



MED437
KING SAUD UNIVERSITY



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Bacterial Upper Respiratory Tract Infections (URTI)



MICROBIOLOGY
437

Important!
Doctor's Notes
Only found in females' slides
Only found in males' slides
Extra Notes

“I’m not telling you it’s going to be easy. I’m telling you it’s going to be worth it.”

Objectives

- Discuss the epidemiology and various clinical presentations of URTIs
- Identify the most important etiological agents causing different URTIs, and discuss their virulence factors, laboratory diagnosis and potential preventative strategies
- Determine the antibiotic of choice for the different URTIs
- Discuss complications of GAS and *C. diphtheriae* infections

Important Notes

By the end of studying you must know all of the following:

- Name of the disease
- Etiology (the cause)
- Morphology of the bacteria (the shape and the arrangement)
- Clinical features
- Diagnosis
- Treatment
- Other notes like (complication, prevention ,etc...)
- **PLEASE READ THE SUMMARY !!**

Outline

- Pharyngitis
 - GAS
 - Diphtheria
- Epiglottitis
- Whooping cough
- Otitis Media
- Sinusitis
- Deep neck space infections

Conducting Passages

Upper respiratory tract

Nasal cavity

Pharynx

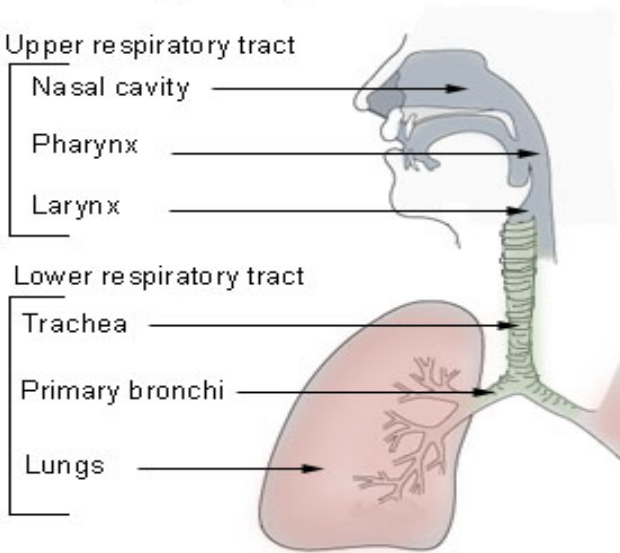
Larynx

Lower respiratory tract

Trachea

Primary bronchi

Lungs



Pharyngitis

- Epidemiology
 - Late fall, winter, early spring
 - 5 to 15 years
 - Etiology
 - Viruses (i.e. respiratory viruses) are the most common cause
 - Streptococcus pyogenes is the most important bacterial cause

- Bacterial causes include:
 - *Group A streptococcus* *
 - *Corynebacterium diphtheria*
 - *Fusobacterium necrophorum* (Anaerobic bacteria, cause of Lemierre's syndrome)
 - *Neisseria gonorrhoeae*



Note : GAS pharyngitis may present with a scarlatiniform rash, described as sandpaper-like

Pharyngitis

Signs and symptoms

More consistent with viral

More consistent with bacterial (GAS)

Sore Throat
Pharyngeal erythema
Edema
fever

Coryza
Cough
Conjunctivitis

Tonsillar exudates
Tender, enlarged >1 cm lymph nodes
Fever 38.4 to 39.4° C

Doctor Notes (Very Important)

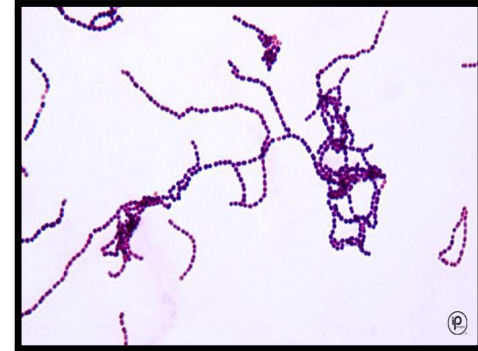
- ❖ Pharyngitis happens mostly during Winter.
- ❖ Most common in **children** but can happen to adult.
- ❖ Most common cause **viruses** but can be bacterial.
- ❖ If bacterial, **streptococcus pyrogens**. Mainly **Group A streptococci**.
- ❖ **Neisseria gonorrhoea** may also cause pharyngitis in incorrect sexual practices.
- ❖ If pharyngitis is viral, then the fever is mostly low grade fever.
- ❖ The name of the rash induced by GAS is Scarlatiniform rash.

GAS (Group A Strept.)

- Gram positive cocci in chains
- Facultative anaerobe
- Beta hemolytic
- Catalase negative
- Causes:
 - Respiratory infections
 - Pharyngitis
 - Otitis
 - Sinusitis
 - Other infections
 - Skin and soft tissue

Virulence factors:

- **Capsule:** anti-phagocytosis & specific attachment to specific tissues
- **M protein in cell wall**
(They help attachment and invading and invading the immune System) (anti-phagocytosis & specific attachment to specific tissues)
- **Streptolysin O & S**
destroys cells) (toxic to a variety of different cell types)
- **Streptococcal pyrogenic exotoxins (SPE)**
toxic to tissues. Main cause that lead to toxic “**shock syndrome**” “super antigens” directly stimulate T-cells (~1000X more than a normal immune response) and cause them release high levels of the cytokines that are responsible for fever and shock
SPE is also responsible for various tissue destruction, including skin lesions, and perhaps scarlet fever



● **GAS Pharyngitis**

Diagnose

Treatment

-Throat swab
Rapid Bacterial antigen detection
Culture on blood agar

-Antistreptolysin O

GAS Pharyngitis Complications

Penicillin x 10 days *ampicillin can be another choice*
Allergy?
Clindamycin or macrolide (e.g. Clarithromycin)

Suppurative : pus forming

Non suppurative

E.g. Peritonsillar abscess, parapharyngeal space abscess

Note : Antibodies against Streptolysin O is a useful serological test to assess for prior group A strep infection

GAS predictably susceptible to penicillin

Occurs 1-6 weeks after acute *S. pyogenes* infection
Rheumatic fever
Glomerulonephritis

Antistreptolysin O
Is serological test used to look for antibodies against streptolysin O. Important when the patients appears with a complication

GAS Pharyngitis Complications

(not caused directly by the infection it caused by the immune response)

Rheumatic fever:

After infection of the respiratory tract.

Inflammation of heart (pericarditis), joints, blood vessels, and subcutaneous tissue.

Results from cross reactivity of anti-M protein Ab and the human heart tissue.

Acute glomerulonephritis:

After infection of the skin or the respiratory tract.

Symptoms: edema, hypertension, hematuria, and proteinuria.

Initiated by(Ag-Ab complexes) on the glomerular basement membrane.

- Poststreptococcal diseases (occurs 1-4 weeks after acute *S. pyogenes* infection, hypersensitivity responses)
- Rheumatic fever: This disease can be reactivated by recurrent streptococcal infections, whereas nephritis does not. Penicillin used as prophylaxis for years after.

The Dr. mentioned this case!

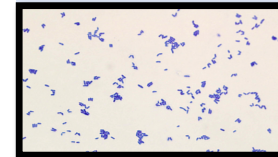
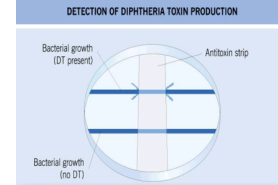
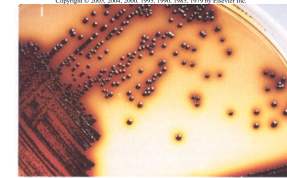
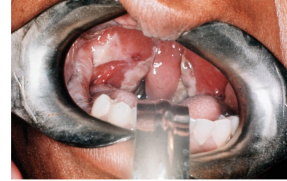
A child 5 years of age who came to the pediatrician complaining of fever and knee pain and during the examination a heart murmur (it is the murmur of the blood when passing from one chamber to other chamber through the heart) was heard and this is how we diagnose rheumatic fever.

Corynebacterium diphtheriae

- Rare in developed countries
 - Why? How is it prevented?
- Mainly presents as URTI.
- Formation of membranes (see the 1st picture) (Membranes only appear in 1/3 of cases) in the throat is characteristic.
- Virulence
 - Diphtheria toxin is an exotoxin that inhibits protein synthesis

- Diagnosis:
 - Throat swab (we can obtain it for culture)
Culture on special media containing tellurite (e.g. Tinsdale media)
 - ELEK's Test for confirmation of toxin production
 - Treatment:
 - Antitoxin + antibiotic
 - Penicillin or erythromycin

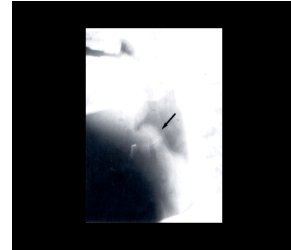
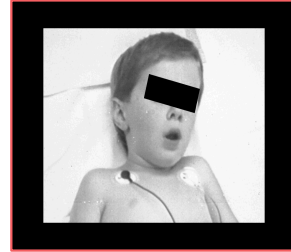
- Prevention:
 - Vaccination with diphtheria toxoid containing vaccine.
- Complications: (can lead to death)
 - Myocarditis
 - Neuritis



Epiglottitis

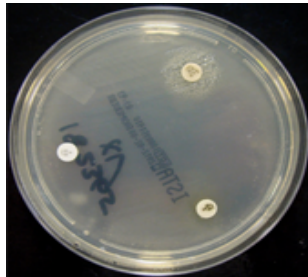
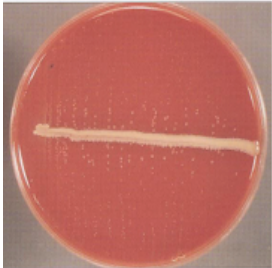
- Usually young unimmunized children presented with dysphasia, drooling, and respiratory distress .
- ***Etiology***
 - *H. influenzae Type b*
 - *S. pneumonia*
 - *S. aureus*
 - Beta hemolytic streptococci

- **Diagnosis:**
 - Blood cultures
 - Culture of epiglottic surface (under controlled setting)
- **Management:**
 - Maintenance of airway
 - Empiric treatment:
 - Ceftriaxone + Vancomycin
- **Prevention: HiB vaccination**

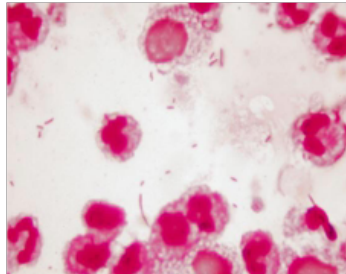


H. influenzae

- Gram negative pleomorphic, coccoid to rod-shaped cells (cocci/bacilli).
- Oxidase and catalase positive.
- Requires X (heme) and V (NAD) factors for growth.



H. Influenzae does not grow on blood agar but may grow on chocolate agar because it's heated blood and contains the nutrients needed for its growth. "staph streak" can also be used because it releases X factor and provide V factor.



• Divided into:

- Encapsulated (typable) strains
 - A-F
 - Most important is type b
 - Prevention through vaccination
 - Causes invasive disease (e.g. epiglottitis, meningitis)
- Nonencapsulated (nontypable) strains
 - Causes local infections (e.g. sinusitis, otitis, pneumonia in elderly)

• Treatment:

- Amoxicillin-clavulanate, 2nd or 3rd generation cephalosporin

Pertussis (whooping cough)

- ❖ Bordetella pertussis (GNB)
- ❖ **Virulence** **severe coughing is a hallmark*
 - ❖ Pertussis toxin (PT)*. *a hallmark*
 - ❖ Filamentous hemagglutinin (FHA).
 - ❖ Pertactin (PRN).

• Incubation period 1 to 3 wks

- Catarrhal Stage 1-2 weeks (starts as a mild cough associated with runny nose)
- Paroxysmal Stage 2-4 weeks. (cough is severe and persists for so long; associated with vomiting and can be life threatening in children)
- Convalescent Stage 1-2 weeks. (the cough begins to calm.)

Diagnosis:

Sample:

- Nasopharyngeal (NP) swabs

Special media needed:

- Charcoal blood (Regan-Lowe)
- Bordet-Gengou

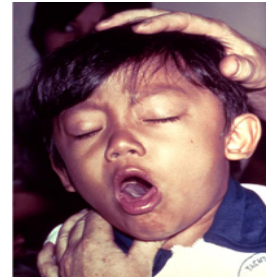
Treatment:

- Macrolide (erythromycin)

Prevention by vaccination

- Acellular pertussis-containing vaccine

The doctor repeated: what distinguishes pertussis is Severe coughing, occasionally vomiting and breathing difficulties. It can be severe in children thus a pregnant should be vaccinated



Acute Otitis Media

Fluid + inflammation of the mucosal lining of the middle ear

More common in children

Etiology:

S. pneumoniae

H. Influenza (non typable)

S. aureus

Moraxella catarrhalis

GAS

Viral(alone or with bacteria)

Diagnosis:

- ❖ Mainly clinical diagnosis
- ❖ Tympanocentesis sometimes needed
- ❖ Middle ear fluid can be sent for culture
- ❖ Bulging tympanic membrane
- ❖ Air fluid level
- ❖ Marked Erythema

Treatment:

❖ Amoxicillin

Or

❖ Amoxicillin

Clavulanic acid

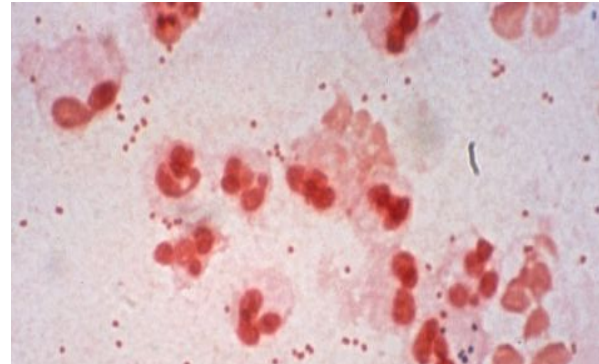
- ❖ To cover S. pneumoniae and H. influenzae

The Dr. mentioned this case!

If acute otitis media became chronic and haven't been treated it will lead to severe complications or a disease which will either be meningitis or brain abscess.

Moraxella catarrhalis

- Gram negative diplococci
- Catalase and oxidase positive
- Causes: Otitis, Sinusitis, Pneumonia
- Treatment: Amox-Clav



Acute Bacterial Sinusitis

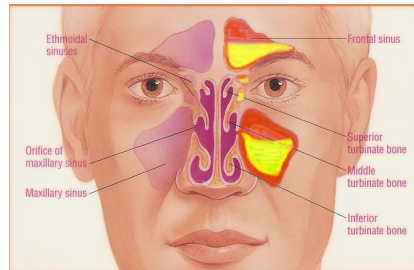
- More common in children
- Occurs with viral URTI
- Etiology:
 - *S. pneumoniae*,
 - *H. influenzae* (non typable)
 - *M. catarrhalis*
 - Anaerobes
 - Viral

May spread to the eye and cause periorbital cellulitis and orbital cellulitis or meningitis, thus it can be severe.

- **Diagnosis:**

Mainly clinical diagnosis

- **Imaging: (CT/MRI) when there is suspicion of complications**
- **Treatment: Amoxicillin Clavulanic acid For 1-2 weeks**



Deep neck space infections

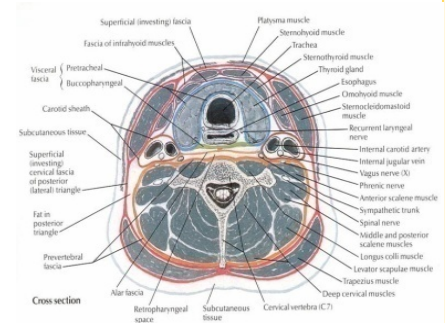
- Lateral pharyngeal, retropharyngeal or prevertebral space
- Patients are very sick and toxic
- Neck stiffness can occur with retropharyngeal spaceinfection/abscess
- Retropharyngeal (danger space) infection may extend to mediastinum and present as mediastinitis

➤ Treatment :

- Usually polymicrobial
- Mainly streptococci and oral anaerobes

● Management:

- ✓ Surgery
- ✓ Antibiotics: [**Meropenem, Piperacillin, Clindamycin**] Duration 2-3 weeks



Lemierre's syndrome

- Complication of pharyngitis or peritonsillar abscess
- Patient presents with sore throat, fever and shock due IJV thrombophlebitis, which leads to multiple septic emboli to the lung
- *Fusobacterium necrophorum*
- Medical treatment same as deep neck space infection
- Venotomy if doesn't respond to medical treatment



Summary

| Name of the disease | Etiology | Clinical presentation | Diagnosis | Treatment | Other |
|--------------------------|--|---|---|---|--|
| Pharyngitis (GAP) | Viruses (mainly) Bacterial (Group A Strept.) | 1)Sore Throat 2)Pharyngeal erythema 3)Fever | 1)Antigen detection 2)Culture (Both from throat swab) 3)Antistreptolysin O | Penicillin for 10 days Clindamycin or Macrolide (in Penicillin allergy) | Complication: Rheumatic fever and Glomerulonephritis |
| Pharyngitis (Diphtheria) | Corynebacterium Diphtheria | Membranes in throat | 1)Culture on Tinsdale media 2)ELEK's test | Penicillin or erythromycin (Antitoxin+Antibiotic) | Prevented by vaccines and Complication of myocarditis or neuritis |
| Epiglottitis | H. Influenza type B | Dysphasia and respiratory distress | 1)Blood culture 2)Epiglottitis culture | Ceftriaxone + Vancomycin | Prevented by HiB vaccine Mainly in kids |
| Whooping Cough | Bordetella pertussis (GNB) | 1)Long cough 2)Vomiting 3)Dyspnea | Nasopharyngeal swab cultured by special media | Macrolide (erythromycin) | Prevented by acellular pertussis vaccine |
| Otitis Media | S.Pneumonia H. Influenza Moraxella catarrhalis | Fluid and inflammation of middle ear | Mainly Clinical | Amoxicillin or Amox-Clavulanic acid | Mainly in kids |
| Sinusitis | Viral Anaerobes (only sinusitis) | Inflammation near the eyes | Mainly Clinical&MRI | Amox-Clavulanic acid for 1-2 week | Mainly in kids |
| Deep Neck Infection | Polymicrobial | Very sick with neck stiffness and retropharyngeal abscess | MRI | Surgery and Antibiotic | |

Quiz (MCQs)

1) Which of the following signs and symptoms of pharyngitis are more consistent with viral infection?

- A- Tonsillar exudate
- B- Tender
- C- coryza
- D- enlarged lymph nodes

2) Which of the following drugs is used to treat Gas pharyngitis?

- A- clindamycin
- B- clarithromycin
- C- Penicillin
- D- erythromycin

3) Which of the following is a complication of Corynebacterium diphtheriae?

- A- Rheumatic fever
- B- Myocarditis
- C- glomerulonephritis
- D- Arthritis

4) Which of the following is correct about Corynebacterium diphtheriae?

- A- gram + rods
- B- gram - rods
- C- gram+ cocci
- D- gram - cocci

5) Hib vaccination is used to prevent which of the following?

- A- Epiglottitis
- B- pertussis (whooping cough)
- C- pharyngitis
- D- otitis media

6) Antistreptolysin O is used to diagnose which of the following?

- A- Corynebacterium diphtheriae
- B- Gas pharyngitis
- C- H influenza
- D- acute bacterial sinusitis

Answers in the next slide

1)C 2)C 3)B 4)A 5)A 6)B

Quiz (SAQ)

- Mohammed 11 years old come to hospital complain from his ear the doctor make a diagnosis and his find erythema ,air fluid ,bulging Tympanic Membrane and Whitish discoloration?
- What is the disease? Acute otitis Media
- What is the causes of the disease ? H.influenza (non typable) S.pneumoniae Viral
- How do you make a diagnosis other than mention in the(question)? Tympanocentesis Middle ear fluid can be sent for culture
- How do you treat the disease? Amoxicillin or Amoxicillin Clavulanic acid

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