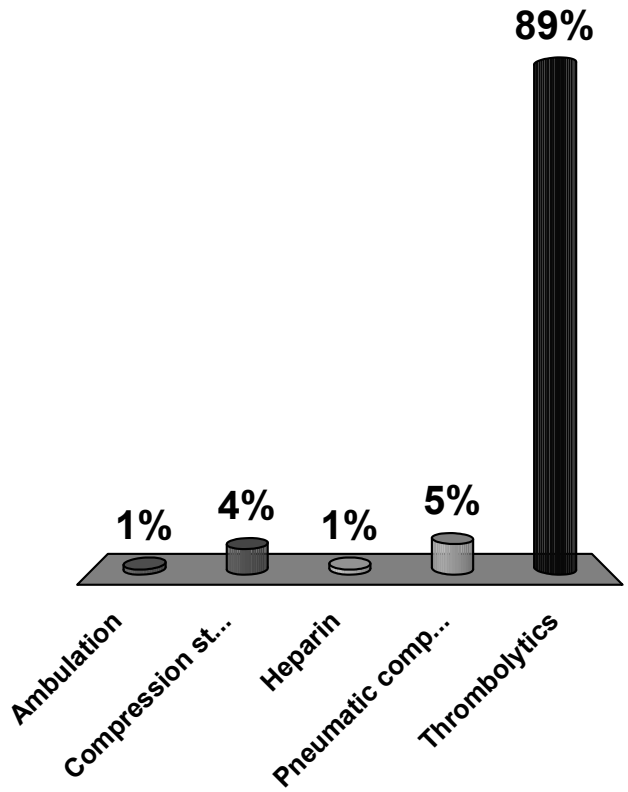
A 52 year-old patient presents to the ER with pleuritic chest pain, cough, dyspnea, and hemoptysis. On exam she is anxious with tachycardia and tachypnea. Lab work demonstrates and elevated D-dimer. CXR is normal. What is the most likely diagnosis?

A. Emphysema
B. Myocardial infarction
C. Pneumonia
D. Pulmonary embolism
E. Tension pneumothorax



Which of the following is not recommended for primary prevention of pulmonary emboli in the immediate post-op period?

A. Ambulation
B. Compression stockings
C. Heparin
D. Pneumatic compression
E. Thrombolytics



Good luck!