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G- rods (Pseudomonads, other nonfermenters), G+ rods

key points of the lecture

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Pseudomonads

- Gram negative rods
- Oxidase positive - dif.dg.from other G - rods
- Non fermentative
- Strict aerobic
- Motile – one or two polar flagella
- Non-fastidious
- Non-sporing
- Produce diffusible pigments

- Most are saprophytes found widely in aquatic environments, including rivers and ponds, in plants, and in a variety of other moist environments

- The group includes important pathogens for man, animals, plants and insects.
- many pseudomonads of clinical interest have been allocated to new genera including Burkholderia, Delftia, Pandoraea and Stenotrophomonas

Medical important species

Pseudomonas aeruginosa
Burkholderia cepacia
Burkholderia pseudomallei
Stenotrophomonas maltophilia

- *Pseudomonas aeruginosa* - most commonly associated with human disease
- *Burkholderia pseudomallei* - important pathogen in tropical countries
- *Burkholderia cepacia* - important pathogens in immunocompromised patients, particularly in individuals with cystic fibrosis or chronic granulomatous disease
- *Stenotrophomonas maltophilia* - infects immunocompromised patients

Pseudomonas aeruginosa – opportunistic human pathogen

- High adaptability
- innate resistance to many antibiotics and disinfectants
- many virulence factors
- an increasing supply of patients compromised by age, underlying disease or immunosuppressive therapy

PSEUDOMONAS AERUGINOSA

- non-sporing,
- non-capsulate,
- nonfastidious
- Gram-negative bacillus
- usually motile by one or two polar flagella

Cultivation

- Strict aerobic bacteria
- grows on a wide variety of culture media,
- over a wide temperature range,
- emits a sweet grapelike odour that is easily recognized

- Most strains produce diffusible pigments:
  - Greenish-blue – pyocyanin
  - Yellow-green - pyoverdin (fluorescent)
  - Red – pyorubrin
  - Brown – melanin

- Colonies – relatively large and flat, beta-hemolytic

- Ps. aeruginosa differs from members of the Enterobacteriaceae
- derives energy from carbohydrates by an oxidative metabolism rather than a fermentative metabolism

- all strains give a rapid positive oxidase reaction (within 30 s)

PATHOGENESIS

- pathogenic for a wide range of animal, plant and insect hosts
- can infect any anatomical surface or organ
- can cause a spectrum of infections with variable morbidity and mortality

- community infections are uncommon and usually mild
- in hospital and other healthcare settings, *Ps. aeruginosa* infections are more common, more varied and more severe

Community infections

- otitis externa (swimming ear)
- varicose ulcers
- corneal infections, particularly keratitis resulting from contaminated contact lenses or other sources
- whirlpool or Jacuzzi® rash (an acute self-limiting folliculitis)
- serious industrial eye injuries, which may lead to panophthalmitis.

Hospital infections

- catheter-related urinary tract infection,
- infected ulcers,
- bedsores,
- burns infections
- eye infections

- vulnerable patients are related to age or diseases such as leukaemia, AIDS, and chemotherapy-induced neutropenia
- Patients in critical care units are at particular risk
- common cause of ventilator-associated pneumonia.

Virulence factors

- Pilli - adherence
- Polysacharid capsule – antifagocytosis, attachment
- Endotoxin – LPS sepsis
- Exotoxin A – most important, blocs proteosynthesis of eukaryotic cells
- Alkalic protease – destruction of tissue
- Phospholipase C – destruction of lipids and lecithin, destruction of tissue

LABORATORY DIAGNOSIS

- Cultivation
- BA agar
- Selective media - Production of pigments
- Oxidase test
- Appropriate commercial multitest system

- PCR

Cultivation media

- BA agar
- MH agar
- TSI agar

TREATMENT

- Most isolates are resistant to commonly used antimicrobial agents
  - **Aminoglycosides**
  - **Antipseudomonads β-lactams**
  - **Fluoroquinolones** exhibit good activity and penetrate well into most tissues - !!!!but resistance may develop!!!
- By monotherapy with broad-spectrum β-lactams resistance occurs rapidly - thus monotherapy should be avoided in the treatment of chronic infections
- **Combinations** provide the potential for antibacterial synergy and reduced antibiotic resistance

BURKHOLDERIA

- *BURKHOLDERIA PSEUDOMALLEI*
- *BURKHOLDERIA MALLEI*
- *BURKHOLDERIA CEPACIA COMPLEX*

BURKHOLDERIA PSEUDOMALLEI

- Causal agent of melioidosis, a life-threatening tropical infection of man and animals
- microorganism is found in soil and surface water, monsoon drains
- Higher incidence during the rainy season

Clinical disease

- **MELIOIDOSIS**
- acquired mainly through skin abrasions
- or by inhalation of contaminated particles (especially during monsoon rains)

- **Symptoms**
- Subclinical infection
- Pyrexia
- Acute pneumonia
- Chronic pulmonary infection that resembles tuberculosis
- Suppurative parotitis in children

Laboratory diagnosis

- Samples
  - Sputum
  - Urine
  - Pus
  - blood
- Gram-negative bacilli
- Oxidase positive
- Motile
- Does not produce diffusible pigments - contrast to *pseudomonas*
- Serology - ELISA

Treatment

- antibiotic therapy are key to successful management
- optimum treatment of severe melioidosis is unclear

- Intravenous ceftazidime, followed by a combination of cotrimoxazole and doxycycline, is emerging as the treatment of choice

BURKHOLDERIA CEPACIA COMPLEX

- life-threatening respiratory infection in immunocompromised patients
- particularly those treated in intensive care or with chronic granulomatous disease
- Clinical disease - acute, fatal necrotizing pneumonia

- Therapy
- carbapenem, meropenem, appears the most active agent
- multiresistance of the organism to antibiotics

Burkholderia mallei

- causes glanders,
- a potentially fatal infectious disease of horses, mules and donkeys.

Acinetobacter sp.

- saprophytes found in soil, water and sewage, occasionally as commensals of moist areas of human skin.
- survive well in the hospital environment,
- Patients in intensive care units are at particular risk.
- Serious infections - meningitis, osteomyelitis, wound infections (including war wounds), pneumonia and septicaemia, are most commonly associated with *A. baumannii*.
-
- Isolates are often resistant to many ATB, therapy according results of atb susceptibility testing.

Other gram negative non-fermenters

- *Bordetella pertussis* – whooping cough, pertussis
- *Bordetella parapertussis* – parapertussis, like pertussis
- *Bordetella bronchiseptica* – respiratory in animals, occasionally in hum.

- *Franciscella tularensis* – tularemia, zoonosis

- *Brucella melitensis* – brucellosis, zoonosis
- *Brucella abortus*, *Brucella suis, Brucella canis* – brucellosis

- *Legionella pneumophila* - Legionnaire´s disease (severe pneumonia with multiorgan involvement), flu-like disease Pontiac fever

Gram positive rods

- *CORYNEBACTERIUM*
- *LISTERIA*
- *ERYSIPELOTHRIX*
- *BACILLUS*

LISTERIA

- non-sporing
- Gram-positive bacilli
- grows well on a wide variety of nonselective laboratory media
- β-haemolysis on blood agar
- non-motile at 37°C, but exhibit characteristic ‘tumbling’ motility when tested at 25°C.

- https://j.gifs.com/311BQA.gif

L. MONOCYTOGENES

- The disease affects
  - the immunosuppressed and
  - elderly,
  - the pregnant women,
  - unborn or newly delivered infants
- Transmission: predominantly by the consumption of contaminated food.

L. MONOCYTOGENES – clinical aspects of listeriosis

- an intracellular parasite

- Causal agent:
  - intra-uterine infection,
  - meningitis and
  - septicaemia
  - gastroenteritis
- The incubation period varies widely between individuals from 1 to 90 days, with an average for intra-uterine infection of around 30 days.

Infection in pregnancy and the neonate

- Pregnant women often have very mild symptoms (chills, fever, back pain, sore throat and headache, sometimes with conjunctivitis, diarrhoea) –symptomatic women may have positive blood culture

- Abortion, stillbirth and early-onset neonatal disease are common, depending on the gestation at infection

Infection in pregnancy and the neonate

- **Early neonatal listeriosis** is predominantly a septicaemic illness, contracted in utero
- **Late neonatal infection** is predominantly meningitic

- Those neonates who die from infection have pneumonia, hepatosplenomegaly, petechiae, abscesses in the liver or brain, peritonitis and enterocolitis.

Adult and juvenile infection

- the main syndromes:
  - septicaemia and
  - central nervous system infection
- Most cases occur in immunosuppressed patients receiving steroid or cytotoxic therapy or with malignant neoplasms
- Autoimmune disease, diabetes, alcohol related disease and immunosuppressive treatments are all risk factors for listerial infection

Diagnosis and treatment

- **Dg**:
- culture of blood and or CSF
- Gram-staining of surface swabs
- PCR
- **Therapy**:
- ampicillin, penicillin, vancomycin, tetracyclines, chloramphenicol, aminoglycosides and co-trimoxazole.
- **Cephalosporins are ineffective**

ERYSIPELOTHRIX

- aerobic, non-sporing,
- non-motile, Gram-positive bacilli

- *E. rhusiopathiae* - disease in domestic animals (pigs), localized cutaneous infection (erysipeloid) in human, commonly affect the hands
- most often associated with close animal contact and usually occurs in groups as veterinarians, farmers, and fish-handlers
- Therapy: β-lactam antibiotics, erythromycin and clindamycin

BACILLUS

- rod-shaped bacteria
- large Gram-positive bacilli
- Spore-forming
- form chains
- usually grow aerobically

Medical important species

Bacillus anthracis
Bacillus cereus
Bacillus subtilis
Bacillus stearothermophilus

BACILLUS ANTHRACIS

- The temperature range for growth is 12–45°C
- typical colonies with ‘ground-glass’ surface appearance and a wavy margin with small projections, the so-called medusa head appearance

CLINICAL FEATURES

- Cutaneous anthrax
- Inhalation anthrax
- Intestinal anthrax

- Complication:
  - Meningitis - Haemorrhagic meningitis may complicate any form of anthrax infection, when the bacteraemia spreads across the blood-brain barrier to the CNS

BACILLUS CEREUS

- food poisoning
- post-traumatic ophthalmitis

- two types of food poisoning:

1. Cases in which vomiting, occurring within 6 h of ingestion, is the main symptom.
2. A diarrhoeal form of food poisoning, occurring 8–24 h after ingestion

Sources

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