Chapter 3

Poor Circulation, Big Consequences: What Every Diabetic Must Know

Obliterative Arteriosclerosis (ASO) is a term used to describe a slow chronic disease of occlusion (obstruction) of the arteries by arteriosclerosis plaques (abnormal hardening and thickening of the artery wall).
ASO involves the large and medium arteries such as the common iliac artery in the pelvic area, the femoral artery above the knee, the popliteal artery, and the tibial artery behind the knee. As people with Diabetes Mellitus, along with ASO patients, the small arteries of the skin and the capillaries of the foot are involved in microangiopathy which is characterized by thickening of the wall of the blood vessel. Therefore, blood circulation problems in diabetic feet are more severe and common. There are several theories that describe how the forms of arteriosclerotic injury affect the arteries, but the risk factors for this disease are well known. Cigarette smoking, high blood pressure, high blood cholesterol, and diabetes are the main factors that contribute to a high risk of disease. Occlusion of the arteries above the level of the pelvis (common iliac arteries) can result in sexual impotence and therefore thigh and leg cramps while walking. Occlusions of the popliteal artery (behind the knee) and the tibial artery (in the calf) are more common in the diabetic patient. The occlusion process can be fast, moderate, or slow. When the process is slow, the collateral arteries may form a communication at the site of the occlusion. In this case, the symptoms may be mild or totally absent.

When there is a rapid occlusion, it is generally due to an arterial embolism (small blood clot that floats in the artery) which means, it is the result of advanced arteriosclerosis. A sudden development of gangrene can be the result of an arterial embolism. If you have a heart problem, the more you suffer from Diabetes Mellitus, the amount of blood that your heart pumps to the body will decrease and therefore the blood circulation to the foot is also reduced.

There are many signs and symptoms that characterize circulation problems in diabetic foot. When the foot is raised above the level of the heart, the toes turn pale(Fig 3-1)


Fig 3-1


Fig 3-2


Fig 3-3

but as soon as you stand up, the toes may turn dark and bluish (Fg 3-2).
This sign is characteristic of arterial problems. The skin of the foot and leg can be smooth, shiny, and paper-thin and toenails become brittle and yellowish because of lack of blood circulation in the toes (Fig 3-3). The foot is cold and wet to touch and the pulses in the foot are absent. Occasionally, you can feel the pulses when the foot is resting, but they disappear during or after exercise. If one foot is colder than the other, it is more significant that both feet are cold. Hair loss on the toes, top of the foot, and lower leg may be present. The thigh and leg muscles can become smaller due to insufficient blood supply.
In some cases, you may have a condition called Intermittent Claudication which is described as pain and cramping of the thigh and / or leg muscles after walking a certain distance (Fig 3-4).


Fig 3-4

Pain and cramps are gradually relieved by discontinuing walking and massaging the leg. As the disease progresses, the distance you can walk without cramping and pain becomes less and less. When the disease reaches its most severe form, you may have pain at night in the buttock, thigh, or calf. This pain is relieved by getting out of

bed and walking around. This means that your leg is congested with blood, and this increases the gravity when standing. In this case, you are at the highest risk for gangrene even from minimal trauma to the foot.

In this advanced stage of the disease, you may develop a foot ulcer and no signs of bleeding can be seen from the ulcer (Fig. 3-5).

Fig 3-5

Fig 3-6

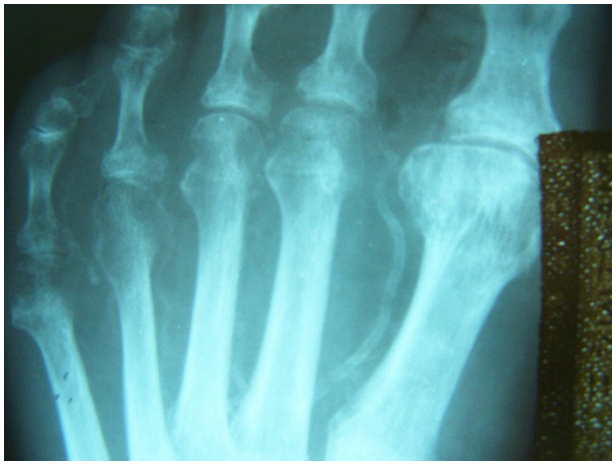

Fig 3-7 Hardening of the artery of the foot

This is called an ischemic ulcer and it can be very painful. However, in diabetics the ulcer can be painless due to the presence of neuropathy.

Symptoms of arterial disease can alert an experienced podiatrist to conduct appropriate diagnostic tests. Capillary filling time with the patient lying down is a simple but specific test to measure the extent of arterial perfusion of the toes. Your doctor may initially order an ultrasound test of your lower extremities as it is an important test for measuring blood flow. This measurement can be taken with the patient standing and after exercising. The experienced doctor can truly discern the different types of sounds that the passage of blood flow produces through ultrasound (Fig 3-6). The ultrasound examination also measures the blood pressure in the arm and foot, and the

radius it provides, is of the utmost importance for a foot wound to heal. Unfortunately, if there are calcified (hardened) arteries in the diabetic foot (Fig. 3-7), the ultrasound will measure the blood pressure and it cannot be used. In fact, the diabetic foot can fool even the most experienced doctor, because circulation problems in diabetic feet are so often mistaken. The foot may be warm, the toes may not turn pale with elevation of the feet, and they may still have pulses.

Nowadays, contrast angiography allows one to see the image of the lumen of the artery and more recently Magnetic Resonance Angiography (Fig 3 - 8) has gained significant popularity among vascular surgeons. The 3D CT (Fig 3 -9) scan is also useful as a diagnostic tool.

Fig 3-8 MR angiogram

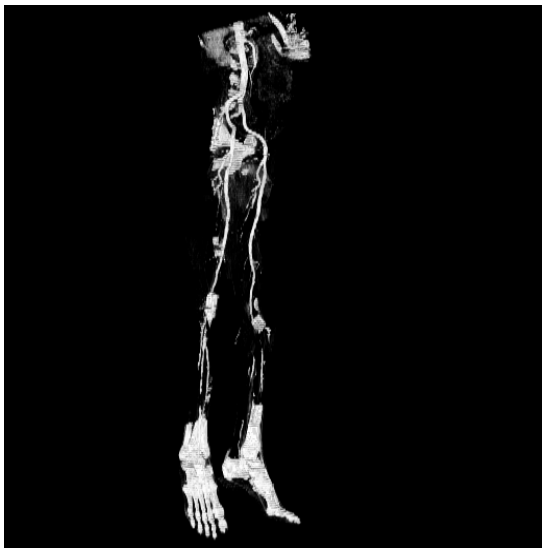

Fig 3-9 3-D CT angiogram

Once you have been diagnosed with arterial disease in your feet, you need to understand the consequences of presenting this significant problem. The foot amputation rate in diabetic people is "fifteen times higher" than in the non-diabetic population. The initial lesion of the skin, be it a blister or a callus, occurs in the painless neuropathic foot. However, there is an arterial circulatory problem that hinders these foot injuries, so that they may not heal. The impaired circulation stimulates necrosis of the tissue around the skin lesion. Bacteria thrive in a rich environment of diabetic foot necrotic tissue where the arterial supply is impaired. The decrease in blood flow to the foot prevents the arrival of antibiotics as well as the cells that fight infection which are called leukocytes. Also, the decrease in oxygen to the contagious site promotes the growth of bacteria that do not require oxygen, and which are very destructive to the foot. Neuropathy as well as damaged blood circulation and infection make diabetic people very susceptible to a crisis that will lead to foot amputation. You need to

understand that diabetic foot arterial disease will stay with you for the rest of your life. You have to change your lifestyle that includes quitting smoking, lowering cholesterol, lowering blood pressure, and intensive diabetes management. Regular exercise becomes important in your life, as collateral blood circulation will form. When you have sufficient collateral circulation, this may prevent surgical treatment or even amputation. Perform exercise daily, walk at a distance where you start to feel a cramp in the leg muscle or if you have pain, then stop, do this three to four times a day. Inspect the feet daily for possible infection or any cuts. Wash your feet daily with a mild soap in warm water. Let it be a doctor or your podiatrist who regularly has your toenails checked, as well as your calluses, and who is taking care of your feet, when you need it. Wear only appropriate shoes (Chapter 10). Orthotic insoles (Chapter 10) are essential for you to wear if you have neuropathy and circulation problems. Ulcers on the sole of the foot will not heal unless the weight of the foot is redistributed away from the ulcer, using this type of insole. These special insoles are important tools in the prevention of foot ulcers in the presence of neuropathy. The fungal infection can seriously affect your already damaged foot and can lead to a bacterial infection and thus gangrene. You have to remember that small infections; such as ingrown toenails (F 3-10), can develop into ulcers, become gangrenous and will require amputation (fig. 3-11).

Fig 3-10

Fig 3-11

There are surgical procedures that can be beneficial for people with severe arterial occlusive disease. If you have foot pain when you rest, foot ulcers that do not heal, frank gangrene, or impending gangrene, you can discuss the possibility of surgery with your doctor. There are surgeries that can prevent a major leg amputation. Vascular surgeons can effectively revascularize the foot or leg so that the level of the amputation site is more limited. You have to be realistic and that not everyone can be a candidate for vascular reconstructive surgery. A vascular surgeon can determine if you may be a candidate for surgery performed by an arteriogram. In case of occlusion of the small

arteries of the foot, amputation of one or several toes may be indicated. In the occlusion of large arteries as in ASO, it would be impossible to avoid surgery, if the amputation were done below the knee (Fig-12) it would be better, than if it were done above the knee (Fig-13), because the risk would be less and the rehabilitation would be easier.

Fig3-12

Fig 3-13

It is extremely important to recognize the early signs of circulation problems in your feet, your consent to seek medical attention and change your lifestyle would prevent you from being just another patient within the statistics.

TEST YOURSELF

(T F) True or false

1. T F Circulation problems to the foot are more common and severe in diabetics than non-diabetics.

2. T F People with diabetes who smoke cigarettes, have high blood pressure and high blood cholesterol level are more prone to foot complications and amputation.

3. T F Intermittent claudication should describe sudden blockage of blood vessels of the leg in diabetics.

4. T F Diabetic foot ulcer develops when there is a problem of blood circulation, but as long as there is no pain from foot ulcer, it is not a concern.

5. T F When you experience cramps or pain in the calf, thigh or buttock, but are relieved by walking, you should let your doctor know immediately.

6. T F If the foot is cold and wet and the toes are bluish / dark; you may be at risk of developing a spontaneous foot ulcer and infection.

7. T F If you have weak pulses in your feet and the hair on your toes which gradually disappear, you may have a blood circulation problem.

8. T F If you have a circulation problem in the feet and legs, you need protective shoes and proper orthotics in shoes to prevent skin irritation.

9. T F Leg blood bypass surgery should increase blood flow to the foot.

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1. (T) 2. (T) 3. (F) 4. (F) 5. (T) 6. (T) 7. (T) 8. (T) 9. (T)

Chapter 5

Hidden Under the Nail: Silent Dangers for the Diabetic Foot

Toenail problems in diabetic patients are of the utmost importance since they can be the frequent causes of infection and gangrene, most of the time they frequently go unnoticed by the body during a routine physical examination at the doctor's office. The main function of the nails is protection, and they help us appreciate the fine touch, however the nails have no appreciable functions except for cosmetic reasons and possibly protection of the toes.

Without the skin, nails have a low water content therefore they are harder and grow more slowly. They are susceptible to fungal infection and the skin around the nail (Fig 5-1) is susceptible to bacterial infection. Nails can show slow changes sometimes indicating insidious systemic diseases such as diabetes (Fig 5-2), thyroid problems and other hormonal problems.

Fig 5-1 Fungus infection of the skin

Fig 5-2 fungal infection of the nail

Nails need an adequate supply of blood, oxygen, and nutrients. However, when the circulation is damaged due to the patient suffering from Diabetes Mellitus, the nails experience many types of pathological changes. They become brittle, whitish and thin when there is poor circulation (Fig 5-3).

Fig 5-3

INGROWN TOENAIL

Initially a portion of the toenail penetrates the surrounding skin and creates an ingrown toenail. This is a painful condition, but if you are unable to feel pain due to neuropathy, this may go unnoticed. Damaged circulation in diabetics hinders the skin to heal and stimulates necrosis (tissue death) of the surrounding tissue(Fig 5-4). Bacteria can multiply rapidly in this necrotic tissue(Fig 5-5). It is this contagious process that stimulates further necrosis of more tissue. The toe becomes whitish to grayish in color, before turning into a gangrenous black toe (Figure 5-6). The bone under the toenail becomes infected and necrotic. This entire process can occur within a few days while the patient is totally unaware of the pain due to his neuropathy. At this time, antibiotics are ineffective due to decreased blood flow to the foot preventing the arrival of the antibiotic to the gangrenous and infected toe. The foul smell of gangrene is due to anaerobic bacteria which do not require oxygen to survive. These are very destructive and multiply rapidly because there is no oxygen reaching the area. At this time, amputation of the toes becomes necessary.

Fig 5-4 ingrown toenail with poor circulation

Fig 5-5 infected ingrown toenail

Fig 5-6 Gangrene from infected ingrown toe nail

THEN WHAT ARE THE CAUSES OF INGROWN TOENAIL ON THE FOOT?

Probably one of the most common causes is improperly clipping nails. Do not cut your toenails too short. Another cause of ingrown toenail is a narrow shoe box pressing the edges of the nail down against the skin of the toe or on either side of the nail. Sometimes, as in the case of a person with a bunion, the great toe presses against the second toe, causing burrowing of one or both nails (Fig. 5-7). Ingrown toenail can also occur when the nail buries in the surrounding flesh and is further aggravated by tight shoes. Sometimes the nail bends compressing the mattress at the nail. In some people, the big toe is deformed, and the surface of the floor presses on the skin, causing a ingrown nail.

Fig 5-7

SO HOW DO YOU PREVENT INGROWN TOENAIL AND INFECTION?

Preventing ingrown toenails is as simple as properly trimming the nails.
If you are diabetic, you should be under the care of diabetic foot specialist, a podiatrist. Nail clippers used around the house, especially if they are rusty, should be thrown away as you should avoid accidentally cutting your skin. If you have extensive arterial disease and neuropathy, it is recommended that you have someone else trim your toenails, preferably a podiatrist. Routine visits to your podiatrist is the most effective way to reduce the number of amputations in a diabetic. Each year an average of 35,000 to 40,000 diabetic patients undergo amputation of either a toe, foot or leg, at a cost of $ 10 billion. This figure does not include the cost of rehabilitation, prosthetics, lost time from work, loss of employment, and welfare payments. Some of the causes of these amputations result from a simple infected ingrown toenail.

Some doctors recommend a treatment to fill the corner of the nails with cotton or cut the center of the nail in a "V" shape, but I personally do not recommend this type of treatment as it does not have any function or purpose. Avoiding the use of narrow and pointed shoes on the toe box is a good way to prevent this problem. But the best way to prevent complications secondary to ingrown toenails is the self-examination every day and regular visits to your podiatrist every month.

Check your feet daily. If this exam is difficult, use the help of a family member or use a hand mirror, which will help you examine the bottoms of your feet. Always check for any redness around your nail, even if you don't feel discomfort or pain in your toes. Redness and inflammation can be the first signs of an infection. Notify your doctor immediately, and don't try to remedy the problem yourself by irritating the skin of the ingrown nail. Initially soak the foot in warm salt water for a few minutes, then dry the skin well and between the toes. Apply antibiotic cream to the affected site and wear loose shoes that do not pinch your toes. Do not soak the foot in an antibacterial

solution such as iodine, which can have minimal results in the presence of an infected foot. The chemical iodine in high concentrations in the water, when your foot is soaked, can damage the normal cells that are present and can aggravate the infection process and necrosis in diabetic feet.

FUNGAL INFECTION OF THE TOE NAILS.

Fungal nail infections are very common in diabetics. One of the most frequent causes of these infections are due to lack of a closed environment such as footwear, the use of synthetic socks and a humid environment inside the shoes, all these causes promote the growth of the fungus. A fungal infection of the nails causes the nail to turn yellowish and thick, and the powdery (Fig. 5-8).

Fig 5-8

The fungus in the nail as such, does not have any immediate damage, (just like the ingrown nails). However, if it becomes secondarily infected by bacteria, this can be a serious problem. The fungus causes severe disturbances in the appearance of the nail as a whole, specifically when the root of the nail is affected (Fig. 5-9).

Fig 5-9

Fig 5-10

The nail is deformed and thickened with accumulation of debris under the nail plate. The fungal infection can start with one toenail and subsequently progress until it infects the rest of the nails, from there it can go on to infect the rest of the skin which is known as "Athlete's Foot".(Fig 5-10). Athlete's foot causes dryness with peeling of the skin, multiple small vesicles with a clear fluid inside, itching, although the latter does not always manifest early. The fungal infection has a typical musty odor that can be problematic and treating the odor can be difficult without treating the fungus first. Foot odor is commonly secondary to these infections caused by the fungus which become chronic due to lack of treatment. Thick and disfigured nails in a tight shoe compress the skin of the toes, and this causes irritations with a high potential to ulcerate and subsequently become infected in a diabetic patient suffering from neuropathy with partial or total absence of pain. These ulcers can also occur below the nail, making it even more difficult to detect before they are detected. In fact, it can be infected by bacteria. When there is pus under the nail, this usually means a serious infection affecting the toe bone. At this level of infection, the oral antibiotics do not always work, specifically in a diabetic who also suffers from poor circulation in his feet. Infection in a diabetic foot almost always causes thrombosis of the small vessels (clots of small vessels), and it can progress to gangrene quickly. Amputation of the toe, foot or leg becomes the only therapeutic remedy.

The appearance of a discolored nail, with a yellowish or whitish tone, probably indicates the beginning of a fungal infection (Fig 5-11)

Fig 5-11

At this level, when only a small part of the nail is affected, there are treatments available that work well early in the infection.

Removing the yellowish portion of the nail and applying the antifungal medication topically can be effective in eradicating the fungus. When the fungal infection becomes

advanced and chronic, the disease becomes chronic and resistant to treatment. Even the strongest topical medication can be ineffective. In my practice, I often prescribe oral antifungal medication. Toenails grow very slowly. It may take more than nine months for the nail to fully grow back, therefore oral antifungal therapy must be continued for more than nine months to achieve a somewhat favorable response. Therefore, instead of using oral antifungal medications or using topical medications, which in most cases are ineffective, I recommend the complete removal of the deformed nail along with its root if the diabetic patient has adequate blood supply to the foot to heal after surgery. It is better to remove a thick one which will be a potential problem in the future. Careful and meticulous evaluation of diabetic patients by a podiatrist is recommended.

BLOOD UNDER THE NAIL

Blood under the toenail (Fig. 5-12) is also a serious concern among diabetics. The accumulation of blood under the nail can occur when the shoe compresses the toes while walking, running, playing tennis or other similar activities. Especially a diabetic person with altered sensation (neuropathy) can continue the activity with little or no discomfort in the toes.

Fig 5-12

The presence of blood under the nail acts as a nutritive medium for bacteria. This condition requires immediate medical attention as this can cost you your toe, foot or even leg. Some physicians like to drill a hole in the nail to evacuate blood, however I

recommend removing the nail completely and fully exposing the base of the nail for examination and removing any necrotic tissue that could be a potential source of infection. Appropriate antibiotics and local wound care should be started immediately. Hospitalization is not necessary if this condition is not complicated by infection, arterial insufficiency (decreased blood flow), or uncontrollable diabetes. X-rays of the foot taken at the time the nail wound is healing. . Subsequent X-rays of the foot become necessary to compare the foot as it heals and to exclude any changes in the bone that may occur, such as a bone infection. If you have a baseline X-ray of the foot, where there are changes in the bone during healing and can be compared with the early X-ray to assess the need for medical intervention for bone infection, this could save your foot.

There is a blood-like condition underneath that is worth mentioning here. Malignant melanoma (skin cancer), under the nail may appear as a dark blue or purple discolored, similar in appearance to a hematoma. This is a relatively rare condition, but easily seen by a doctor. It can appear as an infection under the nail and can destroy the base of the nail without showing any growth. The cure rate is higher than malignant melanoma of the skin if it is diagnosed and treated early.

Prevention of blood under the nail can be achieved with appropriate shoes. Don't buy shoes half a size larger than what you wear. I see frequently among diabetic patients, who think they need more space for their toes. There are commercially available shoes with a extra depth made for diabetic patients for this particular reason. The appropriate insoles are also recommended for those who regularly participate in physical activities. It is important that you examine your feet every time you remove your shoes, looking for blisters or any nail problems as discussed in this chapter.

TEST YOURSELF

(T F) True or false

1. T F Infecting ingrown toenail, as long as there is no pain, it should be left alone.

2. T F Gangrene is the result of an ingrown infected toenail.

3. T F You cannot lose a leg from "such a little thing" like an ingrown toenail.

4. T F You must soak the foot in the iodine solution when you have an ingrown infected toenail.

5. T F To prevent ingrown toenails, you should visit your foot specialist regularly.

6. T F Fungal infection of the toenails is as dangerous as ingrown toenails.

7. T F Thick yellow toenails usually indicate fungal infection.

8. T F To prevent blood under the toenail, you should buy one size larger than your usual shoe size.

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1. (F) 2. (F) 3. (F) 4. (F) 5. (T) 6. (F) 7. (F) 8. (F)