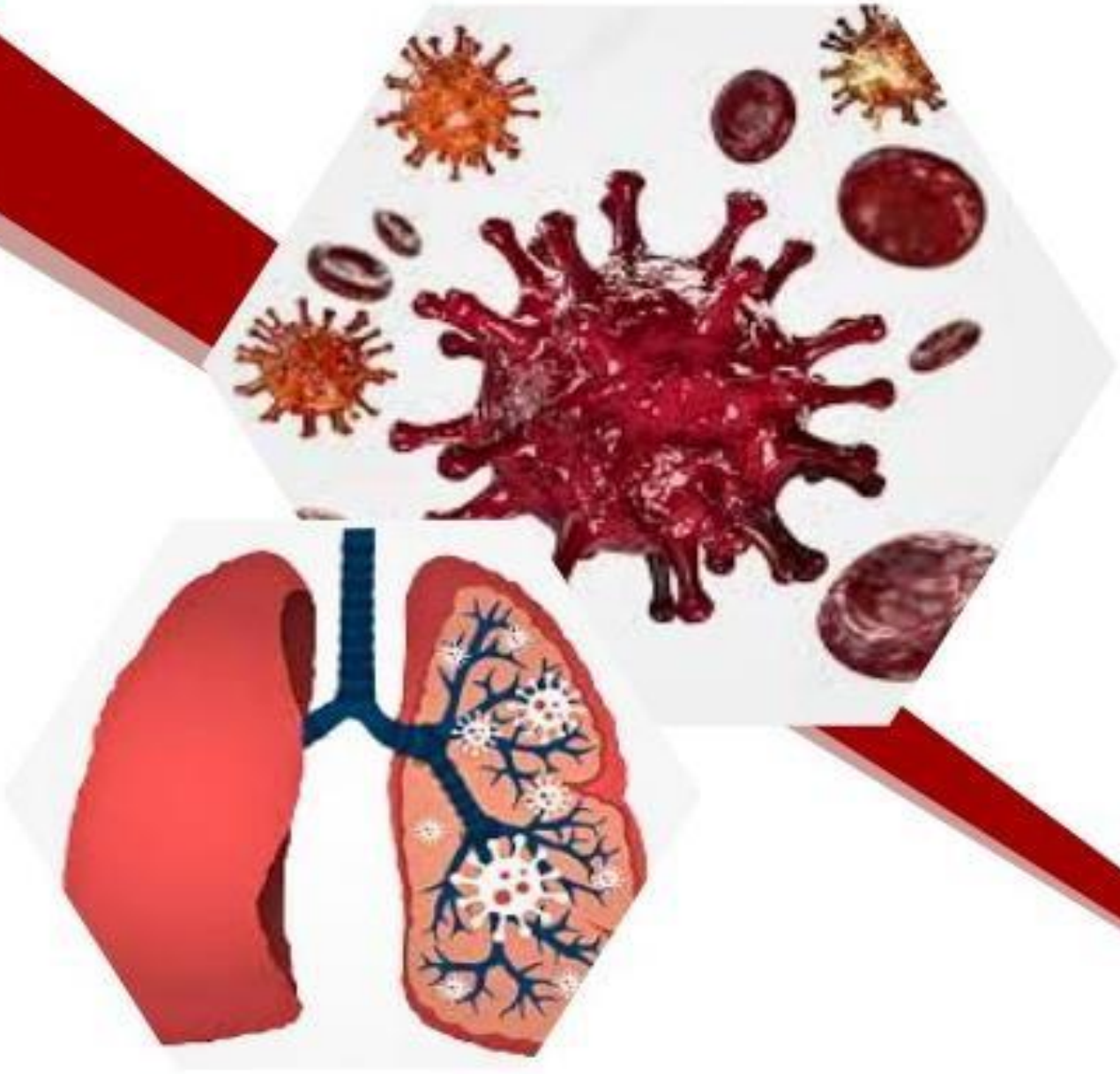
Doctor.021

no.

RS MICROBIOLOGY



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Doctor:

Hello there, in this lecture we will discuss two organisms that share the same spectrum of disease, and share the same virulence factor which is the capsule.

Their capsule is antiphagocytic, so they can invade blood and reach many organs and cause disease like sepsis or meningitis.

STREPTOCOCCUS PNEUMONIAE

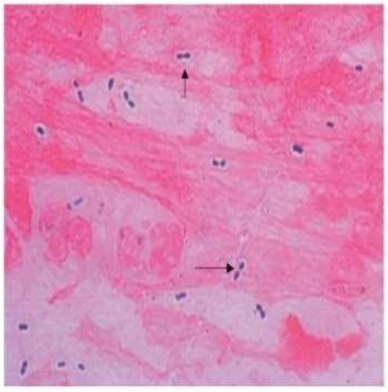


FIGURE 15–15 *Streptococcus pneumoniae*—Gram stain. Arrows point to typical gram-positive diplococci. Note that the clear area around the organism is th capsule. (Used with permission from Professor Shirley Lowe, University of California, San Francisco School of Medicine.)

Pneumococci are gram-positive facultative anaerobe, lancet-shaped cocci or bullet shaped cocci arranged in pairs (diplococci) or short chains (The term lancet-shaped means that the diplococci are oval with somewhat pointed ends rather than being round.

- **All virulent strains have surface capsules, composed of high-molecular-weight polysaccharide polymers.**
- **On blood agar, they produce α-hemolysis (partial), In contrast to viridans streptococci, they are lysed by bile or deoxycholate, and they are sensitive to optochin.**
- **Pneumolysin forms pores after release by autolysins, and play major rule in virulence it.**
- **Notice that these pneumolysin isn't exotoxin, it is an enzyme that is elaborated when strep.pnemoniae undergo autolysis and destructs ciliated epithelial cells and facilitates the infection.**
- **They aren't classified under Lancfield because they don't have carbohydrate antigen on their surface.**

Pathogenesis, virulence factors:

- The most important virulence factor is the capsular polysaccharide 91 type used in serotyping of strep.pneumoniae, and anticapsular antibody is protective.
- Notice that immunity is sterotype specific and usually isn't lifelong.
- Lipoteichoic acid: attachment factor as well as complement activator, it induces inflammatory cytokine production contributes to the inflammatory response and to the septic shock syndrome that occurs in some immunocompromised patients (a bit similar to protein A in LPS in Gram negatives).
- Pneumolysin, the hemolysin that causes α-hemolysis, may also contribute to pathogenesis.
- Pneumococci produce IgA protease that enhances the organism's ability to colonize the mucosa of the upper respiratory tract.
- Although Strep.pneumoniae isn't highly communicable, it is the most common bacterial cause of pneumonia, meningitis, sepsis in people who had undergone splenectomy or have functional asplenia, sinusitis and otitis media in children (hot ear disease) .

Factors that lower resistance and predispose persons to pneumococcal infection include (factors that reduce mucus clearing or factors that decrease immune reaction)

- (1) anything that can depress the cough reflux: alcohol or chronic smokers or drug intoxication or other cerebral impairment (geriatrics,CVA, mental impairment) ,(which inhibit CNS responses, so they develop impaired cough reflex) all contribute to an increase aspiration of secretions (and thus pneumonia)
- (2) abnormality of the respiratory tract (e.g., viral infections), (e.g. Viral infections (influenza virus which impairs the barriers (mucocilliary function) allowing for superimposed bacterial infection due to lower clearance rates), pooling of mucus,

bronchial obstruction, and respiratory tract injury caused by irritants (which disturb the integrity and movement of the mucociliary blanket) all prevent clearing of mucus and predispose to community acquired pneumonia caused by pneumococcus.

- (3) abnormal circulatory dynamics (e.g., pulmonary congestion and heart failure)- will congest (more stasis) the blood in the lung, increase pulmonary secretions pneumococcus
- (4) Anatomical splenectomy (capsule, reduces immunity) and certain chronic diseases such as sickle cell anemia and nephrosis, patients with sickle cell anemia autoinfarct their spleen, become functionally asplenic, and are predisposed to pneumococcal sepsis, because spleen has special phagocytes that able to clear encapsulated organisms, also spleen produce opsonins like properdin and toftin.
- (5) Trauma to the head that causes leakage of spinal fluid through the nose predisposes to pneumococcal meningitis.
- (6) malnutrition,overcrowdedness.

Transmission:

- Humans are the natural hosts for pneumococci; there is no animal reservoir.
- Because a proportion (5%–50%) of the healthy population harbors virulent organisms in the oropharynx, pneumococcal infections are not considered to be highly communicable (often it the infection is from your own flora).
- Resistance is high in healthy young people, and disease results most often when predisposing factors are present.
- There is debate about whether the infection occur through aspiration of your own bacteria or inhalation and exchange new strains.
- In general, aspiration of normal flora occurs in adults and cause pneumonia and meningitis. On the other hand, inhalation occur in children and cause upper respiratory tract infection like sinusitis and otitis media.

Diseases

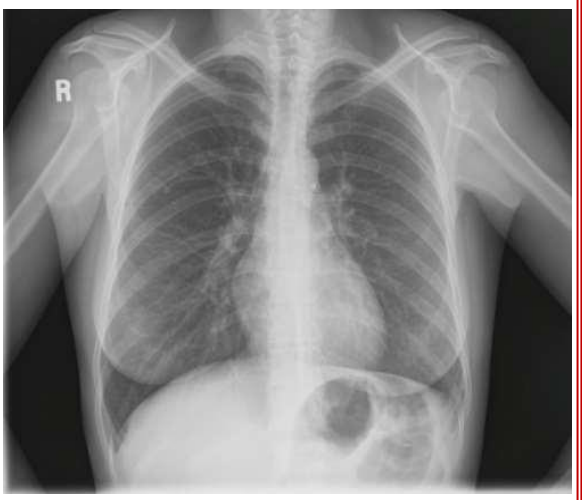
- **Streptococcus pneumoniae (pneumococcus) the most common bacterial cause of:1) pneumonia 2) bacteremia 3) meningitis, and 4) URTI (upper respiratory tract infections)- such as otitis media, mastoiditis, and sinusitis.**

- **Pneumococci are the most common cause of community-acquired pneumonia. However, in hospital acquired pneumonia (after 48 hours from admission) or ventilator associated pneumonia the cause mainly drug resistant bacteria in hospitals such as Pseudomanas, Klebsilla, Enterobacter, Citrobacter, Maltophilia and can be -less common- Strep.pneumoaie and Hemophillus Influenzae.**
- **Meningitis: has bimodal distribution in children and elderly The most common bacterial (pyogenic) cause is Strep.pneumoaie then Hemophillus Influenzae then Neisseria.**
- **Bacteremia in 20-25% of patients whether they are splenectomized or not, whereas in splenectomized patients the percentage is much higher. Here you will have positive blood culture.**
- **Otitis media, and sinusitis: the most common bacterial cause is Strep.pneumoaie then Hemophillus Influenzae then Moraxilla catarrhalis.**
- **They are a common cause of conjunctivitis, especially in children.**

Pneumonia:

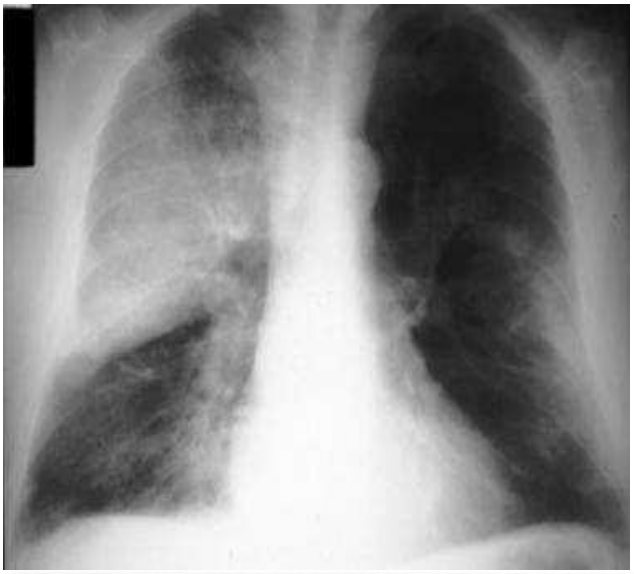
- **The most common form of strep.pneumoniae.**
- **Second most common nosocomial infection (the most common one is UTI).**

- ***Str. pneumoniae*** **is the most frequent cause of pneumonia with an estimated annual incidence of 1–3 per 1000 of the population, with a 5% case fatality rate.**
- **Remember the rule of capsule in invagination and avoiding phagocytosis in the blood to reach the meninges and cause meningitis and cause subdural empyema.**
- **Pneumococcal pneumonia usually follows aspiration (!) with subsequent migration of through the bronchial mucosa to involve thesurrounding lymphatics.**
- **The inflammatory reaction is focused primarily within the alveolus of a single lobule or lobe, although multilobar disease can also occur.**
- **Contiguous spread commonly results in inflammatory involvement of the pleura; this may progress to empyema (pus in pleural space).**
- **Pericarditis is an uncommon but well recognized complication.**
- **Pneumonia: edema+PMNs accumulate in alveolar sac (which normally filled just with air) and this the cause of consolidation on X-RAY.**

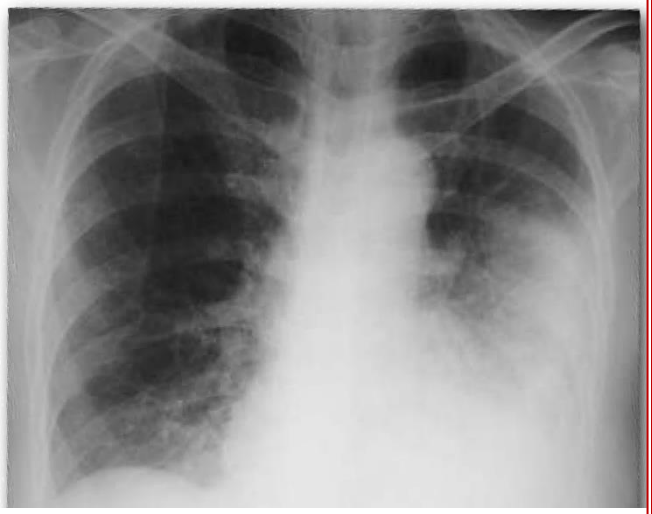


- **Here you can see the normal x-ray**

- **In these x-rays you can see the well demarcated consolidation or opacification, also you can see air in bronchi that are coming to the affected lobule and this called (with air bronchogram) which means that the inflammation and the pathogenesis spare the bronchi and the disease occurs in alveolar sacs.**



- **In contrast, viral infection infiltrates the hole lung or both lungs, so it appears scattered.**



- **Occasionally, lung necrosis and intrapulmonary abscess formation occur with the more virulent pneumococcal serotypes.**
- **Bacteremia may complicate pneumococcal pneumonia in up to 15% of patients.**
- **This can result in metastatic involvement of the meninges, joints causing septic arthritis and rarely the endocardium.**
- **The mortality rate from pneumococcal pneumonia in those admitted to hospital in the UK is approximately 15%.**
- **It is increased by age, underlying disease, bloodstream involvement, metastatic infection and certain types of pneumococci with large capsules and have higher mortality rate (e.g. serotype 3).**

Otitis media and sinusitis: (URTI)

- **Middle ear infections (otitis media) (also called hot ear disease) affect approximately half of all children between the ages of 6 months and 3 years; approximately one-third of cases are caused by *S. pneumoniae*.**
- **In diagnosing otitis media, you can feel the hotness of ear and you will see redness and bulging in tympanic membrane.**
- **Disease occurs after acquisition of a new strain to which there is no pre- existing immunity.**
- **The prevalence is highest among children attending kindergarten or primary school,**
- **where there is a constant exchange of pneumococcal strains.**
- **In sinusitis, you will see the opacification in X-RAY because sinuses are filled with PMNs and fluids.**

Meningitis

- ***Str. pneumoniae* is among the three leading causes of bacterial meningitis. It is assumed that invasion arises from the pharynx to the meninges via the blood- stream, as bacteraemia usually coexists. Meningitis may occasionally complicate pneumococcal infection at other sites, such as the lung and middle ear.**
- **The incidence of pneumococcal meningitis is bimodal and affects children less than 3 years of age and adults of 45 years and above. Notice that in these patients have +ve blood culture.**
- **The fatality rates are 20% and 30%, respectively, considerably higher than those associated with other types of bacterial meningitis.**

- **Can be caused as a complication for pneumococcal disease or can get access directly to meninges causing meningitis and then disseminate and infects other organs**

Clinical Findings:

- **Pneumonia:**
- **sudden chill, fever, productive cough, and pleuritic pain (chest pain that increases with chest movement-breathing).**
- **Sputum is a red or brown "rusty" color.**
- **Sputum is a green in pseudomonas infection.**
- **Sputum is a red currant jelly in Klebsilla infection.**
- **Bacteremia occurs in 15% to 25% of cases.**
- **Spontaneous recovery may begin in 5 to 10 days and is accompanied by development of anticapsular antibodies.**
- **Pneumococci are a prominent cause of otitis media, sinusitis, mastoiditis, conjunctivitis, purulent bronchitis, pericarditis, bacterial meningitis, sepsis and empyema.**
- **Pneumococci are the leading cause of sepsis in patients without a functional spleen.**
- **There is no structural damage (the alveolar sac returns to its normal structure after atelectasis), so there is spontaneous recovery in 5-10 days.**

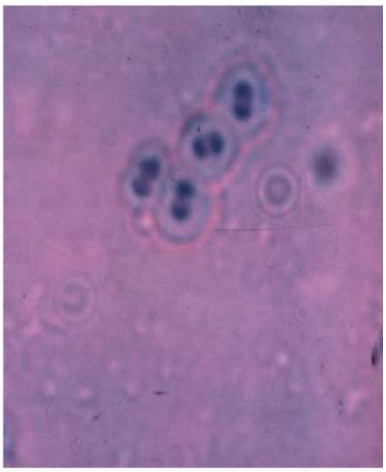
  Laboratory Diagnosis

  In sputum: lancet-shaped gram-positive diplococci in Gram-stained smears.

- **Nasal swabbing is one of the methods used strep. Pneumonia diagnosis.**
- **Nasal washing (irrigation) → Moraxella catarrhalis**
- **Sputum sample, blood smear, CSF sample if meningitis is susceptible.**

Can be detected by using the quellung reaction with multitype antiserum.

- **Quelling reaction is a biochemical reaction whereby pneumococci are mixed with anti-capsule typing serum in which antibodies bind to 91 serotypes of capsular antigens, then examined under the microscope, if the capsule is swollen it gives positive.**
- **Blood cultures are positive in 15-25% of pneumococcal infection.**
- **To distinguish between the pneumococcal infection and S.mitis, optochin sensitivity is used to differentiate between them (strep Pneumonia is susceptible while mitis is not)**



Quellung reaction

On blood agar, pneumococci form small α-hemolytic colonies.
The colonies are bile-soluble (i.e., are lysed by bile), and growth is inhibited by optochin.
Blood cultures are positive in 15% to 25% of pneumococcal infections.

Treatment:

- **Most pneumococci are susceptible to penicillins and erythromycin, although significant resistance to penicillins has emerged**
- **Usually it is given orally, but hospitalized patients can take injectable penicillin.**
- **Some patients may develop resistance to penicillin due to the bacterial ability to alter or change the penicillin binding proteins, unlike haemophilus influenza which has beta lactamase activity, vancomycin is the drug of choice for those patients.**

• In severe pneumococcal infections, penicillin G is the drug of choice, whereas in mild pneumococcal infections, oral penicillin V can be used.
• A fluoroquinolone with good antipneumococcal activity, such as levofloxacin, can also be used.
• In penicillin-allergic patients, erythromycin or one of its long-acting derivatives (e.g., azithromycin) can be used.

- Patients allergic to penicillin are given macrolides (clindamycin, azithromycin, etc...)

• An increasing percentage of isolates, ranging from 15% to 35% depending on location, show high-level resistance, which is attributed to multiple changes in penicillin binding proteins.
• They do not produce β-lactamase. Vancomycin is the drug of choice for the penicillinresistant pneumococci, especially for severely ill patients.
• Ceftriaxone or levofloxacin (fluroquinolones) can be used for less severely ill patients.

Prevention

• Despite the efficacy of antimicrobial drug treatment, the mortality rate of pneumococcal infections is high in immunocompromised (especially splenectomised) patients and children under the age of 5 years Such persons should be immunized with the 13-valent pneumococcal conjugate vaccine (Prevnar 13) (must be given booster doses every 5 years).

- There are two types of this vaccine, (Prevnar 13 and pneumovax 23)
- (13 indicates the most common prevalence serotype that causes illness in children and the same number indication in pneumovax 23, but pneumovax23 is for elderly)
- Prevnar 13 is a polysaccharide conjugated vaccine, S.Pneumoniae polysaccharide antigen is conjugated to another antigen or bacterial toxoid (diphtheria or tetanus)

- **Why are conjugated vaccines administered to children? the case of young children, their immune systems might not respond as effectively to certain antigens, especially polysaccharides found in bacterial capsules. Conjugated vaccines overcome this limitation by conjugating (combining) these weakly immunogenic polysaccharides with a carrier protein that enhances the overall immunogenicity of the vaccine.**
- **as you know, polysaccharides are recognized by B cells, and proteins recognized by t cells, by attaching polysaccharides to a protein, the immune system can elicit a T-cell-dependent response, leading to a more robust and longer-lasting immune memory.**
- **-Under the age of 5 we give Prevnar 13 (5 doses at 2 months old, 4, 6, 14 ,18)**
- **Over the age of 50 we give unconjugated pneumovax 23**
- **Immunity of each vaccine lasts for 5 years**

• The immunogen in this vaccine is the pneumococcal polysaccharide of the 13 most prevalent serotypes conjugated (coupled) to a carrier protein (diphtheria toxoid). The unconjugated 23-valent pneumococcal vaccine (Pneumovax 23) should be given to healthy individuals age 50 years or older (booster doses at 65).

• These vaccines are safe and effective and provide long-lasting (at least 5 years) protection.

HAEMOPHILUS important Properties

• H. influenzae G-ve ROD encapsulated with a polysaccharide capsule.

- **They are facultative anaerobes means that they are ordinary aerobes but they have the ability to live in anaerobic conditions.**

- **Polyribitol phosphate is a key component responsible for the pathogenesis of Haemophilus influenzae. It serves as the basis for the development of the vaccine against Haemophilus influenzae**
- **H.influenza has a spectrum similar to S.pneumonia, they cause URT infections, pneumonia and meningitis.**
- **The capsulated serotypes are associated with invasiveness namely, bacteraemia, meningitis, pneumonia as well as epiglottitis.**
- **They are classified into typeable and non-typeable according to possessing a capsule, the typeable one has 6 serotypes (a,b,c,d,e,f), the most common capsulated haemophilus influenza serotype causes infection is serotype b.**
- **Non-typeable serotypes of Haemophilus influenzae express outer membrane proteins that contribute to their pathogenesis, primarily causing otitis media and sinusitis.**
- **Not typeable serotypes also implicated in chronic bronchitis**
- **Remember, the leading causes of URT infections (otitis media and sinusitis) are: 1-strep pneumonia, 2-haemophillus influenza (non-typeable one), 3-morxilla catarrhalis**
- **While meningitis is caused mainly by 1: strep pneumonia, 2-haemophillus influenza (typeable one B), 3-Neiseria meningitidis.**

• one of the three important encapsulated pyogens (pneumococcus and the meningococcus).
• Using serologic methods against the antigen of the polysaccharide capsule, six serotypes are detected, with serotype B (group B) being the most significant one.
• Serotype B is the one most responsible for the more serious illnesses (meningitis, epiglottitis, sepsis)
• The type B capsule is composed of polyribitol phosphate, promotes
antiphagocytosis and invasiveness

• Unencapsulated strains are less invasive but can cause disease usually limited to the upper respiratory tract (sinusitis and otitis media).
• Growth of the organism on laboratory media requires the addition of two components, heme (factor X) and NAD (factor V), for adequate energy production.

- named for their affinity for blood, Haemophilus bacteria require two factors, heme and NAD (nicotinamide adenine dinucleotide), for cultivation on blood or chocolate agar. These specific requirements distinguish them from Neisseria bacteria.

Diseases H. influenzae used to be the leading cause of meningitis in young children
• Note we have 1 representative from each Gram reaction and shape that is a respiratory organism, the three capsulated ones are causative of meningitis and have vaccines made against the capsule:
• Pneumococcus G+ve coccus = capsulated respiratory organism causes mengitis and URTI
• Meningiococcus G-ve coccus also capsulated which can colonize the respiratory epithelium
• and now the Gram-negative ROD, Haemophilus is also a respiratory capsulated organism that is the third most common cause of meningitis.

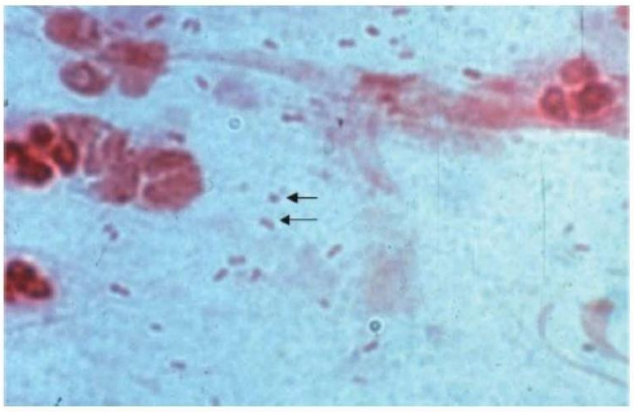


FIGURE 19–1 *Haemophilus influenzae*—Gram stain. Arrows point to two small "coccobacillary" gram-negative rods. (Used with permission from Professor Shirley Lowe, University of California, San Francisco School of Medicine.)

Notice from the picture, it is a small bacterium, it has a coccobacillary shape especially when it grows in young culture

H. influenzae infects only humans with no animal reservoir.

- strep.pneumonia, strep.pyogenes, haemophilus influenza, Corynebacterium (except diphtheroid), bordetella, they are exclusively have human pathogens without animal reservoir.

- **Similar to other respiratory pathogens, it is transmitted by the inhalation of airborne droplets into the respiratory tract, this can result in asymptomatic colonization or infection (otitis media, sinusitis, pneumonia).**
- **Also like all respiratory pathogens, to be able to survive in this environment, the organism produces an IgA protease that degrades secretory IgA which would otherwise inhibit its attachment to the mucosa.**
- **After becoming established in the upper respiratory tract, the organism can enter the bloodstream (bacteremia) and spread to the meninges.**

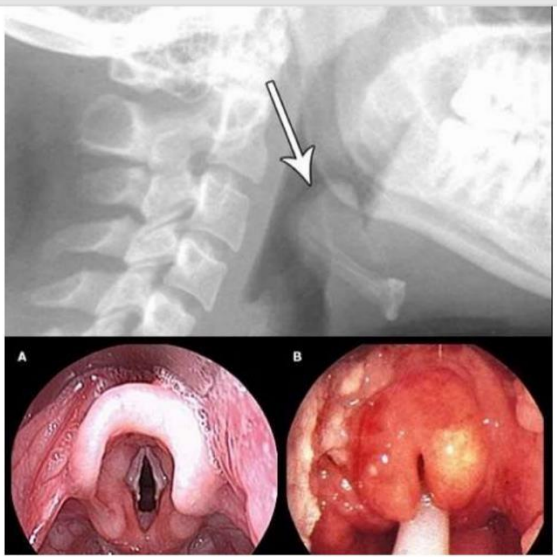
- the percentage of bacteraemia (sepsis) occurrence is higher in patients with H.influenza (especially the typeable form) than patient infected with strep.pneumonia

- **As mentioned, capsulated strains cause meningitis (they have to have antiphagocytic capability to survive the trip through the blood to reach the meninges, this is true for Pneumococcus and Meningiococcus)**
- **meningitis caused by capsular type b has been greatly reduced by vaccine contains the type b polysaccharide as the immunogen.**
- **Similar to pneumococcus and meningococcus, the pathogenesis of H. infleunzae is pyogenic with no exotoxin production (capsule and endotoxin based)**

Clinical Findings

• Meningitis caused by H. influenzae produces a clinical picture that is almost identical pneumococcal or meningococcal meningitis.
• Meningitis → The rapid onset of fever, headache, stiff neck, (neurological symptoms; drowsiness), is typical. • URTI ◊ Sinusitis and otitis media cause pain in the affected area, opacification of the infected sinus, and redness with bulging of the tympanic membrane.
• H. influenzae is second only to the pneumococcus as a cause of these two infections. • Other serious infections: septic arthritis, cellulitis, and sepsis (more in asplenic patients, due to the fact that this is a capsulated organism).
• Epiglottitis→ rare, but can obstruct the airway and CAN BE FATAL. Upon inspection, a swollen "cherry-red" epiglottis is seen.

- One of the most notable findings in Hemophilus infected patients especially type b is epiglottitis.
- The carriage rate of Hemophilus influenza -typeable one- is much less than strep.pneumonia because it is involved in the national vaccination program.
- Epiglottitis: inflammation of the epiglottis characterized by inspiratory stridor (indication for airway obstruction), medical emergency state, since it is emergency you should do intubation or tracheostomy, they are diagnosed at time and don't wait cultural results to start treatment.



- Also, could be diagnosed by x-ray of the lateral neck, showing thumb sign, pathognomonic of epiglottitis.

- This life-threatening disease of young children is caused almost exclusively by H. influenzae. Symptoms include,

drooling, stridor (high pitched breathing noise) and comfort on sitting up.

- Pneumonia in elderly adults, especially those with chronic respiratory disease, can be caused by untypeable strains of H. influenzae

Laboratory Diagnosis

• Need to isolate the organism to make the Dx, inactivated blood must be used (chocolate agar, to remove inhibitors of growth in the blood) enriched with two growth factors required for bacterial respiration (chocolate agar +factor x and factor V).

- Blood culture positivity in H.influenza is higher than strep.pneumonia

• An organism that grows on Chocolate+Factors X and V is assumed to be H. influenzae; other species of Haemophilus, such as Haemophilus parainfluenzae, do not require both factors.

• Quelling reaction (Antibody against the (6 serotypes of the PRP) capsule which shows swelling of the capsule if contained the antigen for the provided antibody) can be used, also biochemical tests.

• Additional means of identifying encapsulated strains include fluorescentantibody staining of the organism and counter immunoelectrophoresis or latex agglutination tests, which detect the capsular polysaccharide

Treatment

• For meningitis and serious systemic infections (remember these are more invasive and aggressive) caused by H. influenzae the treatment of choice is ceftriaxone (3rd gen).

• From 20% to 30% of H. influenzae type b isolates produce a β-lactamase that degrades penicillinase-sensitive β-lactams such as ampicillin but not ceftriaxone.

• It is important to institute antibiotic treatment promptly, because the incidence of neurologic sequelae (subdural empyema) is high.
• Untreated H. influenzae meningitis has a fatality rate of approximately 90%. (prophylaxis is very important, rifampin is given)
• H. influenzae upper respiratory tract infections (such strains as mentioned are less aggressive and less invasive), that cause otitis media and sinusitis, are treated with either amoxicillin-clavulanate or trimethoprimsulfamethoxazole

Prevention
• Capsule= vaccine, so the vaccine contains the capsular polysaccharide of H. influenzae type b conjugated to diphtheria toxoid or another carrier protein.
• Depending on the carrier protein, it is given sometime between the ages of 2 and 15 months.
• This vaccine is much more effective in young children than the unconjugated vaccine and has reduced the incidence of meningitis caused by this organism by approximately 90% in immunized children.
• Meningitis in close contacts of the patient can be prevented by rifampin.
• Rifampin is used because it is secreted in the saliva to a greater extent than ampicillin. Rifampin decreases respiratory carriage of the organism, thereby reducing transmission

- Keep on mind, household contacts especially in children are prone to develop the whole spectrum of H.Influenzae, so we need to protect them by giving Rifampin (Prophylactically). Note: Rifampin has high concentration in respiratory secretions; highly potent against it, and a side effect is that it causes a red colored body secretion! It's part of the hexa vaccine program; (Diphteria, Tetanus, Acellular pertussis, Hepatitis B, Poliomyelitis and Haemophilus Influenzae type B).

An 18-month-old boy has been playing with a child who develops Haemophilus influenzae meningitis. The boy's parents consult his paediatrician, who says she is comfortable that the child will be fine because he has been fully immunized with the polyribitol ribose phosphate (PRP) – protein conjugate vaccine. For what reason is it necessary to immunize infants of 2 months to 2 years of age with polysaccharide – protein conjugate vaccines?

A) The conjugate protein is diphtheria toxoid, and the goal is for the infant to develop simultaneous immunity to diphtheria.

B) Infants 2 months to 2 years of age do not immunologically respond to polysaccharide vaccines that are not conjugated to a protein.

C) The conjugate vaccine is designed for older children and adults as well as infants.

D) Maternal (transplacental) antibodies against Haemophilus influenzae are gone from the infant's circulation by 2 months of age.

E) None of the above

Answer: B

Sketchy links:

Haemophilus influenza:
https://mega.nz/folder/VuUFFQrZ#zKktM105APnElLedXIA3Lg/folder/p6MWTbwa
Strep.pneumonia:
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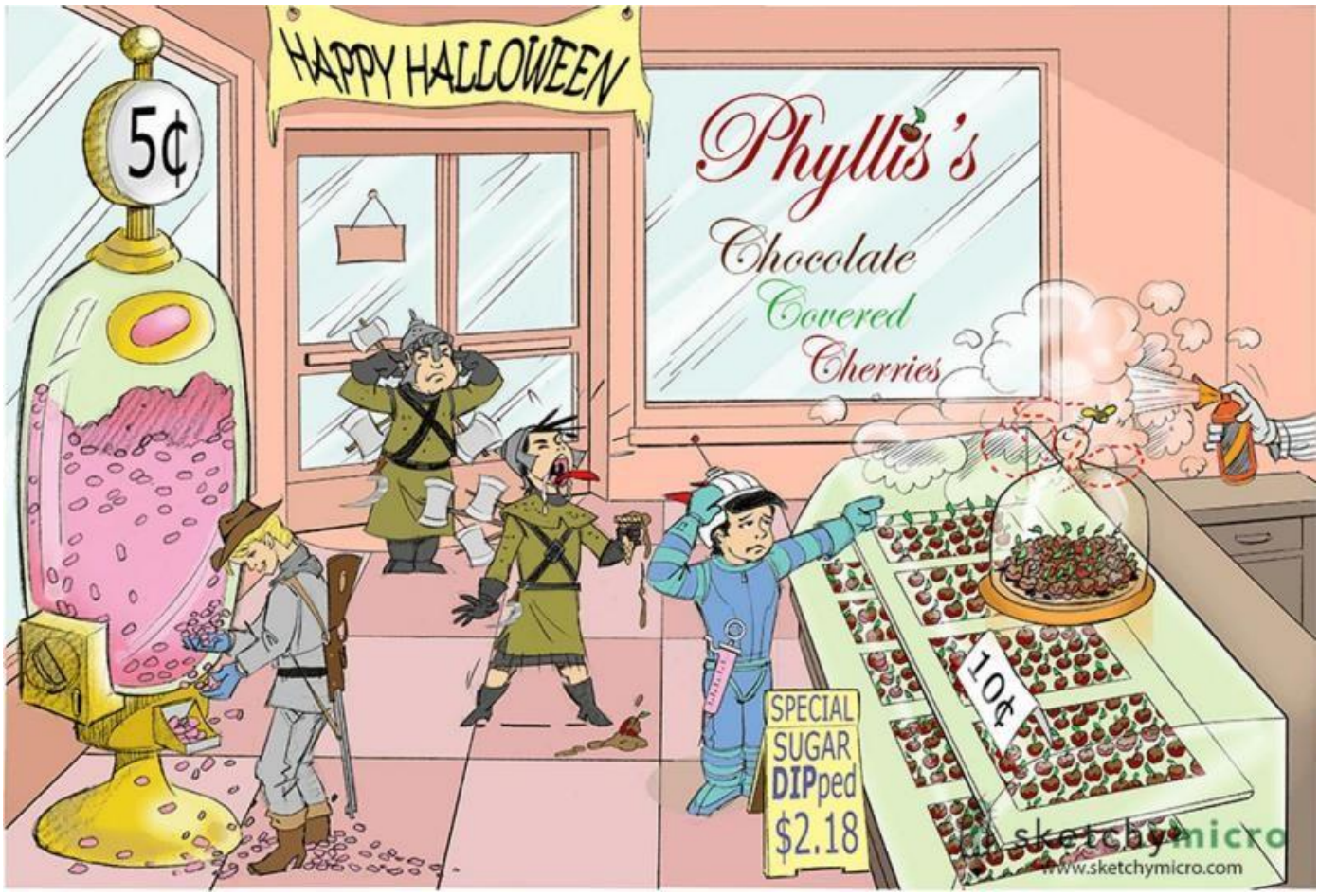

Haemophilus Influenza - "Phyllis's Chocolate Covered Cherries"

1. Red Hues - Gram Neg
2. Shape of the candy machine and candy on top of the machine - Coccobacillary Shape
3. Chocolate sign – Grown in chocolate agar
4. 10 cent sign – Needs Factor 10 “Hemodin”
5. 5 cent sign - Grown on chocolate agar needs factor 5 (NAD, nicotinamide) and factor 10 (Hemodin) "hemoTEN"
6. Child Coughing and aerosol spray - Infection primarily moved by aerosol transmission leading to droplets going to respiratory track calling pneumonia
7. Child sticking out the red tongue screaming - Disease Epiglottitis - symptoms Drooling, inflamed epiglottis, strider, drooling
8. Cherries - "cherry red epiglottis"
9. Child plugging his ears - Otitis Media
10. Meningitis helmet and Bee flying around - Meningitides - only caused by type B capsular form.
11. Sickles attached to belts - Sepsis and Septic arthritis in patients without a spleen, hemophilic infections, especially sickle cell disease
12. Syringe and Capsule with the Bee flying around it - Vaccine for only the type B capsule is conjugated with diphtheria toxoid and haemophilus type B capsule
13. **Dip**ped for 2.18 - Vaccinate between 6 weeks - 18 months (bound to diphtheria) Dip=Diphtheria
14. Three Axes -Treatment Ceftriaxone
15. Rifle - Treatment for close contacts is rifampin

Strep Pneumonia "the alpha knight tournament"	Strep Viridians
1. Purple Background - G+ 2. α knight tournament – α hemolytic, partial hemolysis where the surrounding zone is a green hue 3. **Strep Pneumonia Knight** 4. Armor – Polysaccharide Capsule is major virulence factor 5. Chin is exposed – Optochin sensitive, optochin inhibits the growth of strep pneumo 6. Double Lance – Lancet shaped diplococci 7. Mud on horses legs - Bile soluble, meaning it does not grow in Bile 8. Rust Colored single lobe on chest – Rust colored sputum and lobar pneumonia 9. Squire mopping up muddy mess MOPS - Meningitides, Otitis Media, Pneumonia, Sinusitis 10. Number 1 sign – number one cause of all these diseases. 11. Cracked Shield with the symbol of IgA dimer molecule - Protease that cleaves IgA that allows invasion of mucosa reducing host defenses 12. Sickle - Removal of spleen leads to susceptibility of infection by encapsulated organisms like in sickle cell anemia. 13. Crows – azithromycin Macrolides 14. 3 Axes - Ceftriaxone 15. **Adults** in the **M**ezzanine, **Children** on the **G**round - 2 pneumococcal vaccines, adult is a 23 valiant polysaccharide vaccine, children is 7 valent but conjugated to a protein. Adults will have a T-Cell independent response creating IgM that does not last long. Adding the protein adds a more robust antigen response leading to a production of IgG in children.	1. No Armor – Not encapsulated 2. Jesters mask protects face including the chin – optochin resistant 3. Donkey with bile resistant boots – Bile resistant 4. Foul Yellow teeth on donkey – associated with dental carries 5. Deck of cards with plate shield - Synthesizes Dextran's from glucose which allows strep viridians to adhere to any fibrin from platelets that has been damaged in the heart. 6. Strep Sanguineous adheres to fibrin platelet aggregates in <u>damaged</u> heart valves, most commonly occurs in mitral valve.

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V2: in page 12, the 3rd most common is Neisseria, not moraxilla catarrhalis.