

Cynovial fluid

By
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CSF

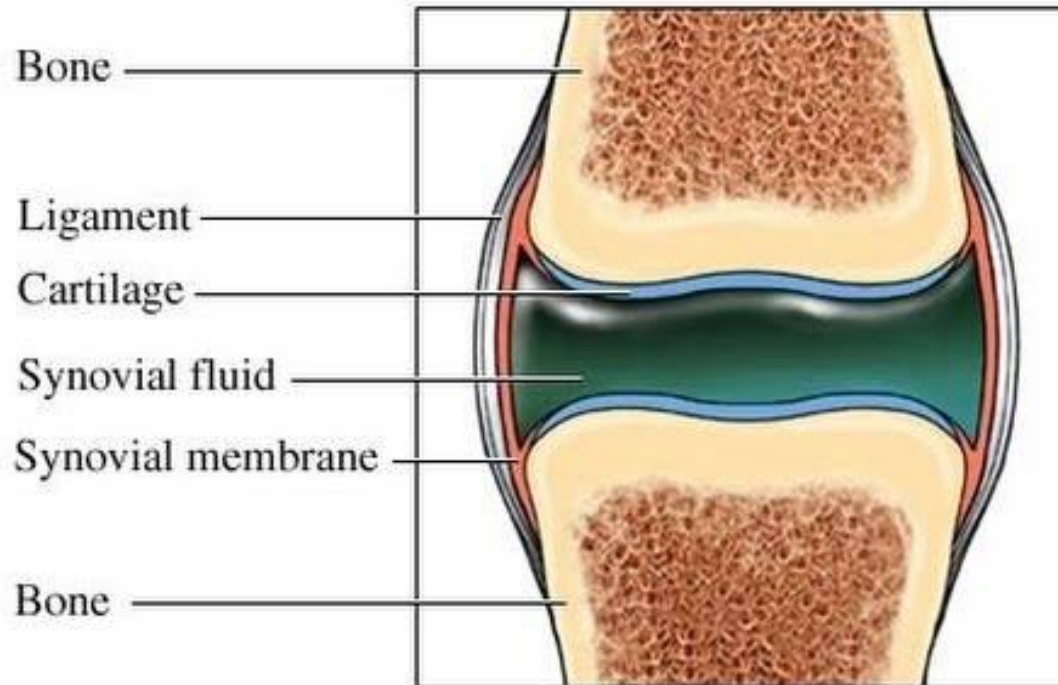
- Synovial fluid is a viscous colorless liquid that is found in the joint cavities
- Also known as joint fluid

CSF

- **Formations**
- Formed as a ultrafiltrate of the plasma across the synovial membrane
- Contains a mucopolysacharide containing hyaluronic acid and small amount of protein secreted by the cells of synovial membrane
- Essentially the same chemical composition can be found as of plasma except large proteins
- Main difference from other fluids is hyaluronic acid

Synovial fluid

- Joint fluid



Cross section of a healthy joint

CSF

- **Functions**
- Main function is to lubricate the joint space
- As a lubricant to the surfaces of the frequently moving joints
- Supplies nutrition to the cartilage
- Synovial fluid has to move to supply fresh nutrition
- Joint movement is essential for cartilage maintenance. Movement
- Acts as shock absorber of tremendous impact resulted due to walking running and jumping thus acting as hydraulic fluid

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- **Sample collection**
- Needle aspiration of the knee called arthrocentesis
- Normally knee contains almost 3.5 ml
- Volume increases during joint problems (can be up to 25 ml)
- Sample is divided in to 3 tubes
 - For crystals and cell counts
 - For microbiology
 - For chemical and immunological tests

CSF

- Purpose of Synovial fluid analysis
- To identify joint problems
- To diagnose certain types of arthritis and inflammatory joint diseases

Synovial fluid analysis

Physical examination	Appearance	
Color	Normal synovial fluid is pale yellow color	
Abnormal colors		
<p>Dark red or dark brown (bloody) may be due to</p> <ol style="list-style-type: none"> 1. Fracture 2. Tumor 3. Traumatic arthritis 4. Hemophilic arthritis 5. Presence of infection <p>Traumatic tap can also be observed by uneven distribution of blood in syringe</p>	<p>Deep yellow or green tinge may be due to</p> <ol style="list-style-type: none"> 1. Bacterial infection 2. Chronic rheumatoid arthritis <p>Milky appearance due to</p> <ol style="list-style-type: none"> 1. Gouty arthritis 2. Tuberculous arthritis 3. Systemic lupus erythmatosis (SLE) 4. crystals 	<p>TRANSPARENCY</p> <p>Normal synovial fluid is crystal clear</p> <p>Turbid – presence of leukocytes</p> <p>Cloudy – crystals</p>

Synovial fluid analysis

I. Noninflammatory	Clear, yellow fluid Good viscosity
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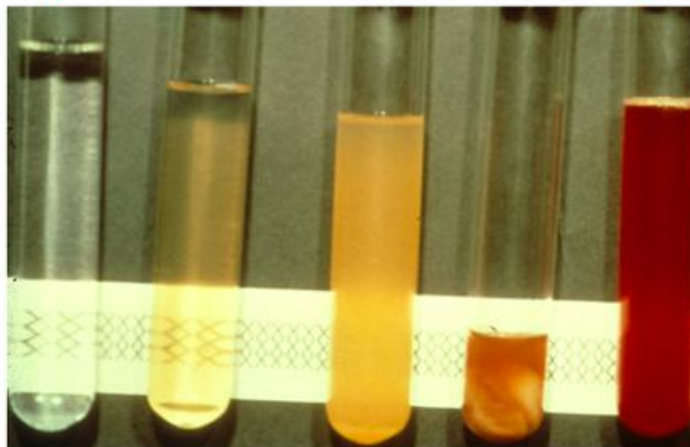
II. Inflammatory	Immunologic origin	Cloudy, yellow fluid Poor viscosity
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Crystal-induced origin	Cloudy or milky fluid Low viscosity
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III. Septic	Cloudy, yellow-green fluid Variable viscosity
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IV. Hemorrhagic	Cloudy, red fluid Low viscosity
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Synovial Fluid Color and Clarity



Normal Non-inflammatory Inflammatory Septic Hemorrhage

Synovial fluid analysis

Physical examination	Appearance
Volume	Depending on age and depending on joint varies.
Viscosity	<ul style="list-style-type: none">• Normal synovial fluid is highly viscous due to polymerization of the hyaluronic acid.• string test : when dropped from syringe if string of 4-6 cm is formed then viscosity is normal• If drop falls like water then the viscosity is low.• Low viscosity is the result of depolymerization of hyaluronic acid which can happen in following conditions<ul style="list-style-type: none">•1. Rheumatoid arthritis• 2. Septic arthritis•3 Gout•Dilution of haluronate complex or decreased production can be observed in trauma
	•THE MUCIN CLOT FORMATION TEST usful.

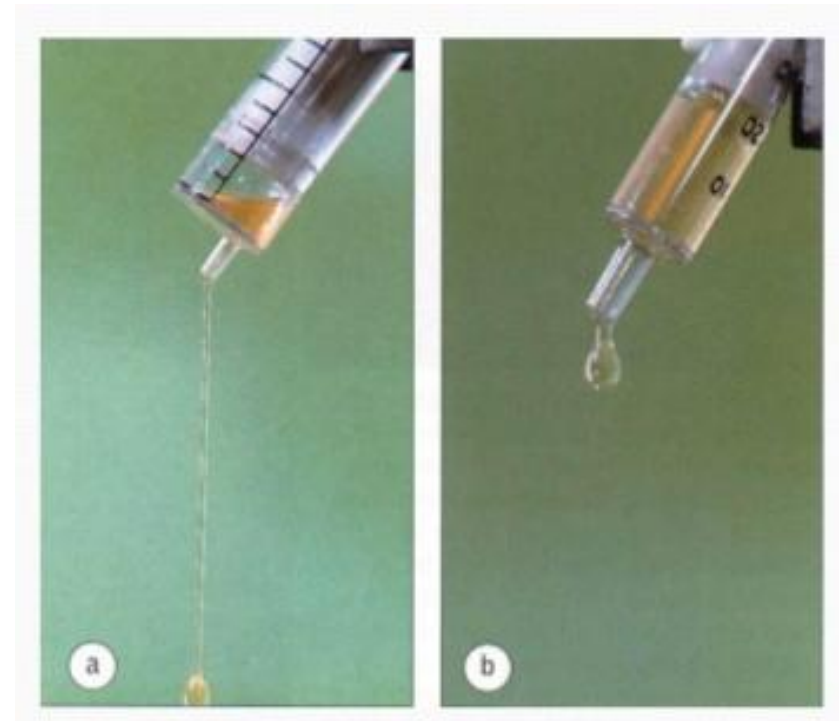
Synovial fluid analysis

Physical examination

Appearance

Viscosity

STRING TEST



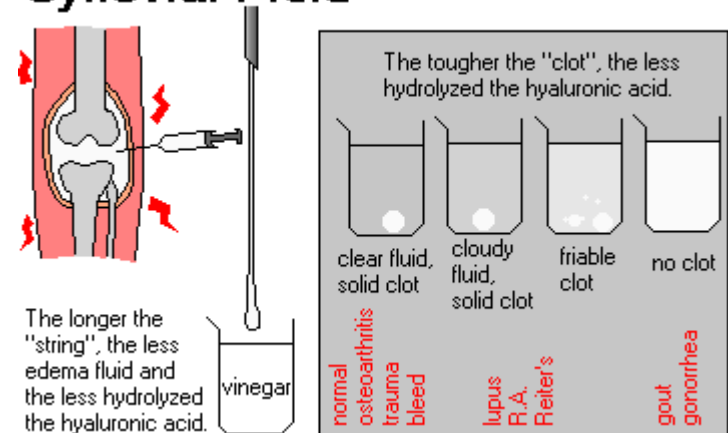
Normal

Low

Synovial fluid analysis

Physical examination	THE MUCIN CLOT FORMATION TEST
Clot formation	Adding acetic acid to diluted synovial fluid forms clot.
	<p>If hyaluronic acid is normal a tight ropy mass forms in a clear solution</p> <p>If softer clot formed in a turbid solution then the mucin is considered good to fair</p> <p>If the precipitate contains shreds then the mucin is poor</p>

Synovial Fluid



Synovial fluid analysis

Physical examination	CLOT FORMATION
Clot formation	Because of lack of fibrinogen and other clotting factors synovial fluid doesn't clot
	Inflammation allow the plasma clotting factors to escape in to joint fluid which then clot

Synovial fluid analysis

Microscopic examination

Cell count and differential staining

- Cell count should be finished without any delay to avoid clumping of leukocytes.
- Degeneration of Leukocytes happens if stored more than 1 hour after sample collection
- If the sample is very thick, to facilitate cell counting sample can be incubated at 37°C with hyaluronidase enzyme.
- RBCs are usually very low in number. Traumatic tap may result in high number

•Types of cells seen

•Lymphocytes

•Polymorpho nuclear cells

•Fat bodies

•Synovial tissue cells

•Macrophages

•Bacteria

Synovial fluid analysis

Microscopic examination

Cell count and differential staining

High neutrophil indicates septic inflammation

1. Bacterial arthritis
2. Gouty arthritis
3. Rheumatoid arthritis

High lymphocytes indicates non-septic inflammation

1. Viral infection
2. Rheumatoid arthritides

High eosinophils can be found during

1. Metastatic carcinoma
2. Acute rheumatic fever
3. Rheumatoid arthritis

Synovial fluid analysis

Microscopic examination

Crystals

Crystals indicate the presence of crystal induced arthritis
As crystals are affected by pH, temperature test should be performed immediately

Endogenous crystals



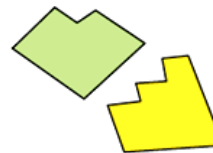



1. Monosodium urate (MSU)
needle like seen in gout
2. Calcium pyrophosphate
dehydrate – needles, plates or rods like
3. Cholesterol – flat rectangular
4. Calcium oxalate – envelop shape
5. Calcium phosphate – small particles

Exogenous crystals

1. Gloves powder
2. Corticosteroids

Synovial fluid analysis

Table 11-6 Characteristics of Synovial Fluid Crystals

Crystal	Shape	Image	Compensated Polarized Light	Significance
Monosodium urate	Needles		Negative birefringence	Gout
Calcium pyrophosphate	Rhomboid square, rods		Positive birefringence	Pseudogout
Cholesterol	Notched, rhomboid plates		Negative birefringence	Extracellular
Corticosteroid	Flat, variable-shaped plates		Positive and negative birefringence	Injections
Calcium oxalate	Envelopes		Negative birefringence	Renal dialysis
Apatite (calcium phosphate)	Small particles Require electron microscopy		No birefringence	Osteoarthritis

Synovial fluid analysis

Chemical examination

As Synovial fluid is ultrafiltrate of plasma chemical analysis values are almost same as plasma values

Glucose

1. Normal value is 0-10% lower than that of serum level
2. When ever joint fluid glucose level is assayed, blood glucose lever also need to be assyaed
3. During inflammatory joint diseases like rheumatoid arthrites joining fluid glucose level may dorp to 60% of plama or even to 40 % during septic arthritis

Protein

Protein concentration of synovial fluid remain substantially less than in plasma. In Knee aspirates total protein is generally and roughly 20% of the that of plasma.

Protein concentration greater than 3 g/dl may be due to increased permeability of antibodies in the following cases

1. Rheumatoid arthritis
2. Gout
3. Septic arthtitis

Synovial fluid analysis

Chemical examination

As Synovial fluid is ultrafiltrate of plasma chemical analysis values are almost same as plasma values

Uric acid

Hyperurecemic patients usually accumulate crystals of uric acid in the synovial fluid. This is seen especially attacks of Gout.

Accumulation of uric acid crystals are due to overproduction of uric acid or low excretion by the kidneys
When serum uric acid levels are chronically higher than 10 mg/dl then the chance of Gout attack is 90%

Alkaline phosphatase

Increased in most cases of arthritis

Next class

Cystic fibrosis & sweat analysis	