# 26 Pathophysiology of the MSK System Cheat Sheet by bee.f (bee.f) via cheatography.com/180201/cs/37968/

#### Introduction

#### What is pathologic synovial disease?

- Inflammatory
- Infectious
- Degenerative
- Traumatic
- Haemorrhogic
- Neoplastic
- => Leading to irreversible joint destruction

What are arthritides? Inflammation of joints due to infectious, metabolic, or constitutional causes

#### Synovial joint



#### Pathophysiology

 $\Box$  Physiology/ function in abnormal states  $\rightarrow$  specifically the functional changes that *accompany* a particular syndrome or disease

□ It's about disordered function, i.e. there's function but it's abnormal

□ When you wish to find/define the pathophysiology of a condition it's helpful to ask: What's not functioning well?

#### Mechanisms

Determined by the pathophysiology, i.e. disordered function

 $\hfill\square$  They're the **defects** in **systems**, **organs**, **cellular** & **molecules** that constitute the *triggers* of specific diseases

□ They **originate** & **explain** the clinical signs & symptoms

□ When you wish to find/define the mechanism of disease, it's helpful to ask: How is the specific *pathophysiology* leading to occurrence of these specific *signs & symptoms*?



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#### Gout

#### Signs & symptoms:

- Acute form: painful, warm & swollen joint
- Chronic tophaceous form: top in tendons, bursae & cartilages

#### Pathophysiology:

- Hyperuricaemia & a ↓ in urinary excretion of uric acid → both lead to *deposition* & *crystallisation* of uric acid in joints → followed by an inflammatory response with *release of enzymes* in joint space

#### Mechanism:

- Deposition & crystallisation occurs in previously traumatised or "cooler" joints. *Neutrophil disruption* leads to enzyme release & inflammatory cascade

## Does the pathophysiology explain/relate to the specific mechanisms of disease, how?

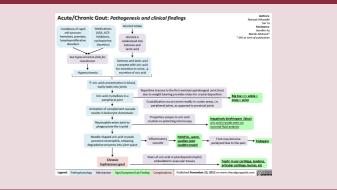
- Yes
- Hyperuricaemia leads to deposition of uric acid
- Previous trauma & location favours crystallisation
- Crystal deposition triggers immune response
- Damage to neutrophils produces the release of enzymes which irritate joints & cause an inflammation, i.e. arthritis

Do the mechanism explain the clinical signs & symptoms, how? - Yes

- Inflammation causes painful, warm, swollen joints in the acute form

- In chronic tophaceous form: long term deposition of uric acid crystals in avascular tissues cause tophi in tendons, bursae & cartilages

#### Gout



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#### **Rheumatoid Arthritis**

#### Signs & symptoms:

- Poly-articular joint pain, swelling & stiffness
- Most commonly affecting the small joints (wrists, metacarpalphalangeals)
- Joint involvement is bilaterally symmetrical
- Extra-articular manifestations are often seen

#### Pathophysiology:

- Autoimmune activation & proliferation of T-cells  $\rightarrow$  leading to production of *inflammatory cytokines & B-cells* differentiation into plasma cells  $\rightarrow$  there's an *inflammatory response* which is systemic & *damage of cartilage tissue* in joints

#### Mechanism:

- The joint damage recruits more immune cells into joint spaces
- Immune cells infiltrate synovial membrane causing it to *proliferate & forming* new blood vessels
- Swollen & blood rich synovial (pannus) *invades & enzymatically destroys* joint tissue
- Severe RA will affect the entire body

# Does the pathophysiology explain/relate to the specific mechanisms of disease, how?

- Yes

- The autoimmune activation of T- & B- cells with consequent inflammation & cartilage damage stimulate nerve endings in subchondraln bone & synovial membrane

- Inflammation of synovial leads to its enlargement with formation of palpable lumps in the affected joints

- Neovascularisation & synovial enlargement cause physical

narrowing of joint space & a decrease joint mobility

- Neovascularisation & synovial enlargement erode cartilage & subchondral bone which may cause joint mal-alignment, subluxation or collapse

#### Rheumatoid Arthritis (cont)

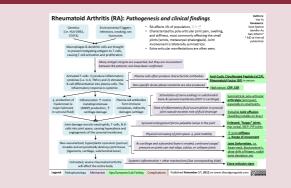
Does the mechanism explain the clinical signs & symptoms, how?

- Stimulation of nerve endings in subchondraln bone & synovial membrane, causes joint pain
- Inflammation of synovial leads to its enlargement with formation of palpable lumps in the affected joints
- Physical narrowing of joint space &  $\downarrow$  in joint mobility causes joint stiffness & a  $\downarrow$  in the range of movement

 Cartilage & subchondraln bone erosion causes joint mal-alignment, subluxation or collapse, explaining the various types of joint deformities

- The systemic inflammation explains the various extra-articular signs of the disease

#### Rheumatoid Arthritis



#### Ankylosing Spondylitis

#### Signs & symptoms:

- Pain in Lx & gluteal regions
- ↓ in Lx spine flexion
- ↓ in Lx lordosis
- ↑ in Tx kyphosis
- Asymmetric arthritis & enthesitis

#### Pathophysiology & mechanism:

- *Autoimmunity* causes *inflammation* of axial joints, peripheral joints & entheses



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#### Ankylosing Spondylitis (cont)

Does the pathophysiology explain/relate to the specific mechanisms of disease, how?

- Yes

- Axial joint arthritis (sacroiliac & vertebral column) causes *release* of *inflammatory substances* that stimulate *nociceptors* 

- Inflammation leads to osteoclast activation & erosion of bone, which in turn causes osteoblast activation with new bone formation

- Leads to an *t* in spinal rigidity

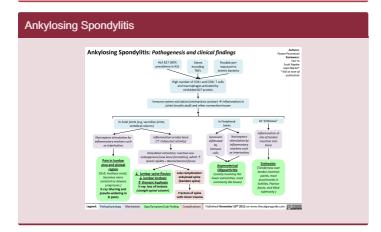
- In *peripheral joints*, the arthritis causes *release of inflammatory substances* that stimulate *nociceptors* 

- There's *infiltration* of the synovium by *inflammatory cells* & *inflammation of the entheses* (places of tendon insertions in bone)

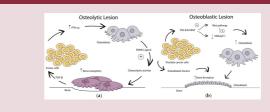
- Do the mechanism explain the clinical signs & symptoms, how?
- Stimulation of nociceptors causes pain in axial & peripheral joints
- *t* in spinal rigidity causes a ↓ in Lx spine flexion, ↓ in Lx lordosis &
   *t* in Tx kyphosis
- Late complications include spinal ankylosis & fractures

- In peripheral joints, *stimulation of nociceptors causes* pain of lower limb joints & knees

- Enthesitis *causes* pain in achilles tendon, plantar fascia & tibial tuberosity\*



#### Bone Remodelling Cycle



#### Osteoarthritis

#### Signs & symptoms:

- Joint pain with loading & motion
- Palpable bone hypertrophy
- ↓ in ROM
- Crepitus (popping/crackling sound)
- Joint effusion
- Pathophysiology & mechanism:
- Joint cartilage destruction with inflammation

Does the pathophysiology explain/relate to the specific mechanisms of disease, how?

#### - Yes

- Cartilage **inflammation** in weight bearing joints **(knee,hip)** & smaller joints stimulates *nociceptors* 

- Joint cartilage loss causes wear of exposed subchondral bone,

which induces defective new bone formation leading to the

appearance of *osteophytes* & *subchondral bone sclerosis* leading to *changes* in joint architecture

- During movement osteophytes & subchondral sclerosis are firmly pressed against normal joint structures
- Cartilage loss brings joint bones into direct contact between
- themselves with *reduction* in *joint movement* & stimulation of *nocice-ptors*

- Joint inflammation leads to *chemical changes* within the joint causing a ↓ in *synovial fluid viscosity* & an ↑ in joint *fluid production* 

Do the mechanism explain the clinical signs & symptoms, how? - Yes

- Stimulation of joint *nociceptors* causes *joint pain* whether upon **loading** or during **motion** 

- Change in *joint architecture* consists of the appearance of *palpable* bone *hypertrophy*, i.e. **Bouchard's nodes** 

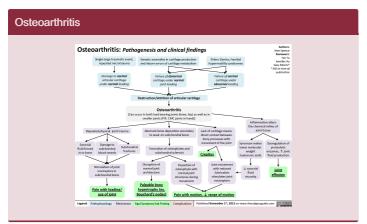
 Osteophytic & subchondral sclerosis impaction against normal joint structures causes pain & \$\dot\$ point ROM

- Joint bones into direct contact causes friction & crepitus, pain & further ↓ in ROM

- ↓ in synovial fluid viscosity & an ↑ in joint production produce joint effusions

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#### Polymyalgia Rheumatica

- Signs & symptoms:
- Morning stiffness
- Aching of pectoral & pelvic girdle muscle structures
- Malaise
- Weight loss

#### Pathophysiology & mechanism:

- Aging combined with systemic (auto) immunologic/inflammatory process targeting structures in the walls of arteries with activation of macrophages

## Does the pathophysiology explain/relate to the specific mechanisms of disease, how?

- More challenging to connect pathophysiology & mechanism

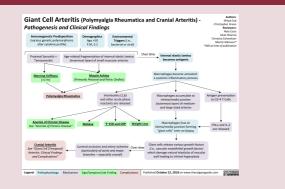
The *inflammation of arteries* may lead to their obstruction potentially causing *hypoxia, ischemia & necrosis* of affected tissues
This include muscles in the shoulder girdle & pelvic girdle

#### Do the mechanism explain the clinical signs & symptoms, how?

- Yes but challenging

 It's plausible that the arteritis & consequent hypoxia & ischemia of affected muscles together with the systemic inflammation *lead to* stiffness, aching, malaise & weight loss\*

#### Polymyalgia Rheumatica



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