MEDICINE

432 Team

14 Community Acquired Pneumonia

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Objectives

Not Given

What is Pneumonia?

Pneumonia is an acute infection of the pulmonary parenchyma. Alveolar infection leading to consolidation of the greater part or one or more lobes, resulting in alveolar filling with fluid and pus causing Air space disease (consolidation and exudation).

It is a common and potentially serious illness (because it is a lower respiratory tract infection) with considerable morbidity and mortality, particularly in:

1) Older adult patients.
2) Patients with significant comorbidities (patient with immune suppressed, cardiac disease, diabetes, etc).

I. Classification (Practical classification)

1- Community Acquired Pneumonia (CAP)

Infection is acquired in the community.

2- Hospital Acquired Pneumonia (HAP)

Pneumonia > 48 hours after admission which was not incubating at the time of admission. 2 types:

- Ventilator Associated Pneumonia (VAP) pneumonia > 48 hours after incubation
- Health Care Associated Pneumonia (HCAP) Pneumonia that occurs in a nonhospitalized patient with extensive healthcare contact (either from doctor or another patients):
  - ✓ Intravenous therapy, wound care, or intravenous chemotherapy within the prior 30 days
  - ✓ Residence in a nursing home (دار المسنين)or other long-term care facility
  - ✓ Hospitalization in an acute care hospital for two or more days within the prior 90 days
  - ✓ Attendance at a hospital or hemodialysis clinic within the prior 30 days
  - ✓ Family member with MDR pathogens (**if somebody known to have member in the family with multiple drug resistant**)

3- Aspiration Pneumonia.

4- Pneumonia in the Immunocompromised Patients (HIV, cancer patient, etc.).

Doctor ask Q : why these definitions(CAP,VAP,HCAP) are important ?
Because each type had different characteristics, CAP not going to be like VAP. EX: VAP may have multi drug resistant Acinetobacter which only only sensitive to colistin. While multi drug resistant Acinetobacter will be rarely in case of CAP.

II. Pathogenesis: {3 main mechanisms by which bacteria reaches the lungs}

1) Inhalation
2) Aspiration
3) Hematogenous spread

1- Primary inhalation: (breathing)

Organisms bypass normal respiratory defense mechanisms or when the Pt inhales aerobic GN organisms that colonize the upper respiratory tract or respiratory support equipment.

Pathogens: S. Pneumonia, TB, viruses, Legionella

Defense mechanism are nose hair, coughing for large particle and cilia. It will be easy for organism to cause infection if patient was ventilated, the organism go directly to lug without passing through defense mechanism

Cleaning of the nostrils and nasopharynx (by doing proper Inhalation-إستنشاق-) likely to reduce incidence and prevalence of pneumonia

Note(s):

- Colonize: live in the noses
-S.pneumonia colonized in the nose.
- Some body colonize with meningiococcus in their noses
- Gram positive may colonized the URT
-30% of nurses colonized with MRSA

- Many of us going to ICU and colonized With MRSA

2- Aspiration:

When the Pt aspirates colonized upper respiratory tract secretions (**EX: in case of seizure patient, they loss their consciousness and aspirate mouth secretions**)

- Stomach: reservoir of GNR that can ascend, colonizing the respiratory tract. (**Ex: patient vomited and organism go to respiratory tract**)
- People who is using Proton Pump Inhibitors (PPIs) to reduce acid in the stomach which enhance the growth of bacteria in the upper GI and increase the chance of aspiration of these bacteria.

Pathogens:

Anaerobes; Common pathogens:

- **Mixed flora**
- **Mouth** anaerobes
- Peptostreptococcusspp, Actinomyces spp.
- **Stomach** contents
- Chemical pneumonitis
- Enterobacterium
- And **Microaspiration** from nasopharynx: S. Pneumonia

3- Hematogenous:

Originate from a distant source and reach the lungs via the blood stream.

- Pathogens: Staph endocarditis, septic emboli.
- Pyelonephritis
- Central line infected
- Drug abuser endocarditis

Pathogens of CAP:

- Usually caused by a single organism.
- S. pneumoniae is the most common cause of community-acquired pneumonia (CAP),
- Isolation of the organism in only 5 to 18 percent of cases.
- Many culture-negative cases are caused by pneumococcus:
- Sputum culture is negative in about 50 percent of patients with concurrent pneumococcal bacteremia.
- Majority of cases of unknown etiology respond to treatment with penicillin
- Caused by a variety of Bacteria, Viruses, Fungi
- Pneumococci are acquired by aerosol inhalation, leading to colonization of the nasopharynx.
- Colonization is present in 40-50 percent of healthy adults and persists for 4 to 6 weeks (carriage is more common in children and smokers).

Even with extensive diagnostic testing, most investigators cannot identify a specific etiology for CAP in ≥ 50%

Pathogenic Organisms according to severity of pneumonia:

1- Outpatients infected by: strep pneumo, mycoplasma chlamydophila, H.influenzae, respiratory viruses.
2- In patient non- ICU infected by : strep pneumo , mycoplasma chlamydophila , H.influenzae , respiratory viruses , legionella (Legionella(water-born) is very sever organisim lead to admission of patient)
3- ICU patient infected by : strep pneumo ,staph aureus, gram negative bacilli , legionella

Note(s):

Hospital-acquired pneumonia caused by: p.auruginosa, E.coli, klebsiella

Community acquired pneumonia in alcoholic, diabetic and elderly patient caused by klebsiella

Cause of CAP in all ages: Strep pneumoniae. The ordering each from most common to least common (strep pneumo is most common in outpatients followed by inpatient and it least common for ICU patient), though the order changes depend on which study you look at. The sicker the patient is, the more likely they have staph aureus, GNR, or legionella and the less likely they have an atypical infection

III. Risk factors:

- Influenza infection
- Alcohol abuse
- Smoking
- Hyposplenism or splenectomy (**spleen function is to identify foreign organisms -usually encapsulated organism; like pneumococcus - to be destroyed by the antibodies**)
- Immunocompromise due to :
  - Multiple myeloma
  - Systemic lupus erythematosus
  - Transplant recipients

Note(s):

Atypical pneumonia: mycoplasma chlamydophila, H.influenzae, respiratory viruses

Post – flu patients are very prone to get staph aureus.

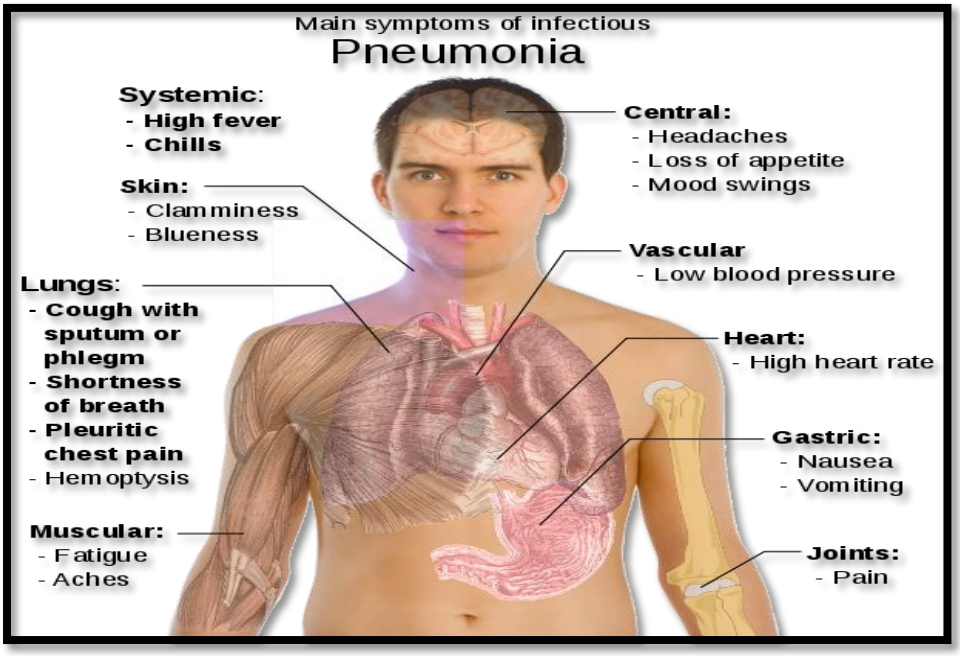
Cystic fibrosis patients more likely to be infected by staph aureus and p.auruginosa

Comorbidity patient (diabetic and smoker) may have gram negative pneumonia

Common etiology:

- Mycoplasma pneumonia (third most common organism of CAP)
- Chlamydia pneumoniae
- Legionella pneumophilla
- Mycobactria
- Virus
- Coxiella burnetii (Q fever) zoonotic- farmer who work with animal more prone for infection by coxiella
- Francisella tularensis (tularemia) zoonotic

- Chlamydia psittaci (psittacosis) zoonotic
- Unlike bacterial CAP,Atypical pneumonia often with extrapulmonary manifestations:
- Mycoplasma: otitis, nonexudative pharyngitis, watery diarrhea, erythema multiforme, increased cold agglutinin titre
- Chlamydophila: laryngitis
- Most don't have a bacterial cell wall → Don't respond to β-lactams



Note(s):

Pleuritic chest pain is where the pneumonia is Klebsiella and staph aureus cause hemoptysis

Sign	Positive LR	Negative LR
General appearance		
Cachexia	4.0	NS
Abnormal mental status	2.2	NS
Vital signs		
Temp >37.9 C	2.2	0.7
RR > 28/min	2.2	0.8
HR >100 bpm	1.6	0.7
Lung findings		
Percussion dullness	3.0	NS
Reduced breath sounds	2.3	0.8
Bronchial breath sounds	3.3	NS
Aegophony	4.1	NS
Crackles	2.0	0.8
Wheezes	NS	NS

NS= not significant. LR= Likelihood Ratio

Note(s):

Abnormal mental status because hypoxia
If the patient is very sick his temperture will be low
Aegophony Say Bee: sounds like Bay
Vocal fremitus will be high

Typical pneumonia:

Clinical presentation:

- **Symptomes**:

1- Sudden onset
2- Fever with chills.
3- Productive cough, Mucopurulent sputum
4- Pleuritic chest pain

- **Signs**:

1. Breath sound: Auscultatory findings of rales and bronchial breath sounds are localized to the involved segment or lobe.
2. **Consolidation** is signs:

◦ Dullness on percussion.
◦ Bronchial breath sounds.
◦ Egophony
◦ Whispered pectoriloquy (whispers are transmitted clearly).

Note(s):

Bronchial (loud & tubular) breathing sounds are abnormal in peripheral areas where only vesicular (soft & rustling) sounds should be heard. When bronchial sounds are heard in areas distant from where they normally occur, the patient may have **consolidation** or compression of the lung. These conditions cause the lung tissue to be dense. The dense tissue transmits sound from the lung bronchi much more efficiently than through the air-filled alveoli of the normal lung.

Atypical pneumonia:

Pneumococcal pneumonia may present atypically, especially in older adults where confusion or delirium may be an initial manifestation, approximately 15% of all CAP

Clinical presentation:

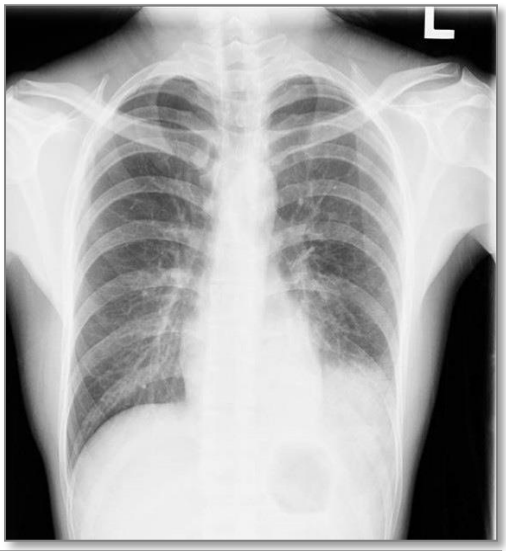
- Gradual onset
- Afebrile
- Dry cough
- Breath sound: Rales
- Uni/bilateral patchy, infiltrates
- WBC: usual normal or slight high
- Sore throat, myalgia, fatigue, diarrhea

Therapy for atypical pneumonia:

- Macrolides, tetracyclines, quinolones (intracellular penetration, interfere with bacterial protein synthesis). It does not response to beta lactam

IV. Investigations:

1. CXR
2. CBC with diff. (lymphoceytosis mean viral infection)
3. Sputum gram stain, culture susceptibility
4. Blood Culture
5. ABG
6. Urea / Electrolytes



32 Y/O male, with Cough for 1 wk and Fever for 2 days. There are Rales over left lower lobe.
We see consolidation in the left lower lobe.

V. Diagnosis:

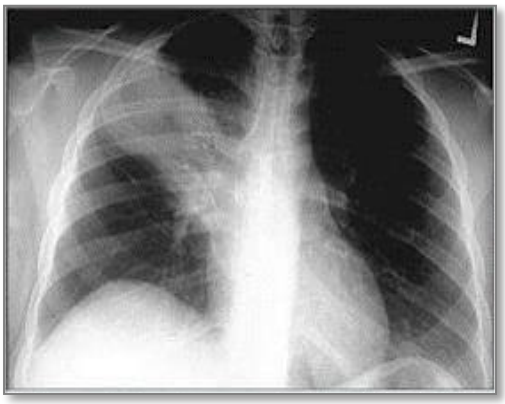
1. Chest x-ray: demonstrate infiltrate.

Establish diagnosis, to detect the presence of complications such as:

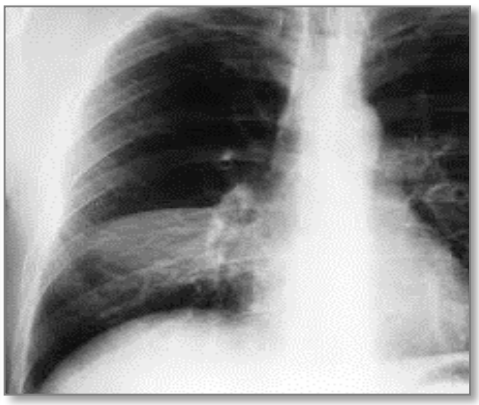
- Pleural effusion (Parapneumonic effusion)
- Multilobar disease.

May not be possible in some outpatient settings

CXR: considered the gold standard



Consolidation in the right upper lobe.



Consolidation in the right middle lobe.

Note(s):

CXR:

- *Plugging of fissure (so much mucus) caused by klebsiella*
- *Lobal consolidation caused by s.pneumonia*
- *Bilateral interstitial infiltrate caused by and atypical pneumonia organism*
- *Fine interstitial infiltrate caused by viral pneumonia*
- *Lung abscess within air fluid level you may think that patient is SBA patient aspirate these before few week*

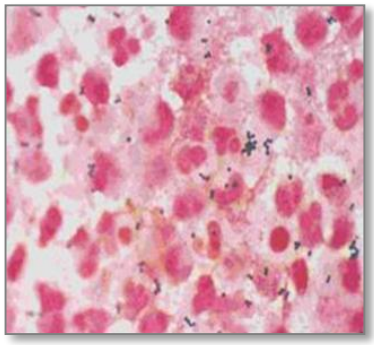
2. Sputum gram stain and culture

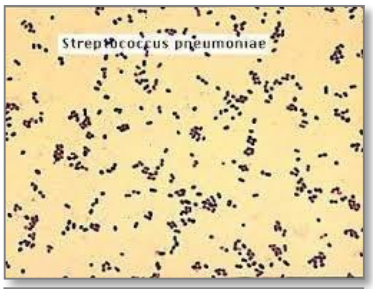
Good specimen include:

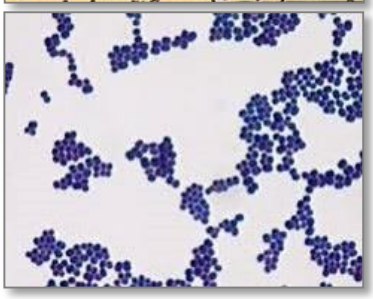
1. PMN's (polymorphonuclear cell) >25/LPF
2. Few epithelial cells<10/LPF (should not be saliva)

When there is many of epithelial cells that mean it come from buccal mucosa and it consider bad specimen

3. Pus cell
4. Single predominant organism (gram positive diplococcic which is Pneumonia)







- Common organisms
  1. Gram positive: diplococci (pairs and chains)
  2. Gram positive: clusters, i.e staphylococcal pneumonia
  3. Gram negative: coccobacillary, ie K.P.
  4. Gram negative: rods

- Organisms not visible on gram stain (Atypical usually not detectable on gram stain; won't grow on standard media)
  1. M.(mycoplasma) pneumonia, Chlamydia
  2. Legionella pneumophila
  3. Viruses
  4. Mycobacterium

VI. Management:

Out-patient:

Organisms: S. pneumo, Mycoplasma, viral, Chlamydia pneumo, H. flu

1. Previously Healthy patient: Patient WHITHOUT comorbidities, no recent antibiotic use, and low rate of resistance:

✓ Azithromycin – 500 mg on day one followed by four days of 250 mg a day or 500 mg daily for three days

Note(s):

Macrolide cover s.pneumonia atypical pneumonia organism and H.Influenza

Respiratory quinolone cover s.pneumonia atypical pneumonia organism and gram negative organism

If you worried of gram negative infection for comorbidity patient you give him respiratory quinolone

- ✓ Clarithromycin – 500 mg twice daily for five days
- ✓ Doxycycline – 100 mg twice daily

Recent antibiotic use within past 3 months, or high rate of resistance:

Respiratory quinolone (moxifloxacin, levofloxacin)

Patient WITH comorbidities

Comorbidities: cardiopulmonary disease or immunocompromised state
Organisms: S. pneumo, viral, H. flu, aerobic GN rods, S. aureus

A respiratory fluoroquinolone:

- ✓ Levofloxacin 750 mg daily, or
- ✓ Moxifloxacin 400 mg daily, or
- ✓ Gemifloxacin 320 mg daily for five days

OR

Combination therapy (if you don't use fluoroquinolone; if the hospital is poor or anything else): a beta-lactam AND macrolide.

- ✓ Amoxicillin, 1 g three times daily or
- ✓ Amoxicillin-clavulanate (Augmentin) 2 g twice daily
- ✓ Cefuroxime 500 mg twice daily.

Pathogen-directed therapy

Dr. said, you don't have to memorize the doses.

In-patient; medical ward:

Organisms: all of the above plus polymicrobial infections (+/- anaerobes), Legionella
Recommended parenteral antibiotics:
Respiratory fluoroquinolone, OR advanced macrolide plus a beta-lactam
Recent antibiotics:
As above. Regimen selected will depend on nature of recent antibiotic therapy.

VII. Complications of Pneumonia

- Usually with misdiagnose or if the patient comes late.
- Bacteremia
- Respiratory and circulatory failure
- Pleural effusion (Parapneumonic effusion), empyema, and abscess
- Pleural fluid always needs analysis in setting of pneumonia (do a thoracocentisis)
- needs drainage if empyema develop: Chest tube, surgical

Streptococcus pneumonia

- Most common cause of CAP
- Gram positive diplococci
- Symptoms : malaise, shaking chills, fever, rusty sputum (blood mixed with pus), pleuritic chest pain, cough (classical pneumonia)
- Lobar infiltrate on CXR, usually single lobe.
- 25% bacteremic

Risk factors for S.pneumonia:

- Splenectomy (Asplenia)
- Sickle cell disease, hematologic diseases (**autosplenectomy**)
- Smoking
- Bronchial Asthma and COPD
- HIV
- ETOH; alcoholic

S. Pneumonia Prevention:

1-Pneumococcal conjugate vaccine (PCV) is a vaccine used to protect infants and young children 7 serotypes of Streptococcus

Note(s):

PCV cover few serotype but is much better immunogenicity than PPSV.

If patient was very immune compromised (hematological malignancy) you should give him PCV followed by PPSV after 2 mounth

2-Pneumococcal polysaccharide vaccine (PPSV)

23 serotypes of Streptococcus
PPSV is recommended (routine vaccination) for those over the age of 65

Vaccination:

- ✓ For both children and adults in special risk categories:
- ✓ Serious pulmonary problems, eg. Asthma, COPD
- ✓ Serious cardiac conditions, eg., CHF
- ✓ Severe Renal problems
- ✓ Long term liver disease
- ✓ DM requiring medication
- ✓ Immunosuppression due to disease (e.g. HIV or SLE) or treatment (e.g. chemotherapy or radio therapy, long-term steroid use
- ✓ Asplenia (Any patient going to have splenectomy, they take vaccine 2 weeks earlier so they develop antibodies).

Haemophilus influenza:

- Second common cause organism of CAP
- Nonmotile, Gram negative rod
- Secondary infection on top of Viral disease, immunosuppression, splecnectomy patients
- Encapsulated type b (Hib)
- The capsule allows them to resist phagocytosis and complement-mediated lysis in the nonimmune host
- Hib conjugate vaccine all children should have it

Children are no more suffering from pneumonia caused by haemophilus influenza.

Specific Treatment: Guided by susceptibility testing when available

S. pneumonia:

- ✓ β-lactams Cephalosporins, eg Ceftriaxone, Penicillin G combined with Macrolides
- ✓ Macrolides eg.Azithromycin
- ✓ Fluoroquinolone (FQ) eg.levofluxacin
- ✓ Highly Penicillin Resistant: Vancomycin

H. influenzae:

- ✓ Ceftriaxone, Amoxocillin/Clavulinic Acid (Augmentin), FQ, TMP-SMX

Remember these associations:

- **Asplenia**: Strep pneumo, H. influ
- **Alcoholism**: Strep pneumo, oral anaerobes (aspirate), K. pneumo, Acinetobacter, MTB
- **COPD/smoking**: H. influenzae, Pseudomonas, Legionella, Strep pneumo, Moraxella catarrhalis, Chlamydophila pneumoniae
- **Aspiration**: Klebsiella, E. Coli, oral anaerobes
- **HIV**: S. pneumo, H. influ, P. aeruginosa, MTB, PCP(Pneumocystis pneumonia), Crypto, Histo, Aspergillus, atypical mycobacteria
- **Recent hotel, cruise ship**: Legionella
- **Structural lung disease** (bronchiectasis):Pseudomonas, Burkholderia cepacia, Staph aureus
- **ICU, Ventilation**: Pseudomonas, Acinetobacter
    - ***Just try to memorize first and second organism.***

Pneumonia: Outpatient or Inpatient?

1- **CURB-65:** it is a score to decide which patient need to be admitted based on the following indicators

5 indicators of increased mortality:

1. Confusion
2. BUN (blood urea nitrogen) >7
3. RR >30,
4. SBP <90 or DBP <60
5. Age >65

- Mortality: 2 factors 9%, 3 factors 15%, 5 factors 57%
- Score 0-1outpt. Score 2inpt. Score >3ICU.

2-Pneumonia Severity Index (PSI):

Variables including underlying diseases; stratifies pts into 5 classes based on mortality risk

No RCTs (randomised controlled trial) comparing CURB-65 and PSI

For out-patient you have to make sure:

1. **The patient will take antibiotics**
2. **Facility to monitor the patient**

If not, you have to admit the patient.

Pneumonia: Medical floor or ICU? Based on the following criteria you decide if patient should be in ICU

1 major or 3 minor criteria = severe CAP → ICU

- **Major criteria:**

Invasive ventilation, septic shock on pressors

- **Minor criteria:**

RR>30; multilobar infiltrates; confusion; BUN >20; WBC <4,000; Platelets <100,000; Temp <36, hypotension requiring aggressive fluids, PaO2/FiO2 <250. **(LOW temp, low WBC, Platelet, low BP)**

No prospective validation of these criteria

CAP Inpatient therapy:

General medical floor:

- ✓ Respiratory quinolone OR
- ✓ IV β-lactam PLUS macrolide (IV or PO)

β-lactams: cefotaxime, ceftriaxone, ampicillin; ertapenem

May substitute doxycycline for macrolide (level 3)

ICU:

- ✓ β-lactam (ceftriaxone, cefotaxime, Amox-clav) **PLUS EITHER** quinolone **OR** azithro
- ✓ PCN-allergic: respiratory quinolone **PLUS** aztreonam

Pseudomonal coverage:

- ✓ Antipneumococcal, antipseudomonal β-lactam (pip-tazo, cefepime, imi, mero) **PLUS EITHER** (cipro or levo) **OR** (aminoglycoside AND Azithro) **OR** (aminoglycoside AND respiratory quinolone)
- ✓ CA-MRSA coverage: Vancomycin or Linezolid

Pearls of therapy:

- ➢ Give 1st dose Antibiotics in ER (no specified time frame)
- ➢ Switch from IV to oral when pts are hemodynamically stable and clinically improving (**we shift to oral when WBC close to 10, no fever for 48 h, vital sign is stabilized, pt able to take by mouth**)
- ➢ Discharge from hospital:
- ➢ As soon as clinically stable, off oxygen therapy, no active medical problems
- ➢ Duration of therapy is usually 7-10 days:
- ➢ Treat for a minimum of 5 days
- ➢ Before stopping therapy: afebrile for 48-72 hours, hemodynamically stable, RR <24, O2 sat >90%, normal mental status
- ➢ Treat longer if initial therapy wasn't active against identified pathogen; or if complications (lung abscess, empyema)

CAP - Influenza:

- More common cause in children
- RSV (Human respiratory syncytial virus), influenza, parainfluenza
- Influenza most important viral cause in adults, especially during winter months
- Inhale small aerosolized particles from coughing, sneezing → 1-4 day incubation → 'uncomplicated influenza' **(fever, myalgia, malaise, rhinitis)** → Pneumonia
- Adults > 65 account for 63% of annual influenza-associated hospitalizations and 85% of influenza-related deaths

More information:

- Recent worlwide pandemic of H1N1 Influenza A (2009-2010)
- Current epidemic in Saudi Arabia (2010-2011)
- H1N1 risk factors: **pregnant, obesity, cardipulmonary disease, chronic renal disease, chronic liver disease**
- CXR findings often subtle, to full blown ARDS
- Respiratory (or Droplet) isolation for suspected or documented influenza (Wear mask and gloves)
- NP (Nasopharyngeal) swab for, Rapid Ag test Influ A, B. H1N1 PCR RNA
- Current Seasonal Influenza Vaccine prevents disease (given every season)
- Bacterial pnemonia (S. pneumo, S. aureus) may follow viral pneumonia

Influenza Therapy:

Neuraminidase inhibitors	**Oseltamivir / Tamiflu**	75mg po bid	**Influenza A, B**
	Zanamivir / Relenza	10mg (2 inhalations) BID	
Adamantanes	**Amantadine / Symmetrel**	100mg po bid	**Influenza A**
	Rimantadine / Flumadine	100mg po qd	

- ✓ We do not give Zanamivir for asthma
- ✓ H1N1 resistant to Adamantanes
- ✓ Neuraminidase inhibitors:
- ✓ 70-90% effective for prophylaxis
- ✓ Give within 48h of symptom onset to reduce duration/severity of illness, and viral shedding
- ✓ Osteltamivir dose in severe disease 150mg bid

MERS Case Definition

First described in 2012 in Saudi Arabia

A patient under investigation (PUI):

Fever AND pneumonia or acute respiratory distress syndrome (based on clinical or radiological evidence) AND EITHER:

A history of travel from countries in or near the Arabian Peninsula within 14 days before symptom onset, OR close contact with a symptomatic traveler who developed fever and acute respiratory illness (not necessarily pneumonia) within 14 days after traveling from countries in or near the Arabian Peninsula OR

A member of a cluster of patients with severe acute respiratory illness (e.g., fever and pneumonia requiring hospitalization) of unknown etiology in which MERS-CoV is being evaluated, in consultation with state and local health departments.

OR

Fever AND symptoms of respiratory illness (not necessarily pneumonia; e.g. cough, shortness of breath) AND being in a healthcare facility (as a patient, worker, or visitor) within 14 days before symptom onset in a country or territory in or near the Arabian Peninsula in which recent healthcare-associated cases of MERS have been identified.

Signs and Symptoms of MERS:

Most people confirmed to have MERS-CoV infection have had severe acute respiratory illness with symptoms of:

•fever

•cough

•shortness of breath

Some people also had gastrointestinal symptoms including diarrhea and nausea/vomiting.

For many people with MERS, more severe complications followed, such as pneumonia and kidney failure.

About 30% of people with MERS died. Most of the people who died had an underlying medical condition.

Some infected people had mild symptoms (such as cold-like symptoms) or no symptoms at all; they recovered.

People with pre-existing medical conditions (also called comorbidities), may be more likely to become infected with MERS, or have a severe case. Pre-existing conditions from reported cases for which we have information have included diabetes; cancer; and chronic lung, heart, and kidney disease. Individuals with weakened immune systems are also at higher risk for getting MERS or having a severe case.

The incubation period for MERS (time between when a person is exposed to MERS-CoV and when they start to have symptoms) is 2-14 days.

SUMMARY

1. In pneumonia you have inflammation and alveolar filling with pus & exudates
2. Pneumonia is the single most common cause of infection-related mortality
3. CAP: - Streptococcus pneumoniae is the most common pathogen.
4. In Clinical Signs:- lung findings are important in pneumonia specially bronchial breath sound and Aegophony
5. Without CXR you can't diagnose Pneumonia
6. Acinetobacter Pneumonia:- polymyxin colistin is the only drug we use against it
7. Coxiella burnetii (Q fever), Francisella tularensis (tularemia), Chlamydia psittaci (psittacosis) are CAP atypical & all of them are zoonotic

Questions

1- A 40-year-old man is admitted with complaints of fever, shortness of breath and cough. You diagnosed him to have pneumonia. Before starting antibiotics your consultant asked you the following question. Which ONE of the following organisms would typically be found in a patient with community-acquired pneumonia?

A. E. coli
B. Legionella pneumophilia
C. Staphylococcus aureus
D. Streptococcus pneumonia

2- A 64-year-old man presents with fever, chills, and increasing shortness of breath. The patient appears in acute respiratory distress and complains of pleuritic chest pain. Physical examination shows crackles and decreased breath sounds over both lung fields. The patient exhibits tachypnea, with flaring of the nares. The sputum is rusty-yellow and displays numerous neutrophils and erythrocytes. Which of the following pathogens is the most common cause of this patient's pulmonary infection?

A. Mycoplasma pneumoniae
B. Pseudomonas aeruginosa
C. Staphylococcus aureus
D. Streptococcus pneumoniae
E. Legionella pneumophila

3- If the patient described in Question 2 is appropriately treated with antibiotics, which of the following is the most likely outcome?

A. Abscess formation
B. Bronchopleural fi stula
C. Bullous emphysema
D. Resolution
E. Scar formation

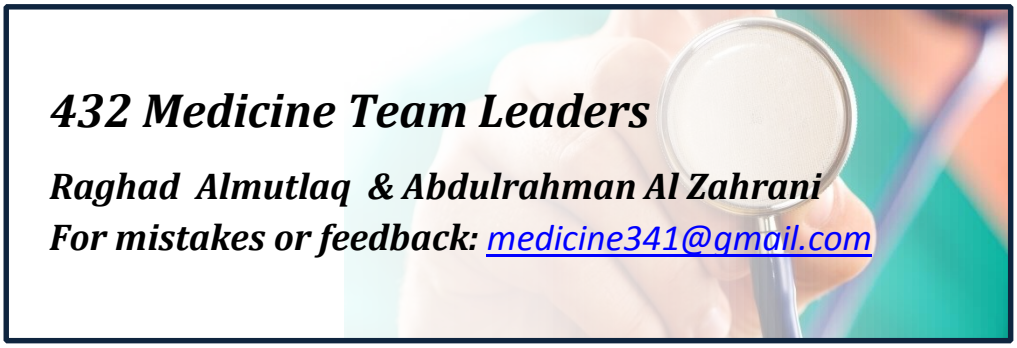
4- A 36-year-old man with AIDS presents with fever, dry cough, and dyspnea. A chest X-ray shows bilateral and diffuse infiltrates. Laboratory studies reveal a CD4+ cell count of less than 50/ìL. A lung biopsy discloses a chronic interstitial pneumonitis and an intra-alveolar foamy exudate. A silver stain of a bronchoalveolar lavage is shown in the image. Which of the following organisms is the most likely pathogen responsible for these pulmonary findings?

A. Cryptococcus neoformans
B. Cytomegalovirus
C. Histoplasma capsulatum
D. Mycoplasma pneumoniae
E. Pneumocystis jiroveci

Comments:

Q3: D; the most common outcome of acute bacterial pneumonia is resolution

Q4: E; *P. jiroveci* (formerly *P. carinii*) is the most frequent cause of infectious pneumonia in patients with AIDS.



Answers:

1st Questions: D

2nd Question: D

3rd Question: D

4th Question: E