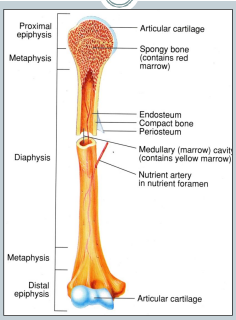
Osteomyelitis and septic arthritis

MAREK ŠTEFAN
ID UNIT, MILITARY UNIVERSITY HOSPITAL PRAGUE

Osteomyelitida

- **Bone infection**
  - Inflammatory destruction of the bone with resultant necrosis
- **Bone anatomy**
  - Compact bone (corticalis)
  - Cancellous bone (trabecular bone)
  - Medullary cavity
- **Acute vs. chronic**
- **Aetiology**
  - Bacteria, mycobacteria, fungi
- **Route of spread**
  - Hematogenous, per continuitatem, inoculation
- **Cierny-Mader classification**

Bone anatomy



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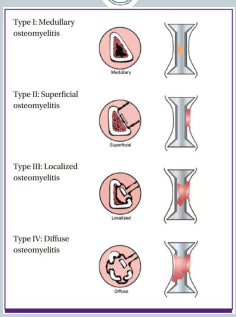
Cierny- Mader (1)



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Cierny- Mader (2)

Anatomical type
Type I: Medullary
Type II: Superficial
Type III: Localized
Type IV: Diffused
Physiological condition
A: Healthy
B: Systemically compromised, Bs
Locally compromised, Bl
Systemically and locally compromised, Bls
C: The majority of damage is due to treatment rather than disease
Factors influencing immunity, metabolism, and local blood supply
Systemic factors (Bs): Malnutrition, chronic renal failure, liver failure, diabetes mellitus, chronic hypoxia, neonate/elderly, malignancy, immunosuppression or immune deficiency.
Local factors (Bl): Chronic lymphedema, venous stasis, major vessel compromise, arteritis, large scar formation, post-radiation fibrosis, small-vessel disease, neuropathy or smoking

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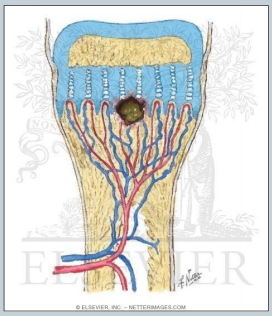
Pathogenesis (1)

- Normal bone is very **resistant to infection**
  - Large inoculum of bacteria or previously damaged bone needed
- **Capillary loops in metaphyses of the long bones (esp. children)**
  - **„hairpin" configuration**
  - Slow blood flow, no basal membrane
  - Bacteria lodge in metaphysis
- **Vertebrae (adults)**
  - **„corkscew" configuration**
- Bacteria survive in osteoblasts and in **biofilm**
- **Pathology**
  - **Microscopy: sign of inflammation, necrosis, osteopaenia**
  - **Macroscopy: sequestrum, subperiosteal abscess, involucrum, fistula**

Patogeneze (2)



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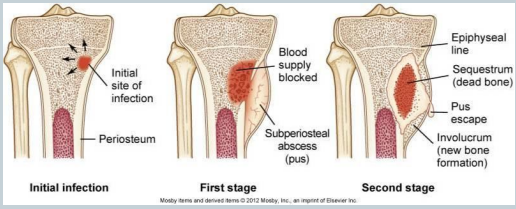
Patogeneze (3)



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Aetiology

- > 50 %
  - **Staphylococcus aureus**, coagulase-negative staphylococci
- > 25 %
  - Streptococci, enterococci
  - Gram negative rods (E. coli, Enterobacter, Proteus, Serratia, Pseudomonas)
  - Anaerobes
  - Mycobacterium tuberculosis
- < 5 %
  - Non-tuberculous mycobacteria
  - Tropheryma, Brucella, Salmonella, Actinomyces
  - Candida, Cryptococcus, aspergillus

Clinical presentation

- **Dolor, rubor, tumor, calor, functio laesa**
- Signs of sepsis
- **Sinus (fistula)**
- **Ulcus**
  - **„probe to bone“ test**
- **Labs**
  - White cell count might be normal
  - ESR and CRP usually elevated
  - Anaemia of chronic diseases

Imaging studies

- XR
  - Osteopaenia (late signs)
  - Soft tissue swelling
  - Periostal reaction, sclerosis, osteolysis, bone desctruction
- MRI
  - Bone marrow oedema
  - Modality of choice
- CT
  - If MRI contraindicated
- Nuclear medicine
  - Bone scan, Gallium scan, leucocyte scan

Microbiological tests

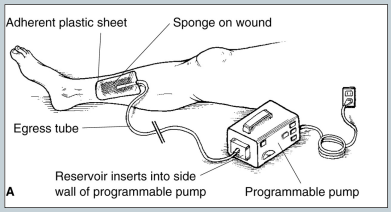
- **Bone biopsy**
  - Open vs. percutaneous
  - Histology, culture, TB, mycology
  - 16S RNA PCR
- **Swab (ulcer, sinus tract)**
  - Usually not useful: bacterial colonization
  - Deep tissue biopsy more helpful
- **Blood culture**

Therapy (1)

- **Surgery**
  - Debridement, drainage
  - Bone stabilization
  - „hardware“ removal
  - (Amputation)
- **Antimicrobial therapy**
  - 4-6 weeks of parenteral antibiotics
    - Inpatient treatment or OPAT (Outpatient Parenteral Antibiotic Therapy)
  - Some patients can be switched to oral antibiotics
    - Drug with good oral bioavailability
  - Sometimes longer duration of treatment needed

Terapie (2)

- Hyperbaric oxygenotherapy
- Negative pressure wound therapy
  - V.A.C. system (Vacuum-Assisted Closure)



OM and open fractures (1)

- Risk of OM 3-25 %
- Staphylococci, Gram negative rods, enterococci, fungi, non-tuberculous mycobacteria)
  - Skin flora, contamination with soil/water, healthcare associated infection
- In case of visibly contaminated open fracture
  - Debridement, stabilization, prophylactic antibiotics (continue 48-72 hours after the surgery)

OM and open fractures (2)

- Established osteomyelitis
  - Several months after the fracture
  - Nonunion, poor healing of soft tissues, sinus tract
- Imaging studies not very helpful
- Debridement
- Bone/tissue culture
- Specific antibiotic therapy (according to culture results)
- „Hardware“ removal if possible
- No hardware removal: antibiotics until the fracture has healed

OM in diabetes mellitus or PVD (1)

- Lower limbs, skin ulcer, continuous spread to bone
- Neuropathy, micro- and macroangiopathy
- Patient with diabetes: lifetimerisk of a skin ulcer is 25%
- In patients with a skin ulcer the risk of OM is 25%
- Complex care is essential
  - Diabetes, dyslipidaemia, other cardiovascular risk factors, podiatry
- „Probe-to-bone“ test
- Bone/deep tissue biopsy

OM in diabetes mellitus or PVD (2)

- Surgical and medical treatment
- Debridement, revascularization, amputation
- Polymicrobial infection!!!
- Specific therapy according to culture results
- Empiric treatment in severely ill patients
  - Must cover G+ , G- and anaerobes
  - In certain patient think of MDR bacteria (MRSA, Gram negative rods)
  - Individual approach (risk factors, previous inpatient hospital stay, MRSA colonization,...)
- Duration of antibacterial treatment
  - 1 week following amputation, 4-6 týdnů following debridement, months if debridement not possible

Acute hematogenous OM

- Long bones
  - **Children**, IVDU, elderly, patients with intravascular catheters
  - (vertebrae in adults, vertebrál OM= spondylodiscitis)
- Metaphysis, Cierny- Mader st. I, tibia, femur
- Complicatiom: septic arthritis
- Newborns: GBS, E. coli
- Children: Staphylococcus aureus, Streptococcus pneumoniae
- IVDU, catheters: Candida, Pseudomonas aeruginosa
- Antimicrobial treatment usually sufficient
- Surgery rarely necessary

Septic arthritis

- Acute purulent joint infection
- Medical emergency
- Hematogennous spread, inoculation, continuous spread
- Risk factors: any joint pathlogy, imunosupression, IVDU, recent joint surgery
- S. aureus (60 %), streptococci (cca 22 %), E. coli, PSAE, Salmonella, H. influenzae, Neisseria meningitidis, N. gonorrhoeae, Borrelia burgdorferi, Listeria

Aetiology in certain clinical settings

Clinical setting	Bacteria
Rheumatoid arthritis	S. aureus
IVDU	S. aureus, PSAE
Diabetes mellitus,tumours	S. aureus, Str. agalactiae
Immunocompromised patients	S. aureus, streptococci, Gram negative rods, Listeria monocytogenes
Children	Gram negative rods, Kingella kingae
Animal bites	Pasteurella multocida, Capnocytophaga, anaerobes
Human bites	Eikenella corrodens, anaerobes, viridans streptococci
Travellers	Brucella, Burkholderia, Str. suis
Sexual transmitted disesases	Gonokok

Pathogenesis

- Adhesion of bacteria to extracellular matrix proteins
- Inflammatory cells (+ bacterial products)
  - Cartilage destruction, osteolysis
- Oedema, raised intra-articular pressure
- Ischaemia, cartilage and synovial necrosis
- Joint space narrowing
- Extra-articular spread (soft tissues, bone)
- Rarely sinus tract formation

Clinical presentation

- **Mono-articular involvement (80-90%)**
- Rubor, dolor, calor, tumor, functio laesa
- **Knee (50%)**
- (hip, shoulder, wrist, ankle)
- Childre: hip
- Small hand joints: injury, bites
- Foot joints: diabetes, ...
- Sacro-clavicular joint: IVDU (PSAE)
- Polyarticular involvement: RA, immunosupression, S. aureus
- Systemic upset not infrequently (but sometimes absent)

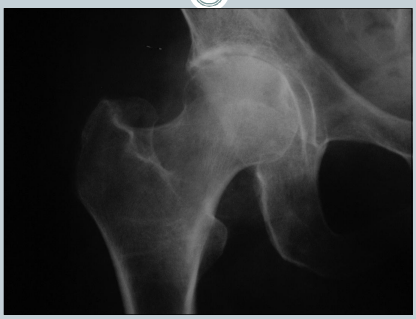
Labs

- **Raised inflammatory markers**
- **Arthrocentesis**
  - Purulent fluid
  - White cell count > 50 000/mm^3
  - (Low glukóza, raised lactate and protein)
    - Low sensitivity and specifity
  - Gram stain
  - Culture
  - Polarized microscopy: crystal arthritis
- Blood culture

Imaging

- **XR**
  - Soft tissue swelling, osteoporosis, joint space narrowing, erosions, subchondral bone destruction
- **Ultrasound**
- **CT**
- **MRI**
- **Nuclear medicine**

RTG (1)



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RTG (2)

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Differential diagnosis

- Gonococcal arthritis
- Lyme artritis
- Viral arthritis
- Gout, pseudogout
- Rheumatological diseases
  - RA, SLE, spondylarthropaties
- Reactive arthritis
- Joint bleeding
- Decompensated osteoarthritis

Therapy

- Drainage (puncture, arthroscopy, open), irrigation
- Antibacterials
- 4 weeks IV
  - Some patients can be switched to oral antibacterials
  - Complete drainage of pus is crucial

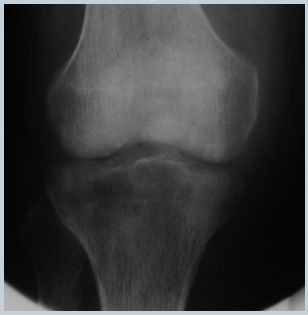
Disseminated gonococcal infections (DGI)

- 2 types
  - Septic arthritis
  - Tenosynovitis, dermatis (pustules), polyarthralgia
- Young women
- DGI in 3 % of all patient with gonorrhoea
- Positive joint fluid culture in 50% (type 1) and in 20-30% (type 2)
- Blood culture positive in type 2 (rarely in type 1)
- PCR: cervical swab, urethral swab, joint fluid, urine
- Ceftriaxon i.v. 1 week

Viral arthritis

Most common viruses causing arthritis/arthropathy
Parvovirus B19
Rubella
HBV
Chikungunya

Thanks. Questions?



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