Gram positive cocci

• ILOs
• Understand basic characteristics and distinctive features
• Virulence factors and roles in pathogenesis
• Associated infections
• MRSA: virulence, risk factors and control
• Diagnosis: proper specimen and specific identification
• Understand general lines of treatment
Gram positive cocci

- Staphylococcus
- Streptococcus
- Enterococcus
Staphyloccoccus

• Part of normal flora on skin and upper respiratory tract of human.
• Also found in animals
• *Staph. aureus* is present in the nose of 30% of healthy people but can cause infections where there is lowered host resistance
• Sources of infection include healthy carriers, infected lesions and animals.
• spread from colonized sites (e.g. skin) occurs by hands, clothing, dust and desquamation from the skin.
Staphylococcus

- Facultative anaerobic
- Catalase-positive
- Resistant to dry conditions and high salt concentrations
**Staphylococcus**

- The major pathogen within the genus, *Staphylococcus aureus* is coagulase positive *(enzyme that clot blood plasma)*
- There is at least 30 other species of staphylococci, all of which lack this enzyme. These coagulase-negative staphylococci (CNS):
  - Skin commensals
  - Can cause opportunistic infections especially associated with prosthesis or foreign bodies (usually due to *Staph. epidermidis*), and urinary tract infections (Staph. saprophyticus)
**Staphylococcus aureus infections**

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</table>
• sinusitis, conjunctivitis, meningitis

• osteomyelitis..

• Any body sites
Staphylococcus aureus

Carbuncle (hair follicles infection)

Impetigo
**Staphylococcus aureus**

- **Description:**
- *Gram-positive coccus usually arranged in grape-like clusters*
- When grown on many types of agar for 24 h at 37°C, individual colonies are circular, 2–3 mm in diameter, with a smooth, shiny surface; colonies appear opaque and are often pigmented (goldenyellow, hence the ‘aureus’).
Staphylococcus aureus
**Staphylococcus aureus**

- **The main distinctive diagnostic features of *Staph. aureus* are:**
  - Production of an extracellular enzyme, **coagulase**, which converts plasma fibrinogen into fibrin.
  - Production of thermostable nucleases that break down DNA.
  - Production of a surface-associated protein known as **clumping factor or bound coagulase** that reacts with fibrinogen.
**Staphylococcus aureus**

- **Virulence factors:**
  - Peptidoglycans, protein A, teichoic acid: immune escape and endotoxin like activity
  - Enterotoxins:
    - Enterotoxins, types A–E, G, H, I and J,
    - produced by up to 65% of strains of *Staph. aureus*,
    - *singly and sometimes in combination.*
    - superantigens
    - *withstand exposure to 100°C* for several minutes.
    - ingested as preformed toxins in contaminated food,
    - within a few hours, induce the symptoms of staphylococcal food poisoning: nausea, vomiting and diarrhoea.
Staphylococcus aureus

- Toxic shock syndrome toxin (TSST-1)
  - Causes toxic shock syndrome, a multi-system disease.
  - A link was established with the use of highly absorbent tampons
  - Superantigen (potent activators of T lymphocytes, liberation of cytokines)
**Staphylococcus aureus**

- **Epidermolytic toxin (types A and B)**
  - Cause blistering diseases.
  - These toxins induce intraepidermal blisters range in severity from:
    - Trivial
    - Distended blisters of *pemphigus neonatorum*
    - *Scalded skin syndrome in small children*: where the toxin spreads systemically and extensive areas of skin are affected, which, after the development of a painful rash, slough off; the skin surface resembles scalding (Fig.).
Scalded skin syndrome
**Staphylococcus aureus**

- **Panton-Valentine leukocidin (PVL)**
  - PVL can adversely affect cells, resulting in leucopenia,
  - Association between necrotizing pneumonia and some complicated skin and soft tissue infections (cSSTI) caused by PVL-positive strains of CA-MRSA.
**Methicillin-resistant Staph. aureus (MRSA)**

- MRSA produces a penicillin binding protein 2a (mediated through the *meca* gene)

- *meca* gene is carried on the staphylococcal cassette chromosome mec (SCCmec) of which there are at least six different types recognized

- Resistance to all beta-lactam antibiotics
**Methicillin-resistant Staph. aureus (MRSA)**

- MRSA produces a penicillin binding protein 2a (mediated through the *mecA* gene)
- *mecA* gene is carried on the staphylococcal cassette chromosome mec (SCCmec) of which there are at least six different types recognized
- Resistance to all beta-lactam antibiotics
- Same range of infection as MSSA, but difficult to treat
- Community and Hospital acquired MRSA
Methicillin-resistant Staph. aureus (MRSA)

- Risk factors as:
  - Debilitated
  - Recurrent hospital admission
  - Antibiotic use

- Control, many such as:
  - Education and antibiotic stewardships?
  - Fast detection, search and destroy
  - Surveillance
  - Isolation
  - Hand hygiene
**Staphylococcus aureus - diagnosis**

Specimens:

- *Pus from abscesses, wounds, burns, etc. is much preferred to swabs.*
- *Sputum from patients with pneumonia (e.g. postinfluenzal or ventilator-associated pneumonia)*;
- bronchoscopic specimens, e.g. bronchoscopic lavage, are increasingly used in critically ill patients.
- *Faeces or vomit from patients with suspected food poisoning, or the remains of implicated foods.*
Staphylococcus aureus - diagnosis

Specimens:

• Blood from patients with suspected BSI such as septic shock, osteomyelitis or endocarditis.

• Mid-stream urine from patients with suspected cystitis or pyelonephritis.

• Anterior nasal and perineal swabs from suspected carriers; nasal swabs should be rubbed in turn over the anterior walls of both nostrils.
Staphylococcus aureus - diagnosis

- The characteristic clusters of Gram-positive cocci can often be demonstrated by microscopy
- The organisms cultured readily on blood agar and most other media within 24 h or less.
- Catalase positive
- The tube or slide coagulase test is performed to distinguish *Staph. aureus* from coagulase-negative species and
- antimicrobial susceptibility testing with cefoxitin to confirm MRSA using standard methods.
- Typing: phage and genetic typing for MSSA and MRSA respectively.
Staphylococcus aureus - treatment

- MSSA: Follow local antibiotic guide lines and lab. Results
- MRSA and CNS strains:
  - resistant to all β-lactam agents, and often to other agents such as the aminoglycosides and fluoroquinolones.
- Choice:
  - Glycopeptides (vancomycin or teicoplanin)
  - Linezolids