

## Urinalysis and Body Fluids 09

### Unit 4

#### Synovial Fluid

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## Synovial Fluid

- Composition and formation
  - Secreted by cells of synovial membrane
  - Very viscous, clear ultrafiltrate of plasma
  - Contains
    - Hyaluronic acid
    - Mucopolysaccharides
    - Limited amount of plasma protein
    - Glucose & uric acid levels equivalent to plasma

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## Synovial Fluid

- Functions
  - - supplies nutrients
  - - lubrication of joint
- Reasons for analysis
  - Infection
  - Hemorrhage
  - Degenerative disorders (arthritis)
  - Inflammatory disease (SLE)

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## Synovial Fluid

- Collection
  - Arthrocentesis



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## Synovial Fluid

- Collection
  - Tubes
    - Heparin - chemistries, immunological tests
    - Sterile tube - culturing and crystal evaluation
    - EDTA - hematology

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## Laboratory Testing

Macroscopic	Microscopic	Chemical	Other
Volume	Cell counts	Protein	Aerobic culture
Color & Clarity	Differential	Glucose	Anaerobic culture
Inclusions	Crystals	Uric Acid	
Viscosity	Cytology	Lactic Acid	
Clotting		LDH	
Mucin Clot		Rheumatoid Factor	

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## Classification of Synovial Fluid

- Normal
- Non-Inflammatory
  - Degenerative joint diseases
- Inflammatory
  - Immunologic disorders (ie lupus, RA, gout crystals, ETC)
- Septic
  - Microbial infections
- Hemorrhagic
  - Traumatic injury, tumors, hemophilia, anticoagulant overdose, etc.

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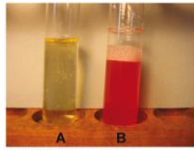
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## Synovial Fluid - Laboratory procedures

- Hematology
- Physical properties
  - Color & clarity = light yellow / straw & clear
    - Abnormal colors/ clarity as for other fluids \*
  - Bloody
    - Hemarthrosis
    - Traumatic tap
  - White / opaque with turbidity
    - Indicate pus cells or debris
- Xanthochromia term not used!



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## Synovial Fluid - Laboratory procedures

- Physical properties
- Viscosity
  - Screening - 'String Test' drop from pipette
    - Evaluates viscosity
    - Normal = @ 5+ cm long before breaking
  - Rope's test for mucin clot
    - measures degree of hyaluronate polymerization
    - Good / normal = tight ropey mass
    - Poor = appears friable or fails to form



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## Synovial Fluid - Laboratory procedures

- Hematology

- Cell counts

- 0 RBCs /  $\mu$ L
- <200 WBC /  $\mu$ L

- Must let hemacytometer sit longer to allow cells to settle before counting.

- If dilution needed must use **saline**

If you use diluent with an acid, such as Unopettes, the sample will clot.

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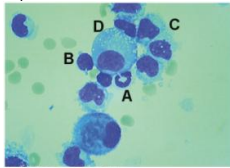
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## Synovial Fluid - Laboratory procedures

- Cell differential - Wright's stain

- Cells of peripheral circulation

- neutrophils 7%,
- lymphocytes 24%,
- Monocytes 48%, macrophages 10%,
- and synovial lining cells 4%.



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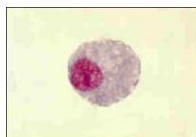
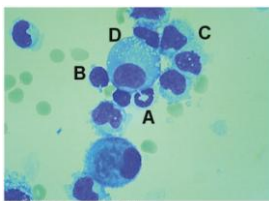
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## Synovial Fluid - Laboratory procedures

- Synovial lining cells

- (look somewhat similar to mesothelial cells)



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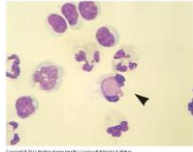
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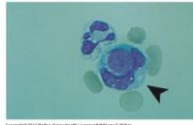
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## Synovial Fluid - Laboratory procedures

- LE cells



- Tart cells



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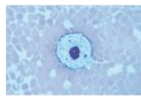
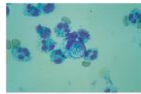
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## Synovial Fluid - Laboratory procedures

- Other cells
  - Reiter cells
- Malignant cells
- Organisms



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## Synovial Fluid - Laboratory procedures

- Microscopic exam for crystals
  - Use regular and polarized light
  - Crystals may be intra-cellular or extra-cellular
    - Monosodium urate - gout artheritis
    - Calcium pyrophosphate - pseudo gout
    - Cholesterol - non specific; chronic inflammatory
    - Apatite - calcific artheritis (mineral change in cartilage)
    - Corticosteroid - drug injections

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## Synovial Fluid - Laboratory procedures

- **Chemistries**
  - **Total protein** NV = 1.07 - 2.13 g/dL
    - Increases seen in inflammatory conditions and following joint hemorrhage .
  - **Glucose** - similar to current blood level
    - Decreased in inflammation or sepsis
  - **Lactate** - assist in differentiation of septic and inflammatory arthritis
  - **Uric acid** - increased in gouty arthritis.
    - if gout is suspected, but no crystals, may need uric acid level.

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## Synovial Fluid - Laboratory procedures

- **Microbiology**
  - Gram stain, acid fast stain & cultures
  - Certain organisms associated with age groups
    - Children - H. influenzae
    - Adults 16-50 - Staph., Strep. Pneumoniae, Strep pyogenes, Neisseria gonorrhoea
    - Adults > 50 - Staph. aureus

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## Synovial Fluid - Laboratory procedures

- **Serology**
  - Serum results more reliable, so not often done for diagnosis of RA or LE
  - Autoantibodies
  - Complement levels
  - QC - no commercial controls available, use serum controls if appropriate

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## Synovial fluid classification

Classification of Synovial Fluid by Test Results					
	Normal	Non-inflammatory	Inflammatory	Septic	Hemorrhagic
Volume	< 3.5 (mL)	> 3.5 (mL)	> 3.5 (mL)	> 3.5 (mL)	> 3.5 (mL)
Color	Straw	Straw / yellow	Yellow	Variable	Red
Clarity	Clear	Clear	Cloudy	Cloudy	Variable
Viscosity	High	High	Low	Variable	Low
Cell count/uL	< 200	200-2,000	2,000-75,000	> 100,000	Same as bld.
% PMNs	< 25 %	< 25 %	> 50 %	> 75%	Same as bld.
Gram stain / culture	Negative	Negative	Negative	> 50% Pos	Negative
Crystals	Negative	Negative	Frequently	Negative	Negative
Associated condition		Degenerative joint disease	Immunologic disorders- LE, RA, Gout, pseudo gout	Non-gonococcal or gonococcal septic arthritis	Trauma, hemophilia, Anticoagulant overdose, etc.

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## Review of Key Points

- **Synovial fluid analysis**
  - Plasma ultrafiltrate secreted by synovial membrane
  - Hyalurinic acid and mucopolysaccharides make it viscous
  - Lubricates and nourishes joints
  - Infection, hemorrhage, degenerative & inflammatory diseases are reasons for analysis
  - Collection is by arthrocentesis
  - EDTA (hematology), heparinized (chemistries and serology) and sterile (cultures and crystals) are collected
  - Straw yellow, clear and viscous are normal characteristics
  - 0 RBC and < 200 WBC/uL are normal
  - Cell counts requiring dilution must be made with saline.
  - Any peripheral circulating cell can be seen as well as synovial lining cells in normal patients.
  - Abnormals are classified as non-inflammatory, inflammatory, septic or hemorrhagic

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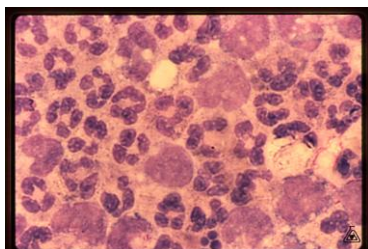
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## Synovial Fluid - Laboratory procedures

- 1989 CAP CM 23 Synovial fluid, segs, & macrophages




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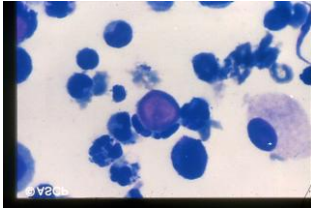
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## Synovial Fluid - Laboratory procedures

- Lupus erythematosus (LE) cells
  - Just below center of field
  - Neutrophil has engulfed a homogenous nuclear mass.
  - ASCP 130 synovial fluid with LE cell



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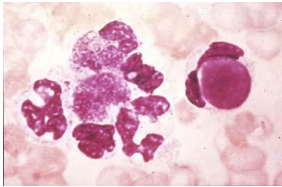
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## Synovial Fluid - Laboratory procedures

- Lupus erythematosus cell - far right side @ 3 o'clock



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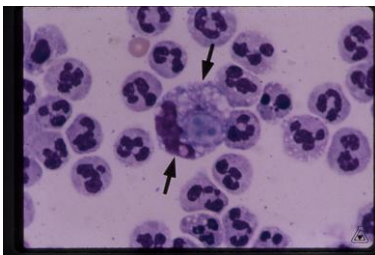
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## Synovial Fluid - Laboratory procedures

- 1993 CAP CM 21 synovial fluid. Segs and leukophage



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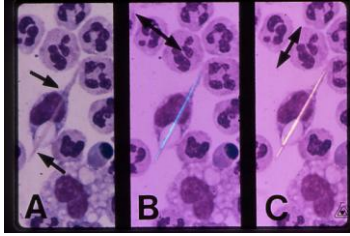
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## Synovial Fluid - Laboratory procedures

- 1993 CAP CM 20 synovial fluid. Monosodium urate crystals



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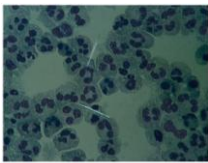
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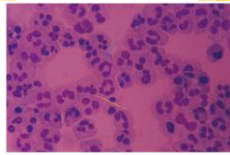
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## Microscopic Analysis: Crystals-Uric Acid



Synovial fluid with acute inflammation and monosodium urate crystals. (Wright-Giemsa stain and polarized light).



Synovial fluid with acute inflammation and monosodium urate crystals. The needle-shaped crystals demonstrate negative birefringence, because they are yellow when aligned with the compensator filter and blue when perpendicular to the filter (Wright-Giemsa stain and polarized/compensated light).

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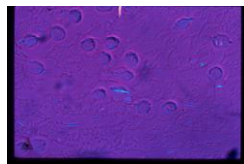
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## Synovial Fluid - Laboratory procedures

- Left - needle shaped monosodium urate crystals seen in a patient with gouty arthritis
- Right 1987 CAP CM 18B synovial fluid. Monosodium urate crystals



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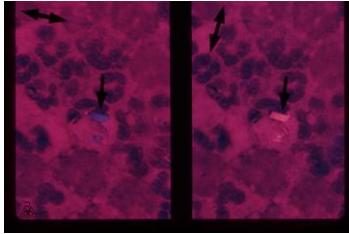
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## Synovial Fluid - Laboratory procedures

- 1989 CAP CM 24 synovial fluid. Calcium pyrophosphate - polarized



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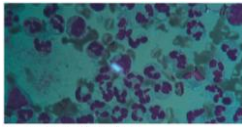
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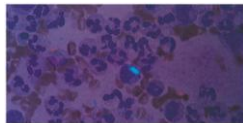
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## Microscopic Analysis: Crystals-other



Synovial fluid with acute inflammation and calcium pyrophosphate dihydrate crystals (Wright-Giemsa stain and polarized light).



Synovial fluid with acute inflammation and calcium pyrophosphate dihydrate crystals. The rhomboidal intracellular crystal (center) demonstrates positive birefringence, because it is blue when aligned with the compensator filter (Wright-Giemsa stain and polarized/compensated light).

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