

1. Introduction to the Rheumatic Diseases and Joint Physiology...

Introduction to the Rheumatic diseases and Joint physiology

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2. Welcome to musculoskeletal pathophysiology!

Welcome to musculoskeletal pathophysiology!

- Two major themes
 - Disorders of the musculoskeletal system
 - Autoimmune diseases: immunology, pathophysiology and clinical manifestations

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3. What is Rheumatology?

What is Rheumatology?

1. **Structural disorders** of the musculoskeletal system not due to direct trauma
 - Anatomy:
 - Joints – e.g.: osteoarthritis
 - Periarticular structures – tendons, bursas, ligaments
 - Etiology - degenerative or related to repeated use
2. **Immune system disorders** leading to autoimmune disease
 - An autoimmune disease is considered "rheumatologic" when involvement is either
 1. predominantly or exclusively of the joints
 2. of *more than a single organ system*
 - Lupus – rheumatologic
 - primary autoimmune hemolytic anemia – not rheumatologic

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4. What is Rheumatology?

What is Rheumatology?

3) Chronic Pain disorders – a subset of these are characterized by musculoskeletal pain though there is no pathology on pathologic examination:

eg: fibromyalgia – a syndrome of chronic pain and fatigue

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5. Course Lectures and Topics

Course Lectures and Topics

- Chronic Arthritis – Rheumatoid arthritis
- Chronic Arthritis – Spondyloarthropathy and Lyme Arthritis
- Osteoarthritis
- Nonarticular Rheumatism
- Pediatric Rheumatic Diseases
- Crystal Arthritis

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6. Course Lectures and Topics

Course Lectures and Topics

- Connective Tissue Diseases
 - Systemic Lupus Erythematosus
 - Scleroderma
- Vasculitis

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7. Key Concepts in Musculoskeletal Pathophysiology Course

Key Concepts in Musculoskeletal Pathophysiology Course

- What is the primary anatomic structure targeted by the disease process?
 - RA, Juvenile arthritis, Lyme arthritis - Synovial tissue
 - Spondyloarthropathies - Entheses (tendon or ligament insertion into bone)
 - Osteoarthritis - Cartilage
 - Lupus – multiple sites of inflammation
 - Scleroderma – **vascular** system, **fibrosis** of skin and other organs, **inflammation** (autoimmunity) in multiple tissues
 - Vasculitis – blood vessel walls

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8. Key Concepts

Key Concepts

- Genetic Influences
- Mechanism of Immune system dysfunction
- Immune system-environmental interaction
- Clinical applications

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9. Classification of Joints

Classification of Joints

- Synarthrodial joints
 - Juncture of the cranial plates
- Amphiarthrodial (fibrocartilagenous) joints
 - Costosternal joints
- Diarthrodial joints
 - Nearly all familiar moveable joints

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10. Articular cartilage

Articular cartilage

Composed of

- Chondrocytes
- Extracellular Matrix
 - Type II collagen meshwork with hydrated proteoglycans
 - Small amount of type IX and XI collagen

Articular cartilage is

- avascular
- aneural

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11.

Synovium

Synovium

- Lines diarthrodial joints (all parts except articular cartilage), some tendons, bursae
- **Composition**
 - **Matrix layer**
 - Thin, loosely constructed and varied by site
 - Features numerous microfibrils and proteoglycans
 - Hyaluronan a major component and filter of protein
 - **Synovial cells – simplified:**
 - Type A (macrophage-like)
 - Type B (fibroblast-like)

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12.

Joint capsule

Joint capsule

- Mainly type I collagen
- Some thin fibrillar type III
- Innervated by mechanoreceptors and free nerve terminals

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13. Physiology – synovial transport

Physiology – synovial transport

- Pathway: synovial capillary → synovial interstitium → synovial fluid → hyaline cartilage
- Features include:
 - Capillaries are fenestrated (small solutes, water)
 - **Glucose** has transport system **into** joint
 - Proteins enter inversely proportional to size
 - Thus albumin > globulin in joint fluid (healthy joint)
 - Hyaluronan plays major filter role for large proteins

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14. Synovial fluid

Synovial fluid

- Transudate of plasma
- Hyaluronan: a glycosaminoglycan that is a major matrix element of synovial fluid (made by type B synovial cells)
 - High viscosity
- Cellular content low
 - WBC < 200 cells/mm³

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15. Joint lubrication

Joint lubrication

Lubrication mechanisms

- Boundary lubrication –
 - lubrication at contact points of cartilage on cartilage
 - The glycoprotein **lubrican** the major element
- Hydrodynamic lubrication
 - Lubrication where film of fluid remains between cartilage layers

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16. The diseased joint

The diseased joint

Categorization:

- By initiating mechanism: mechanical vs. inflammatory
- By synovial fluid white cell count:
 - WBC<2,000 – noninflammatory
 - WBC>2,000 - inflammatory

The above two categorizations are usually but not always in accord. The latter is the more true pathogenic differentiator

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17. The diseased joint – gross pathology in acute inflamma...

The diseased joint – gross pathology in acute inflammation

- Must differentiate clinically from involvement of skin, veins and periarticular structures (tendons, ligaments, bursae)
- Joint takes position of **least intrasynovial pressure**

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18. Physiology of acute joint inflammation

Physiology of acute joint inflammation

- Vasodilatation
- Edema
- Neutrophilic infiltration
- Depolymerization of hyaluronic acid
 - Reactive oxygen species do this
 - Loss of viscosity in joint results
- Synovial fluid volume increases massively
- Synovial ischemia

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19. Transfer of solutes in the acutely inflamed joint

Transfer of solutes in the acutely inflamed joint

Contrasting effects on protein and glucose

- Protein – the normal structural and cellular blocks to diffusion are disrupted
- Glucose
 - Transport system from capillary into joint fails
 - Consumption is increased
 - Increase in anaerobic metabolism (glycolysis turned on)
 - Increased cell mass devouring glucose

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20. Clinical implications of acute synovitis

Clinical implications of acute synovitis

Joint damage varies:

Bacterial arthritis – rapid cartilage loss

Crystal arthritis – attacks are severe but self-limited so damage slow over time

Rheumatoid arthritis – Synovial tissue turns from Jimmy Buffet gentle tropical to “Katrina-like” destructive pannus and gradually erodes cartilage and bone

Lupus – Immune complex deposition in synovium does **not** elicit destructive synovitis

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21. Mechanism of joint damage in acute arthritis

Mechanism of joint damage in acute arthritis

- Reactive oxygen species released by neutrophils are damaging
 - Hyaluronan depolymerized
- Proteolytic enzymes are released
- Prostaglandins and leukotrienes

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22. Synovial fluid analysis

Synovial fluid analysis

- WBC cells – very useful in diagnosis
- Crystal content
 - Gout (monosodium urate)
 - Pseudogout (calcium pyrophosphate)
- Glucose
 - low in infection, rheumatoid arthritis
- Culture

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23. Synovial fluid analysis

Synovial fluid analysis

Arthritis Type	White Cell Count	Crystal analysis	Glucose	Culture/Gram Stain
Septic Arthritis	>100,000	none	low	positive/positive
Inflammatory Arthritis				
R.A.	>2,000	none	low	none
Gout	>2,000	negatively birefringent	normal	none
Pseudogout	>2,000	positively birefringent	normal	none
Lyme	>2,000	none	normal	none*
Lupus	<5,000	none	normal	none
Osteoarthritis	<2,000	none	normal	none

*routine bacteriologic techniques cannot easily detect *Borrelia Burgdorferi*

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24. Diagnosis and treatment of acute arthritis

Diagnosis and treatment of acute arthritis

- ALWAYS consider bacterial infection
- Use joint aspiration to help diagnose
- Immobilize, then mobilize
- Infection
 - Must be drained effectively
 - Appropriate antibiotics immediately

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