

Diabetic Foot

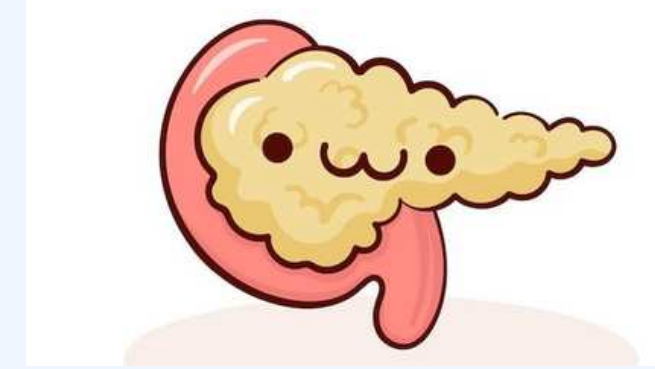
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Diabetes mellitus (DM)



- A group of metabolic disorders characterized by hyperglycemia that results from defects in insulin secretion, insulin action, or both.
- Nearly one-third of patients are unaware that they have hyperglycemia.
- Normal blood glucose: usually 70 to 120 mg/dL.
- According to the American Diabetes Association (ADA) and the WHO, diagnostic criteria for diabetes include :

Diabetes Diagnosis Criteria		
Fasting PG ≥ 126 mg/dL	2hr PG 75 g OGTT ≥200 mg/dL	A1c ≥6.5%
Random PG ≥200 mg/dL + hyperglycemic symptoms		
Definitions		
PG = Plasma Glucose	OGTT = Oral Glucose Tolerance Test	Hyperglycemic Symptoms: Polydipsia (↑ thirst), Polyuria (↑ urination), Polyphagia (↑ hunger)

Classification:

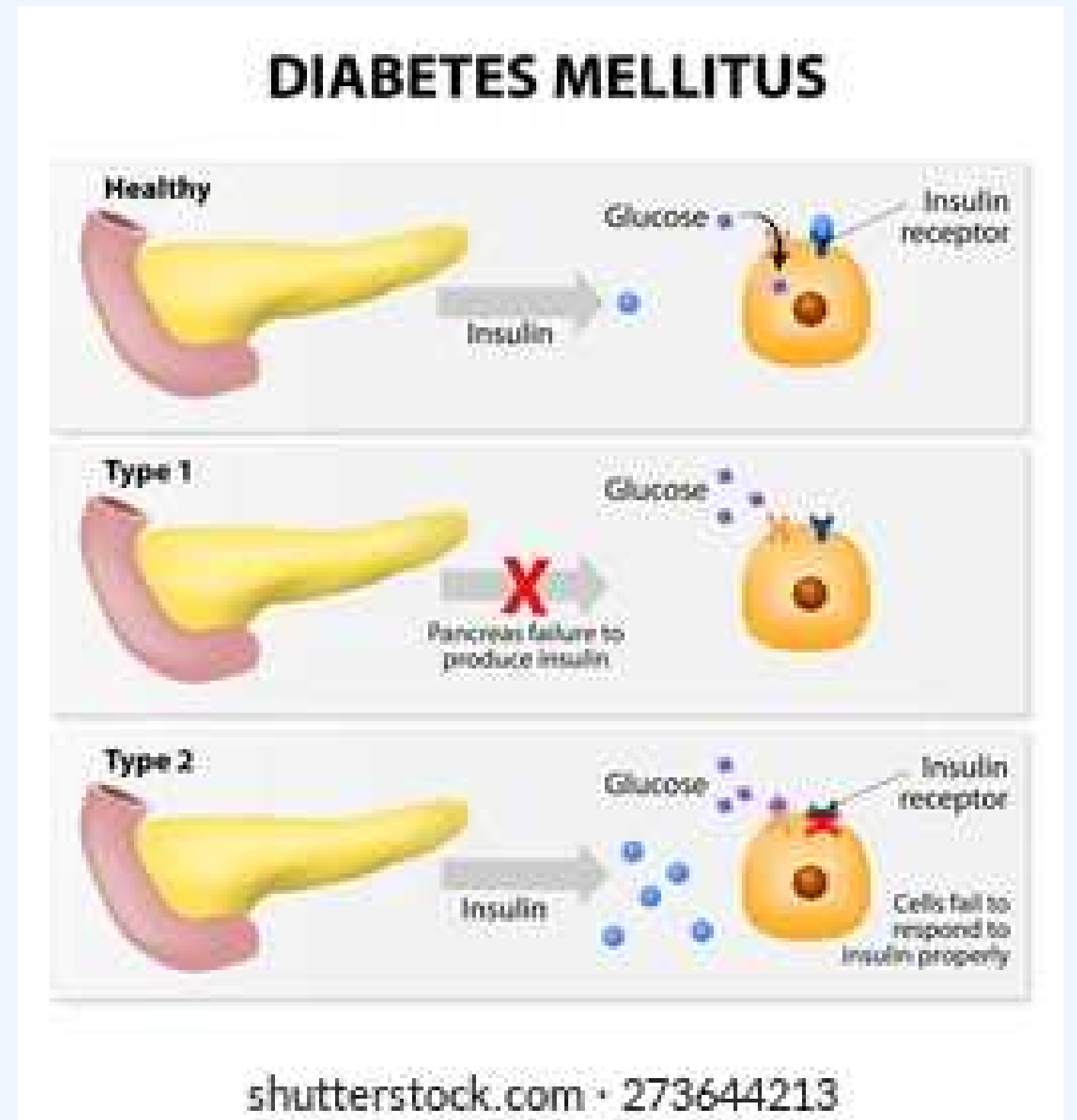
-Etiologic classification that reflects the pathogenesis of each variant:

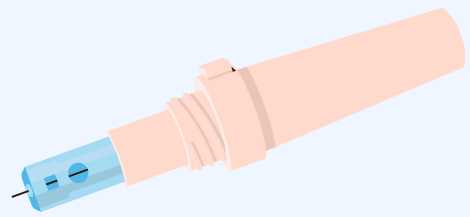
1. Type 1 diabetes (5% to 10% of all cases):

- An autoimmune disease characterized by pancreatic β -cell destruction and an absolute deficiency of insulin.
- The most common subtype in patients younger than 20 years

2. Type 2 diabetes (90% to 95% of cases):

- Caused by a combination of peripheral resistance to insulin action and an inadequate secretory response by the pancreatic β cells (“relative insulin deficiency”).
- Classically considered “adult-onset” (but increasing in children and adolescents).

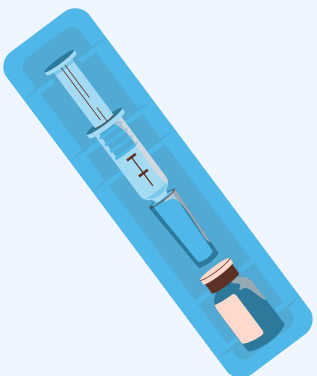




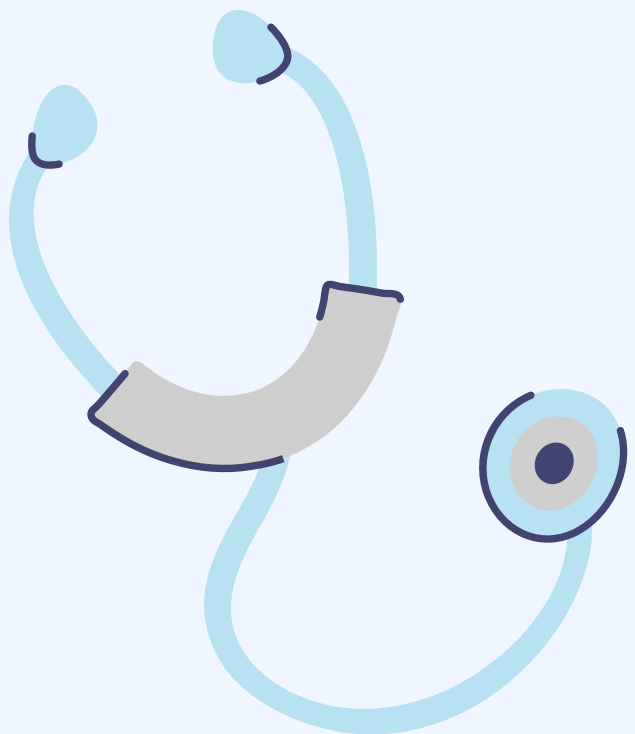
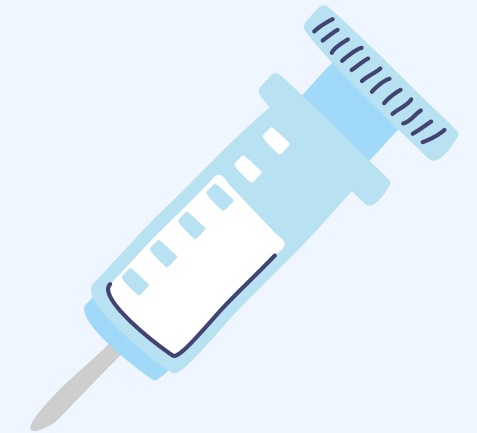
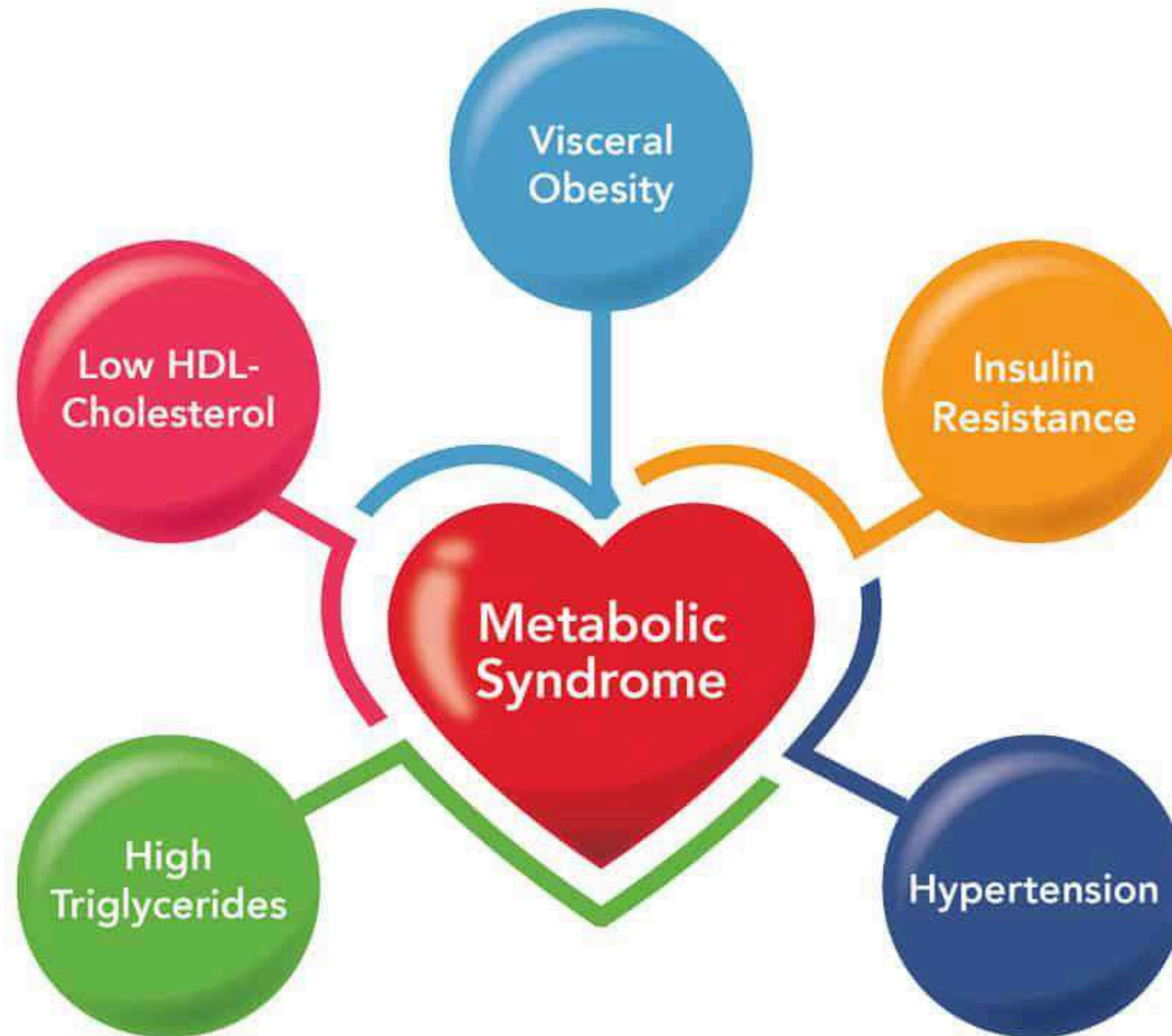
Diabetes mellitus is assuming pandemic proportions worldwide and so are its associated long-term complications.

In addition to the delayed complications like nephropathy, retinopathy, neuropathy, etc., diabetic foot disease is one of the most common and dreaded complication of diabetes mellitus, especially in developing countries.

According to the World Health Organization (WHO) and International Working Group on the Diabetic Foot, diabetic foot is defined as the foot of diabetic patients with ulceration, infection, and/or destruction of the deep tissues, associated with neurological abnormalities and various degrees of peripheral vascular disease .



What is Metabolic Syndrome?

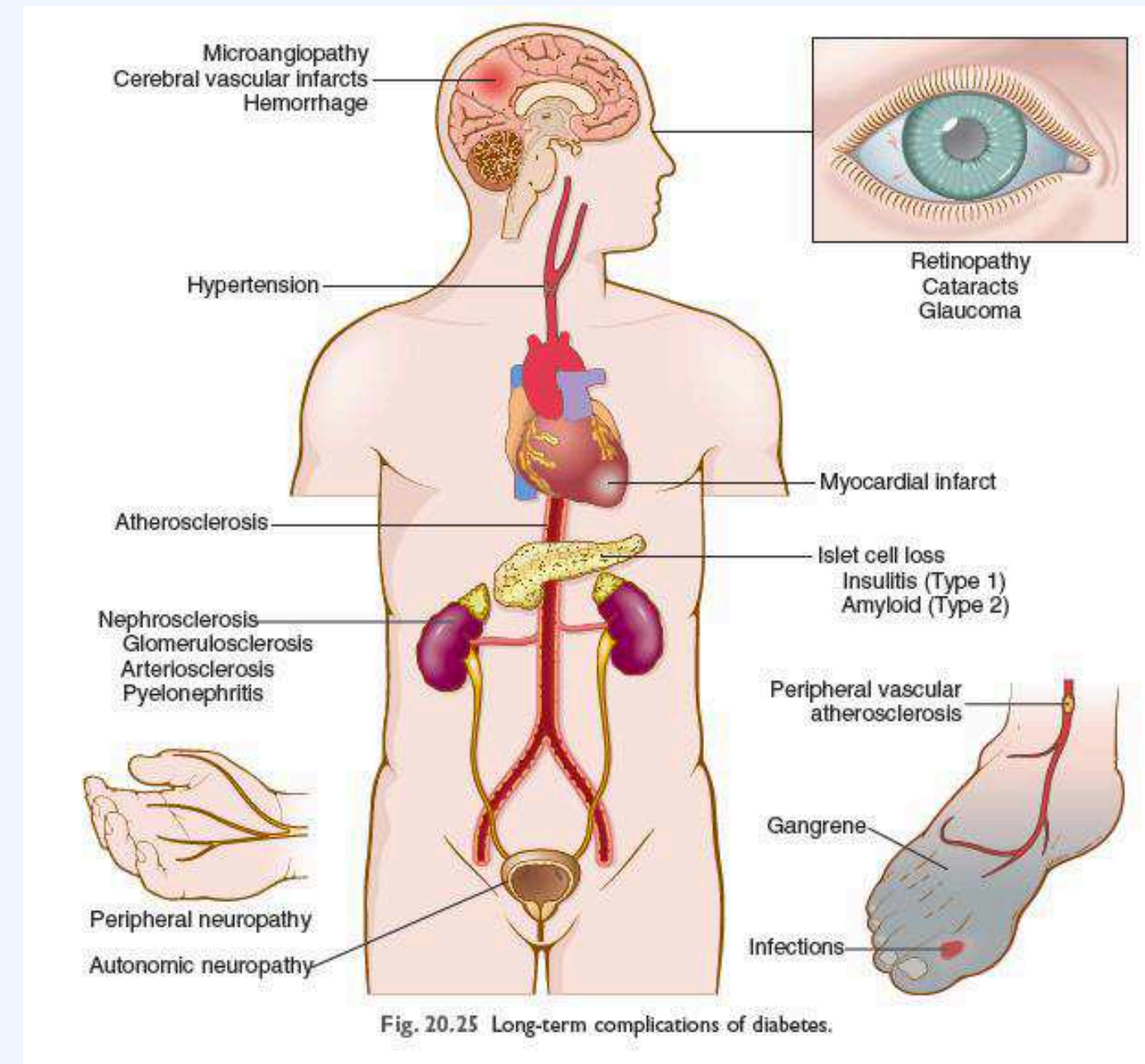


Chronic Complications of Diabetes



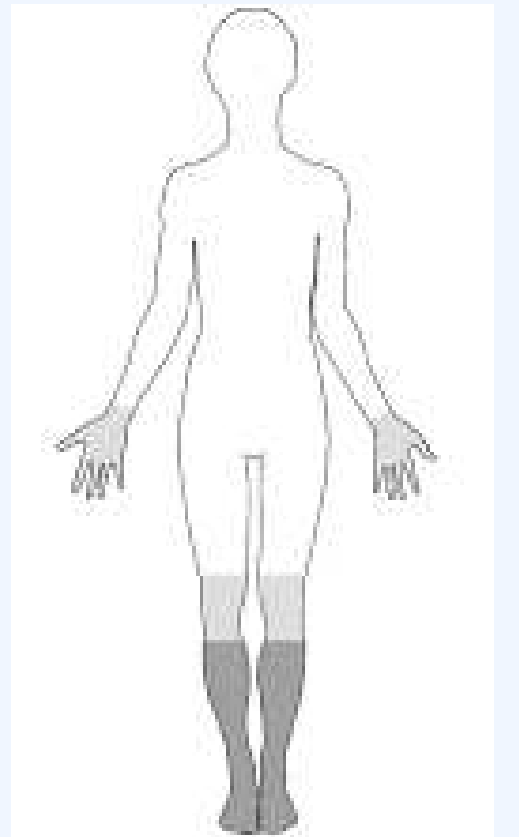
- **Macrovascular disease:** causes accelerated atherosclerosis .
- **Microvascular disease:** retinopathy, nephropathy, and neuropathy

There is extreme variability among patients in the time of onset of these complications, their severity, and the organs involved.



Diabetic neuropathy:

- Affects the CNS, peripheral sensorimotor nerves, and autonomic nervous system.
- The most frequent pattern is a distal symmetric polyneuropathy of the lower extremities, affecting both motor and sensory function, particularly the latter.
- Over time, the upper extremities may also be involved “glove and stocking” pattern of polyneuropathy
- Other forms include:
 - autonomic neuropathy: disturbances in bowel and bladder function and sometimes sexual impotence
 - diabetic mononeuropathy: as sudden foot drop, wrist drop, or isolated cranial nerve palsies.



OUTLINES :

- 1- Overview
- 2- Clinical Presentation
- 3- Differential Diagnosis
- 4- Work up
- 5- Guidelines
- 6- Physical Examination
- 7- Treatment & Management



Overview:

What's a diabetic foot ?



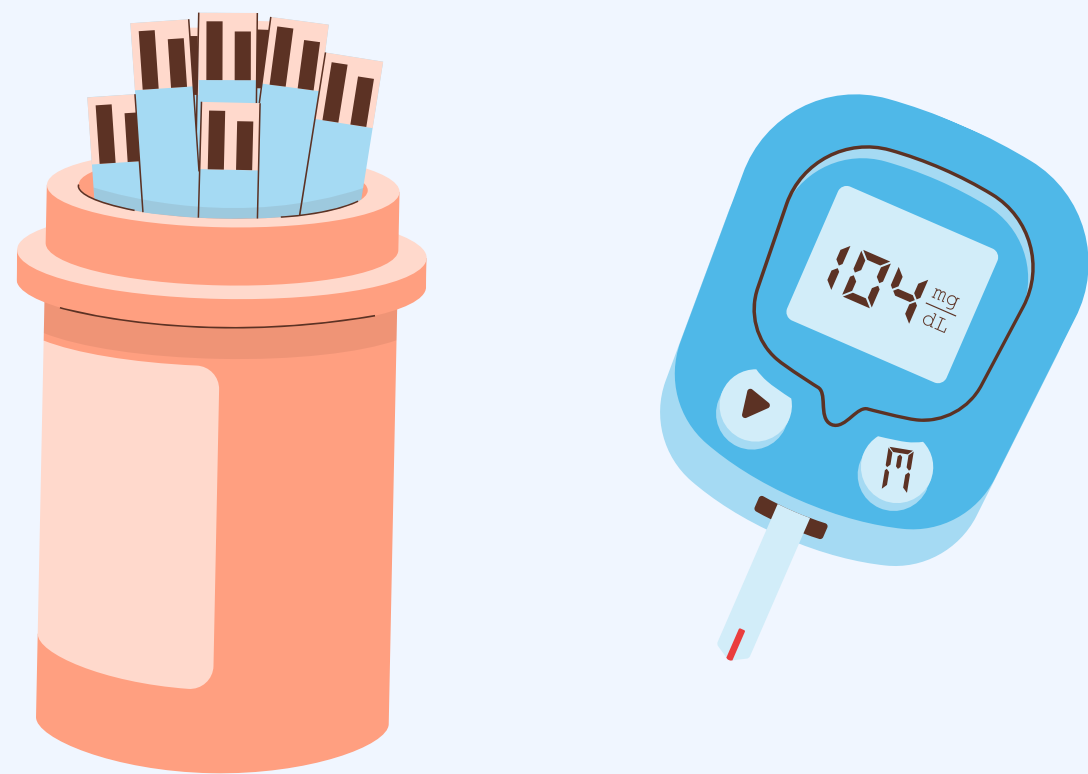
- Diabetic foot is a medical condition in diabetic patient . They occur as a result of various factors of the foot due to mechanical changes , nerve and vascular which is in high frequency in diabetic patient .
- This damage often leads to foot ulcers, infections, and deformities .

Diabetic foot increases the risk of severe complications like gangrene and amputation, especially when wounds go unnoticed or untreated. Proper foot care, blood glucose management, and regular medical check-ups are essential to prevent and manage diabetic foot.

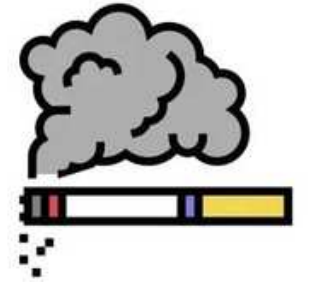
Diabetes is the leading cause of nontraumatic lower extremity amputations in the United States, with approximately 5% of diabetics developing foot ulcers each year and 1% requiring amputation.



Diabetic foot lesions are responsible for more hospitalizations than any other complication of diabetes.



Risk Factors



- Elderly males who are smokers and have habit of alcohol intake and have long duration of type 2 diabetes are at major risk for this problem.
- The other significant risk factors are: Poor glycemic control, neuropathy, angiopathy, nephropathy, and retinopathy

- The history should focus on the signs and symptoms of a diabetic foot ulcer or pre-ulcerative lesion. Symptoms indicative of possible peripheral neuropathy or peripheral arterial insufficiency should also be investigated.
 - **History of trauma**
 - **History of puncture wound**
 - **History of deformity, either acquired or congenital**
 - **History of callus or blister**
 - **History of wound care management**
 - **Local signs of infection**
 - **Systemic signs of infection**



Symptoms of peripheral neuropathy

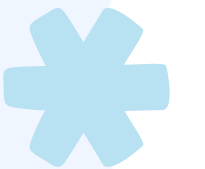
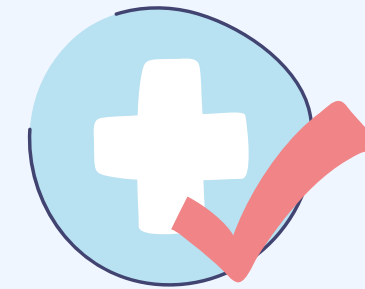
The symptoms of peripheral neuropathy include the following :

- **Hypoesthesia** : decreased sensitivity to stimulation.
- **Hyperesthesia** : extreme sensitivity in your sense of touch .
- **Paresthesia** : burning or prickling sensation that is usually felt in the hands, arms, legs, or feet .
- **Dysesthesia** : symptoms that disrupt how you experience touchbased sensations .
- **Radicular pain** : type of pain that radiates from your back and hip into your legs through the spine.

Symptoms of peripheral arterial insufficiency

- Most people harboring atherosclerotic disease of the lower extremities are asymptomatic; others develop ischemic symptoms. Some patients attribute ambulatory difficulties to old age and are unaware of the existence of a potentially correctible problem.
- Patients who are symptomatic may present with intermittent claudication, ischemic pain at rest, nonhealing ulceration of the foot, or frank ischemia of the foot.
- Cramping or fatigue of major muscle groups in one or both lower extremities that is reproducible upon walking a specific distance suggests intermittent claudication.
- This symptom increases with ambulation until walking is no longer possible, and it is relieved by resting for several minutes. The onset of claudication may occur sooner with more rapid walking or walking uphill or up stairs.

- The claudication of infrainguinal occlusive disease typically involves the calf muscles. Discomfort, cramping, or weakness in the calves or feet is particularly common in the diabetic population because they tend to have tibioperoneal atherosclerotic occlusions .
- Calf muscle atrophy may also occur.
- Rest pain is less common in the diabetic population. In some cases, a fissure, ulcer, or other break in the integrity of the skin envelope is the first sign that loss of perfusion has occurred. When a diabetic patient presents with gangrene, it is often the result of infection.



Pathophysiology



-Trophic changes , Atherosclerosis and peripheral neuropathy occur with increased frequency in persons with diabetes mellitus .

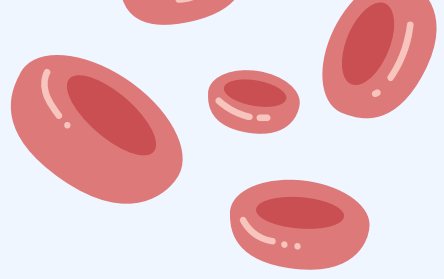
Trophic changes :

-Non-enzymatic glycosylation of skin and connective tissue, along with decreased collagen production in people with diabetes, result in alterations in the biomechanics in the diabetic foot.

-This is frequently seen in the Achilles tendon, where increased stiffness results in a contracture that limits ankle dorsiflexion, a condition known as equinus.

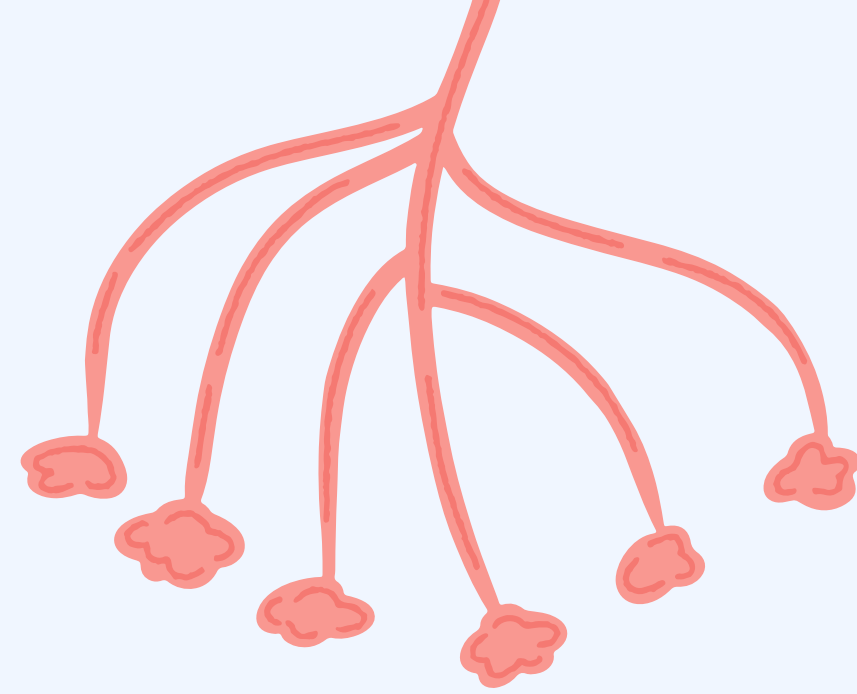
-Equinus has been associated with diabetic foot ulcers, as it increases plantar pressures in the forefoot and midfoot.

Atherosclerosis :



- Overall, people with diabetes mellitus (DM) have a higher incidence of atherosclerosis, thickening of capillary basement membranes, arteriolar hyalinosis, and endothelial proliferation. Calcification and thickening of the arterial media are also noted with higher frequency in the diabetic population .
- The reason for the prevalence of this form of arterial disease in diabetic persons is thought to result from a number of metabolic abnormalities, including high low-density lipoprotein (LDL) and very- low-density lipoprotein (VLDL) levels, elevated plasma von Willebrand factor, inhibition of prostacyclin synthesis, elevated plasma fibrinogen levels.

neuropathy :



Increased serum glucose leads to insulin resistance, dyslipidemia, and oxidative stress of the endoplasmic reticulum and mitochondria.

These processes contribute to accumulating reactive oxygen species (ROS), inflammation, and cellular damage.

The infiltrated macrophages inside peripheral nerve cells trigger cytokine and chemokine production, promoting inflammation and nerve fiber damage .



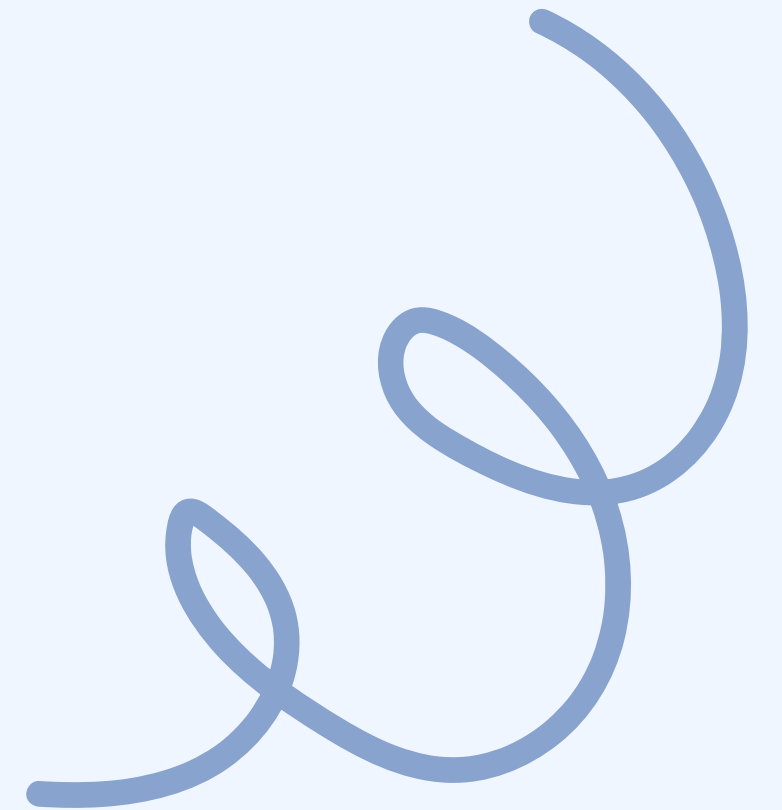
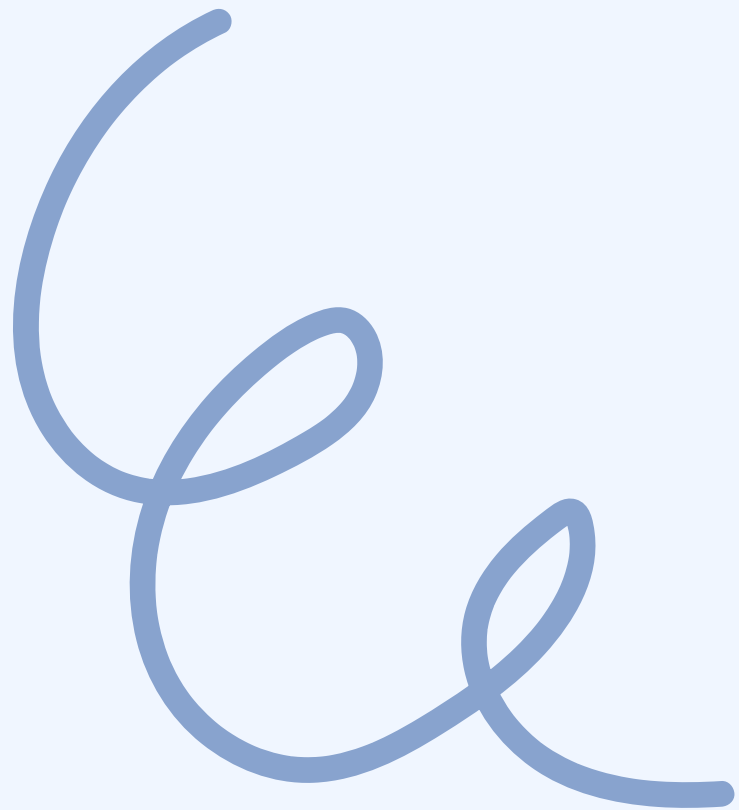
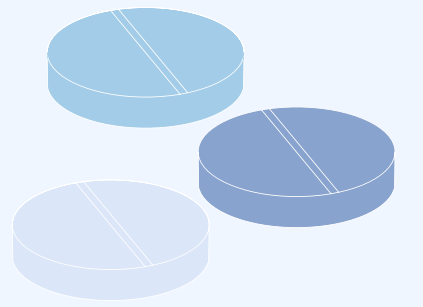
Prognosis

- **Limb loss is a significant risk in patients with diabetic foot ulcers, particularly if treatment has been delayed. Diabetes is the predominant etiology for nontraumatic lower extremity amputations in the United States. Half of all nontraumatic amputations are a result of diabetic foot complications, and the 5-year risk of needing a contralateral amputation is 50%.**
 - **In diabetic people with neuropathy, even if successful management results in healing of the foot ulcer, the recurrence rate is 66% and the amputation rate rises to 12%.**
- 

Differential Diagnosis

- The classic diabetic trophic ulcer must be distinguished from various other problems that tend to occur in persons with diabetes, (such as diabetic dermopathy, bullosis diabeticorum, eruptive xanthoma, necrobiosis lipoidica, and granuloma annulare.)
- The leg pain of peripheral arterial disease must be distinguished from other causes of leg pain, such as arthritis, muscle pain, radicular pain, spinal cord compression, thrombophlebitis, anemia, and myxedema.
- Diabetic neuropathy should be distinguished from other forms of neuropathy, including vasculitic neuropathies, metabolic neuropathies, autonomic neuropathy, radiculopathy, and many others.

- Atherosclerosis
- Basal Cell Carcinoma
- Bites
- Chronic Venous Insufficiency
- Cutaneous B-Cell Lymphoma
- Cutaneous Squamous Cell Carcinoma
- Cutaneous T-Cell Lymphoma
- Diabetic Foot Infections
- Kaposi Sarcoma
- Pressure Injuries (Pressure Ulcers) and Wound Care
- Pyoderma Gangrenosum
- Vasculitis and Thrombophlebitis



Other types of ulcer

1-Venous ulcer

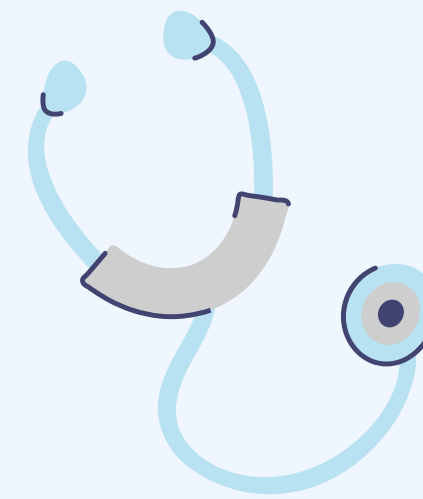
- Occurs typically around medial malleolus (inner ankle).
- The pain is mild to moderate ,arterial pulses are present .
- Skin changes : stasis dermatitis with lipodermatosclerosis .



Other types of ulcer

2- Arterial ulcer

- Occurs in Tips of toes , lateral malleolus and heel.
- Painful, punched out appearance with minimal bleeding ,cold skin and diminished or absent pulses.
- Skin changes: shiny atrophic skin with hair loss .



Other types of ulcer

3- Decubitus ulcer (pressure ulcer).

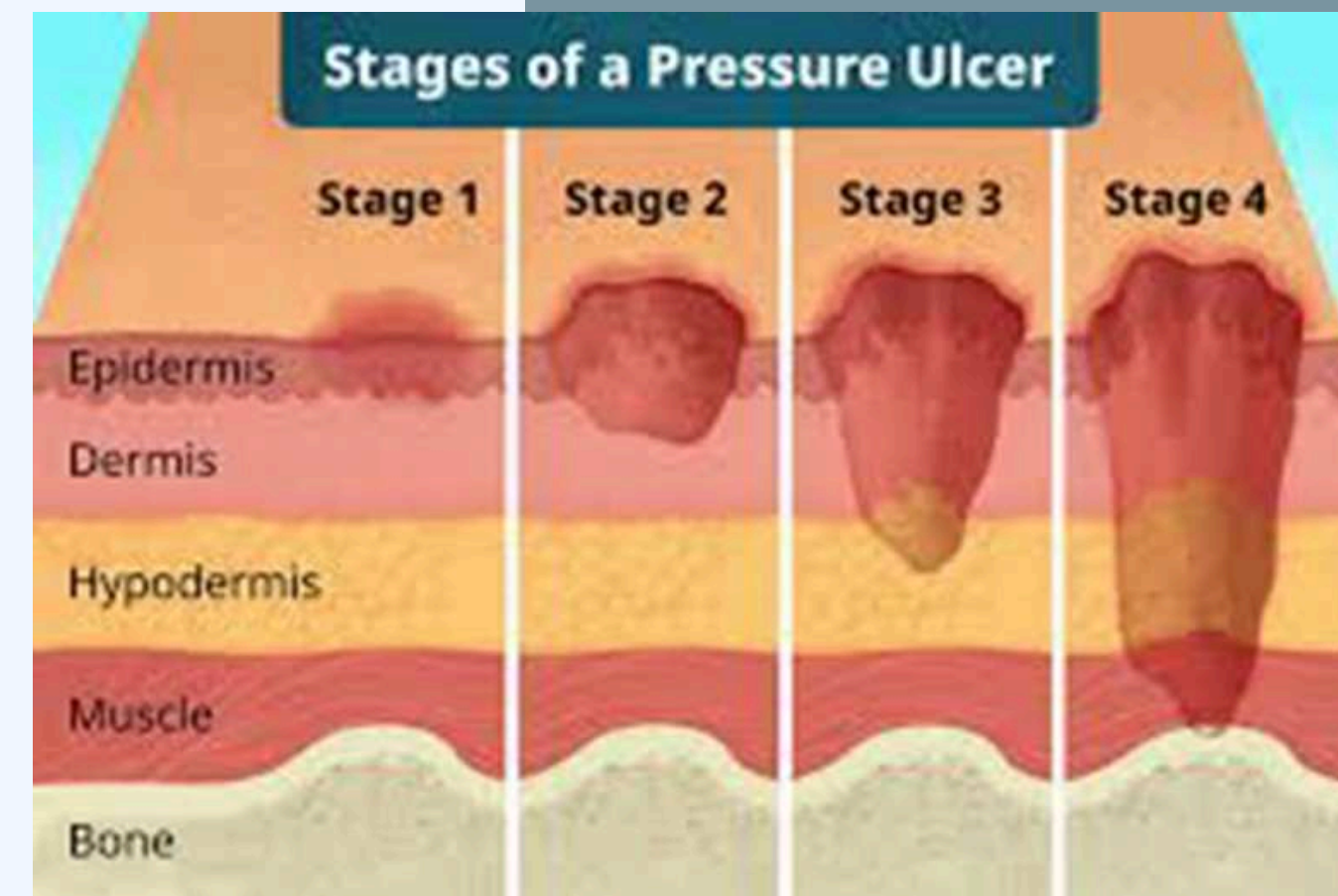
- Occurs over bony prominence e.g, heels
- Caused by prolonged pressure, often seen in immobile or bedridden patients
- Skin changes : depends on the stage and the depth of tissue involvement .
- Stage 1 (non-blanchable erythema) red or discoloration may appear purple or blue in dark skin .
- Stage 2 (partial thickness skin loss) it involves epidermis and possibly the dermis . Pink or red without slough . It presents as a shallow , open wound or as a blister .



Other types of ulcer

3- Decubitus ulcer (pressure ulcer).

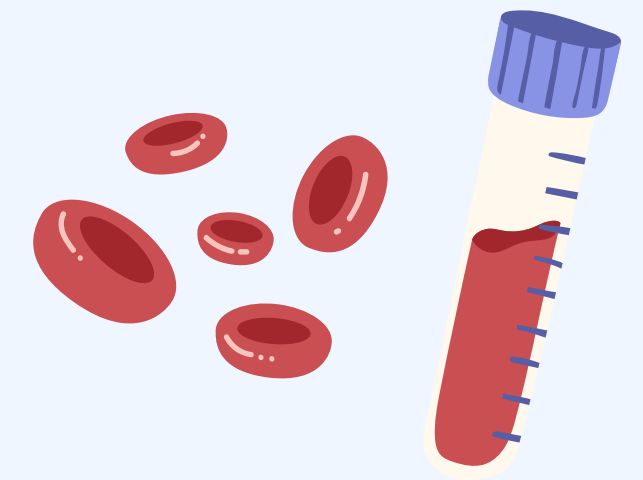
- Stage 3 (full thickness skin loss) extends through the dermis into the subcutaneous tissue . May contain slough . Can be red ,warm or inflammed
- Stage 4 (full thickness tissue loss) extends through all skin layers with bone,tendon or muscle exposed . Deep large ulcer with significant tissue destruction . May contain slough or eschar . Swelling , foul odor with pus discharge.



Common Locations of Diabetic Foot Ulcers



Work up



Blood Test :

A complete blood count (CBC) should be performed. Leukocytosis may signal an associated diabetic foot infection. Wound healing is impaired by anemia. In the face of underlying arterial insufficiency, anemia may precipitate rest pain .

Blood testing should also include an HbA1c assessment, since a normal value is a surrogate marker for wound healing.

Erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP) are inflammatory markers which are elevated in the setting of infection and osteomyelitis. They can be measured serially to determine the efficacy of treatment.

MRI :

In the setting of osteomyelitis, MRI is said to be both specific and sensitive. MRI is also useful for evaluating deep space infections, infectious tenosynovitis, myositis, and septic arthritis. However, in the setting of Charcot arthropathy, it is difficult to distinguish that condition from osteomyelitis.



Ankle-brachial index (ABI) :

- The systolic pressure in the dorsalis pedis or posterior artery divided by the upper extremity systolic pressure is called the ankle-brachial index (ABI) and is an indication of severity of arterial compromise. Normal ABI averages 1.0.
- An ABI less than 0.9 suggests atherosclerotic disease, with a sensitivity of approximately 95%. In general, an ABI below 0.3 suggests a poor chance for healing of distal ischemic ulcerations.
- Unfortunately, the ABI often is falsely elevated (and thus may be unreliable) if the underlying arteries are heavily calcified, a finding common in diabetic persons.

Staging

Wound classification is as follows:

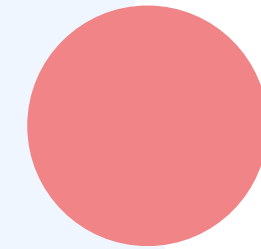
Grade 0 - Rest pain; no wound, no ulcer, no gangrene.

 **Grade 1** - Small shallow ulcer(s) on distal leg or foot; any exposed bone is only limited to distal phalanx; no gangrene

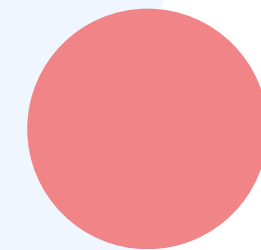
Grade 2 - Deeper ulcer on distal leg or foot with exposed bone, joint, or tendon, or shallow heel ulcer without involvement of the calcaneus; gangrenous changes confined to the digits

Grade 3 - Extensive deep ulcer of the forefoot and/or midfoot or full-thickness heel ulcer with or without involvement of the calcaneus

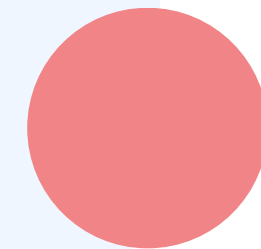
Classification of Ischemia is as follows



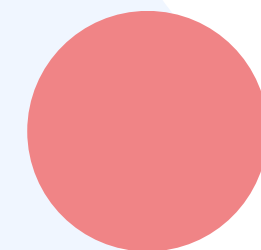
Grade 0 – ABI 0.8



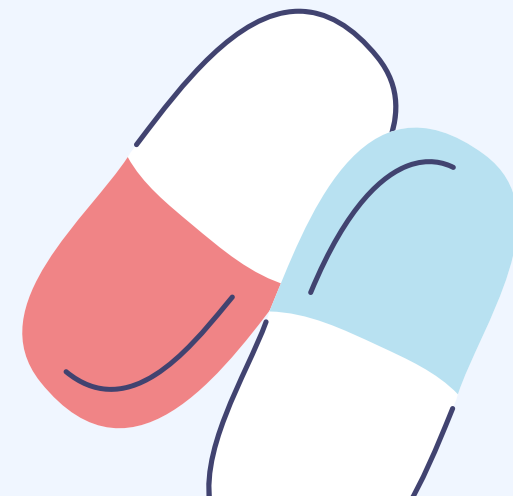
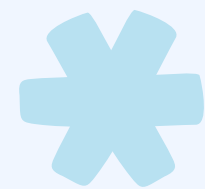
Grade 1 – ABI 0.6-0.79



Grade 2 – ABI 0.4-0.59



Grade 3 – ABI 0.39



Physical Examination



The exam is used to check the feet for:

- 1-Problems with the nerves and blood flow.
- 2- Signs of damage or injury.
- 3- Changes in shape

In the examination we will do :

- 1 -Inspection
- 2- palpation
- 3- pulses
- 4- Nerve function
- 5- ulcer examination



Inspection

- The exposure should include both lower limbs .
- you should check everything bilaterally .
- don't forget to check dorsal aspect and between toes .

In the inspection we will focus on :

- 1- Color
- 2- Hair distribution
- 3- Deformities
- 4- Any scar or amputation



- 5- Edema
- 6- Nail changes
- 7- Black discoloration
- 8- Muscle wasting



Palpation

check temperature of both legs with the back of your hand .

cool

Peripheral vascular disease

hot

Cellulitis / dvt



check for capillary refill time
If it's more than 2 sec that
suggest pvd





Pulses



Dorsalis pedis pulse :
on dorsum of foot in
the first intermetatarsal space
just lateral
to extensor tendon of great toe

Tibialis pulse :
2cm inferior and posterior
to medial malleolus





Pulses



Popliteal pulse :
flex leg a knee and palpate
with both hands

Femoral : just below the midpoint
of inguinal ligament (half way
between the ASIS and symphysis
pubis)



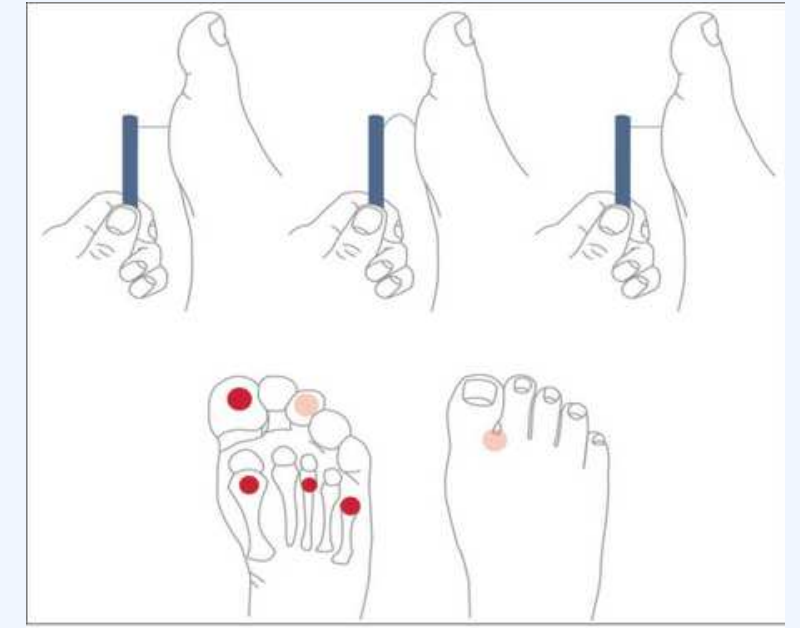
Nerve function

- **Use monofilament :**

Provide an example of monofilament on patient's sternum .

Let the patient close eyes .

Let them tell you if they feel monofilament .



- **Vibration :**

Assessment using tuning fork .

Start at the distal phalanx and move proximally if impaired.



- **Proprioception :**

If patient can tell direction of movement of big toe .

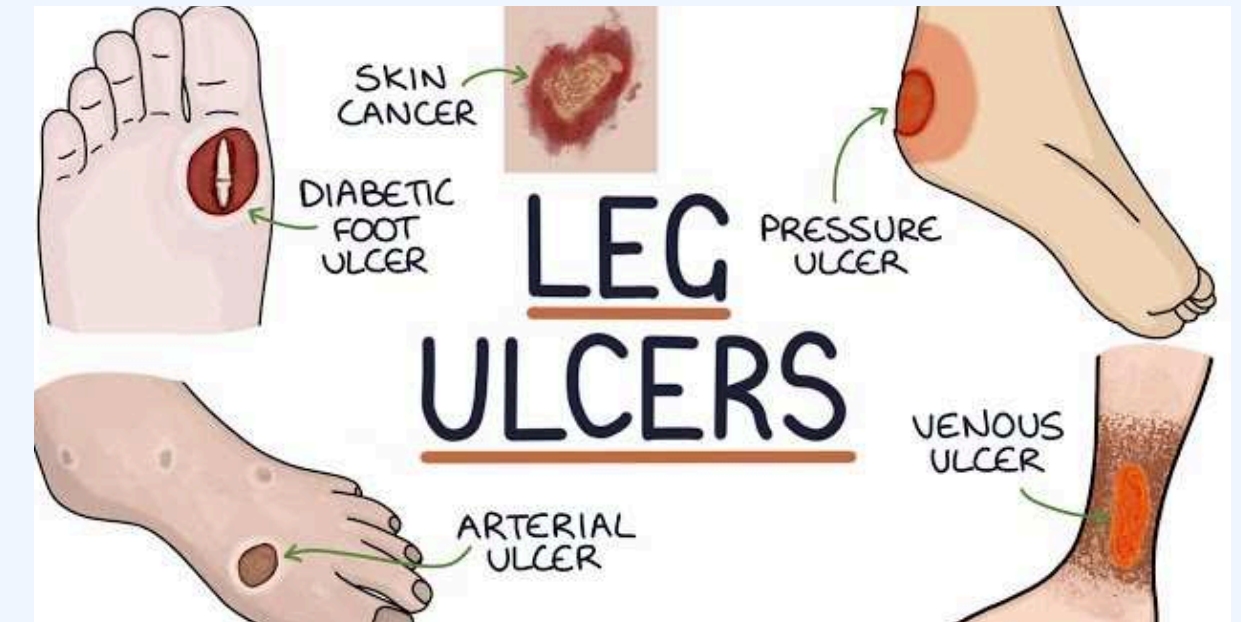
if impaired move proximally .



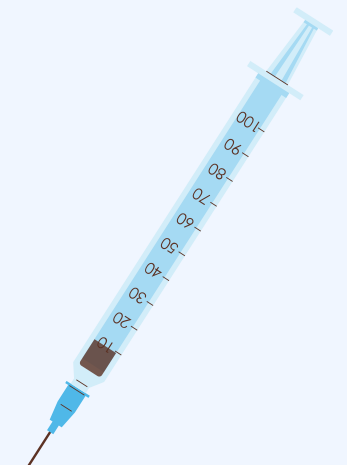
Ulcer examination

Check for :

- 1- Site
- 2- Shape
- 3- Number
- 4- Venous ulcer or arterial ulcer or neuropathic ulcer



ARTERIAL VS VENOUS ULCERS	
Arterial	Venous
 - Often found on the lower legs or feet - Characteristic 'punched out' appearance with well defined edges - Minimal wound exudate - Caused by arterial insufficiency due to poor blood flow THINK Arterial dangle the legs	 - Typically located around the ankles - Irregular shape and shallow wound edges - Moderate to heavy wound exudate - Caused by venous insufficiency & blood 'pooling' in the legs THINK Venous elevate the legs



Ulcer examination

you should look for :

-Surrounding tissue:

is it red? Necrotic ?

Margin = line of demarcation between normal and abnormal

Edge= the part between margin and floor

-Floor = exposed part of ulcer , Moist or dry dead tissue, Granulation tissue.

- Base =Sc fat, Muscle tendon , Bone .

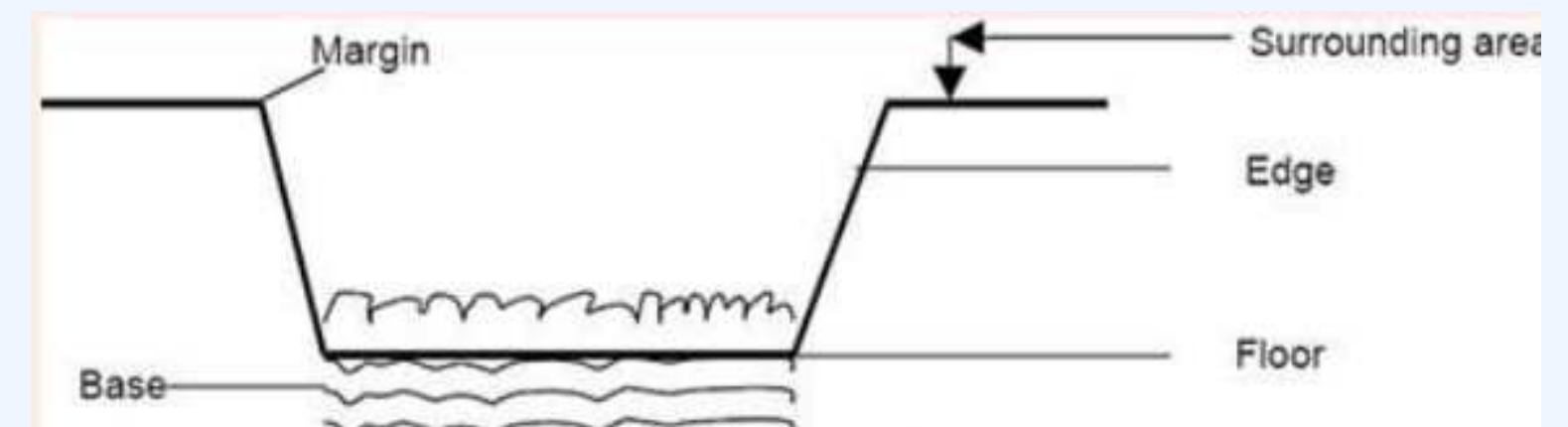
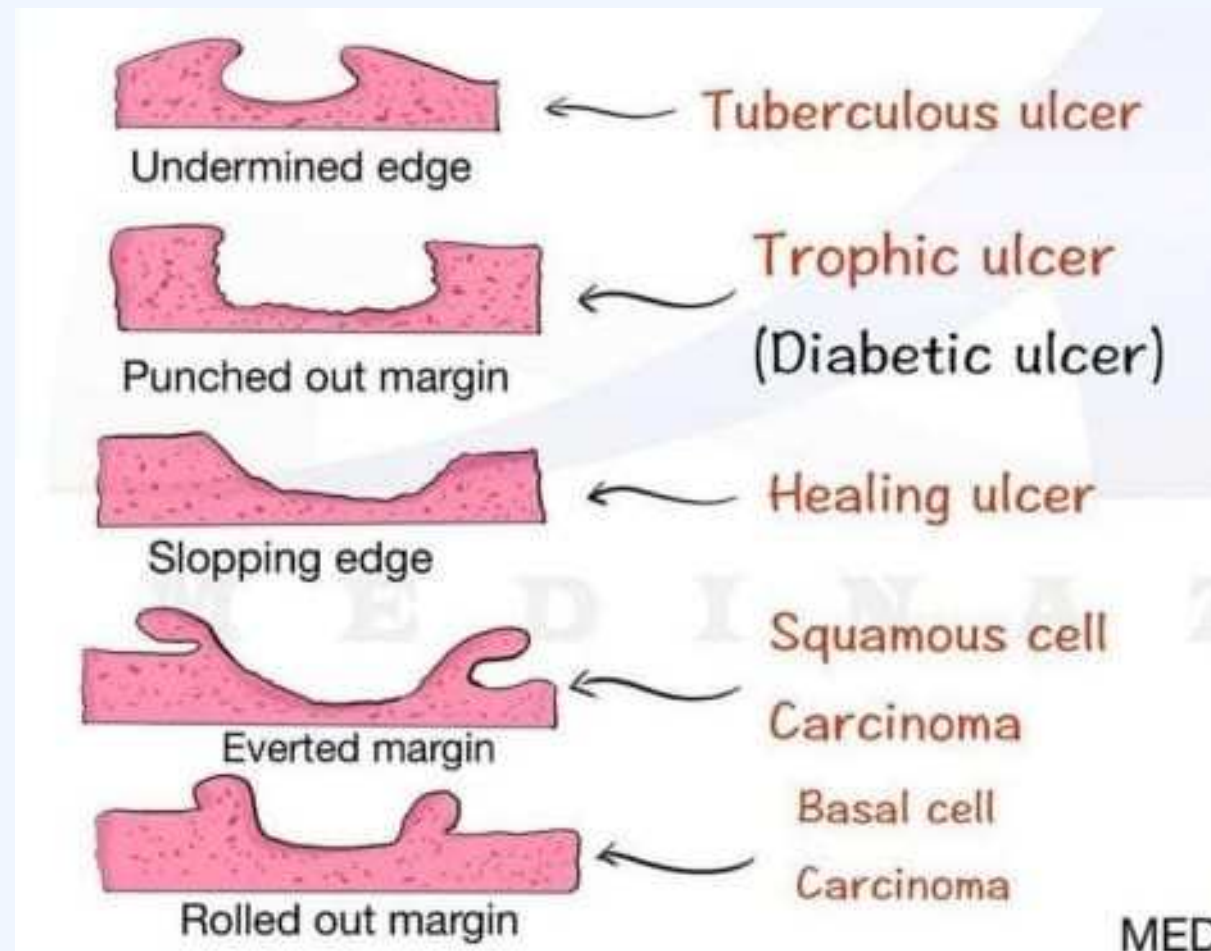
-Discharge=

Serous- healing ulcer

Blood stained- malignant

Purulent- bacterial

Greenish- pseudomonas infection



Treatment



Six intervention demonstrate efficacy in diabetic foot management :

- 1- off loading
- 2- Debridement and drainage
- 3- wound dressing
- 4- appropriate use of antibiotic
- 5- revascularization
- 6- limited amputation



Debridement

- Debridement is a procedure used to clean out dead or infected skin and tissue from a foot ulcer. It allows your doctor to assess the extent of the soft tissue damage and encourage healing.
- Adequate debridement must always precede the application of topical wound healing agents, dressings, or wound closure procedures .

Types:

- Autolytic debridement occurs naturally in healthy people.
- Enzymatic debridement (using proteolytic enzyme)
- Mechanical debridement
- Surgical debridement



OFF -LOADING

Diabetic offloading devices are used to treat or prevent foot ulcers. Their purpose is to redistribute pressure on plantar surfaces thereby reducing the risk of foot ulcers and infection



Common methods to offload the foot include bed rest, wheel chair, crutch-assisted gait, total contact casts, felted foam, half shoes, therapeutic shoes, and removable cast walkers

AMPUTATION

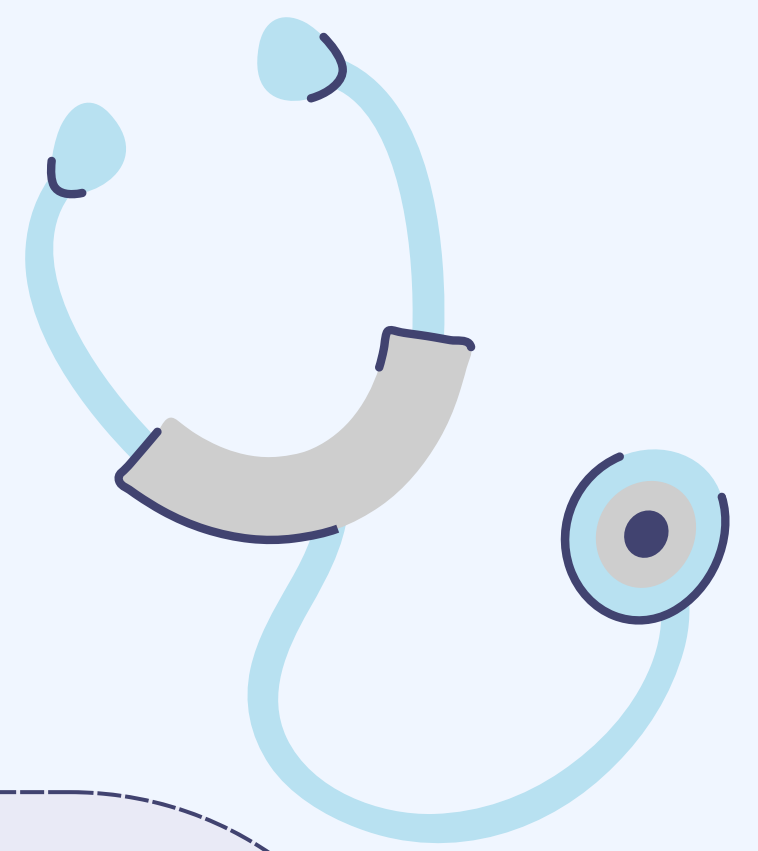
Indications for Amputation :

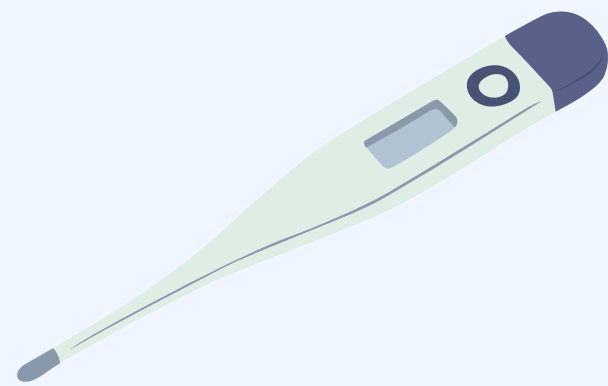
The limb has been
affected by **gangrene**

severe osteomyelitis

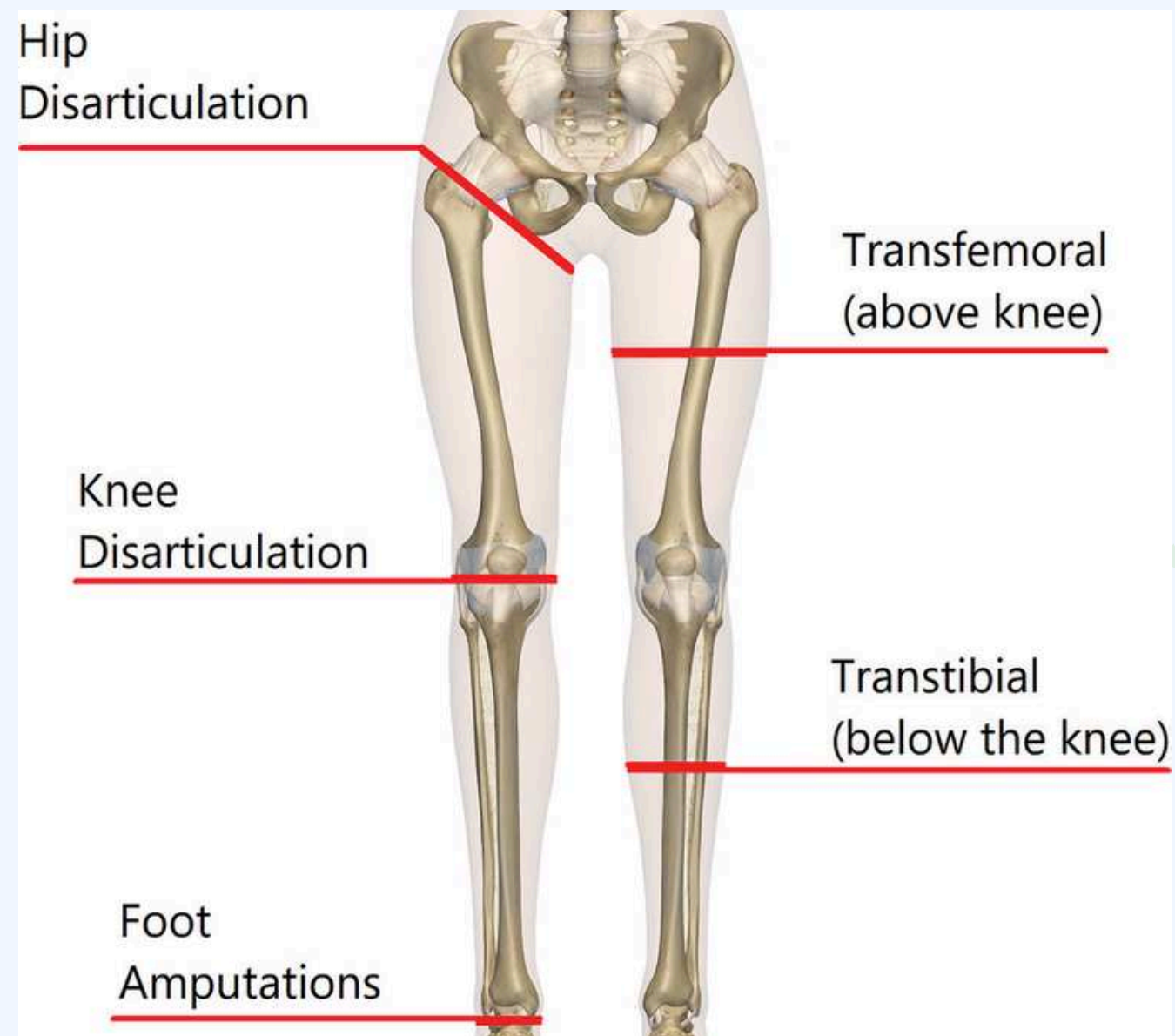
**severe ischemic lower
limb**

**chronic neuropathic ulcer
(most common cause for
amputation)**





TYPES OF AMPUTATION



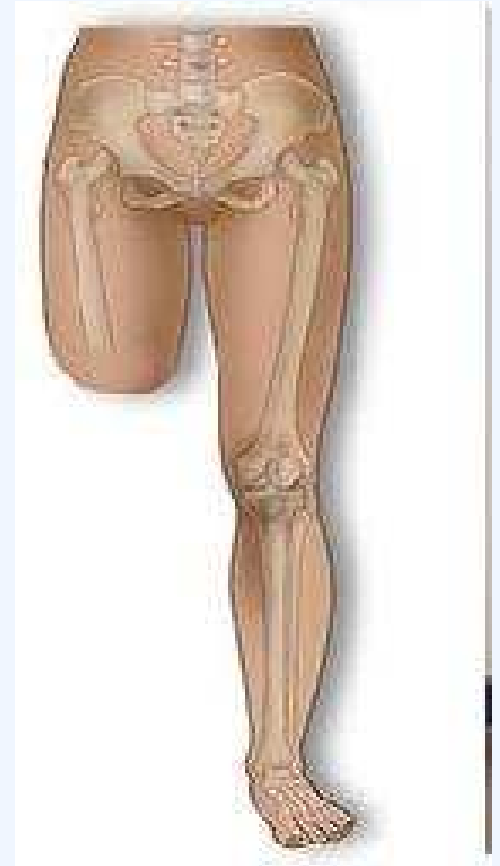
Major amputation

is defined by any ankle disarticulation, transfemoral amputation, or transtibial amputation

Minor amputation

defined as a toe or transmetatarsal amputation

Complications of Amputation:



01

Haemorrhage



02

Infection



03

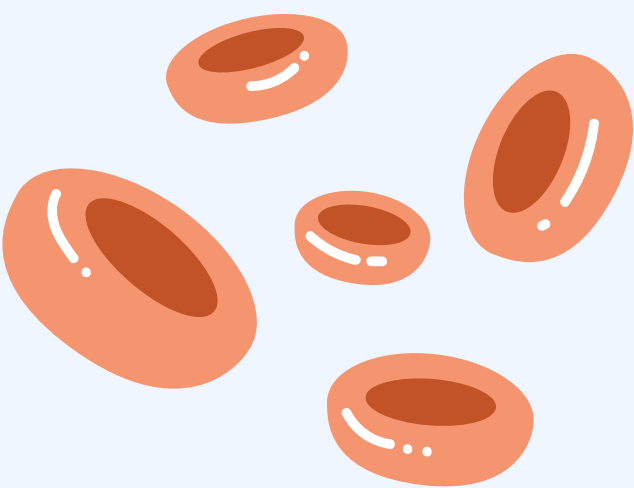
**Joint
contracture**



04

Phantom limb pain

the sensation that an amputated or missing limb is still attached to the body and is moving appropriately with other body parts



Medication

- Patients with mild infections can be treated in outpatient settings with oral antibiotics that cover skin flora including streptococci and S aureus .
- Agents such as cephalexin, dicloxacillin, amoxicillin-clavulanate, or clindamycin are effective choices.
- If MRSA infection is suspected, then clindamycin, trimethoprim-sulfamethoxazole, minocycline, or linezolid may be used.
- If gram-negative aerobes and/or anaerobes are suspected, dual drug treatment with trimethoprim-sulfamethoxazole plus amoxicillin-clavulanate clindamycin a fluoroquinolone .





Medication

- For moderate-to-severe infections, patients should be hospitalized for parenteral antibiotic therapy.
- Empiric choices should cover streptococci, MRSA, aerobic gram-negative bacilli, and anaerobes.
- MRSA is covered by vancomycin, linezolid, or daptomycin. Acceptable choices for gram-negative aerobic organisms and anaerobes include ampicillin-sulbactam, piperacillin-tazobactam, meropenem, or ertapenem.





Medication



- Duration of therapy should be individualized. For those treated in outpatient settings with oral antibiotics, duration of treatment is usually 7- 14 days.
- In those treated parenterally but without osteomyelitis, 2-4 weeks is sufficient.
- Longer duration of therapy is required for those with osteomyelitis—4-6 weeks at a minimum is suggested.
- Duration of treatment may be shortened in those patients who undergo amputation as part of the treatment regimen.