

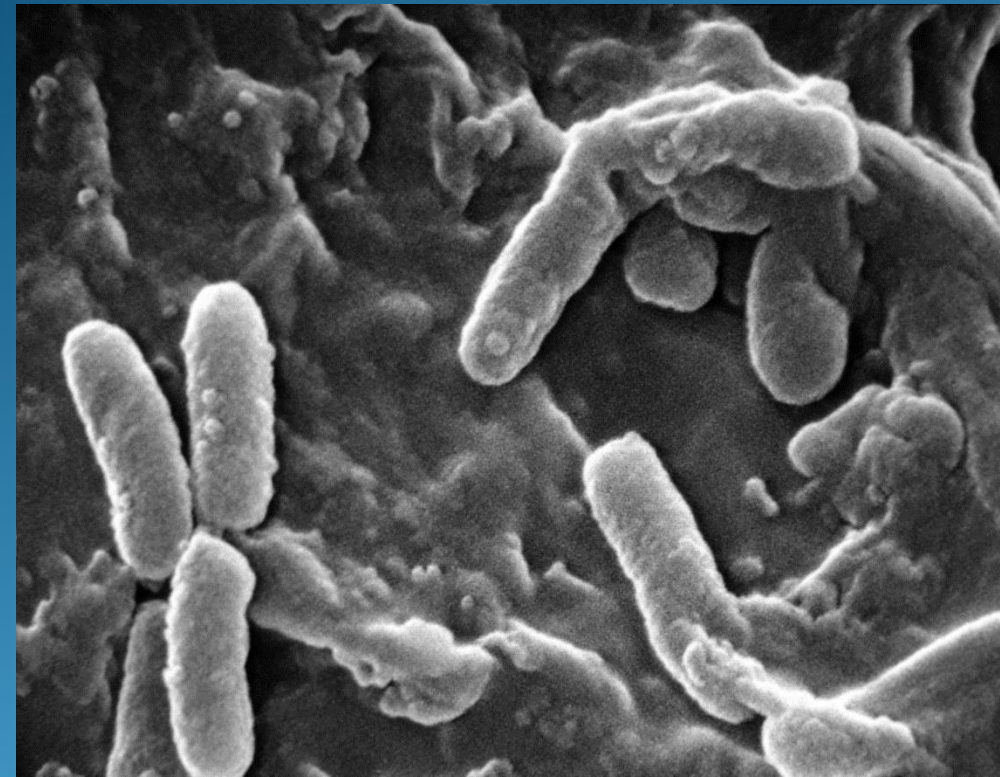
Medical Microbiology

Gram-negative rods

Pseudomonads



Pseudomonas Aeruginosa



- *Ps.* infect immunocompromized patient.
- Usually causes hard to treat nosocomial infections.
- It show resistance to most antibiotics.

- People at risk include:
 - Hospitalized patients
 - Immuno-compromised persons
 - Healthy individuals
 - CF patients

Very successful hospital pathogen



Ecological factors

- Pa is primary a nosocomial pathogen,
- it is ubiquitous water and soil organism
- Survive well in domestic environments like contact lenses and solutions, and in hospital (food, cut flowers, sinks, toilets, floor mops, respiratory therapy and dialysis equip, and even in some disinfectant solutions)
- Rarely it can be a part of normal flora in healthy individuals

Important of prevention



- Pa is found almost everywhere In hospital, it is even found in disinfectant
- Pa is able to survive and proliferate in water with minimal nutrient



Bacteriology

- Bacteria
- Gram negative and gram positive
- Gram negative: Cocci, rods, acid-fast
- Gram negative rod: facultative, anaerobes, aerobics
- *Pa* is **obligate aerobic** gram negative rod (oxidation)
- *Pa* in non-fermenter (cytochrome oxidase C)
- *Pa* non fermenting oxidase positive gram negative rods



- *Pa* has a polar flagella and pilli that make *Pa* mobile



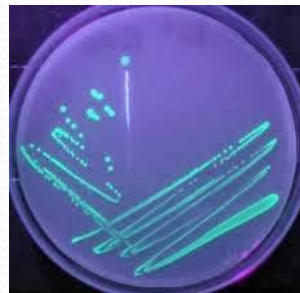
- Production of colorful water-soluble pigments



Pyocyanin



Pyoverdinin



- Characteristic metallic sheen
- Intense fruity odor like the smell of crapes



- Pa live in slime enclosed biofilm



General characteristic

1. Obligate aerobic, gram negative bacilli non-sporing, non-capsulate
2. Non-lactose fermenter
3. Oxidase positive
4. Glucose oxidizer
5. Catalase positive
6. Citrate positive
7. Motile by a polar flagella



8. It produces pigments

8.1 **pyocyanin = blue green pigment** (only in PA)

8.2 **pyoveridin = Yellow- fluorescence.**

8.3 **pyorubin= (red)**



Pathogenesis

- ▶ Opportunistic pathogen
- ▶ Weak invasive ability
- ▶ Require break of first-line defenses (wound or contaminated solution)



Virulent factors

- Endotoxin, exotoxin, enzymes, flagella, pilli, biofilm, biocyanin, type 3 secretion system



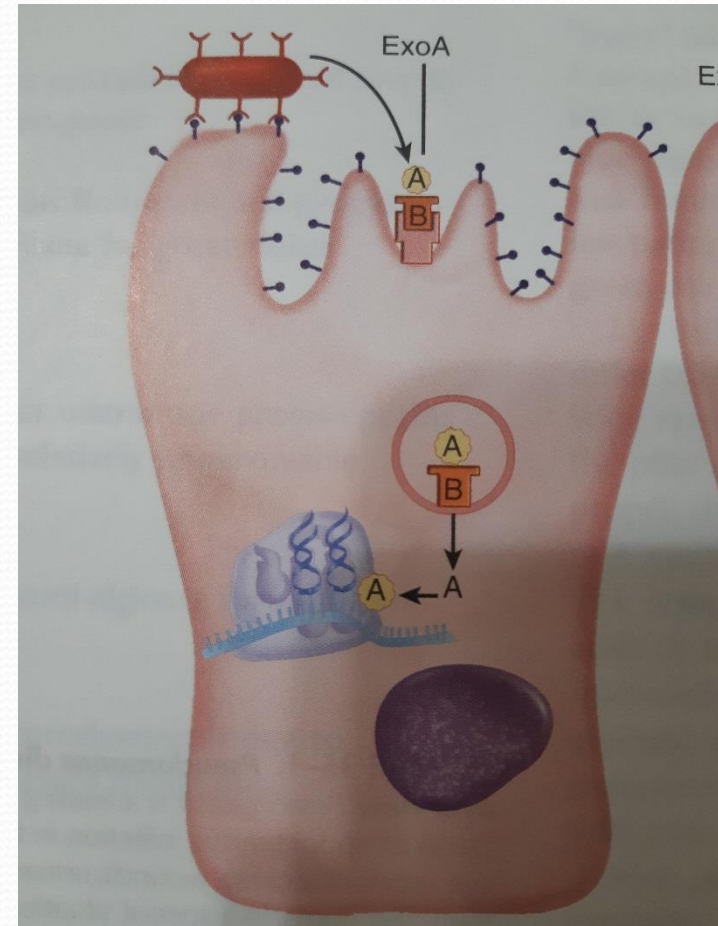
Virulent factors

- Endotoxin (lipid A): sepsis and endotoxin shock



Exotoxin

- Exotoxin A
 - tissue necrosis
 - A-B toxin
 - Stopping translation,
 - **inactive the EF2**
 - Mean there is a necrosis
 - Similar in structure to Diphtheria toxin
 - Causes Dermatonecrosis in burn wounds, corneal damage in ocular infections, and tissue damage and necrosis in chronic pulmonary infections.



- Exo S, T, Y and U
 - cause epithelial cell damage, facilitating bacterial spread, tissue invasion, and necrosis



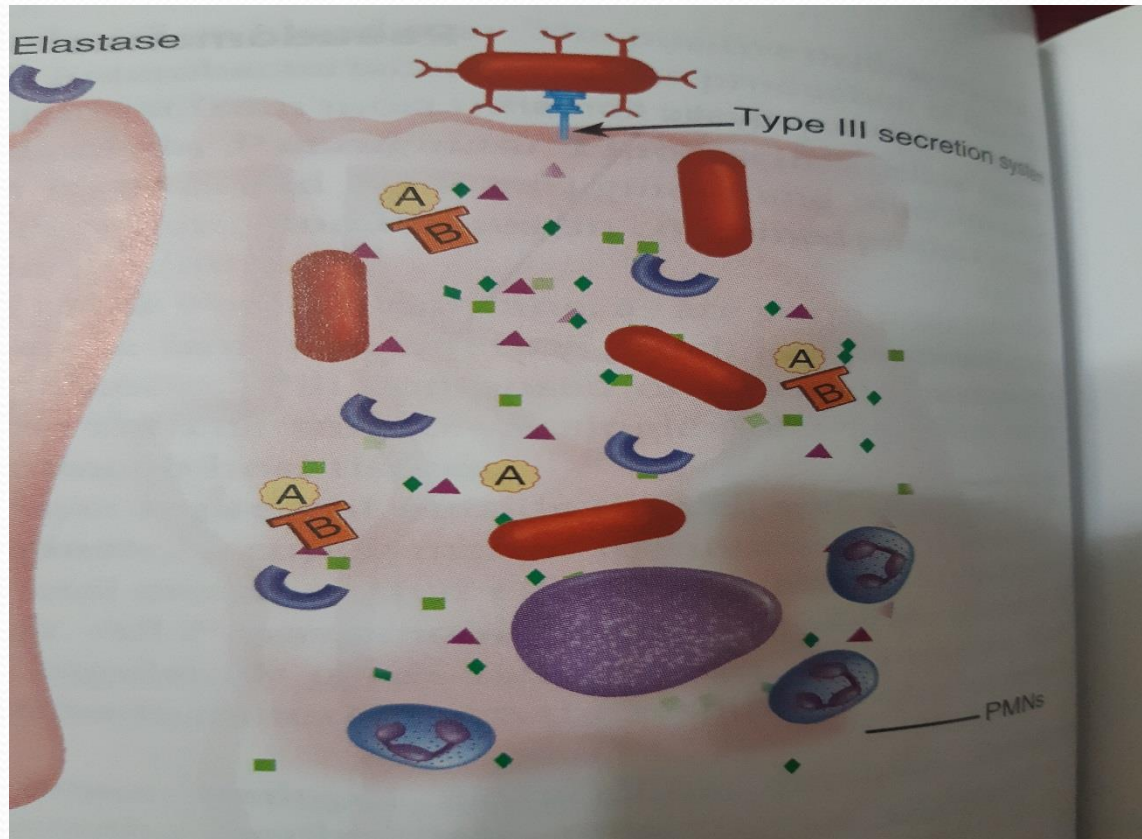
Enzymes

- Elastase, phospholipase C and protease
 - Histotoxic
 - Cause destruction and disruption of the body tissue
 - Facilitate the organism to reach blood stream
 - Elastase:
 - Destruction of elastin-containing tissues (blood vessels, lung tissue, skin), collagen, immunoglobulins (IgA and IgG), and complement factors
 - Can produce hemorrhagic lesions (ecthyma gangrenosum) associated with disseminated infection
 - **Phospholipase C**
 - Breaks down lipids and lecithin causing tissue destruction



T3SS

- They transfer exotoxin from bacteria directly into the adjacent human cell



Flagella and Pilli

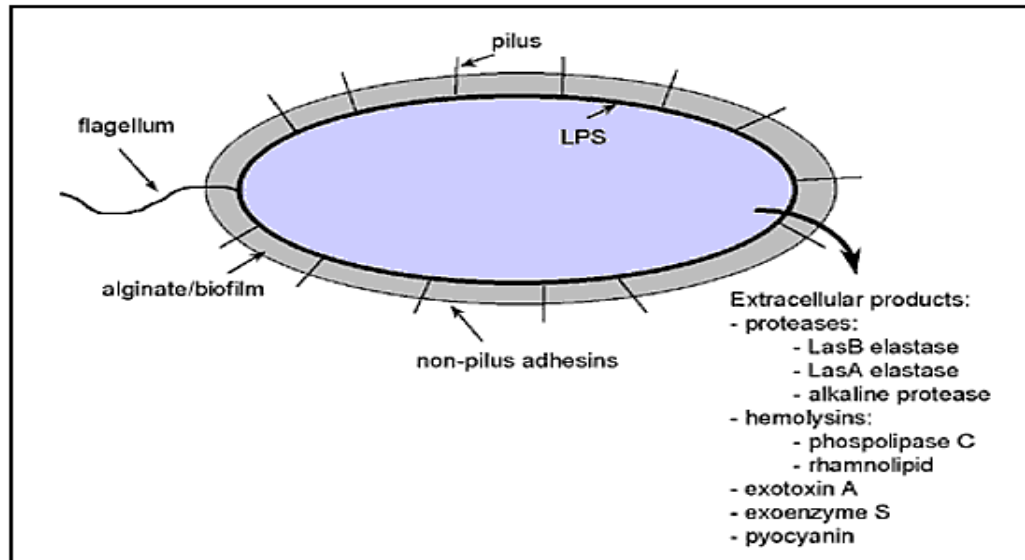
- Mobile.
- Pulmonary infection
- Pili facilitate the adhesion of pa to epithelial cell



- Pyocunin can damage cilia and mucosal cells and immune cell in respiratory tract
 1. Can mediate tissue damage
 2. It also stimulates IL-8 release, leading to enhanced attraction of neutrophils
 - Mediates tissue damage through production of oxygen radicals



- ▶ Alginate – mucoid exopolysaccharide that forms a shiny biofilm protecting from antibodies, complement, phagocytosis, and antibiotics



Gram stain and culture

- Specimen obtained as indicated of type of infection
- **Gram stain** : gram negative, rod that is motile and encapsulated
- Electron microscope: polar flagella it has pili
- Gram negative Motile encapsulated rod with polar flagella

Ps. aeruginosa is indistinguishable from other gram negative bacilli. Therefore there is a little significance for gram staining.



- Culture: far the most important and specific test for diagnose pa infection
- Grow well on ordinary media such as Blood Agar, Nutrient Agar and MacConkey Agar.
- Pa does not ferment lactose
- Pa grow in non lactose fermenting colony in macConkey agar



- *Blood agar*

- Metallic sheen
- Many are haemolytic



- *Mac conkey agar*

- Colourless, non lactose fermenters



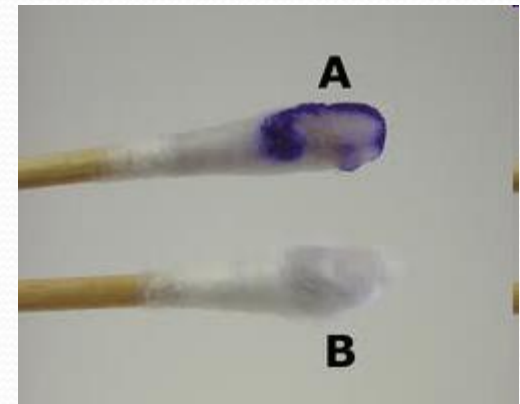
- *Cetrimide agar*

- selective media



Biochemical reactions

- Oxidative/fermentation glucose test-oxidative
- Catalase-positive
- Oxidase-positive
- Nitrate reduction-positive
- Citrate test-positive



Cont...

- Sugar fermentation tests
 - Glucose-only acid
 - Lactose-negative
 - Sucrose-negative
 - Mannitol-negative



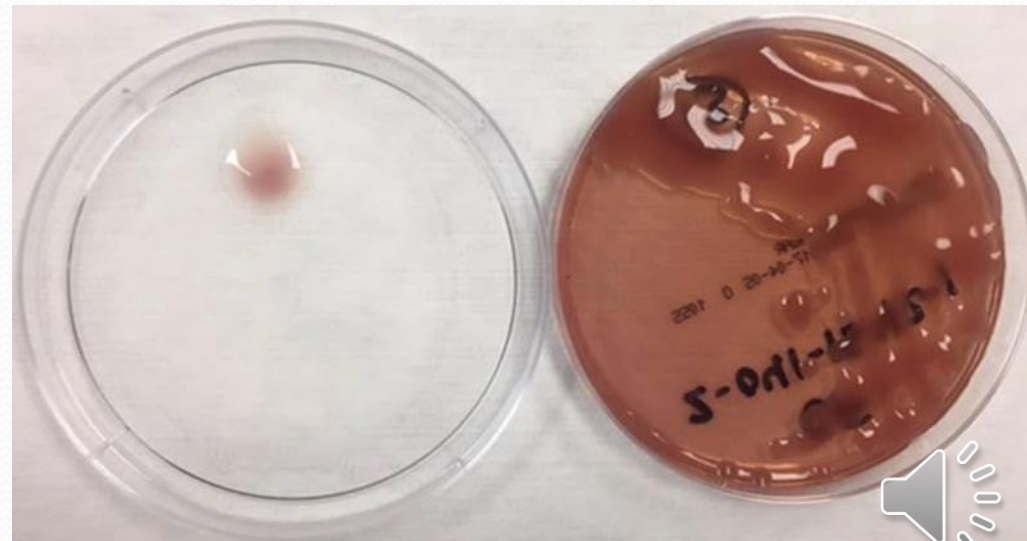
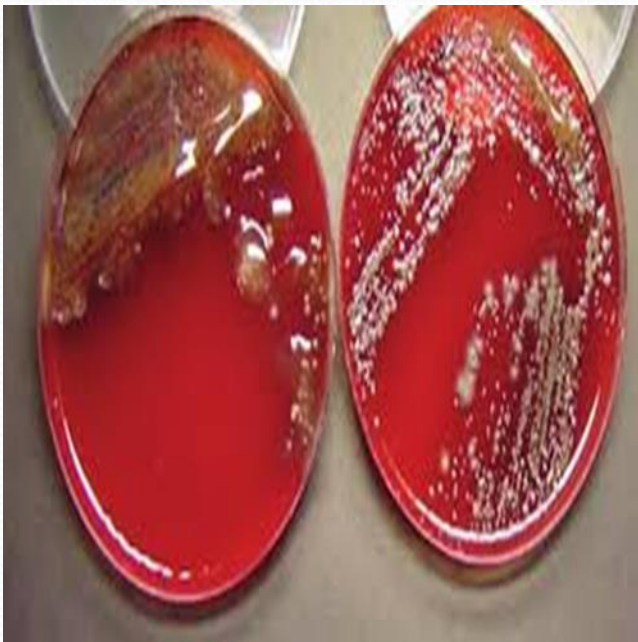
- These tests differentiate Pa from other oxidase negative gram negative rods
- Pa non lactose fermenting oxidase positive gram negative rod



- Ps produce diffusible greenish pigment which is a combination of pyoverdinin and pyocyanin



- Mucooid appearance of pa due to over production of alginate,
- Alginate is an exopolysaccharide that provide the matrix for pa to live in this biofilm



- Summary the culture feature of Pa
 - Non lactose ferment oxidase positive
 - Green blue
 - Metallic sheen
 - Mucoid appearance
 - Fruit smell
 - These feature are sufficient to diagnosis pa and confirmation by biochemical test



Clinical Presentation

- Pulmonary infections, common in cystic fibrosis patients
- Primary skin infections: Opportunistic infections of existing wounds (e.g., burns) to localized infections of hair follicles
- UTI infections: Opportunistic infections in patients with indwelling urinary catheters
- Ear infections: range from mild irritation of external ear "swimmer's ear" to invasive destruction of cranial bones
- Eye infections: Opportunistic infections of exposed, mildly damaged corneas e.g., contact lens wearer
- Bacteremia: Dissemination of bacteria from primary infection to other organs and tissues



Ecthyma Gangrenosum

- Ecthyma gangrenosum is a well recognized cutaneous manifestation of severe, invasive infection by *Pseudomonas aeruginosa* that is usually seen in immunocompromised, burn patients, and other critically ill patients



Black necrotic ulcer,
often no pus



Burn

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



Malignant Otitis Externa

Diabetic and HIV
pts

No fever
No leukocytosis.
Otologi and
headache

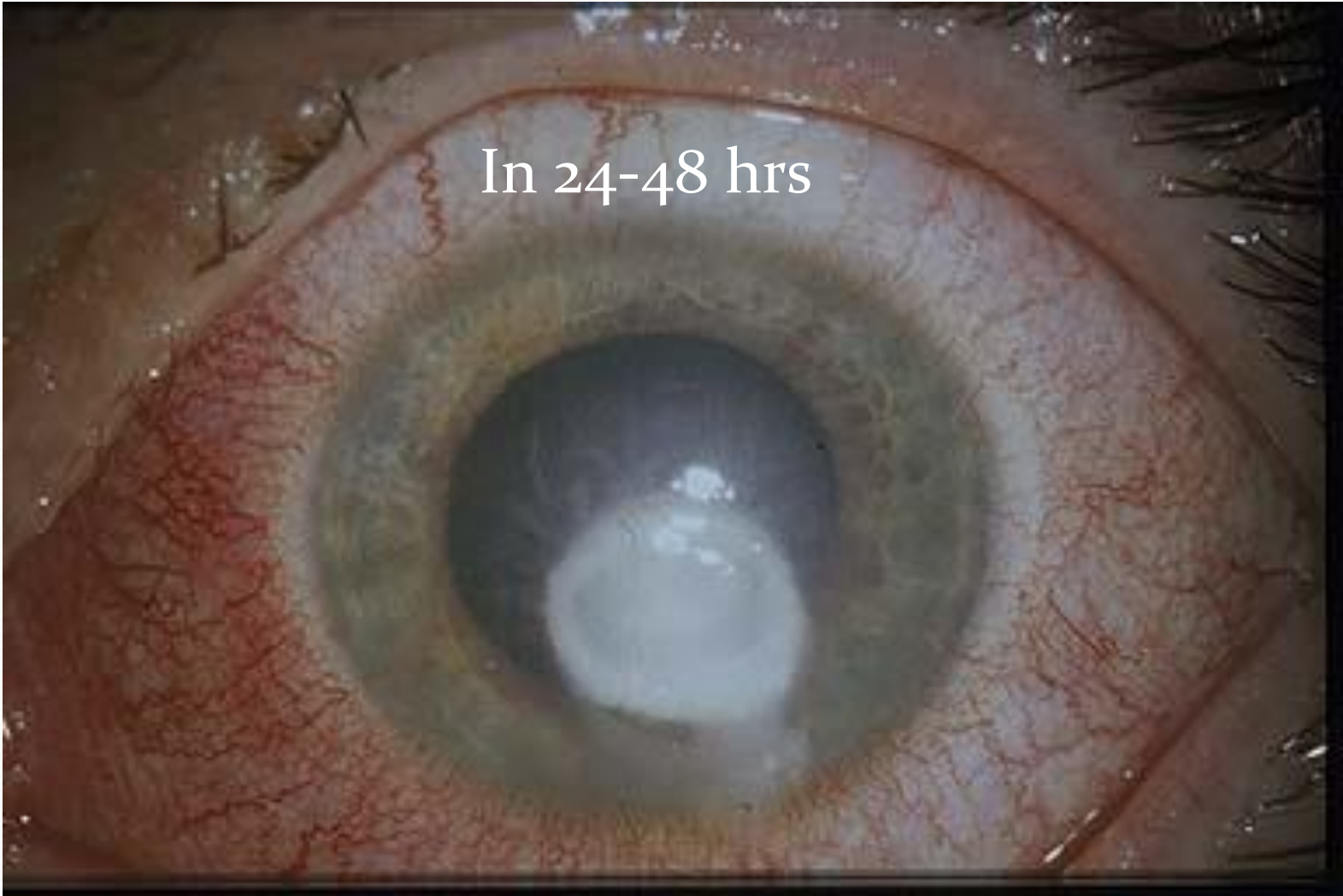
Oral cipro



Pseudomonas Keratitis and Corneal

U

In 24-48 hrs



Mild infection



Hot tub folliculitis



Swimmer ear



Paronychia



Prevention

- Observe proper hand hygiene
- Proper education of hospital related personnel on hand hygiene
- Good housekeeping limit the chance of transmission of pa
- Do not bring fruit and raw vegetable in burn unit
- Use sterile water for washing medical equipment and devices and do not use tap water
- Limit use of broad spectrum antibiotics disturb normal flora, give pa an opportunity to infect
- Place all CF patients in private room that should not share bathroom or shower
- Avoid direct contact



Treatment

- Inherently resistant to many antibiotics (penicillin, ampicillin, tetracycline, earlier aminoglycosides and sulfonamides)
- Can mutate to more resistant strains during therapy
- Production of B-lactamases
- Combination of active antibiotics generally required for successful therapy (Anti- β -lactam and aminoglycoside)



- Extended spectrum penicillin (ticarcillin piperacillin)
- Carbapenem (imipenem)
- Aminoglycoside gentamicin amikacin tobramycin
- Cephalosporin 3rd 4th the 3rd: ceftazidime, 4th cefepime
- fluoroquinolone
- Monobactam
- Polymyxin B
- inhaled tobramycin
- Vaccine experimental

