MICROBIAL DISEASES OF THE RESPIRATORY SYSTEM

STRUCTURE & FUNCTION

1) UPPER RESPIRATORY SYSTEM:
   Mouth, nose, throat (pharynx), epiglottis, larynx (voice box), & other systems (Eustachian tube, middle ears, sinuses, nasolacrimal duct)
   Nose: hair, mucous membrane (ciliated)
   Throat: mucous membrane

2) LOWER RESPIRATORY SYSTEM:
   Trachea (windpipe), bronchial tubes and alveoli (air sacs); all have ciliated mucous membranes
   Pleura: the double – layered membrane around the lungs
   Alveolar macrophages or dust cells: locate, ingest most of them

   Normal flora:
   At nasal cavity: diphtheroids, staphylococci, bacilli
   Throat: streptococci, Hemophilus influenzenae, Neisseria meningitidis
   Trachea: a few
   Bronchus: germ free, sterile

INFECTIONS (DISEASES) IN THE RESPIRATORY SYSTEM:

1) UPPER RESPIRATORY SYSTEM:
   Pharyngitis (sore throat)
   Laryngitis (voice – lost)
   Tonsilitis
   Sinusitis
   Epiglottitis (inflammation of the epiglottis)

2) LOWER RESPIRATORY SYSTEM:
   Bronchitis (bronchiolitis)
   Whooping cough
   Pneumonia
   Croup

UPPER RESPIRATORY INFECTIONS:

A) Streptococcal pharyngitis (“strep” throat)
   Pathogen: S. pyogenes; β - hemolytic
   Route & symptom: inflammation of the mucous membrane of the throat; Sometimes complication
   Pharyngitis ➔ tonsillitis; Another complication ➔ middle ear infection
   Route: unpasteurized milk, respiratory secretion
   Treatment: penicillin

B) Scarlet fever
   Pathogen: S. pyogenes; Erythrogenic (reddening) toxin; Lysogenized stain
   Route & symptom: Bacteremia ➔ pinkish – red skin (due to the skins generalized cutaneous hypersensitivity reaction to the circulating toxin)
   Treatment: penicillin
   “Dick test” with Erythrogenic toxin: No reaction: Ab present: Reaction: No Ab

C) Diphtheria
   Pathogen: C. diphtheria; G+, non – endospore, pleomorphic rod, lysogenized cell exotoxin
   Route & symptom: Sore throat fever ➔ malaise swollen neck (Bull neck)- need “tracheotomy”
   Treatment: antitoxin; Penicillin, tetracycline; Prevention: DPT vaccine
“Schick test” with toxin: No reaction – Ab present
*Cutaneous diphtheria: skin infection – minimal circulation of the toxin

D) Otitis media:
   Pathogen: *S. aureus*, *S. pneumoniae*, *H. influenzae*
   Symptom: middle ear infection, formation of pus, which builds up pressure, painful

VIRAL DISEASE:

Common cold:
   Pathogen: rhinoviruses – 40%
   coronaviruses – 15 – 20%
   Adenovirus, parainfluenza virus – 10%
   Rest of these (40%) not identified
   • rhinovirus – likes lower temperature than that of the body
   • Treatment: symptomatic

LOWER RESPIRATORY SYSTEM:

BACTERIAL

A) Whooping cough (Pertussis)
   Pathogen: *Bordetella pertussis*; Small non – motile, endotoxin
   Route & symptom:
   a) The initial stage – catarrhal stage: common cold
   b) The second stage – paroxysmal stage (sudden spasm attack of the symptom)
   c) The third stage – convalescence stage (may last months)
   Route – inhalation       dense growth of trachea & large bronchi – violence cough anoxia/hyphoxia
   Treatment: severe case; erythromycin, tetracycline DPT

B) Tuberculosis:
   Pathogen: *M. tuberculosis*
   Slow growing (20 hrs, doubling), acid fast due to lipid waxy material in CW.- Ziehl – Nelson tech
   Route & symptom:
   Respiratory       lymph node       lung       tubercle
   Necrosis caseous lesion, scar tissue
   Miliary tuberculosis (lung & other organs)
   Weight loss, cough (sputum)
   Treatment: isoniazid (INH) + rifamycin; + Ethambutol = streptomycin
   Skin tests: CMI, Tine & Mantoux tests
   BCG vaccine (Bacillus of Calmette & Guerin) – a live culture of *M. bovis*

C) Bacterial pneumonia
   a) Pneumococcal – most common in adults
   Pathogen: *S. pneumoniae*, capsule α - hemolytic
   Symptom & route:
   Alveoli & bronchi infection       bronchi swelling due to fluid infiltration
   Treatment: penicillin; Quelling test      Fever, chest pain (Wet lung)
b) **Klebsiella**
   Pathogen: *K. pneumonia*, G- rod, capsule
   Symptom: clinically debilitated mal nutritional patient, e.g., Alcoholic
   Treatment: Not sensitive to penicillin, Cephalosporins or gentamycin
   Quelling test

c) **Mycoplasmal:**
   Pathogen: *M. pneumonia*, Children & adults, confused with viral
   Symptom: atypical, not isolated bacteria, cough & low fever
   Treatment: tetracycline

D) **Legionnaires disease ( legionellosis)** 1976 – Philadelphia convention
   Pathogen: *Legionella pneumophila*, G- pleomorphic, air – condition units
   Route & symptom: more like pneumonia
   Treatment: erythromycin

**VIRAL:**

A) **Viral pneumonia**
   Pathogen: respiratory syncytial viruses, but not quite identified

B) **Influenza (flu)**
   Pathogen: *influenza virus*
   Variation in H & N antigens: H₀, H₁, H₂, N₁, N₂
   1933 – H₀N₁; 1957 – H₂N₂; 1968 – H₃N₂
   Antigenic drift – minor (epidemic); Antigenic shift – major (pandemic)

**SYSTEMIC MYCOSES:**

Having two forms – subclinical, mild respiratory; If not treated fatal
Fungi → respiratory tract → not much contagious in initial case

Some compromised patients

Chronic form

Purulent or granulomas, pulmonary lesion (resembles tuberculosis)

**Transmission:** Air borne spores → human
**Diagnosis:** Most fungi which cause systemic mycoses; dimorphic fungus from infected tissue
**Treatment:** Amphotericin B, 5 – fluorocytosine; Surgical removal
**Control:** No vaccine; Avoid areas like bird roosts & caves

a) **Coccidioidomycosis:**
   Skin test to react with coccidioidin (which is derived from *Coccidioides immitis* culture similar to tuberculin)
   Prevalent in the south western U.S., Central South America
   Mold in soil → arthropods → air borne → pulmonary infection
   Approximately 50 – 80% of residents of Central Valley of California skin test positive
   So called “valley fever” – by residents of California San Joaquin valley
   **Treatment:** Amphotericin B (fungizone)
b) **Histoplasmosis:**

By *Histoplasma capsulatum*

- Soil fungi → inhaling spores → infection

- Prevalent in Ohio & Mississippi river valleys
- Skin test with histoplasm (like coccidiodin treatment)
- Mild lung infection leaves, on healing, small modules (similar to tubercles on X-rays)
- Mold growth – dimorphic
  
  *In the body:* yeast like (budding) growth quickly engulfed by cells of RES
  
  *In soil:* hyphae, conidiospore, at room temperature, yeast like growth at body temperature

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c) **Blastomycosis (North American):**

By *Blastomyces dermatitidis*

Another mold, indigenous to soil

- Air borne route → body infection
- Spores or hyphal fungi → respiratory infection → skin & bone lesions
- - rarely human to human
- - Skin test with blastomycin
- - very isolated cases in US & Canada middle west & eastern half of US & Canada – so called:
  North American Blastomycosis”
- Treatment: Amphotericin B or hydroxystilamidine isethionate

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d) **Blastomycosis (South American)**

Also called “paracoccidioidomycosis” – often fatal

- Chronic mycosis with living involvement
- - ulcerative lesion of the skin & mucosa in the oral & nasal or rectal areas
- - glands (especially adrenal gland) may be affected
- - endemic in South America (e.g. Brazil)
- - adult males more susceptible

**Treatment:** Intravenous Amphotericin B also prolonged treatment of sulfanamide

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**Cryptococcosis:**

By the yeast *Cryptococcus neoformans* throughout the world.

- Spores (in soil & habitats of pigeons) → respiratory tract infection

  * Spread through body

  * Fungal meningitis

  * Central Nervous System

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**Pneumocystis pneumonia**

Caused by *Pneumocystis carinii, P. jiroveci*

- Discovered in 1909, Taxonomic confusion: fungi or protozoan
  
  (Trypanosome, yeast – Relatedness by RNA study)
- Found in lungs of healthy individuals, opportunistic pathogen (superinfection)
- Pathogenic symptoms among AIDS patients
  
  Any immosuppressed patients or persons receiving immunosuppressant (drugs) to minimize organ rejection.