

Micro-RS - Final

Summary

by danier

Arashdan

3 lectures + 1 lab

# Lecture 1

# Lecture (1) Bacterial infections of Respiratory Tract

**Bordetella** → Pathogenesis → Attachment → Damage cilia ⇒ Persistent Cough. **Whooping Cough.**

## Characteristics

Gram -negative coccobacilli (rod-shaped) single or paired

- Obligate aerobe - Requires O<sub>2</sub> to live
- Colonizes the respiratory tract
- Specific to human hosts
- 7 species, The main species
  - 1. B. pertussis: Whooping Cough (Pertussis)
  - 1. B. parapertussis mild infx.
  - 2. B. bronchiseptica

Bordetella pertussis is spread by respiratory droplets and remains localized to the trachobronchial tree.

- It is highly contagious, infecting more than 90% of exposed susceptible persons.

## Virulence Factors

### Adhesins (Attachment)

- Filamentous hemagglutinin (FHA)
- Pertactin
- Agglutinin  
Anchor Bordetella to epithelium

### Toxins. *جائیں سب الی علی ہوں*

Tracheal Cytotoxin (TCT)

- Direct toxicity to Tracheal epithelium.
  - Paralysis of cilia.
- ↓  
Bulding up mucus.  
↓  
triggers Cough.

B pertussis does not directly invade the cells of the respiratory tract or spread to deeper tissue sites

Pertussis Toxin (PTX)

- Attachment to epithelial Surface.
- ↑ Lymphocytes in Blood but inhibit it from leaving the Blood.
- ↑ Sensitivity to histamin  
- narrowing the airway ⇒ whooping sound.  
- swelling (edema)

Adenylate Cyclase Toxin (CYA)

- invasive toxin
- Inhibit Phagocytosis of immune cells & cell signal.
- Activated by host Calmodulin
- Apoptosis.

## Stages

Incubation (4-21 days).

3 stages:

① Common mistaken for Cold  
Catarrhal Stage 1-2 weeks

- Sneezing, low fever, mild cough, runny nose
- nasal congestion (flu-like) symptoms.
- Red - watery eyes
- The most communicable stage (contagious) because large # of organisms in nasopharynx

② Attachment & multiply  
Paroxysmal Stage 1-6 weeks

- \* Whooping cough, which consists of uninterrupted fit of coughing followed by an inspiratory whooping noise
- end with high pitched "whoop" sound during the next breath (closed swollen epiglottis)
- up to 50 times

Severe and prolonged coughing attacks may:

- Petechiae vomiting
- Collapsed lung
- Thin petechial in the face
- Hematuria
- Cause extreme fatigue

③ Coalescent Stage weeks-months

- # Gradual recovery starts
- # Airway heal

## Paroxysmal stage in children

Children  
In infants — especially those under 6 months of age — complications from whooping cough are more severe and may include:

- Pneumonia (superinfecting)
- organism such as Streptococcus pneumoniae)
- Slowed or stopped breathing
- Dehydration or weight loss due to feeding difficulties
- Seizures
- Brain damage related to the venous pressure effects of the paroxysmal coughing and the anoxia produced by inadequate ventilation and apneic spells.

## Tm

Once the paroxysmal coughing stage has been reached, the treatment of pertussis is primarily supportive.

- Antimicrobial therapy is useful at earlier stages
- macrolides are preferred for both treatment and prophylaxis.

Pertussis vaccine  
Diphtheria, Tetanus, and Pertussis (DTP) vaccine as early as 6 weeks but no later than 6 y/o

# Bacterial Pneumonia

Case. جاسے سوائے

(solid)  
- Fluid  
- Inflammation & Pleura.



Infections of the lungs that lead to inflammation and accumulation of fluids and white blood cells in the alveoli.  
 ? Bacterial pneumonia is a prevalent, potentially serious infection  
 ? As the alveoli fill with fluids and white blood cells (consolidation), air exchange becomes impaired and patients experience respiratory distress

Three bacterial species cause most clinical cases:

Streptococcus pneumoniae,

Mycoplasma pneumoniae.

H. influenzae

The most common cause of community-acquired bacterial pneumonia

This gram-positive, alpha hemolytic streptococcus  
 ? Inhabits the nasopharyngeal areas of healthy individuals  
 ? S. pneumoniae is extremely sensitive to optochin  
 ? The cells tend to be somewhat lancet-shaped and typically appear as pairs

Encapsulated strains of Haemophilus influenzae are known for causing meningitis and epiglottitis  
 Non-encapsulated strains are important causes of pneumonia.  
 Small, gram-negative coccobacillus is found in the pharynx of the majority of healthy children.  
 ? H. influenzae is spread by droplets and aerosols produced by coughing.  
 ? A fastidious organism, H. influenzae will only grow on media with available factor X (hemin) and factor V (NAD).  
 ? chocolate agar Not Blood agar.

Signs and symptoms of pneumonia

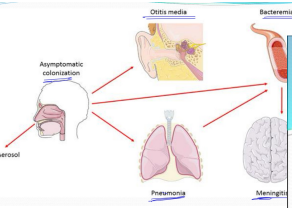
- Wet cough and fever (Productive cough with sputum. Community-acquired bacterial pneumonia)
- Pleuritic pain
- Rusty-coloured sputum (extracellular bacterial)
- The patient breathes rapidly and shallowly.
- Dyspnea, tachycardia, hypotension, low O2 saturation, low energy, chest pain, abdominal pain, chills, purulent sputum, hemoptysis
- The affected side of the chest moves less.
- Signs of consolidation may be present. (air-filled spaces of the lung are filled with the products of disease)
- The mortality rate is approximately 15-25%.

45 years old man, smoker. Sudden onset fever and chills  
 Shortness of breath and pleuritic chest pain Productive rusty colored sputum (blood stained)

Examination:  
 Vitals: RR 20 (normal 12-18), T 39, B.P normal, O2 Saturation 90% (decreased)  
 Chest: decreased air entry, dull on percussion, decreased chest expansion.  
 CXR: Right upper lobe consolidation  
 WBC 16000/mm3 (normal 4-11) mainly neutrophils

Consolidation indicates filling of the alveoli and bronchioles in the lung with pus (pneumonia)

- Complications
- Inflammatory involvement of the pleura, Empyema and Pericarditis.
  - Bacteremia
  - Metastatic involvement of the meninges, joints and, rarely, the endocardium.



## Difference between bacterial and viral pneumonia

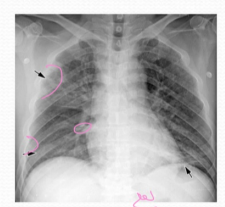
**Bacterial pneumonia**

- Abrupt onset
- not preceding URTI
- fever: high grade
- Cough: productive
- Pleuritic chest pain: present
- Physical sign of consolidation: yes (Localized)
- CBC: neutrophil predominate
- CXR: lobar and segmental opacity
- Blood culture: positive in 10% of cases

TESTS	RESULTS	REFERENCE RANGE
WBC Count	11.8	4.8 - 10.8
Hemoglobin (HCT)	14.4	13.8 - 15.2
RBC count	4.14	4.0 - 5.4
MCV	80	80 - 100
MCH	28.8	27 - 32
MCHC	35.2	32 - 36
RDW-CV	12.2	11.6 - 14.0
Platelet Count	250000	150000 - 400000
MPV	8.6	7.4 - 10.4
PDW	12.3	10.0 - 13.0
RDW	11.8	11.6 - 13.8

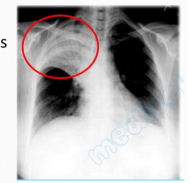
**Viral pneumonia**

- Less abrupt onset
- preceding URTI
- fever: low grade
- Cough: dry
- Pleuritic chest pain: absent
- Physical sign of consolidation: No (diffused)
- CBC: lymphocytes predominate
- CXR: interstitial infiltrate. No consolidation
- Blood culture: negative



TESTS	RESULTS	REFERENCE RANGE
WBC Count	17000	4000 - 11000
Lymphocyte Count	15000	4000 - 11000
Neutrophil Count	4000	2000 - 7000
Differential Count		
Neutrophils	20 %	40 - 70 %
Lymphocytes	90 %	20 - 40 %
Monocytes	10 %	2 - 8 %
RBC Indices		
Hemoglobin (HCT)	14.4	13.8 - 15.2
RBC count	4.14	4.0 - 5.4
MCV	80	80 - 100
MCH	28.8	27 - 32
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- Chest X-ray confirms the area of consolidation (lobar), but radiological changes lag behind the clinical course;
- So that X-ray changes may be minimal at the start of the illness. Conversely, consolidation may remain on the chest X-ray for several weeks after the patient is clinically cured.
- The chest X-ray usually returns to normal by 6 weeks



Atypical پنسیل

# 3- Atypical Pneumonia ~ like viral.

- not effectively treated by antibiotics for typical.

Intracellular bacteria or virus

No consolidation.

don't produce the typical symptoms & radiological findings.

(Milder symptoms)

- No fever

- No productive cough

## \* Bacteria that cause A typical pneumonia:

### 1. Mycoplasma Pneumonia

**\* most common**

Walking Pneumonia

Walking Pneumonia

- A. Mild symptoms / Coughing Sneezing
- B. Don't need hospital.
- C. Adults / spread by droplets by

D. Don't have cell wall / Polymorphic

E. Im Don't use βlactams that target cell wall

use macrolid antibiotic therapy

### 2. Chlamydia Pneumonia

#### 1. Chlamydia Pneumonia

↳ transmitted by droplets.

#### 2. Chlamydia Psittaci (Parrot fever)

↳ Psittacosis ↳ zoonotic disease (birds to humans)

#### 3. Chlamydia trachomatis (vagina).

↳ sexually transmitted disease

↳ can cause pneumonia in infants (mother → baby) during birth

↳ obligate intracellular

↳ mild to severe pneumonia & Bronchitis.

Im

### \* Antibiotics

targets intracellular

• Macrolides (azithromycin) • Tetracyclines (doxycycline)

• Fluoroquinolones (levofloxacin)

### Dx

- Culture is difficult & slow.
- Intracellular pathogens.
- PCR & serology based tests.

### 3 Legionella Pneumophila.

#### Legionnaire Disease

or (Legionellosis)

Gram(-) bacillus (aerobic)

air conditioning Cooling Towers, Fountains

isn't spread Person-to-person but by water droplets & aerosols

infect people who suffer from lung or heart disease with weakened immunity

#### ↳ Severe Pneumonia

• high fever, chills, cough

↳ chest pain (dyspnea).

↳ myalgia & fatigue.

↳ GI symptoms (Diarrhea, nausea, vomiting)

↳ renal impairment in severe cases

↳ severe cases can lead to septic shock

- [10% die]

- no vaccine

Im → Macrolides • Tetracycline

• fluroquinolone

# 4 Klebsilla Pneumonia → Extracellular organisms

G<sup>-</sup> rod shape

↳ opportunistic

↳ atypical

↳ characterized by ((lung necrosis)) & ((current jelly sputum))  
(Bloody) x productive Cough. x clumps of Blood mucus, debris

↳ K. Pneumonia (Multidrug Resistant)

From thick Polysacch. capsule produced by bacteria.



Aminoglycoside & Cephalosporins often prescribed but not always effective.

sputum سعال  
سعال  
زجاجي

↳ Frequently Fatal even when treated.

## Diseases

↳ Bacteraemia

↳ Meningitis

↳ affect immune + hospitalized people.

↳ Non Motile / Lactose fermenter

↳ OX(-) / cat(+) / G<sup>-</sup> / facultative anaerobe.

↳ direct contact / droplets.

↳ ICU / ventilator associated pneumonia.

# 5: Health care - Associated Pneumonia (HCAP)

↳ Contact with health care system. المرضى في المستشفى

↳ hospital-acquired Pneumonia (Patients) +

↳ more resistant the Community-acq.

↳ Multidrug Resistant bacteria: - MRSA Klebsilla

Lecture - 2

# Lecture 2

علاج الفطريات

## 2) Respiratory Mycosis

Fungal Infection	Causative Organism	Symptoms
Histoplasmosis	<sup>all dimorphic</sup> <u>Histoplasma capsulatum</u>	Fever, cough, chest pain, fatigue, pneumonia <u>(granuloma, chronic and reactivation)</u>
Coccidioidomycosis (Valley fever)	dimorphic <u>Coccidioides immitis</u>	Fever, cough, chest pain, fatigue, <u>joint pain</u> pneumonia <u>(granuloma, chronic and reactivation) cutaneous</u>
Blastomycosis	dimorphic <u>Blastomyces dermatitidis</u>	Fever, cough, chest pain, <u>skin lesions</u> , possible pneumonia, <u>cutaneous</u>
Aspergillosis	Dimorphic <u>Aspergillus species</u>	Cough, fever, chest pain, <u>difficulty breathing</u> , possible pneumonia
Pneumocystis Pneumonia (PCP)	Dimorphic <u>Pneumocystis jirovecii</u>	<u>Cough, fever, shortness of breath,</u>

Fungal Infection	Transmission	Risk Factors
Histoplasmosis	<u>Inhalation of spores from soil with bat/bird droppings</u>	<u>Immunocompromised</u> , outdoor activities, farming
Coccidioidomycosis	<u>Inhalation of spores from dry, dusty environments</u>	<u>Immunocompromised</u> Living in or visiting endemic areas
Blastomycosis	<u>Inhalation of spores from decaying organic matter</u>	<u>Immunocompromised</u> , outdoor activities
Aspergillosis	<u>Inhalation of spores from moldy environments</u>	<u>Immunocompromised</u>
Pneumocystis Pneumonia (PCP)	<u>Inhalation of airborne spores (p-to-p?)</u>	<u>HIV/AIDS</u> , organ transplant, chemotherapy

Fungal Infection	Diagnosis	Treatment
Histoplasmosis	Serology, PCR, culture, chest X-ray	Mostly self-limiting Antifungal (e.g., itraconazole, amphotericin B)
Coccidioidomycosis	Serology, PCR, chest X-ray, sputum culture	Mostly self-limiting Antifungal (e.g., fluconazole, itraconazole)
Blastomycosis	Serology, culture, PCR, chest X-ray	Antifungal (e.g., itraconazole, amphotericin B)
Aspergillosis	<u>Microscopy</u> , culture, PCR, chest CT scan	Antifungal (e.g., voriconazole, amphotericin B)
Pneumocystis Pneumonia (PCP)	PCR, sputum culture, chest X-ray	Antifungal (e.g., <u>trimethoprim-sulfamethoxazole</u> )

HIV Treated with Antiretroviral

① TB → G+ / acid fast / non-spore forming.  
 → cell wall (Mycolic acids).  
 → chronic granulomatous disease.  
 → chest-X-ray (Ehon Complex) cat + lymphadenitis. Blood.  
 → vaccine (BCG) test Mantoux tuberculin skin test

### 1. Histo plasmosis (Histoplasma capsulatum)

- ↳ bat/birds droppings in soil.
- ↳ No human-to-human. X
- ↳ similar to TB ⇒ granuloma
- ↳ Reactivation. ⇒ TB
- ↳ dissemination to other organs. (liver/spleen)

### 2. Coccidioidomycosis (Coccidioides immitis)

- ↳ valley fever ↳ Inhaling fungal
- ↳ Asymptomatic & self limiting.

↳ endospores can transported to Blood leading to formation of granulomatous lesion on face & nose. + Joint Pain.  
 ↳ complication → fatal Meningitis.

### 3. Blastomycosis (Blastomycosis dermatidis)

↳ Mild flu-like symptoms.  
 ↳ leading to chronic cutaneous disease (warty) (scar) (clusty) lesions  
 Face/hands (Subcutaneous lesion)



# 5. Pneumocystic Pneumonia

↳ soil / caused by **Pneumocystis jirovecii**

↳ in Patients with **AIDS (HIV)**

+ infants + ↓ immunity.

↑ mortality

- Sym
- Fever
  - Cough
  - Dyspnea.

at least 2000

# 4. Aspergillosis (Aspergillus).

↳ filamentous (soil + debris).

↳ Rare → healthy. × immunocompromised.

Excep

× Types of Aspergillosis:

## 1 Allergic Bronchopulmonary Aspergillosis (ABPA)

- Inhalation of spores.
- Asthma-like Allergic reactions.
- hypersensitivity rxn → Cystic Fibrosis, Asthma
- Symptoms (wheezing, cough, dyspnea)
- Tm → Anti Fungal, corticosteroids.

## 5 Sinus Aspergillosis

- ↳ infection of sinuses (Immunocompromised).
- ↳ Nasal congestion, headache, facial pain.
- ↳ Tm → Antifungal.
- ↳ surgical debridement.

## 2 Lung Infx

### Chronic Pulmonary Aspergillosis (CPA)

- chronic lung infx often those with pre-existing conditions.
- Symptoms → Cough (chronic), hemoptysis (cough blood), weight loss
- Tm → Anti Fungal (- itraconazole, - voriconazole)
- surgery of Fungal balls

## 3 Inhalation of spores

- \* aspergilloma (Fungal balls)
- ↳ hyphal colonies in lung.
- ↳ can invade the host tissues leading to - bloody cough, - Pulmonary hemorrhage
- The Disease may progress to a disseminated form that is fatal.
- Death → pneumonia → hemorrhage → Brain.

## 4 Invasive Aspergillosis

- Sever infx can spread to heart, brain, kidney
- Tm → High Dose of Anti Fungal.
- surgery.
- voriconazole
- amphotericin B.

## 6 Cutaneous Aspergillosis

- skin infx
- wounds or ↓ imm
- sym → painful, Red lesions or abscess
- Tm → Anti Fungal, wound care.

Lecture - 3

# Lecture 3

## Case Study: *Pseudomonas Aeruginosa*

## *Pseudomonas Aeruginosa*



- Polar flagella / Pili (Mobile)
- **G(-) / Non lactose fermentor. Ox(+)** → usually causes hard to treat Nosocomial infx.
- Colorless (Mackoney)
- located every where in hospital → it shows Resistance to Most antibiotics.
- (watery areas) / dialysis equip / Food / cut flowers → immunocompromized
- People at risk
  - hospitalized
  - healthy (mild).
  - Cystic Fibrosis Patients. } → case

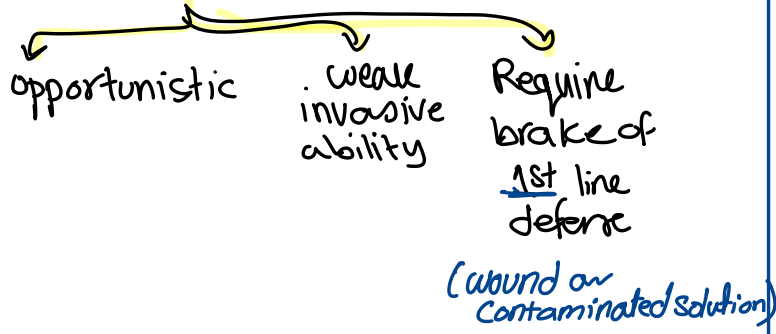
\* Production of colorful water-soluble Pigments.



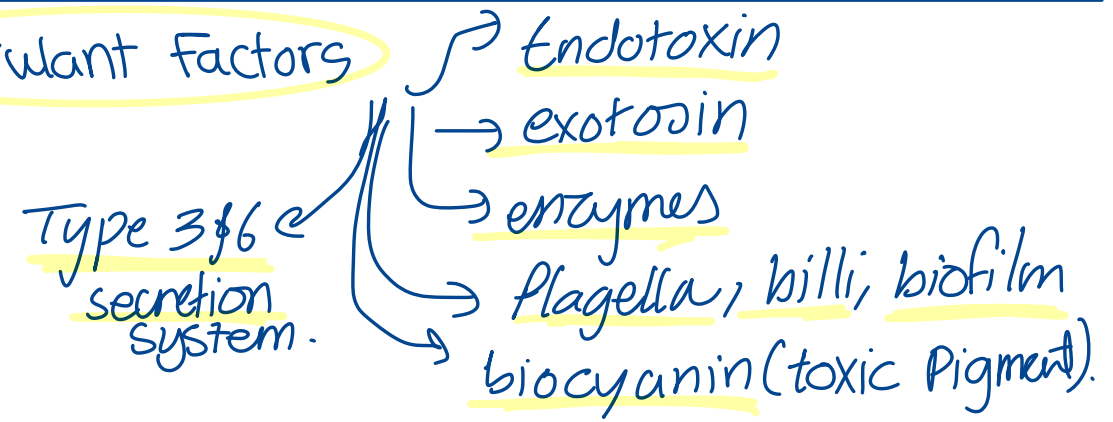
\* Fruity odor.

\* live in a slime enclosed biofilm

### \* Pathogenesis



### \* virulent factors



### \* Exotoxin A

- ↳ Tissue necrosis
- ↳ A-B toxin
  - ↳ inactivation
  - ↳ binding
  - ↳ inactive EF2 (necrosis)
  - ↳ cause Dermatonecrosis in burns....

### \* Biofilm

- ↳ **Alginate**
- ↳ mucoid exopolysach
- ↳ Transfer exotoxin from form shiny biofilm bacteria to human cell.
- Protect from Ab, C, Antibiotic Phagocytosis.

### \* Type 3 Secretion System (T3SS)

# Pseudomonas Aeruginosa.

↳ Culture & Gram Stain.

↳ Most important test

↳ grow well in

(G<sup>-</sup> / OX<sup>+</sup> / non lactose fermenter)

rods

↳ Mucoid appearance  
due to (Alginate)

↳ Provide the matrix

↳ Pa to live in this biofilm

استرجع

Blood agar

↳ Metallic

Sheen.

لا تسمى  
عن الدم



Macconky agar

↳ colourless

↳ non lactose fermenter.  
oxidase (+)

Cetrimide agar

↳ selective media.

Neutrient agar

↳ sweetish


aromatic  
odour

↳ Greenish blue  
Pigment  
استرجع



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# Clinical Presentation

- ① Pulmonary infx → Cystic fibrosis
- ② Skin infx (burns) in hair follicles.
- ③ UTI infx / urinary catheter.
- ④ Ear infx (swimmer ear)
  - mild irritation → external ear.
  - <sup>or</sup> - invasive destruction of cranial bones
- ⑤ Eye infx. (damage cornea) (lens)  
  
*انفخ العين*
- ⑥ Bacteremia ⇒ from primary infx to other organs.

# Ecthyma Gangrenosum.

well recognized  
↳ Cutaneous manifestation (severe/invasive)

- ↳ seen in
1. immunocompromised
  2. burn patients.
  3. critically ill.

*وغيره*

\* Black necrotic ulcer

no Pus.



# Burn

- Bluish greenish discoloration
- Tissue necrosis ✓
- Grape like smell
- Tt: debridement and anti-psudomase

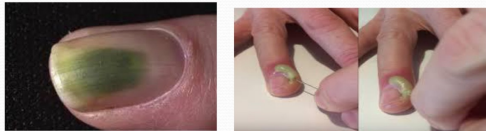


## Mild infection



Hot tub folliculitis

Swimmer ear



Paronychia

# Malignant Otitis Externa

redistribution in air canal.

Diabetic and HIV pts

No fever  
No leukocytosis.

Otologi and headache

Oral cipro



HIV

# Pulmonary Infections

- Can range from asymptomatic colonization to severe **necrotizing bronchopneumonia**
- Colonization is seen in patients with **cystic fibrosis, chronic lung disease, and neutropenia**
- **Mucoid strains** are commonly isolated from chronic pulmonary patients and are more difficult to eradicate
- Mortality rate can be as high as 70% for invasive bronchopneumonia

## Prevention

- Observe proper **hand hygen**
- Proper education of hospital related personnel on **hand hygiene**
- Good housekeeping limit the chance of transmission of pa
- Do not bring fruit ad row vegetable in **burn unit**
- Use **sterile water** for washing medical equipment and devices and do not use tape water
- Limit use of **broad spectrum ab disturb normal Flore**, give pa an opportunity infect
- Place all **cf patent in private room** that should not share bathroom or shower
- Avoid direct contact

- Categories of Anti-Pseudomonas Antibiotics
- Beta-Lactam Antibiotics:
    - Penicillins:
      - Piperacillin-tazobactam
    - Cephalosporins:
      - Ceftazidime
      - Cefepime
    - Carbapenems:
      - Meropenem, Imipenem-cilastatin
    - Monobactams:
      - Aztreonam:

## Treatment

- Inherently **resistant to many antibiotics** (penicillin, ampicillin, tetracycline, earlier aminoglycosides and sulfonamides)
- **Combination of active antibiotics generally required for successful therapy** (**Anti-β-lactam and aminoglycoside**)

- Fluoroquinolones:
  - Ciprofloxacin
  - Levofloxacin

only oral
- Aminoglycosides:
  - Tobramycin:
  - Amikacin
  - Gentamicin
- Polymyxins
  - Colistin (Polymyxin E)
  - Polymyxin B
- Others:
  - Fosfomycin

Lab

# ① Throat Swab (Gram (+) cocci)

Staph.  
Cat (+)  
MSA (Yellow)

Staph. albus [Coagulase (-) No clot X]  
Staph. Aureus [Coagulase (+) clot V]

1. Cat

2. MSA (Manitol Salt agar)

Sheep Blood agar ⇒ Strep spp.

Strep  
Cat (-)  
MSA (Pink)

α-hemolytic  
green, Partial hemolysis

Pneumonia (optochin sensitive)

x zone of inhibition ≥ 14

viridans (optochin Resistant)

x no zone of inhibition

β-hemolytic  
Complete hemolysis  
Clear (white)

Pyogens (A)  
(Bacitracin sensitive)

agalactia (B)  
(Bacitracin Resistant)

γ-hemolytic

No hemolysis

→ other than Enterococcus group D.

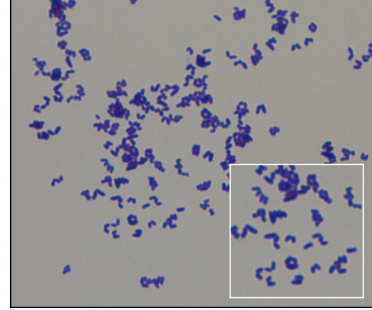
(E. faecalis) (Enterococcus) group D \*

Bile-esculin test  
⊕ entero (Black) - esculin



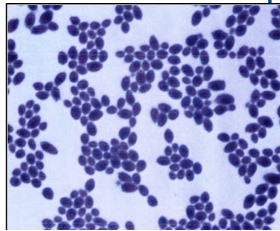
## ② Diphtheroids (G+ coccobacillus)

↳ chinese letters.



## ③ Candida spp.

\* Larger than Bacteria



\* Budding

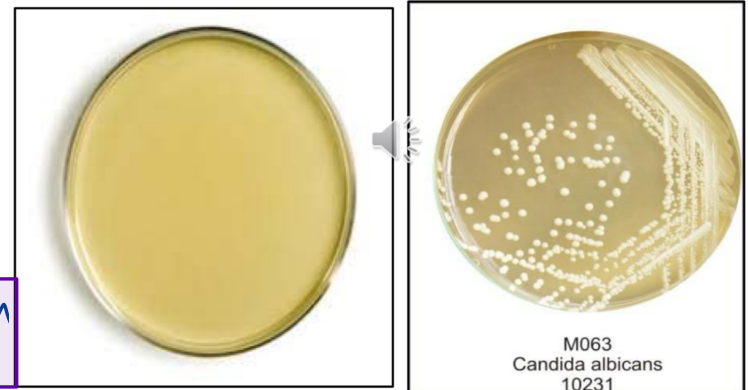
① C. albicans

② C. krusei

③ C. tropicalis

④ C. glabrata

~~✗~~ sabouraud dextrose agar



M063  
Candida albicans  
10231

To Differentiate between C. albicans and other Species

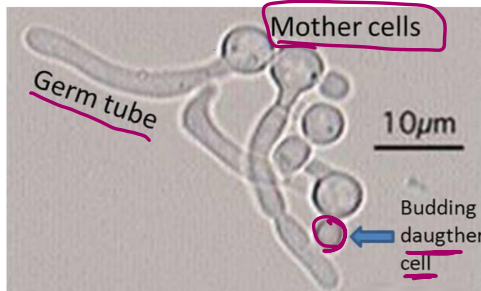
### ① chrom agar

↳ glabrata (violet) gelstring.

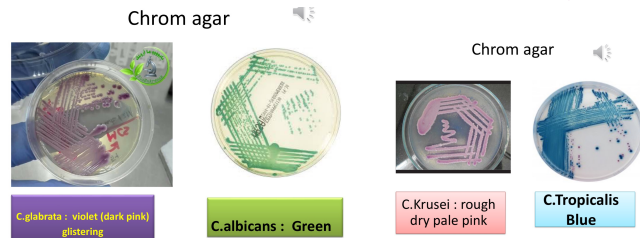
↳ C. albicans (green).

↳ tropicalis (blue)

↳ krusei → dry pale pink.



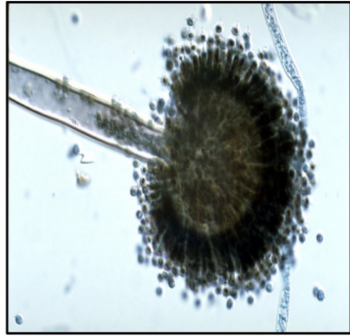
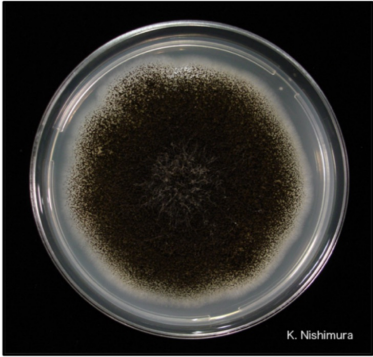
**Germ tube**  
[ Serum + candida ]



# ④ Aspergillus Niger

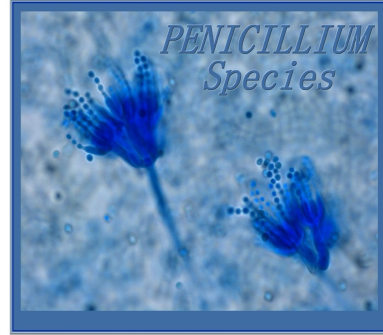
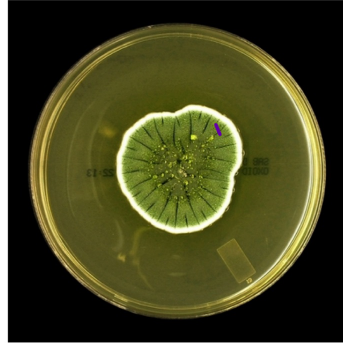
**Aspergillus Niger**

أبواغ



# ⑤ Penicillin Spp.

**Penicillium Spp.**

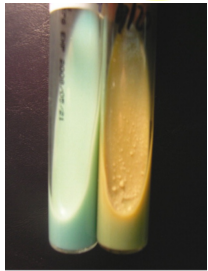


# ⑥ TB

①

Lowenstein-Jensen Medium.

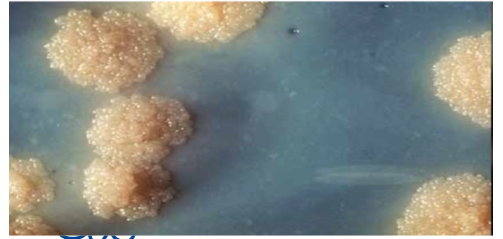
Incubation  
4 weeks



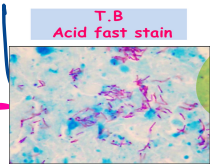
contains Malachite green & egg albumin.

Media color: green

cell → Rough  
→ Tough  
→ BUFF.



Put the Media in covered tube to avoid drying.

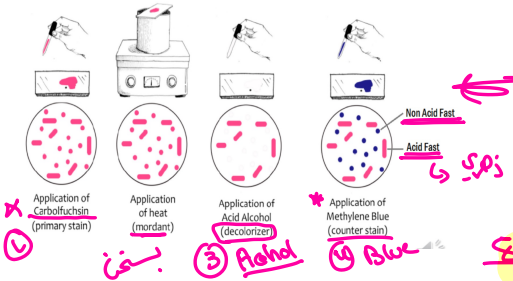


②

Ziehl-Neelsen (Acid Fast Stain).

M.TB

cell wall are waxed for that reason → heating during staining.  
Methylene Blue + hydrochloric acid (HCl) + Carbol fuchsin



① Carbol fuchsin (primary stain) بسفن  
② Alcohol  
③ Blue

Stain

« نعم جعد للشبه »

بارئ غزوة  
بارئ المسلمين  
في كل مكان...

« نسألك انقام النعم »  
دعواتكم