Tikrit University | جامعة تكريت
College of Medicine | كلية الطب
Depart. of Microbiology | فرع الأحياء المجهرية
Assist.Prof.Dr. Ala'a Zanzal Ra'ad | أ.م.د. آلاء زنزل رعـد
3rd Class / 2018 | الصف الثالث

Objectives of lecture:

1. Identify the *Pseudomonas* & its species.
2. Recognize the microscopical & macroscopical characteristic features of *Pseudomonas aeruginosa*.
3. Define the toxins of *Pseudomonas aeruginosa*
4. Explain the main pathogenesis of *Pseudomonas aeruginosa*.
5. Explain the diseases of *Pseudomonas aeruginosa* such as cystic fibrosis.
6. Outline the treatment of *Pseudomonas aeruginosa*.

The main references:

1. Medical microbiology (Jawetz, Melnick & Adelberg`s).
2. Medical Microbiology an introduction to infectious diseases (Sherris).
3. Diagnostic microbiology (Bailey & Scott`s).
4. Pictures from the net.

Pseudomonas

- The Pseudomonas are widely distributed in soil, water, plants and animals.
- *Pseudomonas aeruginosa* sometimes colonize humans & is the major human pathogen than other species.
- *Pseudomonas aeruginosa* is invasive & toxogenic produce infections in patients with abnormal host defenses.
- *Pseudomonas aeruginosa* is important nosocomial pathogen is opportunistic pathogen for human.

- *Pseudomonas aeruginosa* present in small numbers in the normal intestinal tract flora & on the skin of human.
- The classification of Pseudomonas depend on rRNA/DNA homology & common culture characteristics.

rRNA/DNA homology group	Genes & species
1. Fluorescent group	- *Pseudomonas aeruginosa* -*Pseudomonas fluorescens* -*Pseudomonas putida*
2. Non Fluorescent group	- *Pseudomonas* tutzeri - *Pseudomonas mendocina*

Pseudomonas aeruginosa

- It is widely distributed in nature especially in moist environment in hospital.
- It can colonize normal human & causes diseases in human with abnormal defenses.

Morphology:

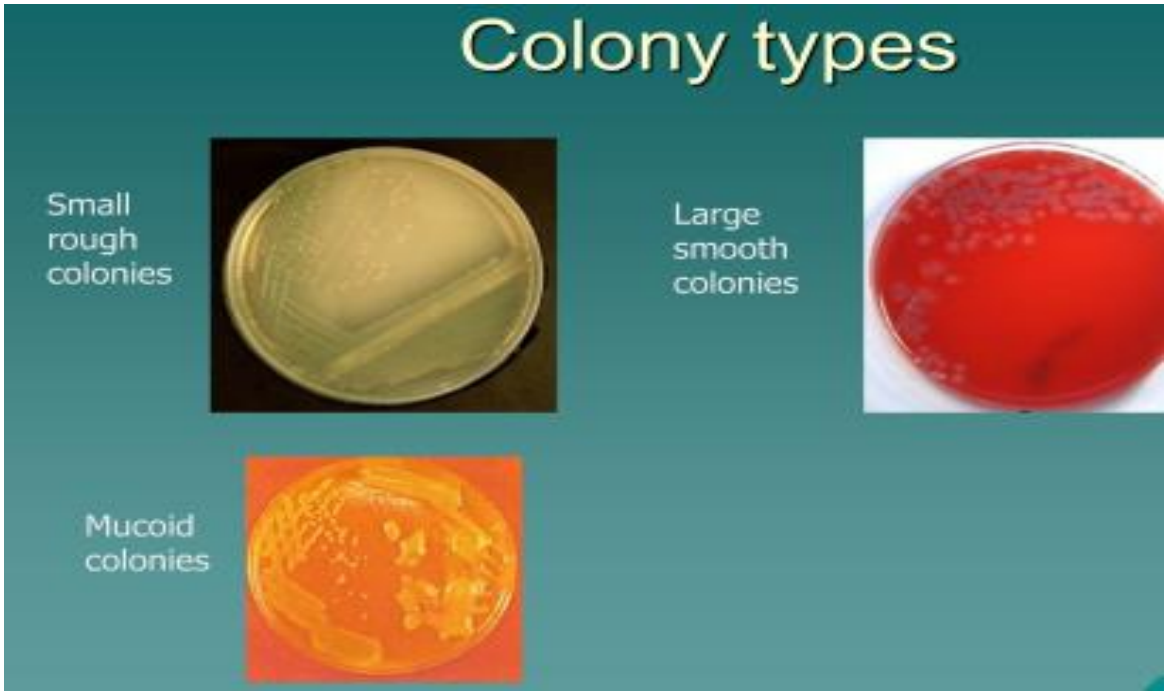
Microscopical features

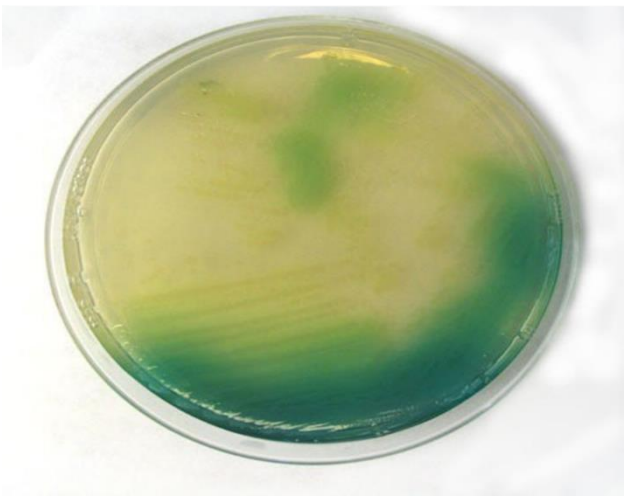
Pseudomonas aeruginosa is Gr –ve, rod bacilli 0.6 – 2 Mm, occurs in single bacteria, pairs & short chains, motile by polar flagella. LPS found in cell wall structure similar to Enterobacteriaceae with differences in polysaccharide side chain. Pilli present on the cell surface.

Growth & cultural features

- *Pseudomonas aeruginosa* strict aerobic.
- It can survive over wide range of temperature 37 – 42 ^{O}C.
- It use oxidative energy – producing mechanism so that Oxidase test is +ve.

- Colonies well developed after night incubation 42 ^{O}C hr.
- Hemolysis may be produced on blood agar.
- It can differentiate *Pseudomonas aeruginosa* from other Pseudomonas by ability to grow at 42 ^{O}C.
- *Pseudomonas aeruginosa* forms smooth, round colonies with fluorescent greenish color on nutrient & Muller Hintoon agar produce by pyoverdin & non fluorescent which give bluish color by producing pyocynin which diffuse into the agar & other Pseudomonas spp. not produce pyocynin.
- *Pseudomonas aeruginosa* also produce dark red pigment (pyorubin) & black pigment (pyomelanin).
- *Pseudomonas aeruginosa* usually form mucoid colonies as a result of over production of alginate (exopolysaccharide).
- *Pseudomonas aeruginosa* con not ferment CHO, but oxidize glucose.





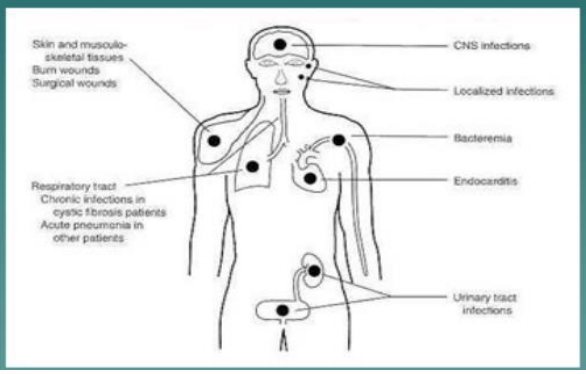
Antigenic Structures & Toxins

- Pilli (fimbriae) extend from the cell surface & promote attachment to the host epithelial cells.
- Exopolysaccharide is responsible for the mucoid colonies.
- LPS is responsible for endotoxin (pyrogenic antigen).
- Pyocin (bacteriocin).
- Most *Pseudomonas aeruginosa* isolates from clinical infections produce extracellular enzymes including elastase, protease & two hemolysins, phospholipase C, & heat stable glycolipid.
- Exotoxin A which causes tissue necrosis & is lethal for animals when injected in purified form. The toxin blocks protein synthesis.
- Antitoxin to exotoxin A are found in some human sera, who recovered from serious *Pseudomonas aeruginosa* infections.

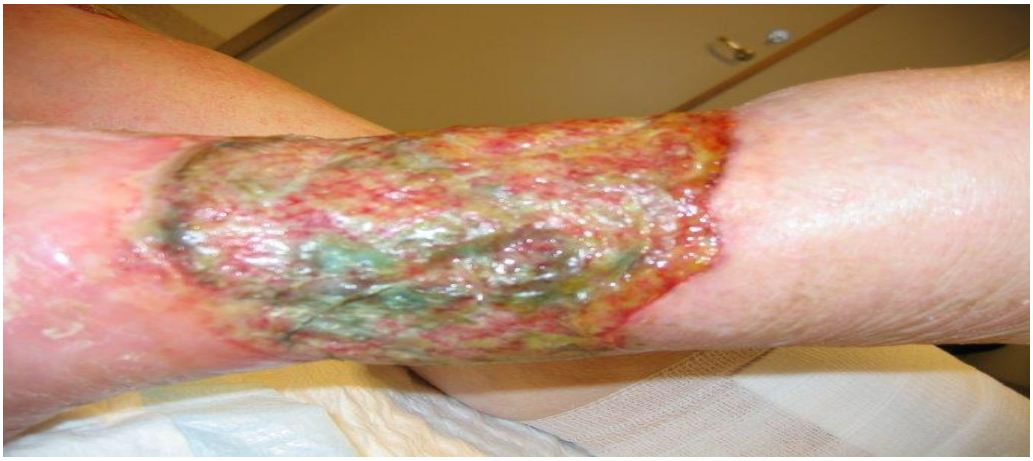
Pathogenesis

- *Pseudomonas aeruginosa* produces infection of wounds & burns giving rise to blue – green pus, meningitis when introduced by lumber puncture, UTI induced by catheter & instruments.
- Also RTI & necrotic pneumonia by contaminated respirators.
- Otitis externa in swimmers.
- In infants & debilitated persons, *Pseudomonas aeruginosa* may invade the blood stream & result in fatal sepsis, this occurs in leukemic patients or with lymphoma who have received antineoplastic drug or chemotherapy.
- Ecthyma gangrenosum is uncommon.
- *Pseudomonas aeruginosa* is multifactorial virulence. After invasion of bacteria, it will protect itself from phagocytosis by LPS & slime (glycolipid) may provide sufficient time for production of collagenase, elastase & other enzymes, allowing spread & local tissue destruction. Exotoxin A is important as a lethal effect of widespread infection.
- Cystic fibrosis infections: *Pseudomonas aeruginosa* is the most common bacterial pathogen to complicate the management of patient with cystic fibrosis which is inherited disease of exocrine glands associated with excessive viscid mucus in the smaller respiratory passage. High proportion of cases become colonized with this bacteria & cause tracheobronchitis or pneumonia.

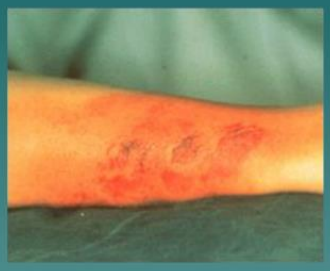
Pathogenesis

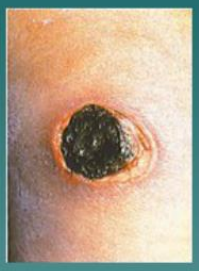


- Opportunistic pathogen that can infect almost any body site given the right predisposing conditions.

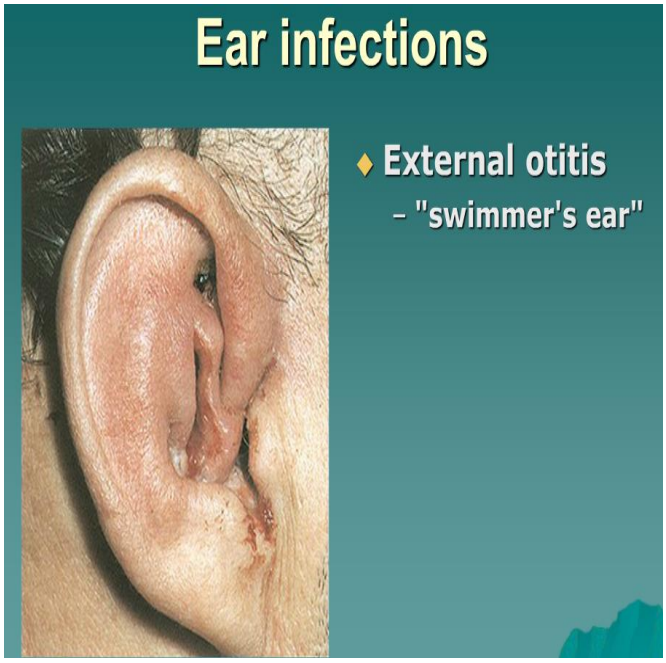


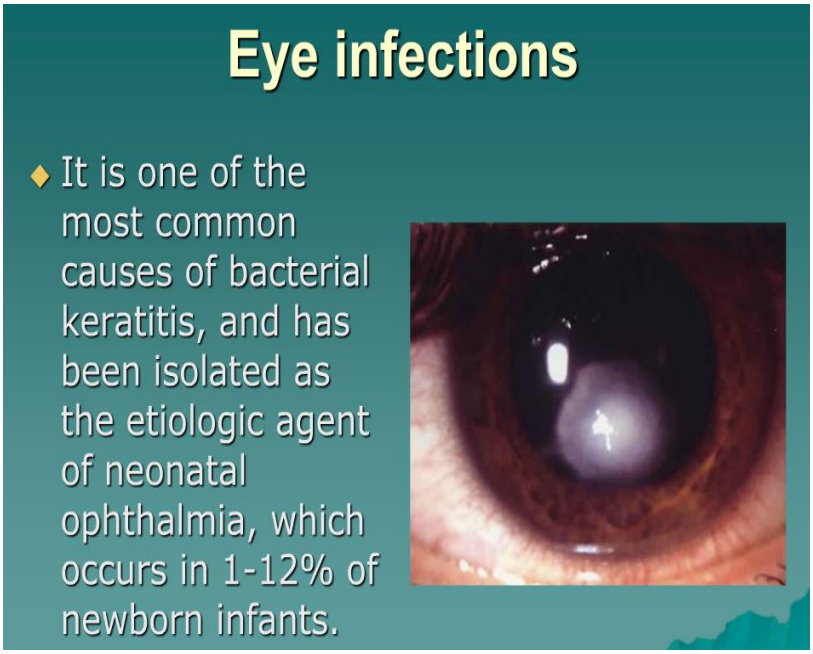
Bacteremia and Septicemia





- Ecthyma gangrenosum:
  Think *Pseudomonas aeruginosa* in neutropenic patients





Treatment

- *Pseudomonas aeruginosa* should not be treated with single – drug therapy since resistant to antimicrobial. It is usually resistant to penicillin, ampicillin, cephalosporin, tetracyclin, chloramphenicol, sulfonamides & aminoglycosides.
- Much efforts has been directed toward the development of antimicrobial with anti-Pseudomonas activity including penicillin such as Piperacillin is used in combination with aminoglycosides usually tobramycin. Other drugs active against *Pseudomonas aeruginosa* including aztreonam & carbapenems.
- Also newer Quniolones including ciprofloxacin.
- Also cephalosporin, ceftazidime & cefoperazone given incombination with aminoglycosides.