MANAGEMENT OF DIABETIC FOOT SYNDROME
CONS AND PROS OF PRACTIC IN EGYPT

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Nomenclature

Diabetic Foot Syndrome (DFS)

Diabetic Foot Syndrome (DFS) refers to a ***group of foot problems in people with diabetes***, which arise due to prolonged exposure to high blood sugar levels.

These complications include neuropathy, ischemia, and infections, leading to ulcers, deformities, and in severe cases, amputations.

Diabetic Foot is not a diagnosis

.Hyperglycaemia And Associated Metabolic Disturbances

Insulin Deficiency or Resistance

Insulin Deficiency: In Type 1 diabetes, autoimmune destruction of pancreatic beta cells leads to little or no insulin production.

Insulin Resistance: In Type 2 diabetes, cells become less responsive to insulin, and insulin secretion may eventually decline.

1- ***Impaired Glucose Uptake***

A- Reduced GLUT-4 Translocation:

Due to insufficient or ineffective insulin, GLUT-4 transporters are not adequately mobilized to the cell membrane, reducing glucose uptake by muscle and fat cells.

B- Hyperglycemia:

As a result, glucose remains in the bloodstream, leading to elevated blood glucose levels.

Hyperglycaemia / Diabetes is a Metabolic Disease

- **GLUT-4 transporters are not adequately mobilized** to the cell membrane, reducing glucose uptake by muscle and fat cells glucose remains in the bloodstream **causing raising blood glucose levels**.

- **Increased Glycogenolysis**: To compensate for perceived energy deficits, glycogen breakdown increases, **further raising blood glucose levels**

- **Excessive Gluconeogenesis**: The liver continues to produce glucose from non-carbohydrate sources, **exacerbating hyperglycemia despite already high blood glucose levels.**

Chronic Hyperglycaemia damage vascular tissue

Vascular Surgeon should not treat hyperglycaemia and refer the patient to Endocrinologist

Absolute Tissue Perfusion Concept

- ***Availability and Utilization***

Many patients are with intact pulses and good capillary refilling and has severe dermatological complication ulcers, etc.…

Adequate tissue perfusion is crucial for cellular function, tissue health

The blood may be available but not utilized by the cell

Availability of blood may not ensuring (Adequate tissue perfusion) adequate delivery of oxygen and nutrients while removing metabolic waste products in metabolic disorder

Metabolic Consequences of Chronic Hyperglycemia

1- Advanced Glycation End-products (AGEs)

Formation: Chronic high blood glucose leads to non-enzymatic glycation of proteins and lipids.

Effects: AGEs accumulate and interfere with normal cellular function,

contributing to vascular damage and complications.

2- Oxidative Stress

Mechanism: Excess glucose increases reactive oxygen species (ROS) production, leading to oxidative stress.

Impact: Oxidative stress **damages cellular components including vascular**

3- Polyol Pathway Activation

Process: Excess glucose is shunted into the polyol pathway, converting glucose to sorbitol and fructose.

Consequences: Accumulation of sorbitol can cause osmotic stress and **cellular damage**

4- Inflammation

Chronic Inflammation: Persistent hyperglycemia induces inflammatory pathways,

causing tissue damage

Metabolic Consequences of Chronic Hyperglycemia

1- **Advanced Glycation End-products** (AGEs)

- Formation: Chronic high blood glucose leads to *non-enzymatic glycation of proteins and lipids.*

- Effects: ***AGEs accumulate*** and interfere with normal cellular function, ***contributing to vascular damage*** and complications.

Vascular damage is a continuing process even with availability of blood

Metabolic Consequences of Chronic Hyperglycemia

2- **Oxidative Stress**

- Mechanism: Excess glucose increases reactive oxygen species (ROS) production, leading to oxidative stress.

- Impact: ***Oxidative stress damages cellular components***, contributing to diabetic complications

Oxidative stress damages cellular components

The need of anti-oxidant for every diabetic patient

Which is usually omitted from medication of diabetic patient

Metabolic Consequences of Chronic Hyperglycemia

3- **Polyol Pathway Activation**

- Process: *Excess glucose* is shunted into the polyol pathway, *converting glucose to sorbitol and fru*ctose.

- Consequences: Accumulation of sorbitol can cause osmotic stress and cellular damage, particularly in nerves and the lens of the eye.

Accumulation of sorbitol can cause osmotic stress and ***cellular damage***

Metabolic Consequences of Chronic Hyperglycemia

4- **Inflammation**

- Chronic Inflammation: *Persistent hyperglycemia* induces inflammatory pathways, contributing to insulin resistance and *tissue damage*.

Persistent hyperglycemia induces inflammatory pathways and cause Tissue damage

Hyperglycaemia And Associated Metabolic Disturbances

Complications

Microvascular Complications: Diabetic retinopathy

Nephropathy--------- Duplex guided intervention is the golden ideal solution

But its use is still limited ??????????????

- SFA & popliteal occlusion and stenosis
- SFA flush lesion
- Covered stent for falce aneurysm and A V fistula of SFA vessels
- IVC filter in pregnant patient
- Dilation & stenting of failing A V fistula in ESRD

? How we investigate Diabetic Foot Lesion (pedal Arch)

API

- Does not suite diabetic patients (medial sclerosis)
- Even in non diabetic patients ***it evaluate the crural arteries*** not the foot arteries
- ***How much we use transcutaneous oxygen pressure (TcPO2) and Skin Perfusion Pressure (SPP) ??????????***

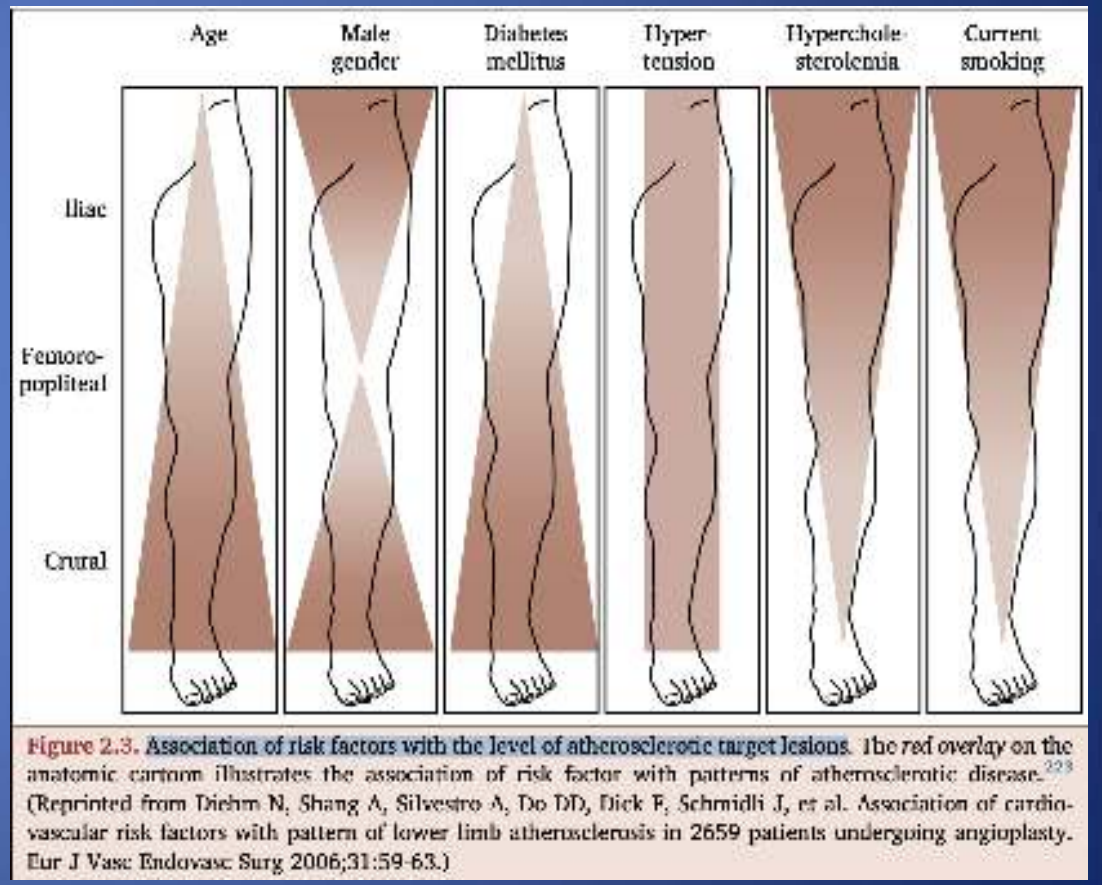

Figure 2.3. Association of risk factors with the level of atherosclerotic target lesions. The red overlay on the anatomic cartoon illustrates the association of risk factor with patterns of atherosclerotic disease.[223] (Reprinted from Diehm N, Shang A, Silvestro A, Do DD, Dick F, Schmidli J, et al. Association of cardiovascular risk factors with pattern of lower limb atherosclerosis in 2659 patients undergoing angioplasty. Eur J Vasc Endovasc Surg 2006;31:59-63.)

Global Vascular Guidelines on the Management of Chronic Limb-Threatening Ischemia

Diabetic **Peripheral** Neuropathy

Diabetic Peripheral Neuropathy

- Motor
- Sensory

  - Superficial plantar cutaneous sensation
  - ***Deep proprioceptive sensation***

Impaired balance and coordination, increased risk of falls ***falls and fracture***

I Walk on a Cotton

The patient should be advised to walk wis support

Can Off-loading devices help for the maintenance of balance ??

Diabetic **Autonomic** Neuropathy

Autonomic Dysfunction

- Gastroparesis
- Orthostatic hypotension
- Bladder dysfunction
- Erectile dysfunction
- ***Loss of vasotone leading to chronic leg oedema***

  (Diabetic neuropathic oedema)
- Abnormal sweating & dry cracked skin

- **Diabetic neuropathic oedema** is a ***chronic and not reversable***
- Unrecognized by many doctors
- Diuretics is usually prescribed which is useless and big mistake

Diabetic **Autonomic** Neuropathy

Autonomic Dysfunction

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- Erectile dysfunction
- Loss of vasotone leading to chronic leg oedema ***(Diabetic neuropathic oedema)***
- ***Abnormal sweating & dry cracked skin***

Care of the skin of diabetic patients with moistring cream should not be neglected

Proximal Diabetic Neuropathy (Diabetic Amyotrophy)

Manifestations:

- ***Severe pain***
- Muscle weakness
- Atrophy in the proximal leg muscles.

This type of Sever leg pain is usually unexplained
or diagnosed by mistake as radiculopathy

Diabetic **Focal** Neuropathy

Sudden onset of nerve dysfunction affecting specific nerves

Manifestations:

Pain and weakness in one specific area, such:-

- The head
- Torso
- **leg**

can include carpal tunnel syndrome, cranial neuropathies, and thoracoabdominal neuropathies.

It could be the cause of unexplained leg pain

Motor Dysfunction

Motor Dysfunction

Muscle weakness leading to foot deformities such as claw toes and hammer toe

Deformity and new pressure areas lead to pressure ulcers with underneath osteomyelitic bone Which cause chronicity and need to be excised in most instances

Macrovascular Complications

Macrovascular Complications:

- Atherosclerosis and Ischemic Foot

- Claudication pain **Vs** Radiculopathy pain
- Diabetic neuropathic pain **Vs** Ischemic rest pain
- **Ischemic gangrene** & **putrefaction** **Vs** **Diabetic soft tissue infection**

Diabetic **Macrovascular** Complications Investigation and Treatment

Macrovascular Complications:

Atherosclerosis and Ischemic Foot

Pedal ARCH evaluation

API **(false / medial sclerosis / does not assess foot perfusion)**

Assessment of foot perfusion ((TcPO2), (SPP) **)**

Angiosome concept

Transcutaneous oxygen pressure (TcPO2), Skin perfusion pressure (SPP) are recommended for evaluation of pedal circulation

Pedal ARCH revascularization open and endovascular

Angiosome concept

Wound Care

Common advice to the patients:- **do not let the water touch your leg**, use saline solution to clean your

???????? leg

Dermatological lesion in diabetic patient

Dermatological lesion in diabetic patient has a special nature:-

It ranges from dry ***cracked skin*** / ***eczematous yellowish skin*** And ***Bullosis Diabeticorum*** (Diabetic Bullae)

Dermatoliposclerosis, oedema and brownish discoloration Bilaterally over the anterior aspect of the leg

mimic chronic venous insufficiency (postphlebitic limb)

Extensive infective ulceration and wide spread skin gangrene

Necrobiosis Lipoidica Diabeticorum

Dermatological lesion in diabetic patient

Contrary to ischemic ulceration it usually takes local spreading areas all over the leg and not necessary over the toes or forefoot

Tissue gangrene can occur in proximal areas and saving the more distal parts

Monilial Infection

Interdigital monilial infection is common in diabetic patients

Interdigital clefts examined for monilial infection in diabetic patients

Infection Control

Diabetic patient is immune compromised patient

Diabetic foot infection has two striking features:-

- Diversity of organisms
- Increase organisms load

Antibiotic usage: It is recommended to use double or even triple broad spectrum antibiotic for longer period than non-diabetic

Medication

Chronic hyperglycaemia consequences

1- Advanced Glycation End-products (AGEs)

2- Oxidative Stress

3- Polyol Pathway Activation

4- Inflammation

Cause vascular damage and turn the ***intima thrombogenic surface***

And turn the ***patient into secondary thrombophilic***

Anticoagulant is used in management of diabetic patient

Necrobiosis Lipoidica Diabeticorum (NLD)