UNIWERSYTET MEDYCZNY
IM. PIASTÓW ŚLĄSKICH WE WROCŁAWIU

Przedmiot: Mikrobiologia (1)

Temat: Gram-positive cocci

Academic Year 2023/2024

Wydział: Lekarski
Kierunek: Lekarski
Poziom studiów (jedn. mgr.)
Forma studiów (stacjonarne, niestacjonarne)
Rok studiów: II

Tytuł naukowy/zawodowy: prof. dr hab.
Imię, nazwisko osoby prowadzącej zajęcia: Beata Sobieszczańska
Stanowisko osoby prowadzącej zajęcia: profesor
Uniwersytet Medyczny im. Piastów Śląskich we Wrocławiu

INFECTIONS

Localized

Pharyngitis, folliculitis, pneumonia

Disseminated

Blood and lymph infections, Abscess with spread to the blood, pneumonia with bacteremia, meningitis

Endogenous infections:
Reservoir: human (body's microflora, part of the microbiota)
Source: human
They do not spread from person to person **= non-contagious**

Non-communicable vs. non-infectious diseases

Bacteria, viruses, fungi, parasites – infectious agents (infectious diseases): contagious or non-contagious
Non-communicable diseases are non-contagious - caused by non-infectious factors, e.g. diabetes, cardiovascular diseases

Family: Micrococcaceae

Względnie beztlenowe

Genus: Micrococcus

Genus: Staphylococcus

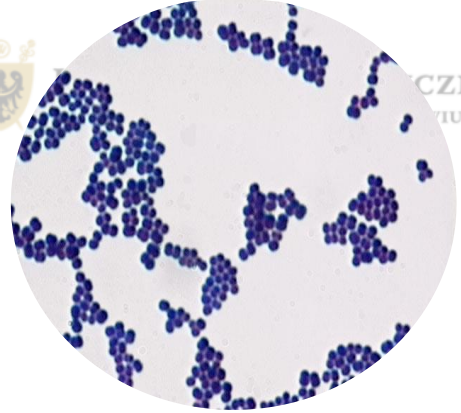
Species: S. aureus

Species: S. epidermidis

Species: S. saprophiticus

Species/strains

Undemanding



Family: Streptococcaceae

Genus: Streptococcus

Species: S. pyogenes

Species: S. agalactiae

Species: S. pneumoniae

Species: S. orale/viridans

Species/strains

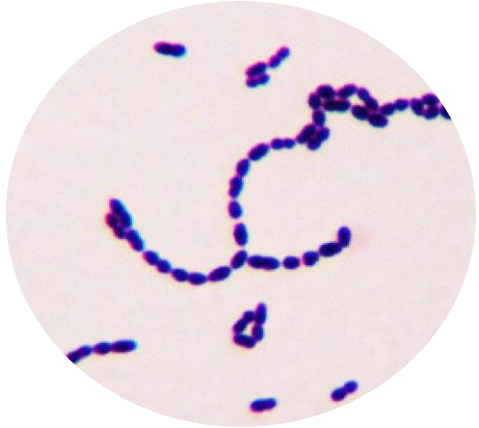
Fastidious

Genus: Enterococcus

Species: E. faecalis

Species: S. faecium

Species/strains



Family: Peptostreptococcaceae

Genus: Peptostreptococcus

Genus: Staphylococcus

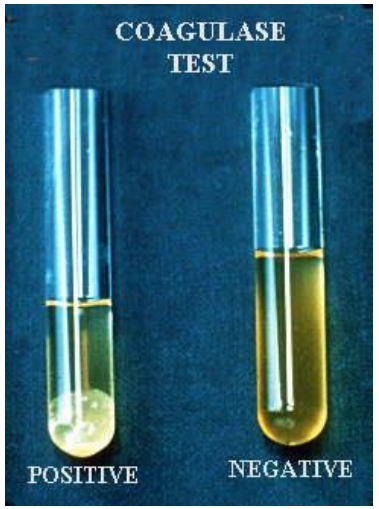
Coagulase-negative

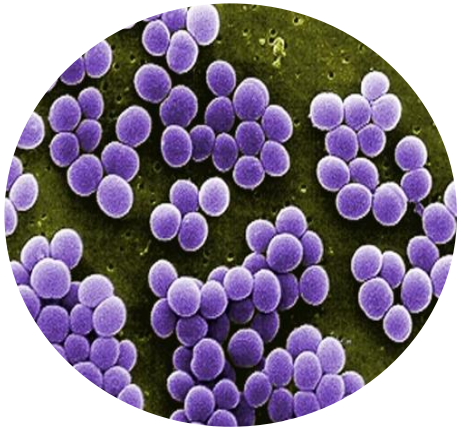
- S. epidermidis
- S. saprophiticus

Endogenous flora

Coagulase-positive

- S. aureus



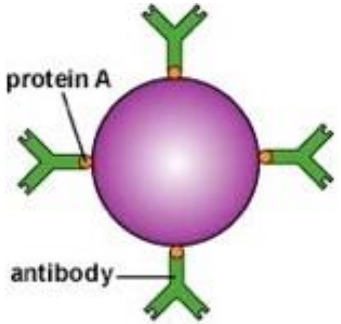


Virulence factors

S. aureus

Cell-bound

Peptidoglycan (LTA)
Coagulase
A protein
Glycocalyx



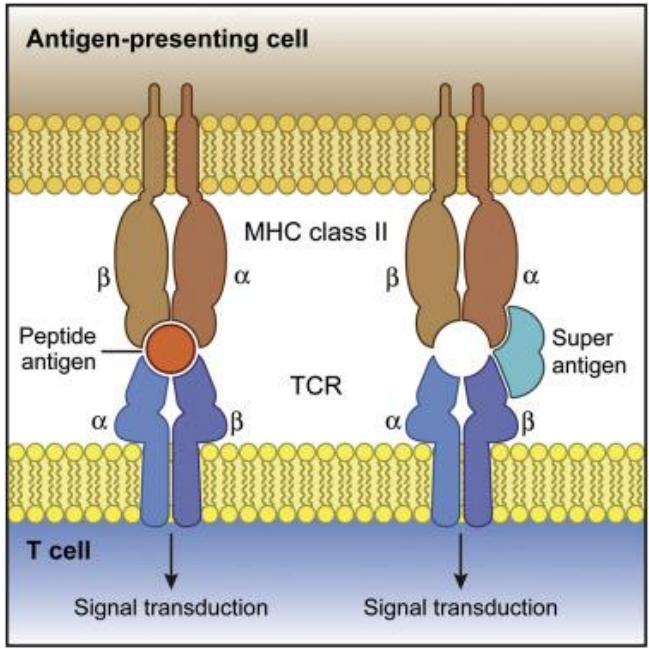
Weakened immune response

Extracellular

Catalase
Coagulase
Fibrinolysin
Hyaluronidase
Hemolysins
Toxins:
Panton-Valentine Leukocidin (PVL)
Epidermolytic toxins (exfoliating toxins)
Enterotoxins
TSST-1 toxin

SUPERANTIGENS

Excessive activation of lymphocytes, secretion of cytokines "cytokine storm" (shock)

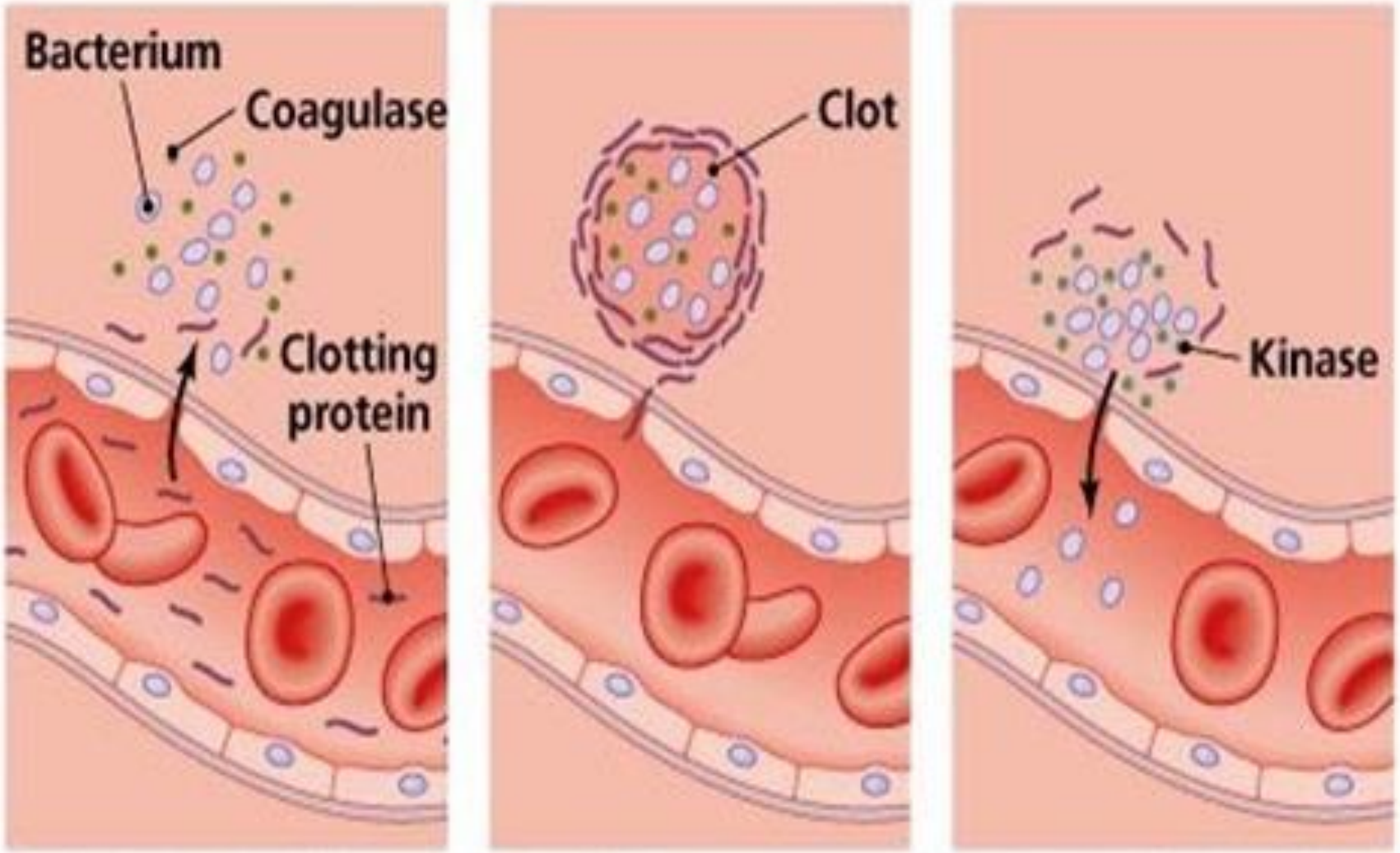


Coagulase - role in the formation of abscesses - a characteristic feature of Staphylococcus aureus

Reservoir: humans

Source: diseased humans, carriers

Transmission: **direct and indirect contact, food-borne, air-borne**



Bacteria produce coagulase

Clot forms

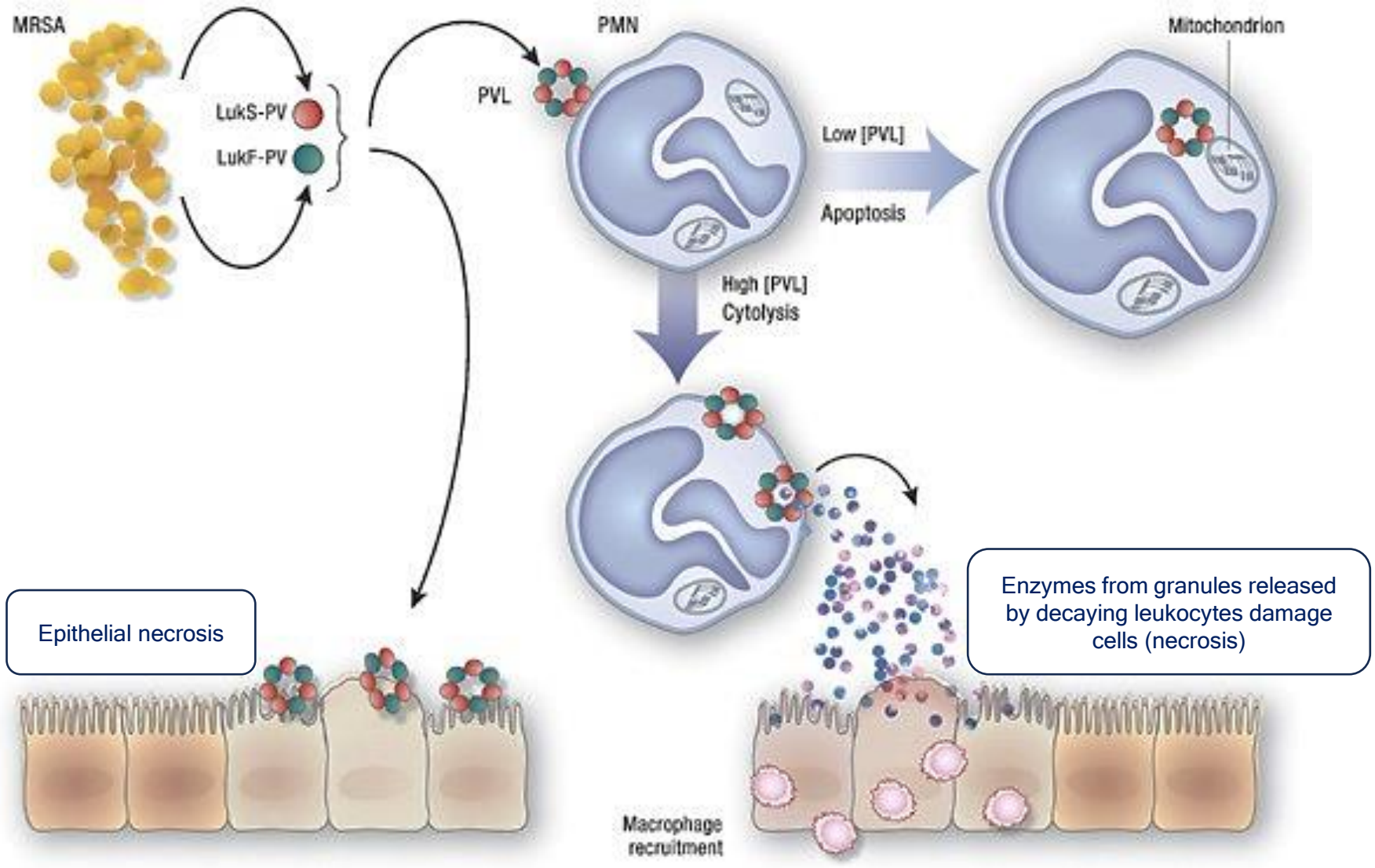
Bacteria later produce kinase, dissolving clot and releasing bacteria

Leukocidin (leukotoxin) Panton-Valentin (PVL) – role in tissue necrosis

Secreted PVL (in the form of subunits) forms a heptamer that is incorporated into leukocyte membranes

Produced by S. aureus strains causing community-acquired infections
Often due to CA-MRSA (community-acquired MRSA),
i.e., S. aureus strains resistant to β-lactam antibiotics

Consequences: tissue necrosis
Role in infections: necrotizing pneumonia, sepsis, necrotizing fasciitiss



S. aureus

Localized purulent infections

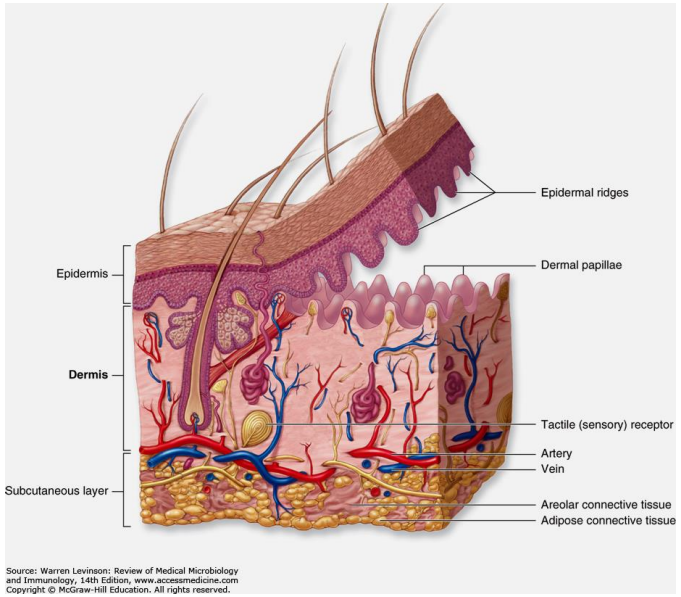
Folliculitis
Impetigo
Abscesses, furuncles, carbuncles, cellulitis
Wound infections; necrotizing fasciitis
Osteomyelitis
Pneumonia (also necrotizing pneumonia)
Lung abscesses
Otitis media, sinusitis
Urinary tract infections

Superantigens-associated diseases

Food poisoning – enterotoxins
Scaled skin syndrome, (Reiter-Lyell disease), **bullous impetigo** - exfoliating toxins
Staphylococcal toxic shock syndrome – TSST-1

Disseminated infections

Blood infections (bacteremia, sepsis, septic shock)
Endocarditis
Meningitis
Brain abscesses



Genus: Staphylococcus

Coagulase-negative

S. epidermidis

S. saprophiticus

Endogenous flora

Potential pathogens

S. saprophiticus

Urinary tract infections (UTI)
in young women (often recurrent)
Treatment: nitrofurantoin, TMP-SMX amoxicillin/clavulanate, cefaclor, fosfomycin, fluoroquinolones (ofloxacin, ciprofloxacin, levofloxacin)

S. epidermidis

Catheter-related bacteremia
(30% of nosocomial bacteremia)
(can induce shock, meningitis, endocarditis, pneumonia, osteomyelitis, phlebitis)

Postoperative endocarditis
Osteitis after implantation of prostheses
Bacteremia after infection of burn wounds
Treatment as for S. aureus infections

Gronkowce

Treatment

Groups of antibiotics:

Strains susceptible to β-lactams (MSSA): **cloxacillin** (drug of choice), amoxicillin/clavulanic acid, cephalosporins (I – IV), macrolides, tetracyclines, clindamycin, TMP-SMX

Strains resistant to β-lactams (MRSA): glycopeptides, lincosamides, daptomycin, ceftaroline, rifampicin (always in combination), tigecycline, tetracyclines, clindamycin, TMP-SMX, fluoroquinolones, aminoglycosides

Localized infections

Infections of the skin and soft tissues, bones, joints, and lungs (depending on the severity of the infection - outpatient vs. hospitalized, depending on whether the strain is sensitive or resistant to β-lactams)

risk of dissemination into the blood

Disinfection, ointments with mupirocin, fusidic acid, retapamulin), TMP-SMX, clindamycin - **local or oral treatment**

Oral or parenteral antibiotics: isoxazolyl penicillins (nafcillin, cloxacillin), amoxicillin/clavulanic acid, cephalosporins, clindamycin, TMP-SMX, tetracyclines, macrolides, fluoroquinolones

Localized infections disseminated to blood

Parenteral: isoxazolyl penicillins (cloxacillin), cephalosporins, glycopeptides, daptomycin, Linezolid, ceftaroline, rifampicin, tigecycline, clindamycin, TMP-SMX, aminoglycosides, fluoroquinolones

Streptococci

Serologic groups: A, B, C, D, E, F, G ....

Hemolysis alpha	Hemolysis beta	Hemolysis gamma
S. orale (viridans) S. pneumoniae	S. pyogenes A (GAS) S. agalactiae B (GBS)	Enterococcus

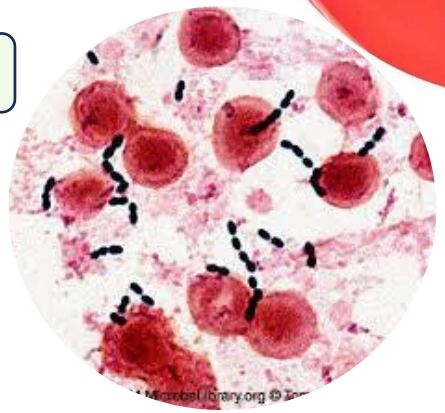
S. viridans group (many species colonizing the oral cavity: S. mitis, S. mutans, S. salivarius, S. sanguis, etc.)

Physiological microflora of the oral cavity
Endogenous infections: caries, mixed infections in the oral cavity (abscesses), subacute endocarditis

Enterococcus (E. faecalis, E. faecium)

Physiological intestinal microflora
Endogenous infections: urinary tract infection, subacute endocarditis, catheter-related bacteremia; less frequently: intra-abdominal infections, post-operative wound infections
An important "nosocomial pathogen„
Resistant to many antibiotics

Treatment of E. faecalis: penicillins (ampicillin, piperacillin), glycopeptides, Linezolid, tigecycline, fosfomycin, chloramphenicol.
E. faecium: glycopeptides, daptomycin, tigecycline, Linezolid, rifampicin, fosfomycin



Streptococcus bovis (grupa D)

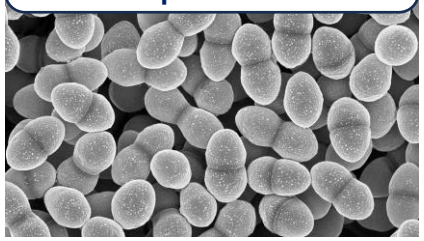
Physiological microflora of the large intestine
Endogenous infections: colon cancer, bacteremia, biliary tract disease, fulminant sepsis, and meningitis in newborns

Antibiotic therapy
cephalosporins

Enterococcus
Intrinsically resistant to cephalosporins

Intestinal dysbiosis
Except for Enterococcus

Enterococcal expansion



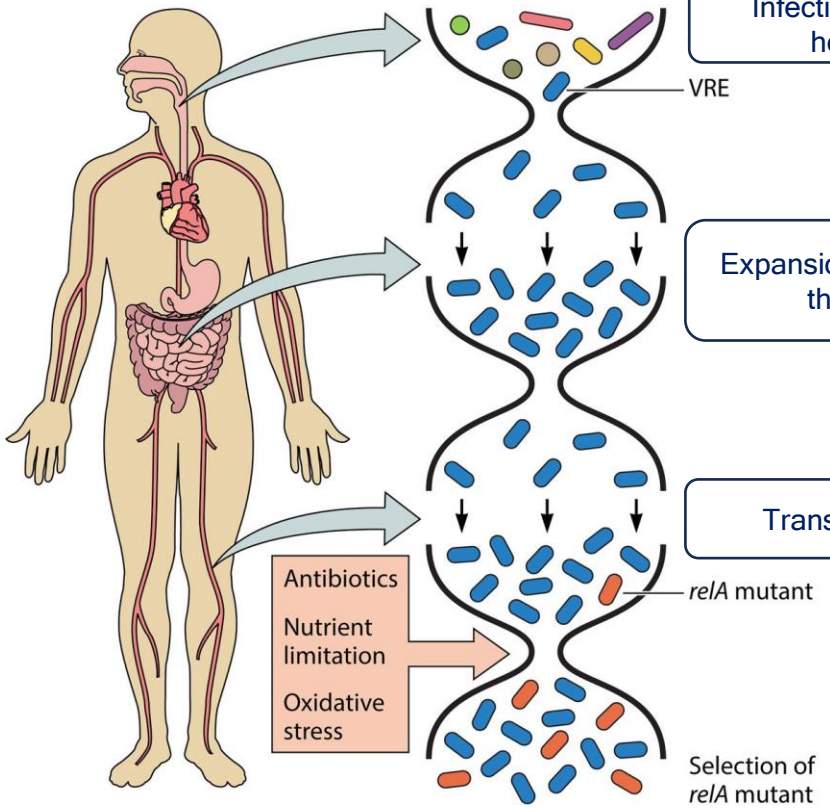
Translocation from the intestines to the blood

Hospitalized patient

Endogenous infections

Elderly people with underlying diseases, after procedures in the urogenital system and intestine

Exogenous infections
Hospital environment
Resistnt strains



Infection with a strain from the hospital environment

Expansion of the acquired strain in the patient's intestine

Translocation into the blood

Mutants (relA) in biofilm resistant to lethal doses of daptomycin, linezolid
= strain selection

Streptococcus pyogenes (GAS)

Reservoir: humans
Source: diseased humans, carriers
Transmission: direct contact, air-borne route, rarely: food-borne (milk)
Carriage: pharynx (rectum)

Czynniki wirulencji

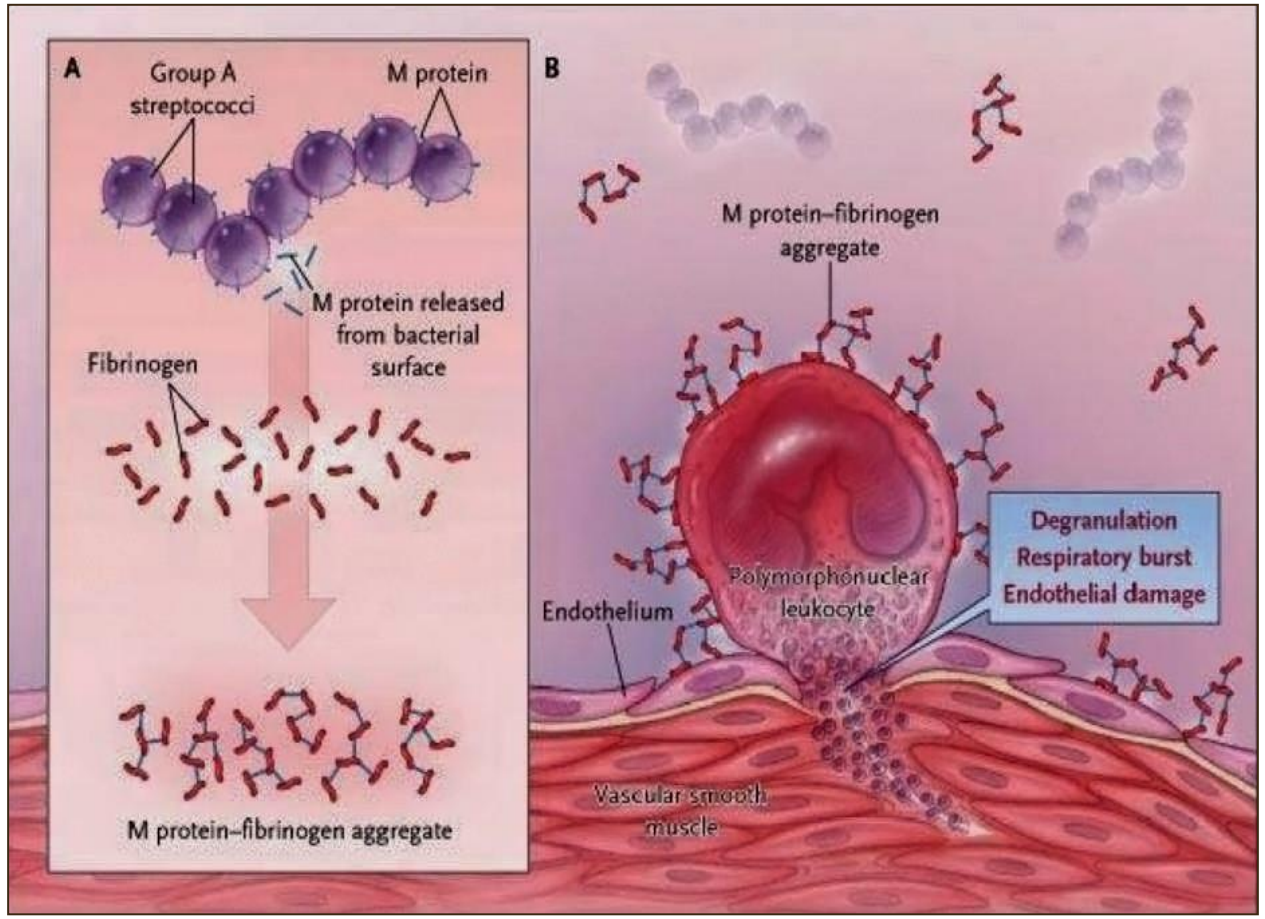
Cell-bound

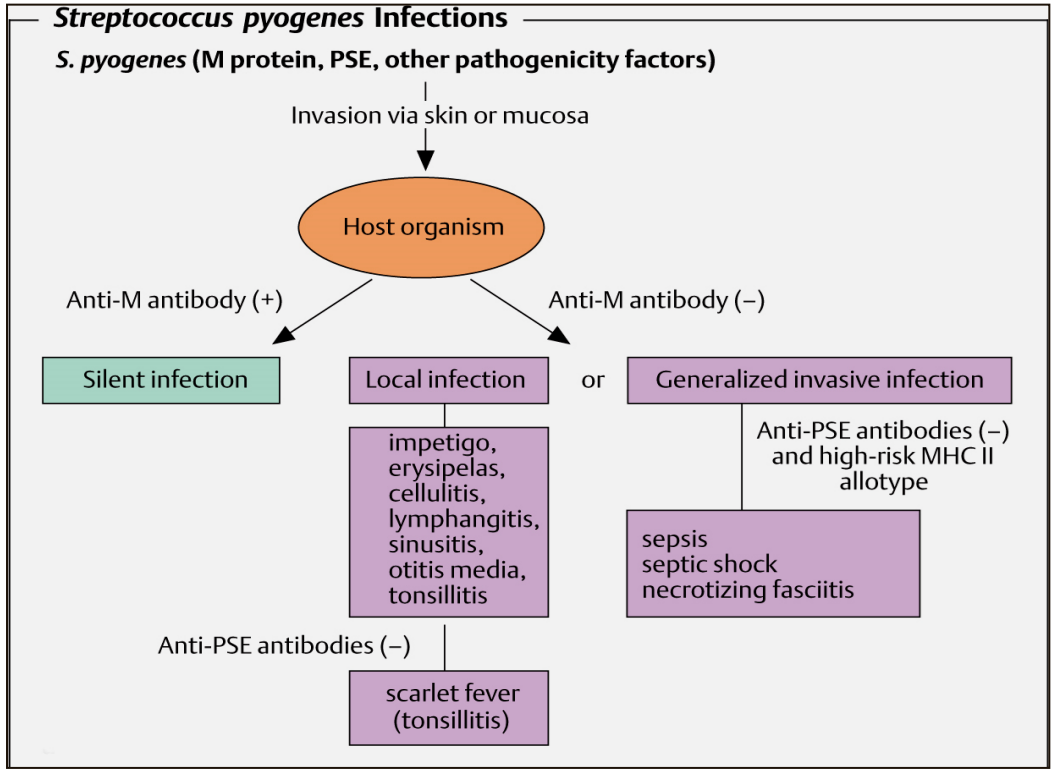
Peptidoglycan (LTA)
M protein
Capsule (hyaluronic)

Extracellular

Hyaluronidase
Streptolysin O
Streptokinase
Pyrogenic exotoxin (SPE) superantigen

Streptococcal toxic shock syndrome
Scarlet fever (scarlet fever)
Necrotizing fasciitis





Primary streptococcal infections

Tonsillitis (strep pharyngitis)
The head: otitis media, sinusitis, peritonsillar abscesses
Skin and soft tissue infections: cellulitis, purulent skin infections, impetigo, erysipelas
Respiratory system: pneumonia
Bones, joints: purulent infections
Systemic: blood infections (bacteremia), puerperal fever, post-traumatic meningitis, endocarditis

Pharyngitis

Infections involving erythrogenic toxin:
1. **Necrotizing fasciitis**
2. **Scarlet fever**
3. **Streptococcal toxic shock syndrome**

Scarlet fever

Necrotizing fasciitis

Skin infection

Erysipelas

Complications after streptococcal infections immunological

After streptococcal pharyngitis:
1) Rheumatic fever
2) Acute rheumatic heart disease
Pathomechanism: autoantibodies against M protein

After skin infections:
3) Glomerulonephritis
Pathomechanism: immune complexes

Rheumatic fever

Treatment:
Penicillin (benzyl or phenoxymethyl)
- drug of choice!
Clindamycin
Macrolides (except for azithromycin!)

Invasive infections - combined therapy:
penicillin + clindamycin
penicillin + linezolid

Clindamycin: inhibits the production of erythrogenic toxin, the synthesis of M protein

Reservoir: humans
Source: diseased humans, carriers
Transmission: **direct and indirect contact, air-borne route**

Streptococcus pneumoniae

Localized purulent infections:
Sinusitis
Otitis media
Pneumonia

Invasive infections (invasive serotypes - mortality 15-25%):
meningitis, brain abscesses, bacteremia, sepsis, endocarditis

Virulence factors

LTA
Capsule (serotypes)
Hyaluronidase
IgA protease
Pneumolysin

Treatment:
Penicillins + BLI, cephalosporins (II-IV gen.), carbapenems, glycopeptides, daptomycin, tigecycline, linezolid, fluoroquinolones, chloramphenicol, rifampicin, clindamycin, macrolides, tetracyclines, TMP-SMX

Specific prevention - protection against invasive infections
Conjugate vaccine for children (> 6 years of age) and adults (> 50 years of age) - capsular antigen with protein (13-valent)
Polysaccharide vaccine (23-valent) for children (over 2 years of age) and adults (>50 years of age)

Streptococcus agalactiae (GBS)

Vaginal colonization in 5-30% of healthy women

Neonatal infections (1%):
sepsis (early onset),
meningitis (late onset)
Neurological complications

Pregnant women: puerperal fever, endometritis, bacteremia, endocarditis, cellulitis, abscesses, toxic shock-like syndrome

Infections in the elderly: bacteremia, pneumonia, endocarditis, osteoarthritis, pressure wound infections, diabetic foot, prostate disease, UTI

Treatment:
Penicillins (penicillin G, ampicillin, amoxicillin)
Macrolides (erythromycin)
Clindamycin
Glycopeptides
Daptomycin

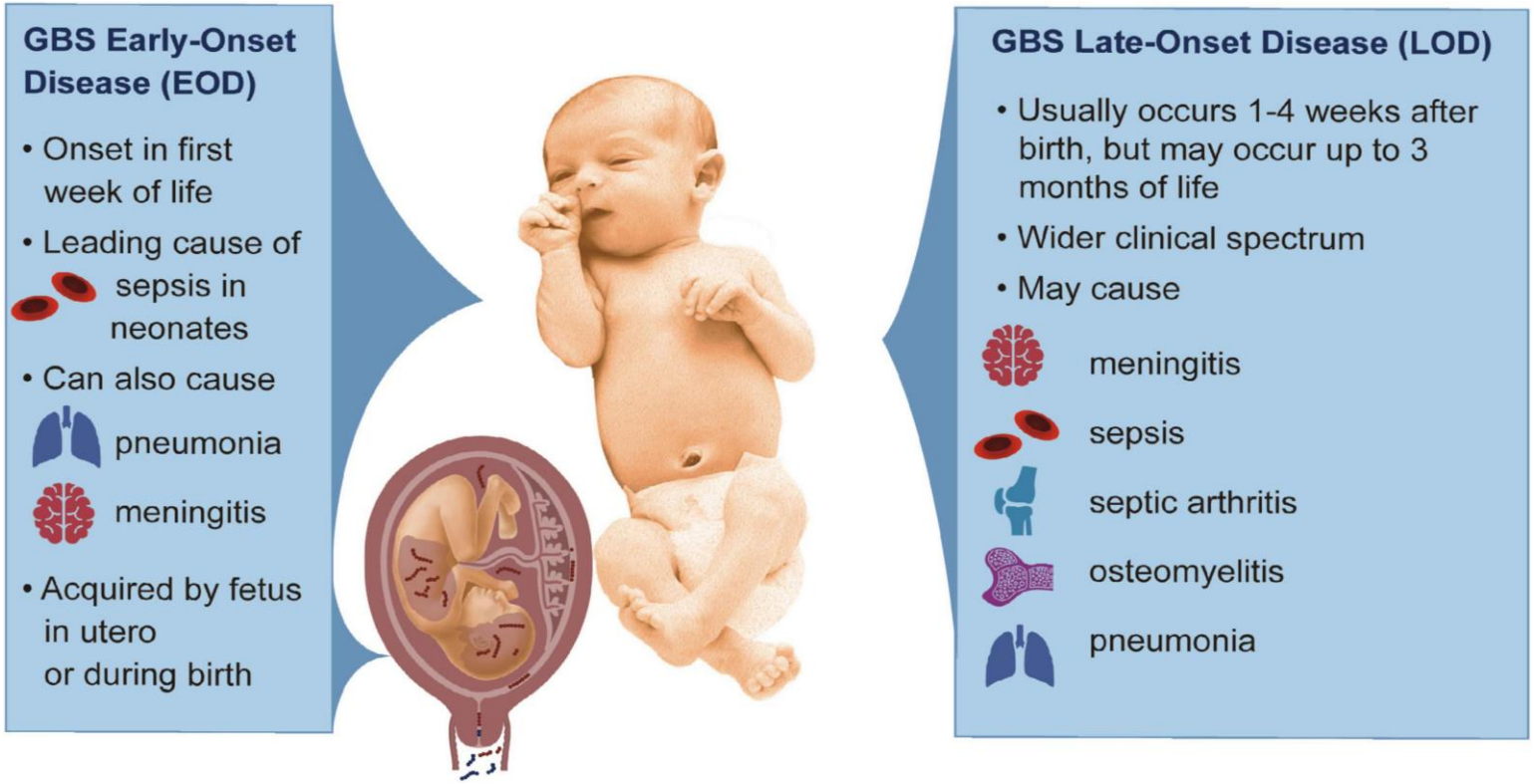
Virulence factors

Capsule
Hemolysin
Pyrogenic toxin
(uncharacterized)

Perinatal prevention

Vaginal swab in pregnant women 36/37 - 38th week of pregnancy

Positive results - parenteral penicillin or ampicillin 4 h before labor or if there is no data on the test, no test, GBS infection in a previous pregnancy, bladder infections, or fever during pregnancy



Reservoir: humans (physiological flora of the intestines, urogenital system)
Source: humans (endogenous infections)

UNIWERSYTET MEDYCZNY
IM. PIASTÓW ŚLĄSKICH WE WROCŁAWIU

Thank you for your attention

In order to get information on the presented content,
please send messages to the e-mail address:

beata.sobieszczanska@umw.edu.pl