Learning Outcome

At the end of the session, students should be able to:

LO1 Apply anatomy of hip joint to clinical presentation of avascular necrosis (AVN)

LO2 Relate the pathogenesis and pathophysiology of AVN to its clinical presentations

LO3 Discuss the psychosocial implications of AVN

Trigger (Part A)

Mr. Ramasamy, a 47-year-old man complained of difficulty in walking due to increasing pain of his left hip. The pain started about 4 months ago without any history of trauma to the left hip. The pain worsened with movement and relieved with rest.

Mr. Ramasamy is single and has been living alone in his mother's house after she passed away 7 years ago. He drinks 4-6 cans of beer every day since then.

Trigger (Part B) – this part should be released to students at minute 30 during first session.

Mr. Ramasamy was subsequently referred to the orthopedic outpatient clinic. Physical examination only revealed pain upon movement of the left hip joint.

Plain radiograph of the left hip joint revealed no abnormalities.

He was diagnosed as having early stage avascular necrosis (AVN) of the left femoral head.

Discussion Points (FOR FACILITATOR ONLY)

No	Key words	Points for discussion	Learning outcome	Reference page

1	- a 47-year old man
	- difficulty in walking due to increasing pain of his left hip
	- The pain started about 4 months ago without any history of trauma to the left hip
	- The pain worsened with movement and relieved with rest
		• Recall the anatomical structure of the hip joint
		• Recall the structure and function of:
		  • articular cartilage
		  • articular capsule and associated ligaments
		  • synovial membrane
		• Describe the process of formation, composition and functions of synovial fluid.
		• Discuss the pathophysiology of pain in the left hip in AVN
			LO1
			
			LO2
				Page 5-6
				
				Page 7

2	- Mr. Ramasamy is single & has been living alone in his mother's house after she passed away 7 years ago.
	
	- He drinks 4-6 cans of beer every day since then.
		• Discuss & appreciate the implication of
		  a) Single man & unhealthy lifestyle
		  b) Importance of family/friend support
		• Understand the quantification of alcohol drinking
		• Discuss the pathogenesis of AVN in alcoholism
			LO3
			
			LO2
				Page 7

3	Physical examination - pain upon movement of the left hip joint. Plain radiograph of the left hip joint -no abnormalities.	• Recall the anatomy of femoral bone • Recall the blood supply of the femoral bone • Relate blood supply to the femoral head with AVN in this case • Apply anatomy of hip joint to identify bony landmark on plain radiograph	*LO1*	*Page 8*

4	- He was diagnosed as having early stage avascular necrosis (AVN) of the left femoral head	• Define AVN • Aetiology of AVN • Pathogenesis of AVN • Other common sites for AVN to occur in the body • Discuss complications of AVN • Describe the association of AVN to osteoarthritis	*LO2*	*Page 9-10*

Discussion guide (FOR FACILITATOR ONLY)

1. - a 47-year old man, difficulty in walking due to increasing pain of his left hip, The pain started about 4 months ago without any history of trauma to the left hip, The pain worsened with movement and relieved with rest

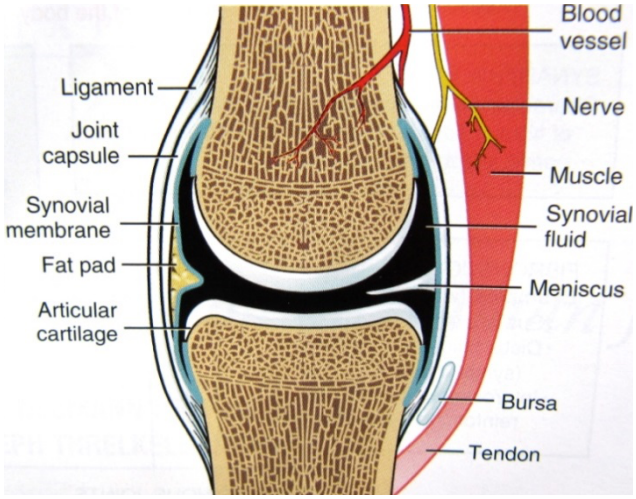
LO1: Explain the clinical presentation of this case scenario in relation to avascular necrosis (AVN)

- **Recall anatomical structure of the hip joint**

Hip Joint

- Articulation between the head of femur and acetabulum of the bony pelvis.
- Allows are flexion, extension, abduction, adduction, medial/lateral rotation and circumduction
- Both acetabulum and head of femur are covered in articular cartilage, which is thicker at the places of weight bearing
- Strengthened by iliofemoral, pubofemoral and ischiofemoral ligaments
- The stability of hip joint depends on the deep socket of acetabulum which encompasses nearly all the head of the femur, the presence of acetabulum labrum, thick capsule and strong ligaments and the supported by various muscles of the gluteal regions

- **structure and function of :**
  - **i. articular cartilage**
  - **ii. articular capsule and associated ligaments**
  - **iii. synovial membrane**



i. Articular cartilage

- Hyaline type
- Covers the articular surfaces of the articulating bones
- Has no nerve supply
- Nourished by the synovial fluid

ii. Articular capsule

- Consists of 2 parts:
  - Fibrous capsule
    - Dense irregular connective tissue
    - Contains blood vessels & nerve fibres

- Synovial membrane
  - Vascular connective tissue (cellular membrane)

Associated ligaments

- Strengthen the joints
- Either:
  - 1. Intrinsic ligaments (capsular)
    - They are thickened parts of the fibrous capsule
  - 2. Extrinsic ligaments (accessory)
    - They are separated from the fibrous capsule

iii. Synovial membrane

- Lines fibrous capsules, exposed osseous surfaces, intracapsular ligaments, bursae and tendon sheaths
- Does not line the articular cartilages, intra-articular discs and menisci
- Produces the synovial fluid that lubricates the joint
- Regenerates if damaged
- Has no nerve supply

Joint cavity

- Contains synovial fluid produced by synovial membrane
- Synovial fluid – for lubrication
- Lined by the synovial membrane; except over the articular cartilage

- **process of formation, composition and functions of synovial fluid.**

Secretion of Synovial Fluid

There are two main types of synovial lining cells, but these can be differentiated only by electron microscopy.

- Type A cells are macrophage-like and have primarily a phagocytic function.
- Type B cells are fibroblast-like and produce hyaluronate, which accounts for the increased viscosity of synovial fluid.

Hyaluronic acid, synthesized by synovial lining cells (type B), is secreted into the synovial fluid, making the fluid viscous.

Composition of Synovial Fluid

- Synovial fluid is made of hyaluronic acid and lubricin, proteinases, and collagenases.
- Synovial fluid also contains lubricin secreted by synovial cells. It is chiefly responsible for so-called boundary-layer lubrication, which reduces friction between opposing surfaces of cartilage.

Physical Characteristics of Normal Synovial Fluid

- Normal synovial fluid is clear, pale yellow, viscid, and does not clot.
- Amount – thin film covering surfaces of synovium and cartilage within joint space
- Cell count – <200/mm3. Less than 25 percent are neutrophils
- Protein – 1.3-1.7 g/dl (20 % of normal plasma protein)
- Glucose – within 20 mg/dl of the serum glucose level
- Temperature – 32 degree Celsius (peripheral joints are cooler than core body temperature)
- pH – 7.4

Functions of Synovial Fluid

Synovial fluid aids in the nutrition of articular cartilage by acting as a transport medium for nutritional substances, such as glucose, and provides lubrication of the articulating surfaces.

LO2: Relate the pathogenesis and pathophysiology of AVN to its clinical presentations

- **Discuss the pathophysiology of pain in the left hip in AVN**

Commonly the will be no symptoms in the early stages of avascular necrosis. As the condition worsens, the affected joint may be painful upon weight bearing activities such as walking. Eventually, the joint may become painful even during lying down.

The pain becomes more severe as the necrosis worsen. Pain associated with avascular necrosis of the hip may be focused in the groin, thigh or buttock. In addition to the hip, the areas likely to be affected are the shoulder, knee, hand and foot.

Some people develop avascular necrosis bilaterally — for example, in both hips or in both knees.

In this case, middle aged man has low risk of osteoarthritis. The absence history of trauma excludes the traumatic cause of pain. The nature of pain for this patient is mechanical pain. This is characterized by pain that is worse with movement and relieved with rest. This is different from non- mechanical where the pain occurs at rest. It is due to conditions like malignancy, infection, etc.

2. Mr. Ramasamy is single & has been living alone in his mother's house after she passed away 7 years ago, He drinks 4-6 cans of beer every day since then.

LO 3: Discuss the psychosocial implications of AVN

- Discuss & appreciate the implication of
  c) Single man & unhealthy lifestyle
  d) Importance of family/friend support

MERCI

Medical:
AVN of left hip joint due to alcoholism

Empathy:
Mr Ramasamy is probably emotionally attached to his mother who had passed away. Being a loner he sought solace with alcohol. His limited movement will further worsen his loneliness and might lead to depression.

Right & Respect:
Mr Ramasamy has the right to proper treatment & counseling to get out of his alcohol problem. He also require proper follow-up at the orthopedic specialist clinic for his left hip problem.

Communication:
Mr Ramasamy problem is complex due to involvement of multi-disciplinary specialty such as orthopedic, physician, psychologist & dietician. He probably requires help from NGO support group or social workers to help him abstain from alcohol & for the long term support.

Insight:

It is also essential for the managing teams to recognize emotional issue & if Mr Ramasamy could understand the extent of his current problem & its implication/future prognosis

LO2: Relate the pathogenesis and pathophysiology of AVN to its clinical presentation

- Understand the quantification of alcohol drinking

- **Discuss the pathogenesis of AVN in alcoholism**

Effect of alcoholism to own body system:
- Poor diet – lack of vitamins
- Body system :
- Heart – cardiomyopathy, hypertension
- Liver – fatty liver, cirrhosis
- Pancreas – pancreatitis
- Immune system - weaken

People who drink alcohol in excess can develop fatty substances that may block blood vessels, causing a decreased blood supply to the bones.
(> 3-4 alcohol unit per day → risk of osteonecrosis)

3. He was diagnosed as having early stage avascular necrosis (AVN) of the left femoral head

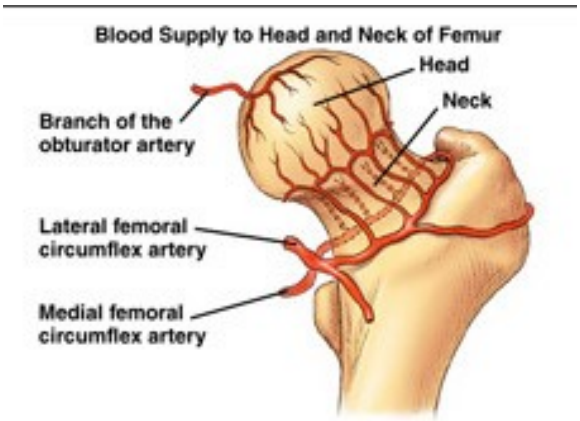
LO1: Apply anatomy of hip joint to clinical presentation of avascular necrosis (AVN)

- **Recall the anatomy of femoral bone**

Students are expected to recall the anatomy of femur from the Anatomy lecture

- **Recall the blood supply of the femoral bone**

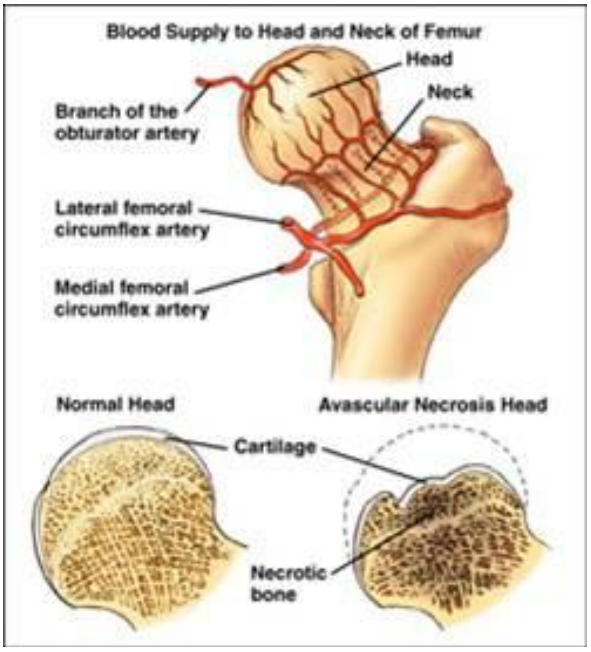
The blood supply to the head of femur:
1. Medial circumflex femoral artery (from profunda femoris artery)
2. Lateral circumflex femoral arery (from profunda femoris artery)
3. Artery of ligamentum teres (From obturator artery)



Nutrient artery to the femur is derived from the 2nd perforating artery (from the profunda femoris artery, one of the deep branches of the femoral artery). In case it is absent, it is replaced by two nutrient arteries derived from the 1st and 3rd perforating arteries. The nutrient foramen is located on the medial side of the linea aspera, and is directed upwards.

- **Relate blood supply to the femoral head with AVN in this case**

Interruption of the blood supply to the head of femur leads to death of bone cells --> this further leads to structural changes in the head of femur. Consequently this leads to collapse and secondary osteoarthritis of the femoral head.



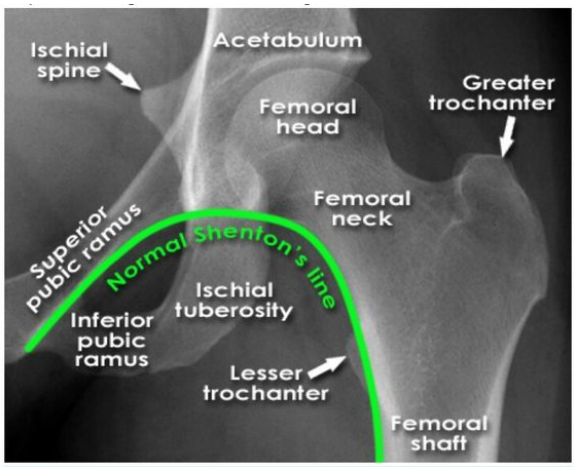
4. Physical examination -pain upon movement of the left hip joint, Plain radiograph of the left hip joint -no abnormalities

LO1: Apply anatomy of hip joint to clinical presentation of avascular necrosis (AVN)

- Apply anatomy of hip joint to identify bony landmark on plain radiograph

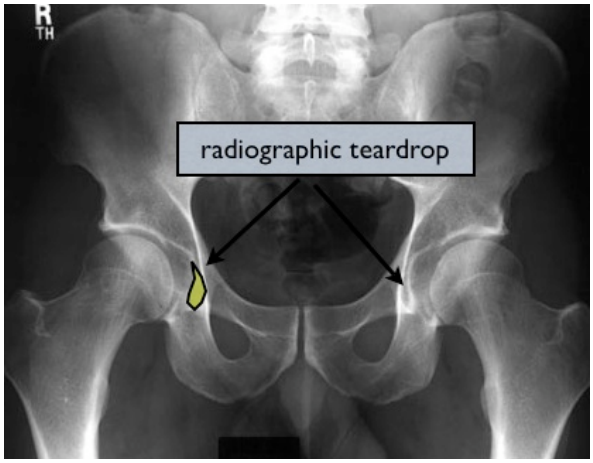
  Bony landmark to be identified on plain radiograph include: 'tear drop', Shenton line, Grater trochanter, lesser trochanter, acetabulum

Abnormal findings in early stage of AVN maybe detected in other imaging modalities (CT scan, MRI, bone scan)



Hip X-ray anatomy - Normal AP

- Shenton's line is formed by the medial edge of the femoral neck and the inferior edge of the superior pubic ramus
- Loss of contour of Shenton's line is a sign of a fractured neck of femur
- **IMPORTANT NOTE**: Fractures of the femoral neck do not always cause loss of Shenton's line



4. He was diagnosed as having early stage avascular necrosis (AVN) of the left femoral head

LO2: Relate the pathogenesis and pathophysiology of AVN to its clinical presentation

- **Define AVN**

AVN is also known osteonecrosis. AVN is a disease resulting from the temporary or permanent loss of blood supply to the bones. Without blood, the bone tissue dies, and ultimately the bone may collapse.

- **Aetiology of AVN**

Traumatic – disruption of blood supply (e.g.posterior hip dislocation)
Atraumatic – alcohol, steroid, Caisson disease, others

- **Pathogenesis of AVN**

Temporary/permanent loss of blood supply the bone → bone tissue dies → ultimately the necrotic bone area may collapse, especially if under constant loading **(General concept)**

Coagulation of the intraosseous microcirculation → venous thrombosis → retrograde arterial occlusion → Intraosseous hypertension → decreased blood flow to bone → AVN → chondral fracture (if joint affected) and collapse

Trauma→ direct disruption of blood supply due to arterial injury→ AVN

- **Other common sites for AVN to occur in the body**

Talus, scaphoid, humeral head, femoral condyles, mandible

- **Discuss complications of AVN**

The most common complication as a result of AVN is osteoarthritis

- **Describe the association of AVN to osteoarthritis**

During the more advance stages of AVN (if not diagnosed and treated early) the affected region of the bone that is intra-articular, will undergo chondral degeneration and subsequently bone collapse. These changes will inadvertently cause secondary osteoarthritis.

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