Chapter one

1.1 Prelude:

Diabetes mellitus or simply diabetes is a group of metabolic diseases in which a person has high blood sugar. This high blood sugar produces the symptoms of frequent urination, increased thirst, and increased hunger. Untreated, diabetes can cause many

complications; an acute complication includes diabeticketoacidosis and non-ketotic hyperosmolar coma, a serious of long term complications include heart disease, kidney failure, and damage to the eyes, diabetes is due to either the pancreas not producing enough insulin, or because cells of the body do not respond properly to the insulin that is produced. (World Health Org. 1999).

There are two main types of diabetes mellitus: type 1 DM results from the body's failure to produce insulin, this form was previously referred to as (IDDM) or "juvenile diabetes, type results from insulin resistance, a condition in which cells fail to use insulin properly, sometimes also with an absolute insulin deficiency this form was previously referred to as (NIDDM) or "adult-onset diabetes", gestational diabetes, is the third main form and occurs when pregnant women without a previous diagnosis of diabetes develop a high blood glucose level, prevention and treatment often involve a healthy diet, physical exercise, not using tobacco, and being a normal body weight, blood pressure control and proper foot care are also important for people with the disease, type 1 diabetes

must be managed with insulin injections, type 2 diabetes may be treated with medications with or without insulin.. Insulin and some oral medications can cause low blood sugar, which can be dangerous, gastric bypass surgery has been successful in many with severe obesity and type 2 DM, gestational diabetes usually resolves after the birth of the baby. (World Health Org. 1999).

Globally as of 2013, an estimated 382 million people have diabetes worldwide, with type 2 diabetes making up about 90% of the cases, this is equal to 3.3% of the population, with equal rates in both women and men, in 2011 diabetes resulted in 1.4 million deaths worldwide, making it the 8th leading cause of death, the diabetes is a well known major risk factor for causing up to four fold increased chance of CLI development, and a high amputation rate of up to 5 to 10 times that for non-diabetic patients ,devascularization by either surgical bypass or endovascular therapy, is the main method for saving an affected limb, and the treatment plan is based on anatomical disease distribution, as mentioned in many major guidelines. Furthermore, infrapopliteal lesions are predominate in diabetic patients. (World Health Org , 1999).

(MDCTA) is a rapid and robust method for evaluating peripheral arterial disease, CT angiography uses a CT scanner to produce detailed images of both blood vessels and tissues in various parts of the body, a contrast agent is usually injected through a small catheter placed in a vein of the arm. A CT scan is then performed while the contrast flows through the blood vessels to the various organs of the body, after scanning the images will be processed using a special computer and software and reviewed in

different planes and projections. CTA's are preformed on the brain, neck, heart, chest, abdomen, pelvis, legs, feet, arms, and hands. You will be given an injection of an iodinated contrast agent through a vein. The contrast agent improves the quality of the test. The contrast travels through your bloodstream and collects in the area of your body that is being scanned. (World Health Org, 1999).

1-2 Research problems:

Increasing the incidence rate of diabetes mellitus among the Sudanese population and imputation. CTA Lower Limb Non-invasive, outpatient procedure, Inexpensive , Fast (~15min), Longer field size than angiography->1500mm, Longer field size than angiography->1500mm, Provides vital information of patients lower limb vascularity.

1.2 Research objectives:

1.2.1 General objective:

To evaluate CTA diagnosis of lower limb in diabetes patient.

1.2.2 Specific objectives:

To evaluate the atherosclerotic changes.

To determine steno-occlusive disease and its complications.

To determine congenital abnormalities.

To detect inflammatory conditions.

To measure aneurismal changes can also affect the arteries of the lower extremities.

To measure the length of occluded vessels.

To examine the best technique used.

Chapter Two

Literature review

2.1 Anatomy:

2.1.1 Arterial System

The aorta is the largest diameter artery in the body and The aorta extends upward from the left ventricle, arches over the heart to the left, and descends just anterior and to the left of the vertebral column, The ascending aorta is the first portion of the aorta, An aortic sinus is a swelling of the aortic wall, Coronary arteries arise from the aortic sinus, Aortic bodies are small structures located within the aortic sinuses and contain chemoreceptor's that sense blood concentrations of oxygen and carbon dioxide (Stephanie Ryan 2010)

2.1.2 The three major arteries:

Originating from the aortic arch are the brachiocephalic artery, the left common carotid artery, and the left subclavian artery, the brachiocephalic artery supplies blood to the tissues of

the upper limb and head. (Stephanie Ryan 2010)

2.1.3 The descending aorta:

Is located the portion of the aorta that moves through the thoracic and abdominal cavity, the thoracic aorta is portion of the descending aorta above the diaphragm, Branches of the thoracic aorta are the bronchial, pericardial, and esophageal arteries ,The abdominal aorta is the portion of the descending aorta below the diaphragm. (Stephanie Ryan 2010)

2.1.4 Branches of the abdominal:

aorta are celiac, phrenic, superior mesenteric, suprarenal, renal, gonadal, inferior mesenteric, lumbar, and middle sacral arteries, The celiac artery gives rise to gastric, splenic, and hepatic arteries which supply upper portions of the digestive tract, spleen and liver, Phrenic arteries supply the diaphragm, The superior mesenteric artery branches to many parts of the intestinal tract, The suprarenal arteries supply the adrenal glands, The renal arteries supply the kidneys, The gonadal arteries supply the ovaries and testes, The inferior mesenteric artery branches into arteries leading to the descending colon, sigmoid colon, and the rectum, Lumbar arteries supply muscle of the skin and posterior abdominal wall, The middle sacral artery supplies the sacrum and coccyx, the abdominal aorta terminates near the brim of the pelvis and divides into common iliac arteries, The common iliac arteries supply lower regions of the abdominal wall, the pelvic organs, and the lower extremities. (Stephanie Ryan 2010)

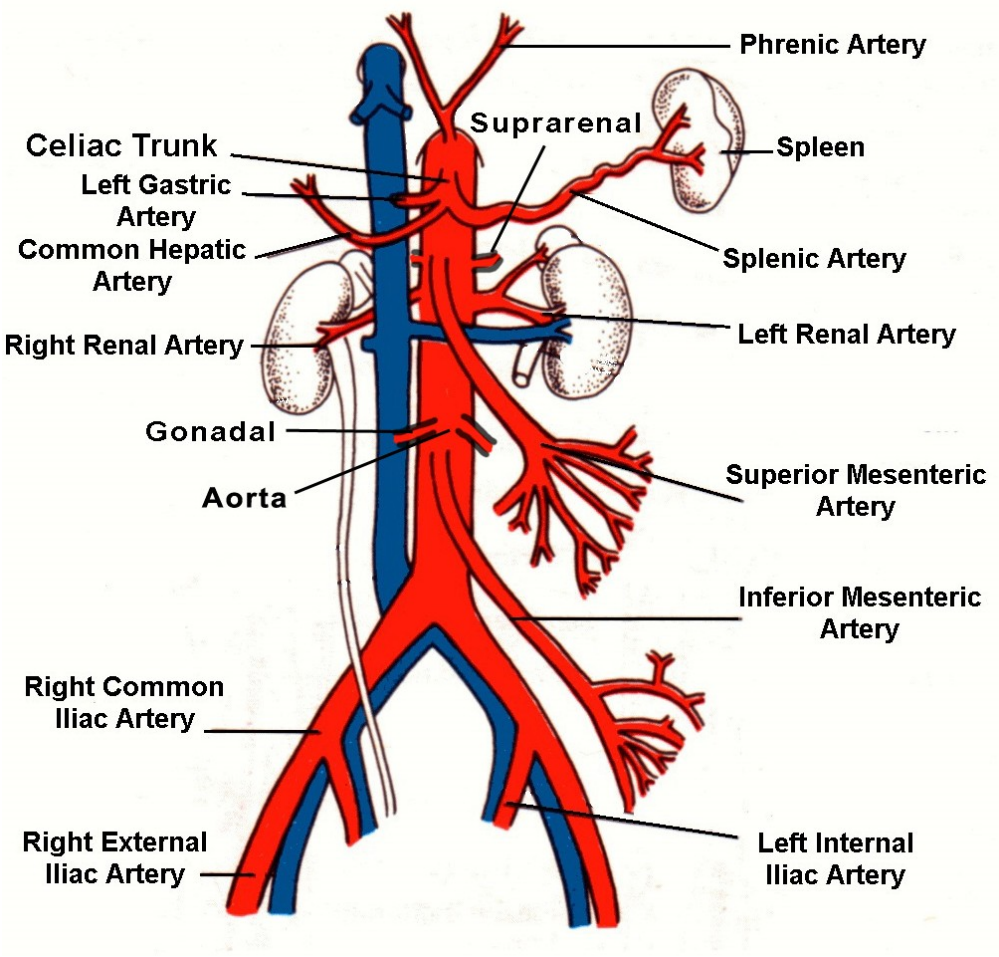


Fig 2.1 show the aorta and its major branches(Stephanie Ryan 2010)

2.1.5 The femoral artery:

It's the direct continuation of the external iliac artery; it enters the thigh by passing behind the mid-inguinal point (midway between the ASIS & the pubic tubercle). After running vertically downward, it enters the femoral triangle then in the adductor canal then pierces the adductor magnum Muscle to enter to the popliteal .fossa to be the popliteal artery the upper 10 cm of femoral artery. (Stephanie Ryan 2010)

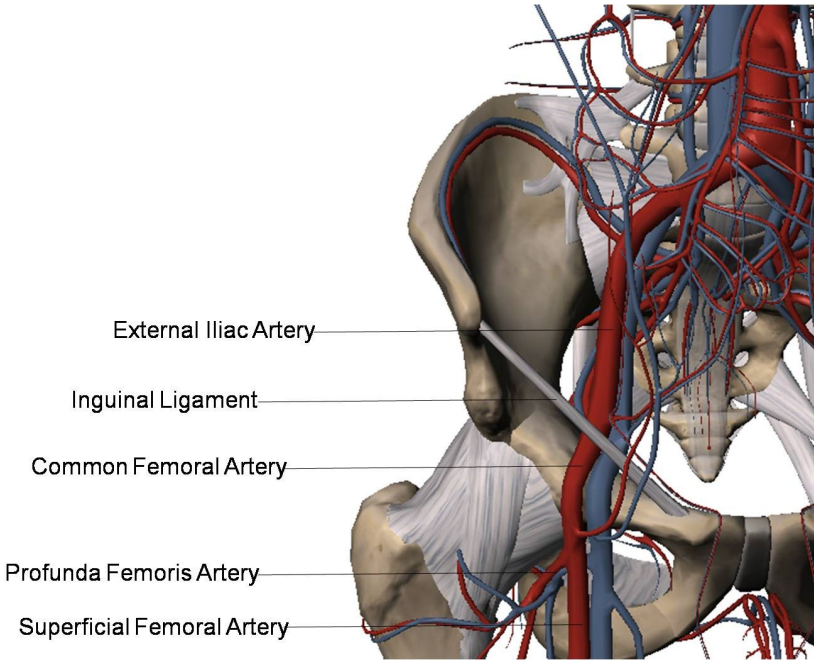


Fig 2.2 shows the external iliac artery and branches(Stephanie Ryan 2010)

2.1.5.1The branches of femoral artery:

Superficial branche s: superficial epigastric artery, superficial circumflex iliac artery superficial external pudendal artery. (StephanieRyan2010)

2.1.5.2 Deep branches:

deep external pudednal artery, the profunda femoris arteryThe profunda femoris artery: is the largest branch , arise from the upper part of femoral artery, to pass behind it to end as the 4th perforating artery , It gives of lateral circumflex femoral artery, medial circumflex femoral artery, four perforating artery. (Stephanie Ryan 2010).

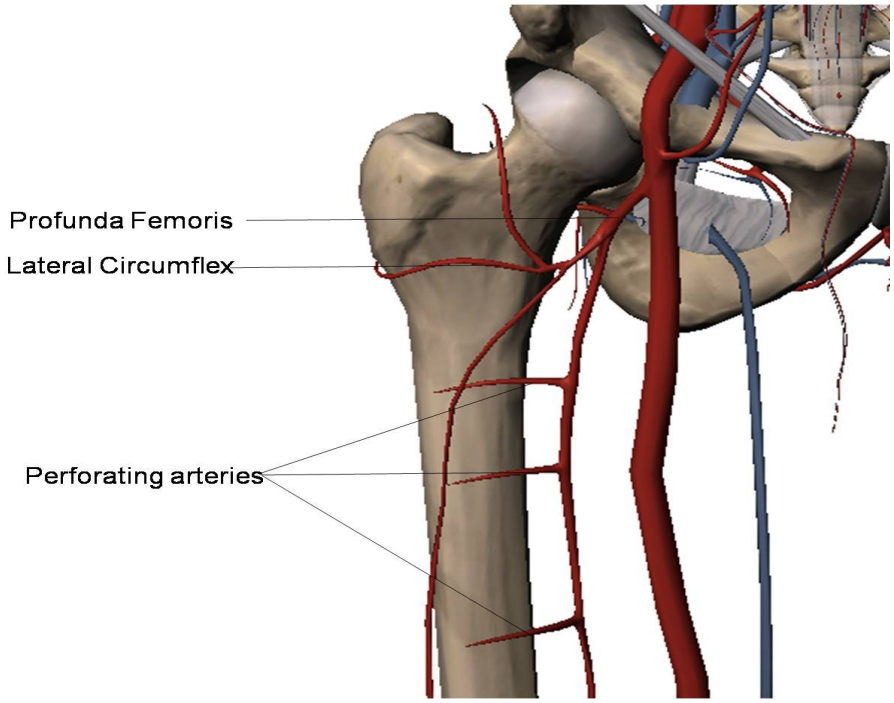


Fig 2.3shows deep external pudednal artery, the profunda femoris artery.

2.1.6 The popliteal artery:

It begins at the opening in the adductor magnus as the continuation of the femoral artery. & ends at the lower border of the popliteus Muscle, by dividing into anterior & posterior tibial arteries is the deepest, of the popliteal Fossa it lies on (from above –downward) the popliteal surface of the femur, then the back of the capsule of the knee joint, then the fascia over the popliteus muscle, it gives of muscular & articular branches to form rich anastamosis around the knee joint. (Stephanie Ryan , 2010)

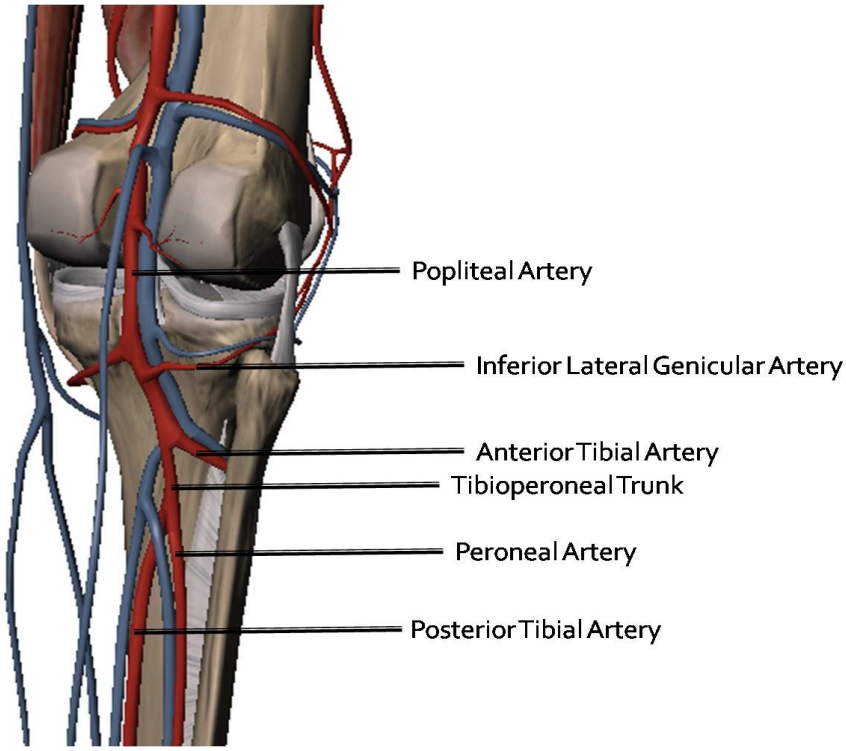


Fig 2.4 show the popliteal, anterior tibial arteries
(Stephanie Ryan 2010)

2.1.6.1The anterior tibial artery:

It begins at the lower border of the popliteal muscle in the posterior as the smaller terminal branch of the popliteal artery & after running downwards in the anterior, of the leg to ends in front of the ankle joint by becoming the dorsalis pedis artery, it gives of anterior. & posterior, recurrent branch to anastamose around the knee joint anterior medial malleolar & anterior, lateral malleolar muscular branch to medial of anterior compartment of the leg. (Stephanie Ryan 2010)

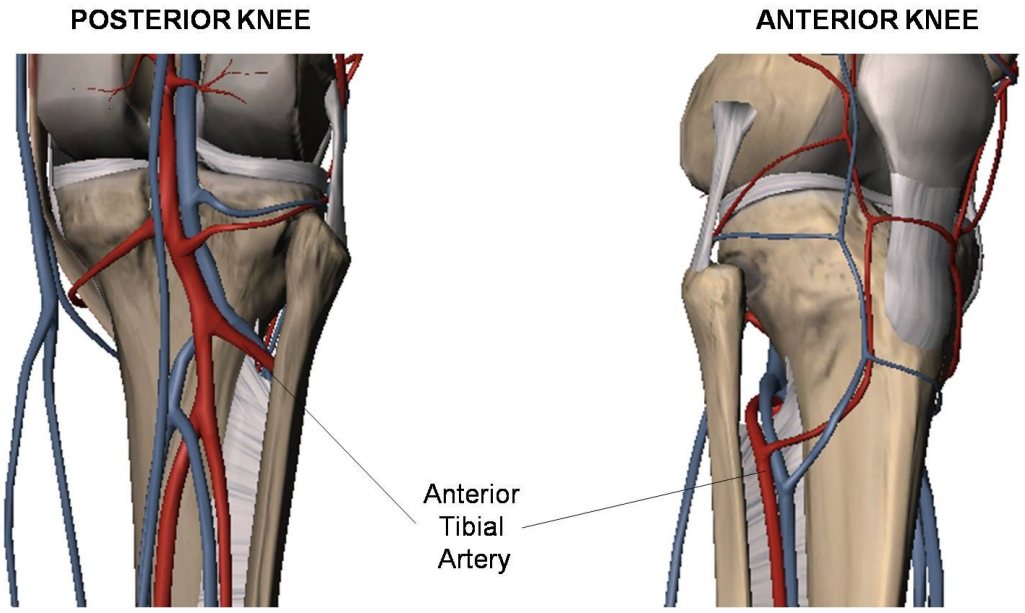


Fig 2.5 show the anterior tibial arteries(Stephanie Ryan 2010)

2.1.6.1 The dorsalis pedis artery:

It begins in front of the ankle joint as a continuation of anterior tibial artery, runs forward on the dorsum of the foot to pass in the 1st intermetatarsal space then reach the sole of the foot to anastamose with the end of the planter arch it passes on the talus, navicular & intermediate cuneiform bone. (Stephanie Ryan 2010)

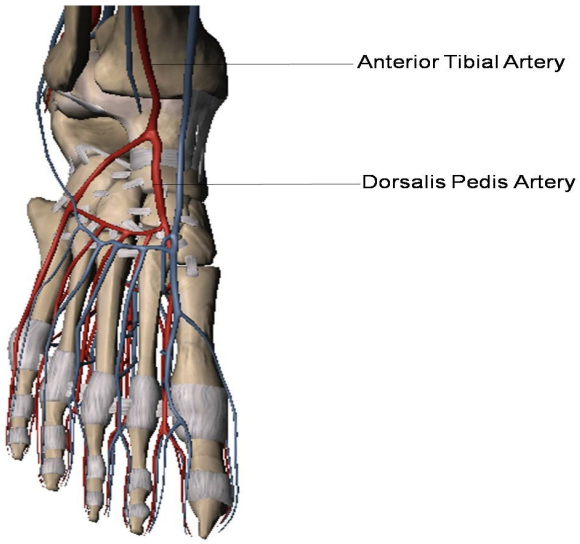


Fig 2.6 show the anterior tibial, dorsalis pedis arteries(Stephanie Ryan 2010)

2.1.6.2 The posterior tibial artery:

begins at the lower border of the popliteus muscle as the larger terminal branch of the popliteal Artery& after running downward posteriorly, it ends by dividing to medial & lateral planter artery, It is deep in the upper part of the leg while superficial in the lower part to be palpated midway between the medial malleolus &medial tubercle of the calcaneum, its divided to medial& lateral planter artery, to form the main blood supply of the foot. (Stephanie Ryan 2010)

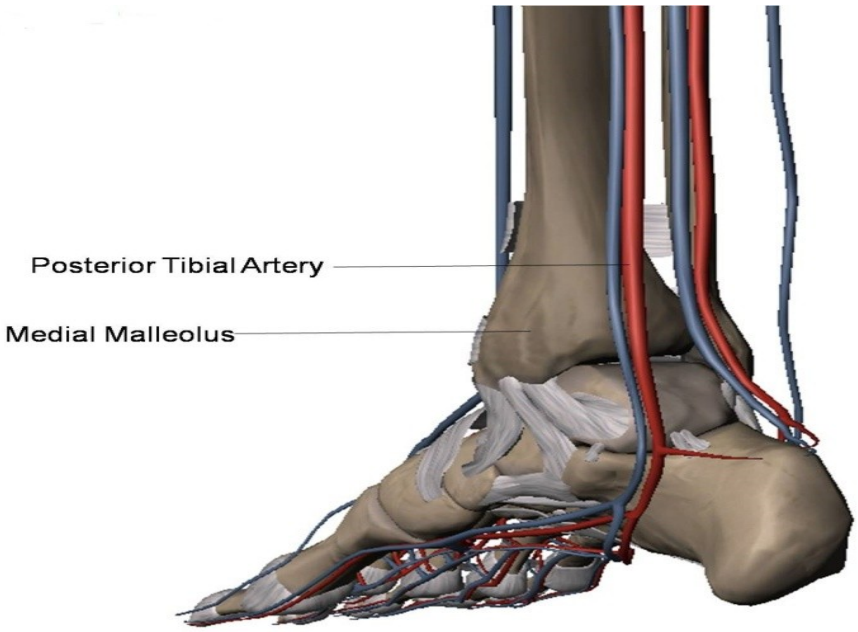


Fig 2.7 show the posterior tibial artery.(Stephanie Ryan 2010)

2.1.6.3 The posterior tibial artery:

The peroneal artery is a big branch arise just below the origin of the posterior tibial artery, passing downward &laterally towards the fibula then vertically with the medial border of the fibula in the lower part to end behind the inferior tibio-fibular joint& share in the anastamosis around the lateral malloelus, it

gives of a perforating branch which pierce the interosseus membrane & share in the same anastamosis. (Stephanie Ryan 2010).

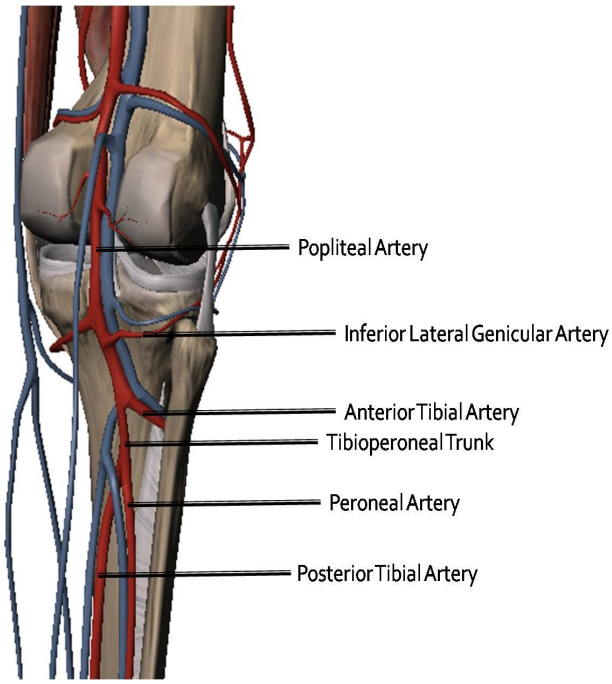


Fig 2.8 show peroneal, posterior tibial arteries. (Stephanie Ryan 2010)

2.1.2The veins of the lower limb:

The veins of the lower limb divided to superficial & deep veins according to the deep fascia The superficial veins : which divided to great (long) saphenous vein & small (short) saphenous vein ,the great saphenous vein, It begins at the medial end of the dorsal venous plexus on the dorsum of the foot & ascends immediately in front of the medial malleolus where the saphenous nerve, lies in front of the vein. Then the vein ascend on the medial side of the leg then the post. Parts of the medial condyles of the tibia & the femur to the groin where it pierces the deep fascia at the saphenous opening to enter the femoral vein,(Stephanie Ryan 2010).

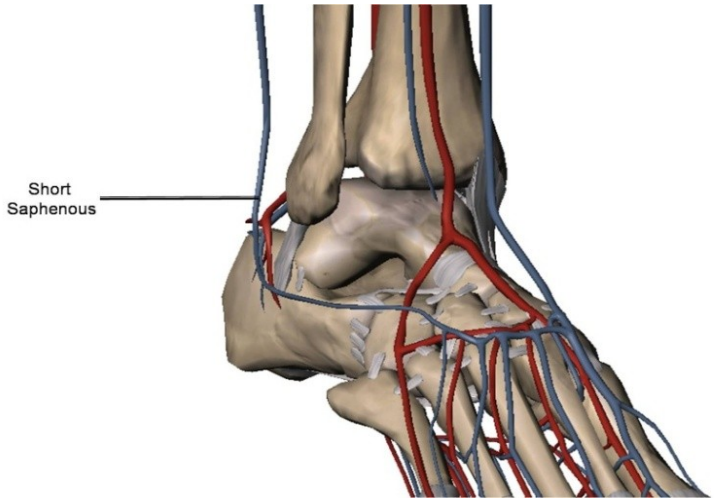


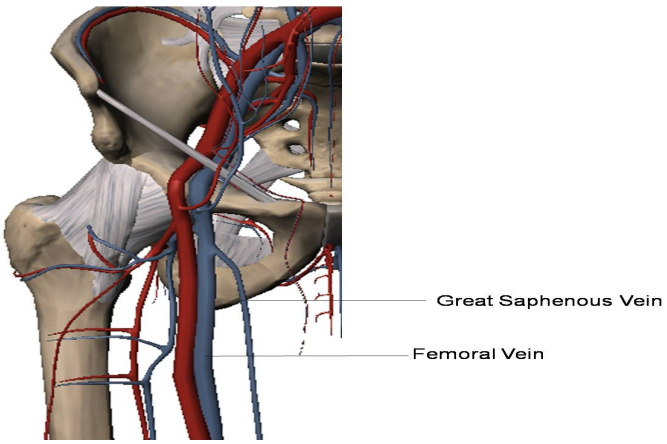
Fig 2.9 show the short saphenous.(Stephanie Ryan 2010)

2.1.2.1Superficial veins:-

The upper part of great saphenous vein,receives superficial veins

from the thigh , external genetalia & anterior bdominal wall The great saphenous vein contain many valves below the knee & 2 valves just before entering the femoral vein, The small saphenous vein :It begins behind the lateral malleolus & drains the lat. side of the venous plexus on the dorsum of the foot .It ascends over the back of the calf to the popliteal fossa where it perforates the deep fascia & ends in the popliteal
vein. (Stephanie Ryan *2010*)

Figure 2.10 show great saphenous , femral veins(Stephanie Ryan 2010)



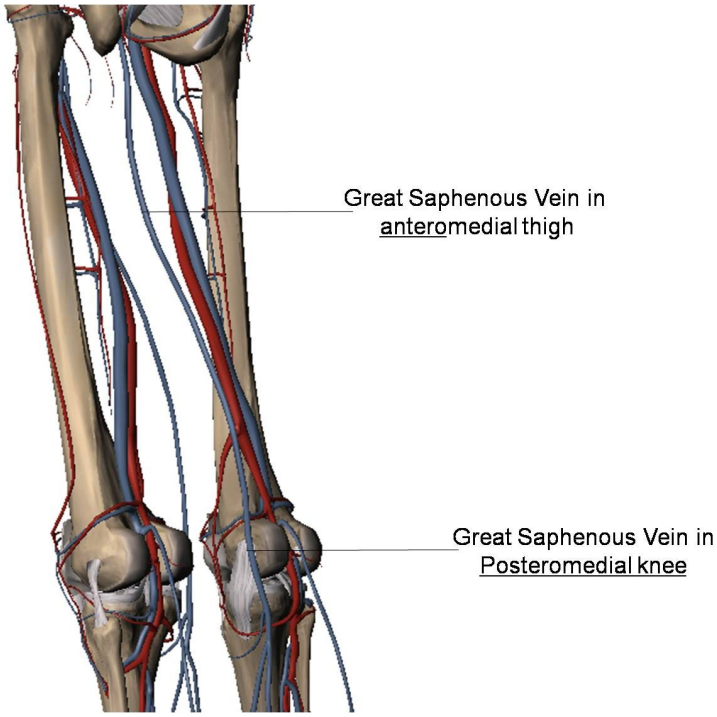


Fig 2.11 great saphenous vein (anterior and posterior) thigh.
(Stephanie Ryan 2010)

2.1.2.2The deep veins of the lower limb:

The venae comitantes of the anterior & posterior tibial artery unite together at the lower border of popliteus muscle to form the popliteal vein which after ascending in the popliteal fossa ,it receives the small saphenous vein ,then enters the opening in the adductor magnus muscle. to form the femoral vein The femoral vein : It begins at the opening in the adductor magnus muscle as a continuation of popliteal vein then pass in the adductor canal the femoral triangle & ends behind the inguinal ligament to become the external iliac vein. It is behind the femoral artery in the apex of femoral triangle to be medial to it in the base of the triangle. (Stephanie Ryan *2010*).

2.2 physiology:

The blood vessels are the part of the circulatory system that transports blood throughout the human body, there are three major types of blood vessels: the arteries, which carry the blood away from the heart; the capillaries, which enable the actual exchange of water and chemicals between the blood and the tissues; and the veins, which carry blood from the capillaries back toward the heart. The word vascular, meaning relating to the blood vessels, is derived from the Latin vas, meaning vessel, a vascular refers to being without (blood) vessels.

(Retrieved . 2014)

The arteries and veins have three layers, but the middle layer is thicker in the arteries than it is in the veins: Tunica intima (the thinnest layer): a single layer of simple squamous endothelial cells glued by a polysaccharide intercellular matrix, surrounded by a thin layer of connective tissue interlaced with a number of circularly arranged elastic bands called the internal elastic lamina, Tunica media (the thickest layer in arteries): circularly arranged elastic fiber, connective tissue, polysaccharide substances, the second and third layer are separated by another thick elastic band called external elastic lamina. The tunica media may (especially in arteries) be rich in vascular smooth muscle, which controls the caliber of the vessel, Tunica adventitia: (the thickest layer in veins) entirely made of connective tissue. It also contains nerves that supply the vessel as well as nutrient capillaries (vasavasorum) in the larger blood vessels, Capillaries consist of little more than a layer

of endothelium and occasional connective tissue, when blood vessels connect to form a region of diffuse vascular supply it is called an anastomosis (pl. anastomoses), a nastomoses provide critical alternative routes for blood to flow in case of blockages, There is a layer of muscle surrounding the arteries and the veins which help contract and expand the vessels. (Retrieved .2014)

This creates enough pressure for blood to be pumped around the body; Blood vessels are part of the circulatory system, together with the heart and the blood. (Retrieved. 2014)

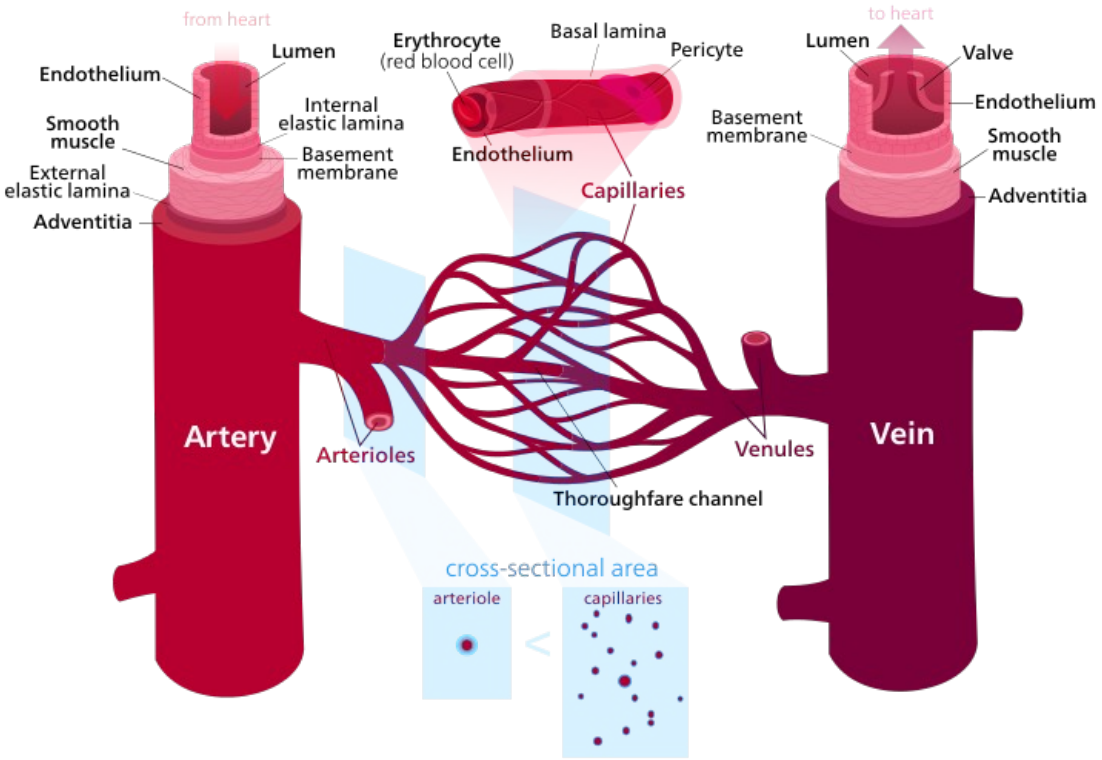


Figure2.11 shows the layers of arteries and veins. (Retrieved. 2014)

Blood vessels do not actively engage in the transport of blood (they have no appreciable peristalsis), but arteries—and veins to a

degree—can regulate their inner diameter by contraction of the muscular layer. This changes the blood flow to downstream organs, and is determined by the autonomic nervous system, Vasodilation and vasoconstriction are also used antagonistically as methods of thermoregulation, Oxygen (bound to hemoglobin in red blood cells) is the most critical nutrient carried by the blood. In all arteries apart from the pulmonary artery, hemoglobin is highly saturated (95-100%) with oxygen. In all veins apart from the pulmonary vein, the hemoglobin is desaturated at about 75%. (The values are reversed in the pulmonary circulation.) The blood pressure in blood vessels is traditionally expressed in millimetres of mercury (1 mmHg = 133 Pa). In the arterial system, this is usually around 120 mmHg systolic (high pressure wave due to contraction of the heart) and 80 mmHg diastolic (low pressure wave), In contrast, pressures in the venous system are constant and rarely exceed 10 mmHg,Vasoconstriction is the constriction of blood vessels (narrowing, becoming smaller in cross-sectional area) by contracting the vascular smooth muscle in the vessel walls, It is regulated by vasoconstrictors (agents that cause vasoconstriction), These include paracrine factors (e.g. prostaglandins), a number of hormones (e.g. vasopressin andangiotensin)and neurotransmitters (e.g. epinephrine) from the nervous system.Vasodilation is a similar process mediated by antagonistically acting mediators, The most prominent vasodilator is nitric oxide (termed endothelium-derived relaxing factor for this reason), Permeability of the endothelium is pivotal in the release of nutrients to the tissue. It is also increased in inflammation in

responseto histamine, prostaglandins and interleukins, which leads to most of the symptoms of inflammation (swelling, redness, warmth and pain). (McGraw Hill, 2012).

2.2.1Factors affecting blood flow:

There is many Factors affecting blood flow resistance occurs where the vessels away from the heart oppose the flow of blood. Resistance is an accumulation of three different factors: blood viscosity, blood vessel length, and vessel radius Blood viscosity is the thickness of ,the blood and its resistance to flow as a result of the different components of the blood. Blood is 92% water by weight and the rest of blood is composed of protein, nutrients, electrolytes, wastes, and dissolved gases. Depending on the health of an individual, the blood viscosity can vary (i.e. anemia causing relatively lower concentrations of protein, high blood pressure an increase in dissolved salts or lipids, etc.). (McGraw Hill, 2012).

Vessel length is the total length of the vessel measured as the distance away from the heart. As the total length of the vessel increases, the total resistance as a result of friction will increase, vessel radius also affects the total resistance as a result of contact with the vessel wall. As the radius of the wall gets smaller, the proportion of the blood making contact with the wall will increase, the greater amount of contact with the wall will increase the total resistance against the blood flow. (Retrieved , 2014).

2.3 Pathology

2.3.1Congenital Anomalies

Aberrations of the usual anatomic pattern of branching, shape and anastomosing. Importance have only: berry aneurysms (developmental aneurysms involving cerebral vessels) and arteriovenous fistulas or aneurysms (abnormal communications between arteries and veins usually arised as developmental deffect, from rupture of an arterial aneurysm into adjacent vein, or from injury, or from inflammatory necrosis of adjacent vessels). Their clinical significance depends on short-circuit blood from the arterial to the venous side, causing the heart to pump additional volume, sometimes inducing cardiac failure. (Gidaspow et al , 1992).

2.3.2 Atherosclerosis

It is a generic term for three patters of vascular disease that have in common thickening and loss of elasticity of arterial walls, Atherosclerosis characterized by the formation of intimal fibrous plaques that often have a central core rich in lipid (fibrofatty plaques), Mönckeberg medial calcific sclerosis characterized by calcific deposits in medium sized muscular arteries in persons older than 50 years, These medial lesions forming irregular medial plates or discrete transverse rings have much less clinical importance, Arteriosclerosis the hyaline and hyperplastic thickening of small arteries and arterioles which causes luminal narrowing and down stream ischemic injury, theromatous plaques are the basic lesions within the intima, having a core of lipid (mainly cholesterol and cholesterol esters) and a covering fibrous cap are also called fibrous, fibrofatty, lipid, or fibrolipid plaques which have white to whitish yellow colour and

rise intima slightly into the lumen of the artery,the centers of larger plaques may contain a yellow debris, hence the term atheroma their distribution in humans is characteristic,the abdominal aorta is usually much more involved than thoracic aorta, and aortic lesions tend to be much more prominent around the origins (ostia) of its major vessel branches, atherosclerosis complicated lesions are defined by patchy or massive calcification, focal rupture or gross ulceration, thrombus formation (thrombosis) producing emboli, hemorrhage into a plaque, aneurysmal dilatation of large vessels, atherosclerosis risk Factors age (advanced age), sex (malpostmenopausal women, the protective effect of estrogens), genetics (polygenic familiar predisposition, genetic abberrations in lipoprotein metabolism resulting in excessively high blood lipid levels), diet, life style, personal habit, there are 6 major well-accepted conditions such as: hyperlipidemia, hypertension,smoking, diabetes mellitus,elevated plasma homocysteine, factors affecting hemostasis and thrombosis.(Gidaspow et al, 1992).

2.3.3 Hypertensive Vascular Disease

One of the most important risk factors in both coronary heart disease and cerebrovascular accidents. It may also lead to cardiac hypertrophy with heart failure, aortic dissectin, and renal failure, About 90-95% of hypertension is idiopathic and apparenly primary – essential hypertension. Of the remaining, 5-10% is secondary to renal disease or, less often, to narrowing of the renal artery (usually by an atheromatous plaque) – renovascular hypertension. Infrequently, secondary hypertension is the result of diseases

related to the adrenal gland (such as primary aldosteronism, Cushing syndrome, pheochromocytoma etc.), About 5% of hypertensive persons show a rapidly rising blood pressure, which, if untreated, leads to death within 1 or 2 years – malignant hypertension. (Gidaspow et al, 1992).

2.3.4 Inflammatory Disease – Arteritides, Vasculitides Vasculitides, bacterial- Neisserial, Rickettsial, Spirochetal, fungal, viral,Non-Infectious Vasculitides: so-called systemic necrotizing vasculitides (affecting aorta, medium-sized vessels) and small vessel vasculitides (affecting arterioles, venules and capillaries). Pathogenesis involves immune compexes, antineutrophil cytoplasmic antibodies (ANCA) and antibodies to endothelial cells. (Gidaspow et al ,1992).

2.3.5 Raynaud Disease

Paroxysmal pallor or cyanosis of the digits of the hands or feet and infrequently the tips of the nose or ears (acral parts) caused by intense vasospasm of local small arteries or arterioles. Typically in young, otherwise healthy women. No organic changes are present in the arterial walls except late, when intimal proliferation can appear. (Gidaspow et al ,1992).

2.3.6 Aneurysms and Dissection

Aneurysm localized abnormal dilatation of blood vessel that occurs most commonly in the aorta or the heart. It can be true (complete but often attenuated arterial wall components) or false (extravascular hematoma that communicates with the intravascular space). The 2 most important causes of true aortic (or any vessel) aneurysms are atherosclerosis and cystic medial

degeneration. Typical is also syphilitic aneurysm (tertiary stage of syphilis), Aortic Dissection (Dissecting Hematoma) – is characterized by dissection of wall and penetration of blood in between and along the laminar planes of the media, with the formation of a blood-filled channel within the aortic wall – a dissecting intramural hematoma (aneurysm). It can rupture, causing massive hemorrhage. In contrast to atherosclerotic and syphilitic aneurysms, it is not usually associated with marked dilatation of the aorta. The more common and dangerous proximal lesions involving either the ascending postion of aorta only or both the ascending and the descending aorta are called types I and II of DeBakey´s classification (often called type A). Distal lesions not involving the ascending part of aorta and usually beginning distal to the (Gidaspow et al ,1992).

2.3.7 Diseases of veins and lymphatics

2.3.7.1 Varicose Veins

Abnormally dilated, tortuous veins produced by prolonged, increased intraluminal pressure and/or by loss of support of the vessel wall. Usually the superficial veins of the leg are involved. There is marked variation in the thickness of the wall. Intraluminal thrombosis and valvular deformities are frequently found. Despite thrombosis of superficial varicose veins, embolism is rare (sharp contrast to the relatively frequent thrombembolism that arises from thrombosed deep veins). (American Journal of Preventive Medicine, 2007)

2.3.7.2Thrombophlebitis and Phlebothrombosis:

Venous thrombosis caused by inflammation or by different mechanisms (hypercoagulability, immobilization, postoperative state, pregnancy etc.). The deep leg veins account for more than 90% of cases of thrombophlebitis. The venous thromboses hav a tendency to embolization into lung. (American Journal of Preventive Medicine ,2007)

2.3.7.3 Syndrome of vena cava inferior:

This syndrome may be caused by the similar processes (hepatocellular carcinoma, renal cell carcinoma, thrombus). Obstruction induces marked edema of the legs, distention of the superficial collateral veins of the lower abdomen, and, when the renal veins are involved, massive proteinuria. (American Journal of Preventive Medicine, 2007)

2.3.8 Borderline tumors

Kaposi sarcoma (frequent occurence in patients with AIDS, classic typ – multiple red-to-purple skin plaques or nodules primarily in the distal lower extremities, slowly growing and spreading to more proximal sites, it is composed of irregular blood vessels which is difficult to distinguish from granulation tissue, over time the number of plump spindle cells accompanied by perivascular aggregates increases).

Hemangioendothelioma (intermediate between the benign, well-differentiated hemagioma and the anaplastic angiosarcoma, epitheloid hemangioendothelioma – tumor cells are plump and often cuboidal, resembling epithelial cells, well-defined vascular channels are inconspicious). (Gidaspow et al 1992).

2.3.9 Malignant tumors

Angiosarcoma (more often older adults, anywhere in the body, predilect sites – skin, soft tissues, breast, and liver).Hemangiopericytoma (rare tumor at any anatomic site, most common on the lower extremities and in the retroperitoneum, formed by sinusoidal spaces surrounded by and enclosed within nests and masses of spindle-shaped cells, 50% of tumors metastasize to lungs, bone, and liver). (Gidaspow et al 1992).

2.4 Previous studies

Daniel. et.al had studied Multidetector CT Angiography of Arterial Inflow and Runoff in the Lower Extremities in Eighteen men (mean age 67.0 years, range 43–83) with aneurismal or occlusive vascular diseases underwent contrast-enhanced CTA of the lower limb arteries utilizing a16-row CT imager. High-resolution CTA lower extremity datasets were acquired successfully, presenting vascular signal intensities of high homogeneity suitable for automated vessel tracking techniques. Automated 3D visualization tools produced reliable, reproducible, and time-efficient centerline extractions that were comparable to manually defined centerlines.(J Endovasc Ther 2004;11:144–151).

P. Gouny.aL et.al had studied Multi-Detector Row Computed Tomography Angiography in In 18 cases the arteriography was done before angioplasty, and in 16 cases before (3 cases) or after (13 cases) an infra-articular lower limb bypass. In result, CT angiography generally provides enough information to make a therapeutic decision in patients Lower Extremity Arterial Occlusive Disease.

(Acta chir belg, 2005, 105, 592-601).

Ci He et.al had studied A Comparison of lower extremity atherosclerosis in diabetic and non-diabetic patients using multi detector computed tomography.

(BMC Cardiovascular Disorders 2014, 14:125)

A.J. Edwards et.al had studied Multi detector row CT angiography of the lower limb arteries: a prospective comparison of volume rendered techniques and intra-arterial digital subtraction angiography in In a prospective comparative analysis of MDCTA and DSA in 44 patients, MDCTA was analyzed using volume-rendered images acquired at a workstation and viewed in tandem with the original axial data, MDCTA machines is insensitive to detecting significant arterial stenoses in the lower limb arteries. MDCTA is superior digital subtraction angiography in its visualization of arterial territories downstream to significant occlusive disease.

(q 2005 The Royal College of Radiologists).

Maged Abdelfattah Ali Algazzar et.al had studied Role of multi detector computed tomography angiography in the evaluation of lower limb ischemia, This study includes 30 patients of variable ages, complaining from peripheral arterial disease referred to the radiology department of Menoufia University hospital ,Conclusion: Multi detector CT angiography has demonstrated its efficacy as a promising new, fast, accurate, safe and a minimally invasive imaging modality in cases of trauma with suspected arterial injuries and in cases of peripheral vascular diseases for diagnosis, grading and for preoperative evaluation. It can also replace color Doppler ultra sonography in many cases.(International Journal of

Medical Imaging 2014; 2(5): 125 130Published online September 30, 2014)

Chapter Three
Material and method

3.1 Study design, area and duration:

This study was a descriptive study type designed to assess the ability of CTA to diagnose the lower limb ischemic in diabetes patient, the data was collected from radiology department of ROYAL CARE INTERNATIONAL HOSPITAL, AL ALMAL NATIONAL HOSPITAL, the study was carried out in the (Sudan–Khartoum state). The study duration from March 2014 to February 2015.

3.1.1 Machine used:

The machine used in this study is a multislice CT Scan Aquilion 64 slice (Toshiba).

3.1.2 Machine principle.

Technique and 3d subtraction MIP +MPR

3.1.3Accessories Instrumentations used

Power Automatic injector medrad stellant

Contrast media (OMNIPAQUE) 125-130ML

Flow rate 5- 6 ML/SEC

3.2.1 Study Population

The study include Sudanese group of patients who were referred to the Radiology department with suspected lower limb ischemia.

3.2.2 Inclusion criteria

The study was conducted in Hospital during the period from March 2014 to February 2015; the patient population consists of 18 females and 22 males with age ranging from 38–75 years, full history was taken from every patient with clinical examination and revision of previous available studies like duplex ultrasonography. Patient's laboratory data was initially revised with particular interest in the results of the renal function tests.

3.2.3 Exclusion criteria

Exclusion criteria Patient whom have traumatic lower limb ischemia and normal patient.

3.2.4 Variables

The data of patients obtained from work sheet is used to collect data on 13 variables (appendix1).these variables were divided in two main categories data of the patient include: age, gender , clinical findings, family history, diagnosis of the disease , site of the disease, best technique according to nature of disease, site , size, disease duration ,contrast media volume ,flow rate of contrast injection, scan protocols.

3.2.5 Data collection

Data collection according to work sheet (appendix) include all above variables data.

3.2.6 Data analysis

Data analysis by using a computerized analytical programs (SPSS version 11) and using a significant test like T test, Frequencies and regression and also correlation between age and prevalence and gender.

2.3.7 Methods

Full history was taken from every patient with clinical examination and revision of previous available studies like duplex ultrasonography, patient's laboratory data was initially revised with

particular interest in the results of the renal function tests, all patients were asked to continue adequate simple fluid intake up to 3 hours prior to examination to ensure adequate hydration, patients were taught how to hold breath during examination when requested, to ensure their cooperation and then underwent lower limb CT angiography with a sixty-four channel multi-detector row CT scanner (Toshiba Aquilion 64 CT Scanner) the patients were positioned supine on the CT table in the “foot first” position with an 18-20 gauge catheter placed into a superficial vein within the antecubital fossa, a two scouts were acquired, anteroposterior and lateral, the examination was planned on these scouts from the level of D12 till the foot and the patients were requested to hold their breath during the first 20 seconds of the acquisition and were allowed to breathe quietly after that the scan technique was 120kV at 150 mAs (300 mA at 0.5s rotation), using 1mm x 16 slices on helical acquisition automatic mA modulation was used to reduce patient dose (Sure Exposure technology, Toshiba Medical Systems).
A detector configuration of 64 x 0.5 mm is used, and 0.5 mm thick sections are reconstructed at 0.3 mm intervals, acquisition timing for optimum opacity is achieved by using automatic bolus tracking (Sure Start technology, Toshiba Medical Systems) of a region of interest placed on an artery the ROI is placed on the abdominal aorta just below the diaphragm, the trigger level is set at 180 Hounsfield units. The study is usually performed with 135-140 cc of low osmolar non-ionic contrast medium (Omnipaque 300) with a flow rate between 5-6 cc/sec; the sure start technique eliminates the problem of the table outpacing the contrast agent in the proximal vessels, a second run by a second scanning box will done

for the distal vessels performing from the knee to the foot to solving contrast media delayed and to exclude there are no any lower limbs vascular occlusion (fouls negative).

2.3.8 Image Post- processing Techniques:

Following completion of the scan axial 1 mm slices are reconstructed and automatically forwarded for 3D processing on the Vitrea workstation. Three dimensionalmaximum intensity projections (MIP), volume rendering (VR) and curved planer reformations . CT angiography was interpreted and the arterial tree was always studied part by part, from the abdominal aorta up tothe ankle.

The criteria of analysis were as follows:

opacification or non-opacification of the studied; absence or presence of significant stenosis (more than 50%) and estimation of its length ; absence or presence of an occlusion and estimation of its length presence of artery wall calcifications masking, or not masking the lumen and assessment of their distribution. The arterial tree was then divided into three segments including aortoiliac, femoropopliteal, and infrapopliteal segments to assess the segmental distribution of the disease, no complications what so ever occurred during the multi-detector row CT angiography examination including contrast extravasation or reaction.

Chapter Four

Results

.Table 4.1 Age classes for the total sample, frequency and Percentages

Age	Frequency	Percent
38-47	5	12.5 %
48-57	4	10.0 %
58-67	9	22.5 %
>68	22	55.0 %

Total	40	100.0 %

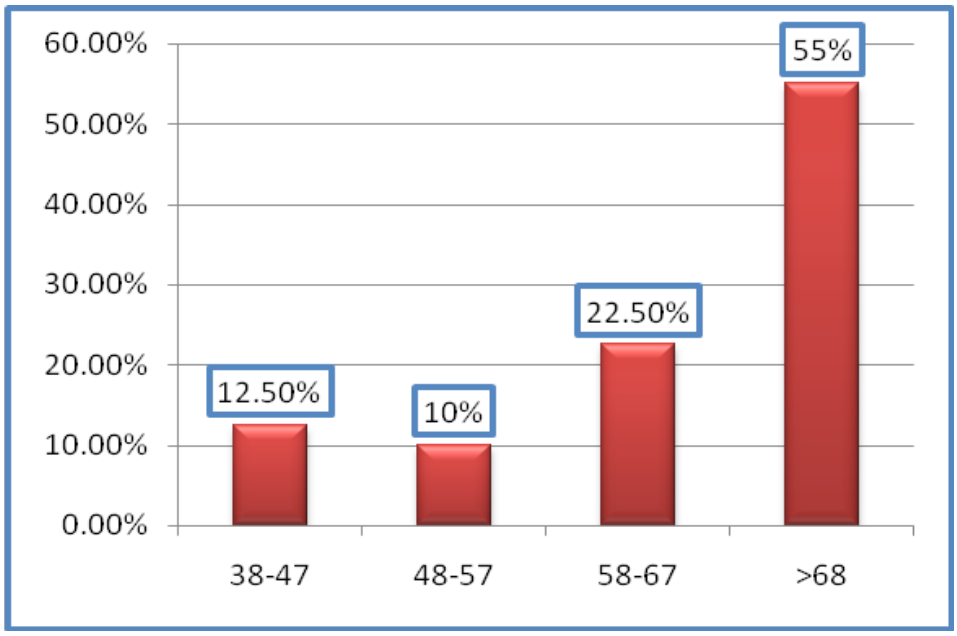


Figure 4.1 Age classes for total samples and frequency

Statistics

Age Mean	64.9750
Median	68.0000
Std. Deviation	12.82323
Minimum	38.00
Maximum	88.00

Table 4:2 Gender, Frequency and Percentages.

Gender	Frequency	Percent
Male	22	55.0 %
Female	18	45.0 %
Total	40	100.0 %

Figure 4:2 Gender, Frequency and Percentages.

Table 4:3 Family history ,Frequency and Percentage

Family history	Frequency	Percent
Yes	29	72.5 %
No	11	27.5 %
Total	40	100.0 %

Figure 4:3 Family history, Frequency and Percentage

Table 4:4 Disease duration, Frequency and Percentage

Disease duration	Frequency	Percent
Less than1	3	7.5
1--5	34	85.0
More than5	3	7.5
Total	40	100.0

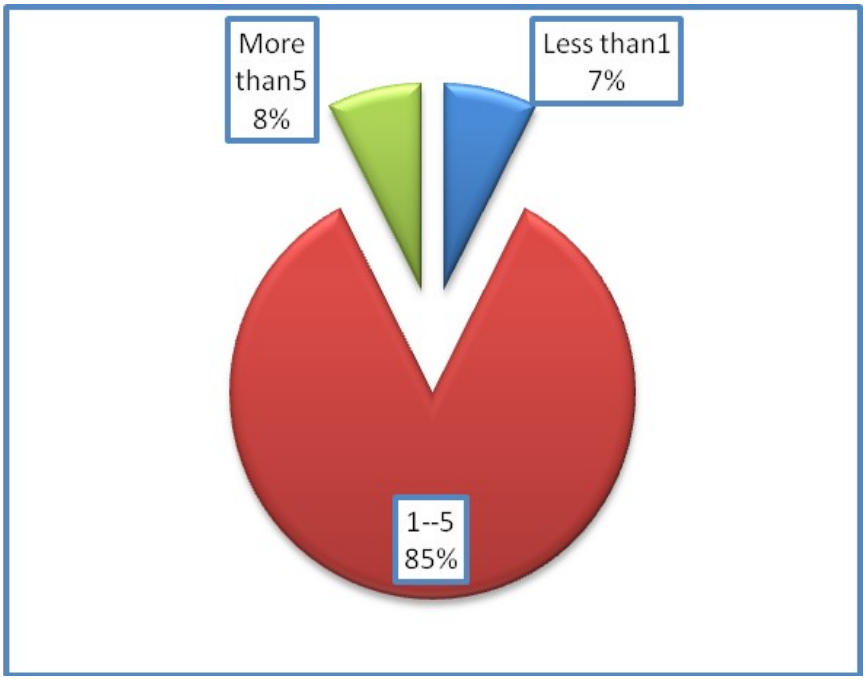


Figure 4:4 Disease duration, Frequency and Percentage

Table 4:5 Contrast Media Volume, Frequency and Percentage

Contrast media volume	Frequency	Percent
100	1	2.5 %
120	16	40.0 %
135	23	57.5 %
Total	40	100.0 %

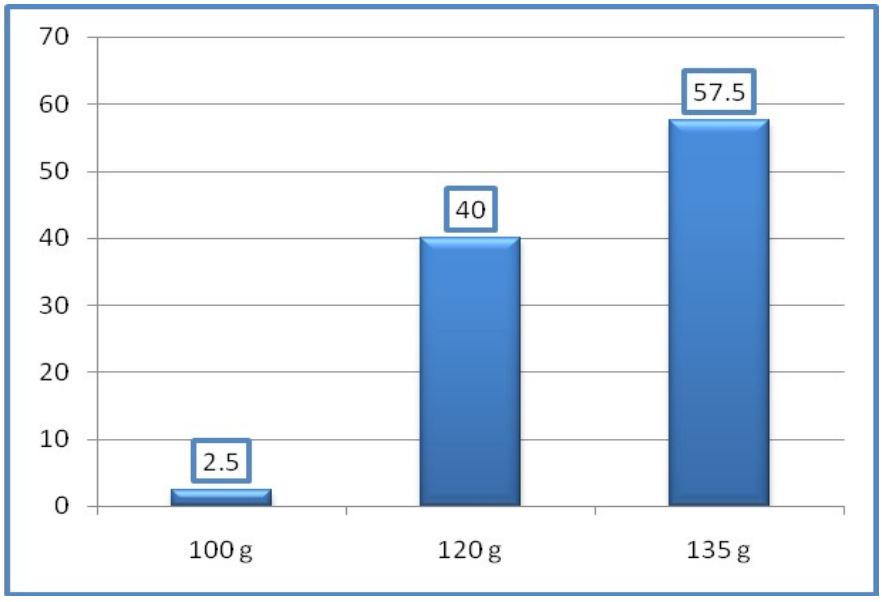


Figure 4:5 Contrast Media Volume, Frequency and Percentage

Table 4:6 Contrast Media Volume Flow Rate, Frequency and Percentage

Flow rate	Frequency	Percent
5	16	40.0 %
6	24	60.0 %
Total	40	100.0 %

Figure 4:6 Contrast Media Volume Flow Rate, Frequency and Percentage

Table 4:7 Scan protocol, Frequency and Percentage

Scan Protocol	Frequency	Percent
One box	19	47.5 %
Tow boxes	21	52.5 %

Total	40	100.0 %

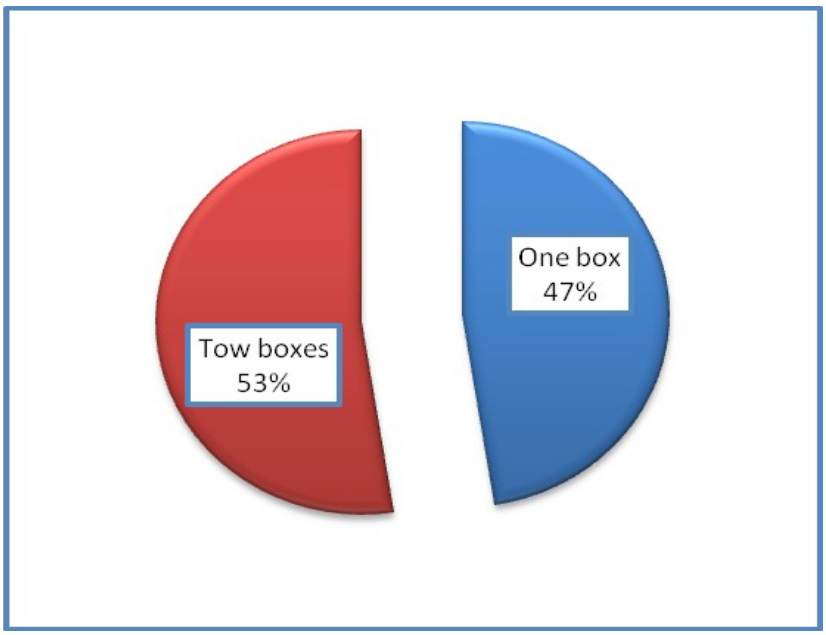


Figure 4:7 Scan protocol, Frequency and Percentage

Table 4:8 Diagnosis , Frequency and Percentage

Diagnosis	Frequency	Percent
Athero sclerosis	1	2.5 %

Total occlusion	5	12.5 %
AVM	2	5.0 %
Athero sclerosis+stenosis	11	27.5 %
Atherosclerosis+total occlusion	3	7.5 %
total occlusion+collateral	17	42.5 %
AVM+Aneurysm	1	2.5 %
Total	40	100.0 %

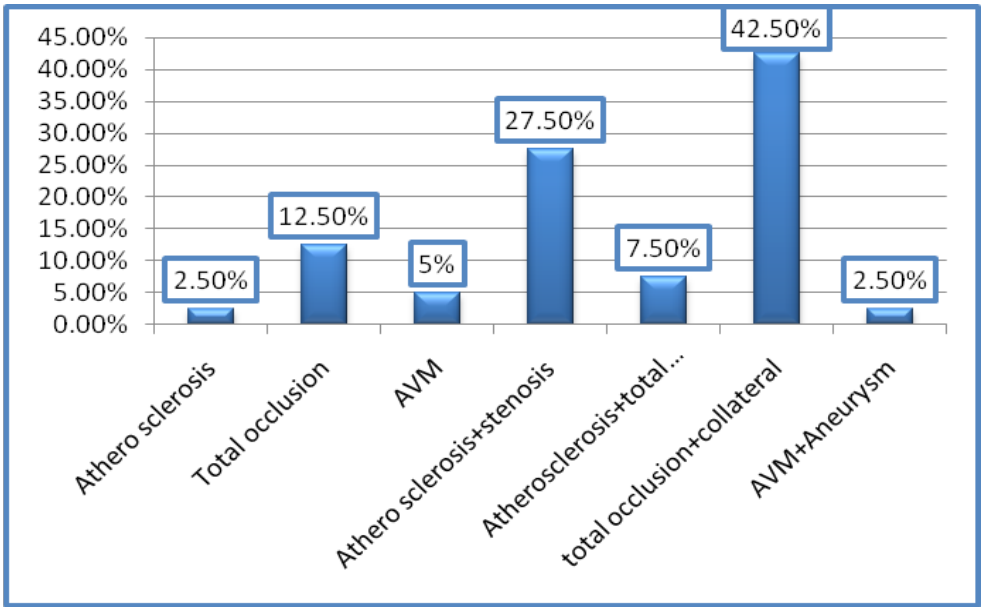


Figure 4:8 Diagnosis , Frequency and Percentage

Table 4:9 Site, Frequency and Percentage

Site	Frequency	Percent
Right	13	32.5

Left	10	25.0
Both	17	42.5
Total	40	100.0

Figure 4:9 Site, Frequency and Percentage

Table 4:10 Size, Frequency and Percentage

Size	Frequency	Percent
1-5	13	32.5 %
5-10	6	15.0 %
More than10	21	52.5 %
Total	40	100.0 %

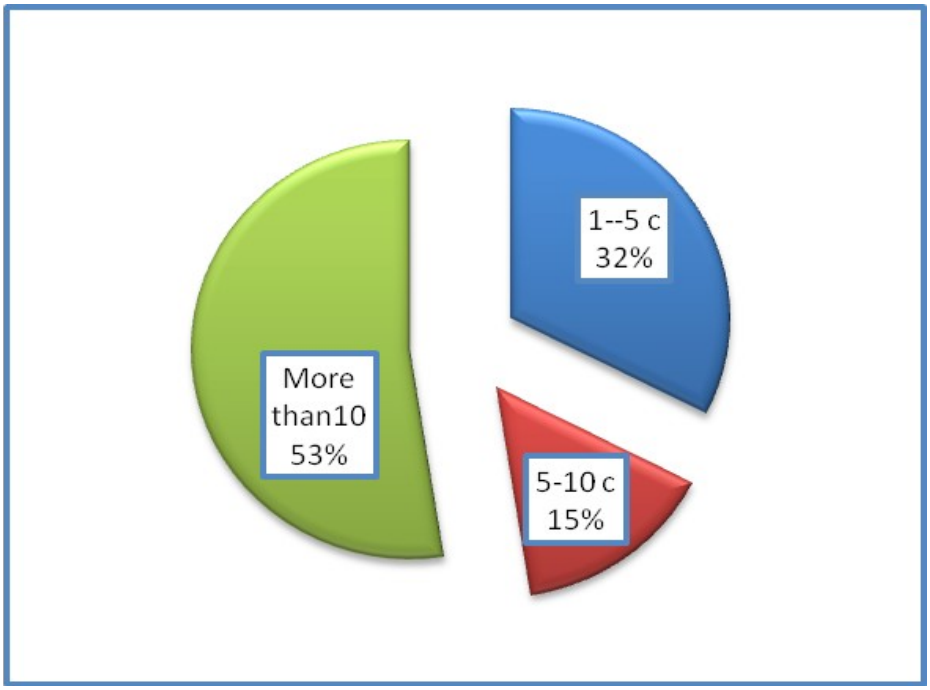


Figure 4:10 Site, Frequency and Percentage

Table 4:11 Technique, Frequency and Percentage

Technique	Frequency	Percent
MIP	4	10.0 %
MIP+VRT	26	65.0 %
MBR+VRT	10	25.0 %
Total	40	100.0 %

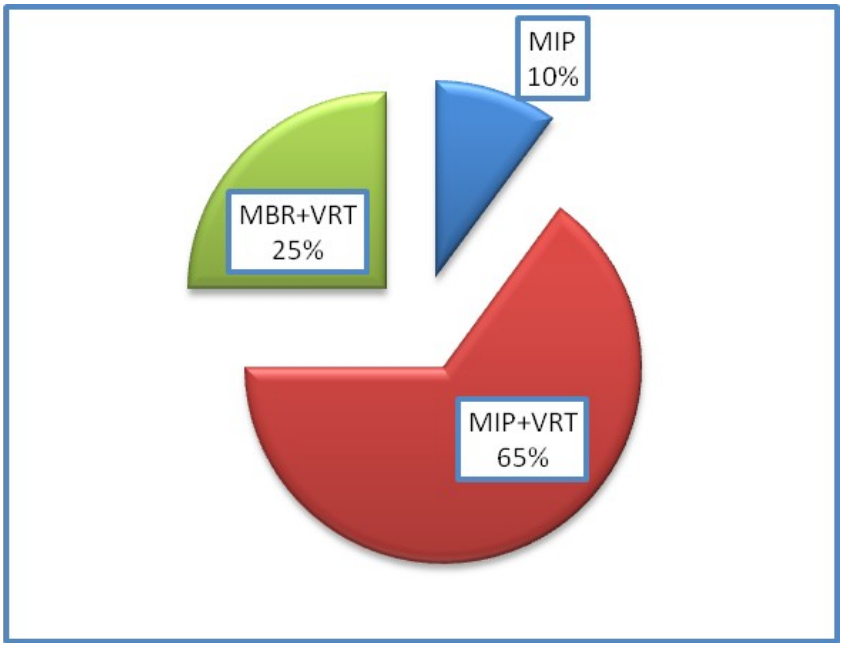


Table 4:11 Technique, Frequency and Percentage

Table 4:12 Association between (Diagnosis) & (Gender)

			GENDER		Total
			male	female	
Diagnosis	Athero sclerosis	Count	1	0	1
		% of Total	2.5%	0.0%	2.5%
	Total occlusion	Count	4	1	5
		% of Total	10.0%	2.5%	12.5%
	AVM	Count	1	1	2
		% of Total	2.5%	2.5%	5.0%
	Atherosclerosis+ stenosis	Count	6	5	11
		% of Total	15.0%	12.5%	27.5%
	Atherosclerosis+ total occlusion	Count	0	3	3
		% of Total	0.0%	7.5%	7.5%

	totalocclusion+ collateral	Count	10	7	17
		% of Total	25.0%	17.5%	42.5%
	AVM+Aneurysm	Count	0	1	1
		% of Total	0.0%	2.5%	2.5%
Total		Count	22	18	40
		% of Total	55.0%	45.0%	100.0%

P –value = 0.312

Table 4:13 Crosstab between Diagnosis and Family History

			Family history		Total
			yes	No	
Diagnosis	Atherosclerosis	Count	1	0	1
		% of Total	2.5%	0%	2.5%
	Total occlusion	Count	3	2	5
		% of Total	7.5%	5.0%	12.5%
	AVM	Count	0	2	2
		% of Total	0.0%	5.0%	5.0%
	Atheroscleris +stenosis	Count	10	1	11
		% of Total	25.0%	2.5%	27.5%
	Atheroscleros + total occlusion	Count	3	0	3
		% of Total	7.5%	0.0%	7.5%

	Total occlusion +collateral	Count	12	5	17
		% of Total	30.0%	12.5%	42.5%
	AVM +Aneurysm	Count	0	1	1
		% of Total	0.0%	2.5%	2.5%
Total		Count	29	11	40
		% of Total	72.5%	27.5%	100.0%

P –value = 0.069

Table 4:14 Crosstab between Diagnosis and DISEASE DURATION

			DISEASE DURATION			Total
			less than1	1-5	more than5	
Diagnosis	Atherosclerosis	Count	1	0	0	1
		% of Total	2.5%	0.0%	0.0%	2.5%
	Total occlusion	Count	0	5	0	5
		% of Total	0.0%	12.5%	0.0%	12.5%
	AVM	Count	0	2	0	2
		% of Total	0.0%	5.0%	0.0%	5.0%
	Atherosclerosis+ stenosis	Count	2	9	0	11
		% of Total	5.0%	22.5%	0.0%	27.5%
	Atherosclerosis +total	Count	0	3	0	3

	occlusion	% of Total	0.0%	7.5%	0.0%	7.5%
	Total occlusion +collateral	Count	0	14	3	17
		% of Total	0.0%	35.0%	7.5%	42.5%
	AVM +Aneurysm	Count	0	1	0	1
		% of Total	0.0%	2.5%	0.0%	2.5%
Total		Count	3	34	3	40
		% of Total	7.5%	85.0%	7.5%	100.0%

P –value = 0.060

Table 4:15 Crosstab between Diagnosis and the contrast media volume

			C.M VOLUM			Total
			100	120	135	
Diagnosis	Atherosclerosis	Count	0	0	1	1
		% of Total	0.0%	0.0%	2.5%	2.5%
	Total occlusion	Count	0	2	3	5
		% of Total	0.0%	5.0%	7.5%	12.5%
	AVM	Count	0	2	0	2
		% of Total	0.0%	5.0%	0.0%	5.0%
	Atherosclerosis+ stenosis	Count	0	3	8	11
		% of Total	0.0%	7.5%	20.0%	27.5%
	Atherosclerosis+totalocclusion	Count	0	1	2	3
		% of Total	0.0%	2.5%	5.0%	7.5%

	Total occlusion +collateral	Count	1	8	8	17
		% of Total	2.5%	20.0 %	20.0%	42.5%
	AVM+Aneurysm	Count	0	0	1	1
		% of Total	0.0%	0.0%	2.5%	2.5%
Total		Count	1	16	23	40
		% of Total	2.5%	40.0 %	57.5%	100.0 %

P –value = 0.842

Table 4:16 Crosstab between Diagnosis and Contrast Media Flow Rate

			C.M FLOW RATE		Total
			5	6	
Diagnosis	Atherosclerosis	Count	0	1	1
		% of Total	0.0%	2.5%	2.5%
	Total occlusion	Count	2	3	5
		% of Total	5.0%	7.5%	12.5%
	AVM	Count	2	0	2
		% of Total	5.0%	0.0%	5.0%
	Atherosclerosis +stenosis	Count	3	8	11
		% of Total	7.5%	20.0%	27.5%
	Atherosclerosis +total occlusion	Count	1	2	3
		% of Total	2.5%	5.0%	7.5%
	total occlusion+ collateral	Count	8	9	17
		% of Total	20.0%	22.5%	42.5%

	AVM +Aneurysm	Count	0	1	1
		% of Total	0.0%	2.5%	2.5%
Total		Count	16	24	40
		% of Total	40.0%	60.0%	100.0 %

P –value = 0.483

Table 4:17 Crosstab between Diagnosis and Scan Protocol

			SCAN PROTOCOL		Total
			one box	Tow boxes	
Diagnosis	Atherosclerosis	Count	1	0	1
		% of Total	2.5%	0.0%	2.5%
	Total occlusion	Count	1	4	5
		% of Total	2.5%	10.0 %	12.5%
	AVM	Count	1	1	2
		% of Total	2.5%	2.5%	5.0%
	Atherosclerosis + stenosis	Count	9	2	11
		% of Total	22.5%	5.0%	27.5%
	Atherosclerosis+ total occlusion	Count	1	2	3
		% of Total	2.5%	5.0%	7.5%
	total occlusion+ collateral	Count	5	12	17

		% of Total	12.5%	30.0 %	42.5%
	AVM+ Aneurysm	Count	1	0	1
		% of Total	2.5%	0.0%	2.5%
Total		Count	19	21	40
		% of Total	47.5%	52.5 %	100.0 %

P –value = 0.077

Table 4:18 Crosstab between Diagnosis and Site

			SITE			Total
			right	left	both	
Diagnosis	Atherosclerosis	Count	1	0	0	1
		% of Total	2.5%	0.0%	0.0%	2.5%
	Total occlusion	Count	2	2	1	5
		% of Total	5.0%	5.0%	2.5%	12.5%
	AVM	Count	2	0	0	2
		% of Total	5.0%	0.0%	0.0%	5.0%
	Atherosclerosis+ stenosis	Count	1	0	10	11
		% of Total	2.5%	0.0%	25.0%	27.5%
	Atherosclerosis+ total occlusion	Count	1	1	1	3
		% of Total	2.5%	2.5%	2.5%	7.5%
	Total occlusion + collateral	Count	6	6	5	17

		% of Total	15.0 %	15.0 %	12.5%	42.5%
	AVM +Aneurysm	Count	0	1	0	1
		% of Total	0.0%	2.5%	0.0%	2.5%
Total		Count	13	10	17	40
		% of Total	32.5 %	25.0 %	42.5%	100.0 %

P –value = 0.031

Table 4:19 Crosstab between Diagnosis and Size

			SIZE			Total
			1-5	5-10	more than10	
Diagnosis	Atherosclerosis	Count	0	1	0	1
		% of Total	0.0%	2.5%	0.0%	2.5%
	Total occlusion	Count	1	2	2	5
		% of Total	2.5%	5.0%	5.0%	12.5%
	AVM	Count	0	0	2	2
		% of Total	0.0%	0.0%	5.0%	5.0%
	Atherosclerosis + stenosis	Count	10	1	0	11
		% of Total	25.0%	2.5%	0.0%	27.5%
	Atherosclerosis + total occlusion	Count	0	0	3	3
		% of Total	0.0%	0.0%	7.5%	7.5%
	total occlusion +collateral	Count	2	2	13	17
		% of Total	5.0%	5.0%	32.5%	42.5%
	AVM + Aneurysm	Count	0	0	1	1

		% of Total	0.0%	0.0%	2.5%	2.5%
Total		Count	13	6	21	40
		% of Total	32.5%	15.0%	52.5%	100.0%

P –value = 0.000

Table 4:20 Crosstab between Diagnosis and Technique

			Technique			Total
			MIP	MIP+ VRT	MBR +VRT	
Diagnosis	Atherosclerosis	Count	1	0	0	1
		% of Total	2.5%	0.0%	0.0%	2.5%
	Total occlusion	Count	1	2	2	5
		% of Total	2.5%	5.0%	5.0%	12.5%
	AVM	Count	1	1	0	2
		% of Total	2.5%	2.5%	0.0%	5.0%
	Atherosclerosis + stenosis	Count	0	11	0	11
		% of Total	0.0%	27.5%	0.0%	27.5%
	Atherosclerosis + total occlusion	Count	1	2	0	3
		% of Total	2.5%	5.0%	0.0%	7.5%
	Total occlusion + collateral	Count	0	9	8	17
		% of Total	0.0%	22.5%	20.0%	42.5%
	AVM +Aneurysm	Count	0	1	0	1
		% of Total	0.0%	2.5%	0.0%	2.5%
Total		Count	4	26	10	40
		% of Total	10.0 %	65.0%	25.0%	100.0 %

P –value = 0.005

Table 4:21 Crosstab between Diagnosis and Age

			AGE				Total
			38-47	48-57	58-67	>68	
Diagnosis	Atherosclerosis	Count	1	0	0	0	1
		% of Total	2.5%	0.0%	0.0%	0.0%	2.5%
	Total occlusion	Count	1	0	0	4	5
		% of Total	2.5%	0.0%	0.0%	10.0%	12.5%
	AVM	Count	1	1	0	0	2
		% of Total	2.5%	2.5%	0.0%	0.0%	5.0%
	Atherosclerosis + stenosis	Count	0	0	4	7	11
		% of Total	0.0%	0.0%	10.0%	17.5%	27.5%
	Atherosclerosis+ total occlusion	Count	0	1	0	2	3
		% of Total	0.0%	2.5%	0.0%	5.0%	7.5%
	Total occlusion + collateral	Count	2	2	5	8	17
		% of Total	5.0%	5.0%	12.5%	20.0%	42.5%
	AVM+Aneurysm	Count	0	0	0	1	1
		% of Total	0.0%	0.0%	0.0%	2.5%	2.5%

Total	Count	5	4	9	22	40
	% of Total	12.5%	10.0%	22.5%	55.0%	100.0%

P –value = 0.149

Table 4:22 DISEASE DURATION and Technique Cross tabulation

		Technique			Total
		MIP	MIP+VRT	MBR+VRT	
DISEASE DURATION	less than1	1	2	0	3
	1-5	3	24	7	34
	more than5	0	0	3	3
Total		4	26	10	40

P –value = 0.018

Table 4:23 Diagnosis and Site Cross tabulation

		SITE			Total
		right	left	both	
Diagnosis	Atherosclerosis	1	0	0	1
	Total occlusion	2	2	1	5
	AVM	2	0	0	2
	Atherosclerosis + stenosis	1	0	10	11

	Atherosclerosis+ tot l occlusion	1	1	1	3
	Total occlusion+ collateral	6	6	5	17
	AVM +Aneurysm	0	1	0	1
Total		13	10	17	40

P –value = 0.031

Table 4:24 Crosstab between C.M Flow Rate and C.M Volume

		C.M VOLUM			Total
		100	120	135	
C.M FLOW RATE	5	0	16	0	16
	6	1	0	23	24
Total		1	16	23	40

P –value = 0.000

Table 4:25 Crosstab between C.M FLOW RATE and SCAN PROTOCOL

		SCAN PROTOCOL		Total
		one box	Tow boxes	
C.M FLOW RATE	5	2	14	16
	6	17	7	24
Total		19	21	40

P –value = 0.000

Chapter Five

5.1 Discussion:

To determine the proper treatment for peripheral arterial disease of diabetes cases, determination of the location stenotic segments and the occlusion severity in the iliac and lower extremity arteries is required. MDCT-A has been shown to be reliable in the evaluation of occlusion pathologies in the arteries of the lower extremity, and its clinical use has been increasing. With CT techniques before the advent of MDCT, it was not possible to image the entire arterial tree of the lower extremity with only one injection of the contrast material. Age classes for the total sample and Percentages the age categorized to (38-47, 48-57, 58-67, >68 and the percentage respectively are 12.5 %, 10.0 %, 22.5 % and 55.0 % and the more appendence age group the age more than 60 years old was illustrated in Table, Figure 4.1, the mean of the ages is 64y and the male percent 55% was more than females 45.0 %in the study population in Figure 4:2. The study revealed that the relation between the family history and the vascular ischemia in DM patients was 72.5 % from the studied population have a previous family

history represented in Table, Figure 4:3. In the study the disease prolongation categorized as (>1 y, 1-5y, and <5 y and percent7.5%, 85.0%, 7.5% respectively the more appeared disease prolongation was 1-5 y groups in Table, Figure 4:4. Table, Figure 4:5 the study demonstrated 57.5 % of sample using 135 cc of contrast media in CTA, the increasing of the used volume depending on the iodine concentration of the contrast agent (300 mg I/ml).contrast media volume flow rate 60.0 % from the total sample size was using 6cc/s and 40% using 5cc/s the observation the flow rate mildly high in CTA, Injection flow rates vary depending on the iodine concentration of the contrast used demonstrate in Table, Figure 4:6. Iodine injection rate is adequate for a 75-kg individual and should be increased or decreased for subjects weigh more than 90 kg or less than 60 kg (Mills JL et al.1999).

(Maged Abdelfattah Ali Algazzar et al, 2014) studied the volume and concentration, and flow rate of the contrast media in CTA the study was performed with 150 cc of low osmolar non-ionic contrast medium (Omnipaque 350) with a flow rate 4 cc/sec and the study disagreed with our study because the researcher was using Omnipaque 300 mg I/ml. Determination of optimal timing for arterial opacification with 64-MDCT device is difficult because the time required for arterial opacification depends on the hemodynamic and vascular state of the patient. In the patients with unilateral severe stenosis, asymmetric contrasting may develop. In the same vein, despite the correct calculation of delay time in 64-MDCT, insufficient opacification may occur in the distal arteries because of rapid scanning. 52.5 % in this study sample using tow boxes in their one protocol and 47.5 % one box to excluded the false positive, represent in Table, Figure 4:7, similar to (Alessandro Napoli.2010).

Table 4:8 Demonstrate the common finding in CTA, frequency and percentage Atherosclerosis, Total occlusion, AVM, Atherosclerosis and stenosis, Atherosclerosis and total occlusion, total occlusion and collateral, AVM and Aneurysm the percentage was 2.5 %,12.5 %, 5.0 %,27.5 %, 7.5 %, 42.5 %, 2.5 % respectively and the common finding was total occlusion and collateral is a similar to the study done by (Alessandro Napoli.2010) the collateral circles formed following lower limbs arterial occlusion and their hemodynamic function.

Table 4:9 demonstrate the site of ischemia by frequency and Percentage Right, Left, Both and the percent 32.5%, 25.0%, 42.5% respectively. the common used technique, and Percentage MIP, MIP+VRT, MPR+VRT 10.0 % , 65.0 %, 25.0 % respectively the common technical used is, MIP+VRT, similar a Portugaller et al reported that when volume rendering technique was used alone, the sensitivity and specificity rates in detecting the high-grade stenosis (>75%) were 84% , and 78.5% respectively. With the use of MIP, however, the sensitivity and specificity rates were 89% and 74% (Table 4:11). There is no a correlation between CTA finding with the Gender were insignificant at the p value 0.312. The correlation between CTA finding and Family History were insignificant at the p value 0.069. Table 4:14 correlation between CTA finding and disease duration were insignificant at the p value 0.060. The correlation between CTA finding and the contrast media volume were insignificant at the p value 0.842. The correlation between CTA finding and Contrast Media Flow Rate were insignificant at the p value 0.483 Table (4:16). And also no correlation between CTA finding and Scan Protocol were insignificant at the p value 0.077 (Table 4:16). In their study the affected side has an impact on the diagnosis as the Rt side is more affected than are significantly at the P value 0.031 (Table 4:18). A correlation between CTA finding and Size of lesion, total occlusion and collateral the percent 42.5%, Atherosclerosis and stenosis the percent 27.5% there were an association at the P value 0.000(Table 4:19).

In our study the most common used technique is the MIP and VRT 65% were significant at the p value 0.005 (Table 4:20).

(Portugaller et al.2014) reported that when volume rendering technique was used alone, the stenosis (>75%) were 84% and 78.5% respectively. With the use of MIP, were 89% and 74% in the same study.

(Laswed et al.2013) conducted the only detailed study that focused on the pedal arteries, and reported sensitivity and specificity rates of 91% and 96% for MDCT in evaluations of crural and pedal arteries all previous studies represent the efficiency of MPR and VRT in diagnoses of vascular disorders also atheroembolism and thromboembolism, aneurysmal disease, and arteritides including Buerger disease and Takayasu arteritis can be precisely evaluated by CTA.

The limitations of MIP include vessel obscuration by other high-attenuation voxels, such as calcification, stents or bone, and the inability to display 3D relationships of vessels and adjacent anatomical structures.

In our study the correlation between CTA finding and Age were insignificant at the p value 0.149 (Table 4:21). The correlation between disease duration and Technique at the P value 0.018 Table (4:22) . The correlation between CTA finding and Site of lesion at the P value 0.031 in the Table 4:24 ,and a correlation between C.M Flow Rate and C.M Volume significant study at the P value 0.000, the Crosstab between C.M flow rate and scan protocol significant study at the P value 0.000, the Crosstab between C.M flow rate and scan protocol significant study at the P value 0.000

5.2 Conclusion:

CT angiography with multislice CT has clearly demonstrate efficacy as a promising new, fast, accurate, safe and non-invasive imaging modality of choice in cases of diabetes peripheral vascular diseases for diagnosis, for grading, for potential usefulness and as a treatment planning tool and are the key to communicating the findings to the treating physician, decisions making (surgical versus transluminal revascularization, or, intervention, conservative treatment).

5.3 Recommendations:

1. This study need further assess by using larger sample size.
2. Multi-detector CT angiography is as a promising new, fast, accurate, safe and a minimally invasive it's a recommended examination for vascular disease.
3. The MIP algorithm, one of the most commonly used formats, has the capability to reveal the entire vascular tree in one image.
4. Optimal technical considerations is essential for performing MDCT angiography in order to achieve accurate diagnosis.
5. Various imaging techniques (MIP,AXIAL ,VRT) are used in the diagnosis of lower extremity arterial disease.
6. CT angiography is able to detect narrowing or obstruction of blood vessels allowing for potentially corrective therapy to be done, faster, non-invasive and has less complications.
7. There is also potentially less discomfort because contrast material is injected into an arm vein rather than into a catheter inserted into a large artery or vein.

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Appendix

Patient's information's:

Age	
Gender	

Clinical history:

- ✓ *Family history*

Disease presence	*+ve*	*-ve*

- ✓ *Duration of disease*

Recently	*Old*	
	1-5 yrs	
	>5yrs	

Examination regard

Contrast media	*Volume*		*Flow rate*	
	100ml		*4 ml/sc*	
	120 ml		*5ml/sc*	
	135 ml		*6ml/sc*	
Scan protocol	*One box*	*2box*	*other*	
Scan view (SV)	*Upper Aortic bifurcation*			
	Lower Aortic bifurcation			
	Distal of Femur			

Findings

Atherosclerotic	*Stenosis*	*Total Occlusion*	*AVM*	*Aneurysm*	*Collateral*	*Others*

Site

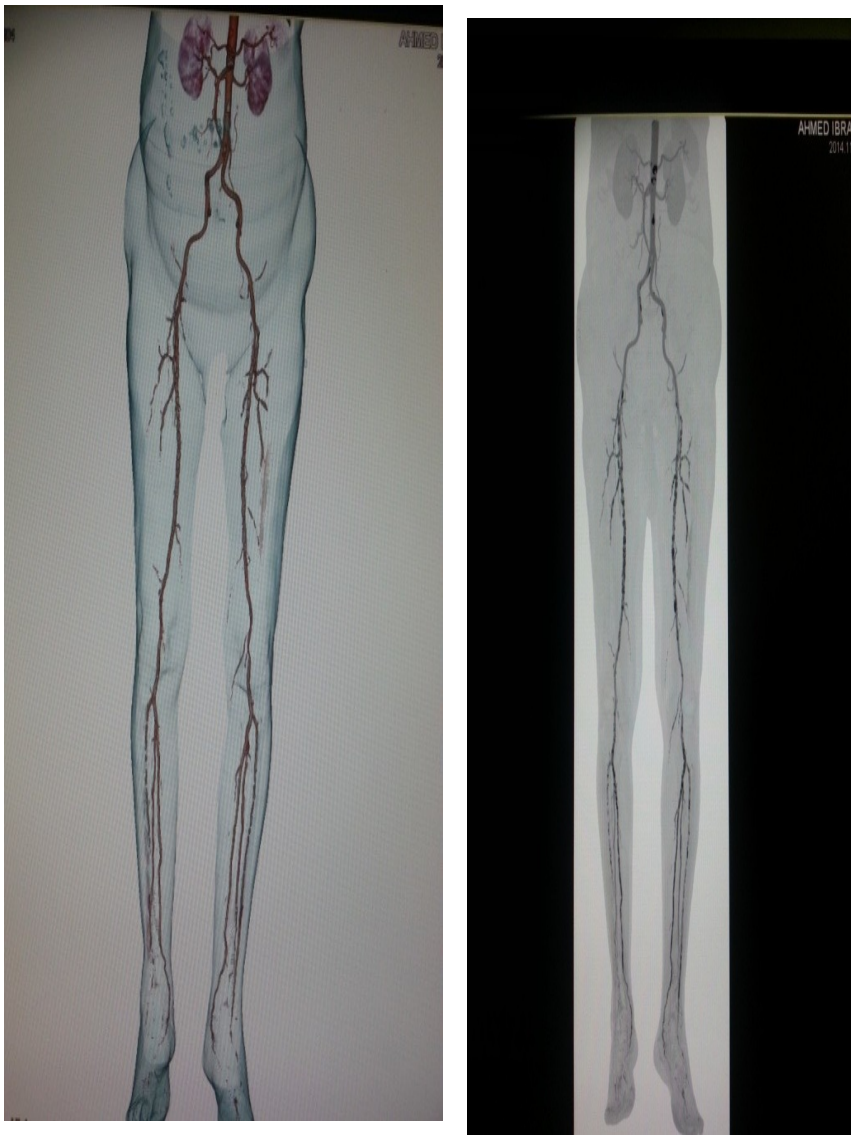
Right	*Left*	*Both*

Size

1-5cm	*5-10cm*	➢ *10cm*

Best appearance

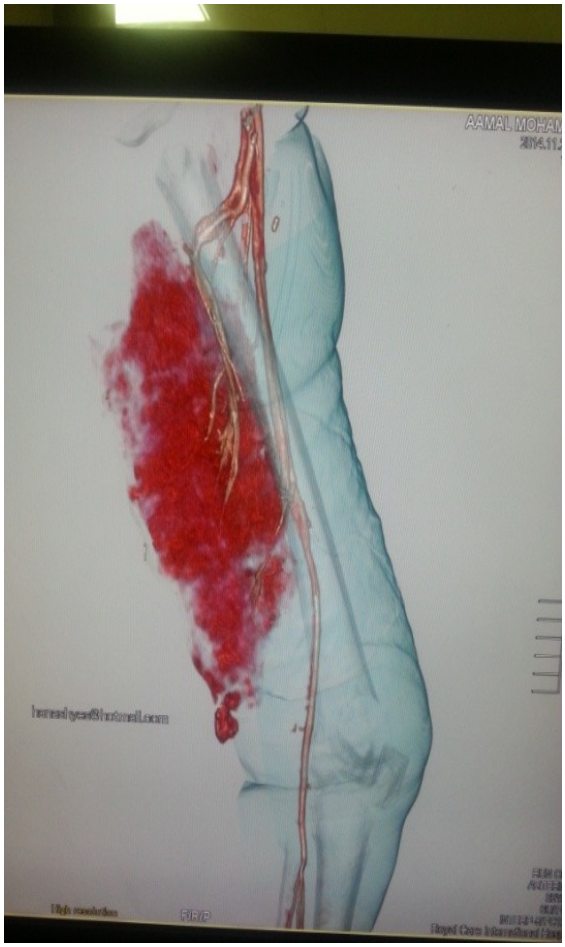
MBR	*MIP*	*VRT*	*AXIAL*	*Other technique*



A **B**

Image (1)

(**A)** VR+ **(B)** MIP invert MDCT images) of a 72-year-old male patient, the findings is stenotic, calcifications in the bilateral lower limb arteries and show occlusion, stenosis.



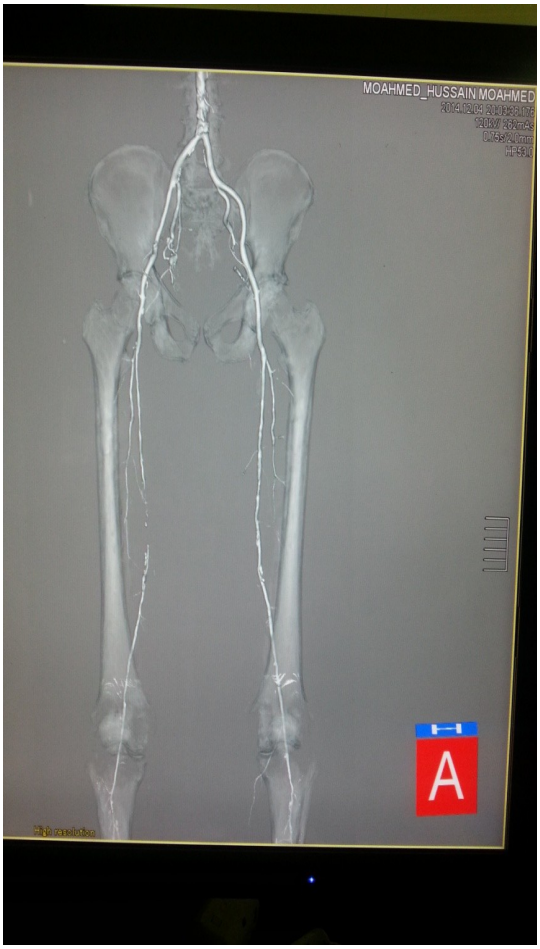
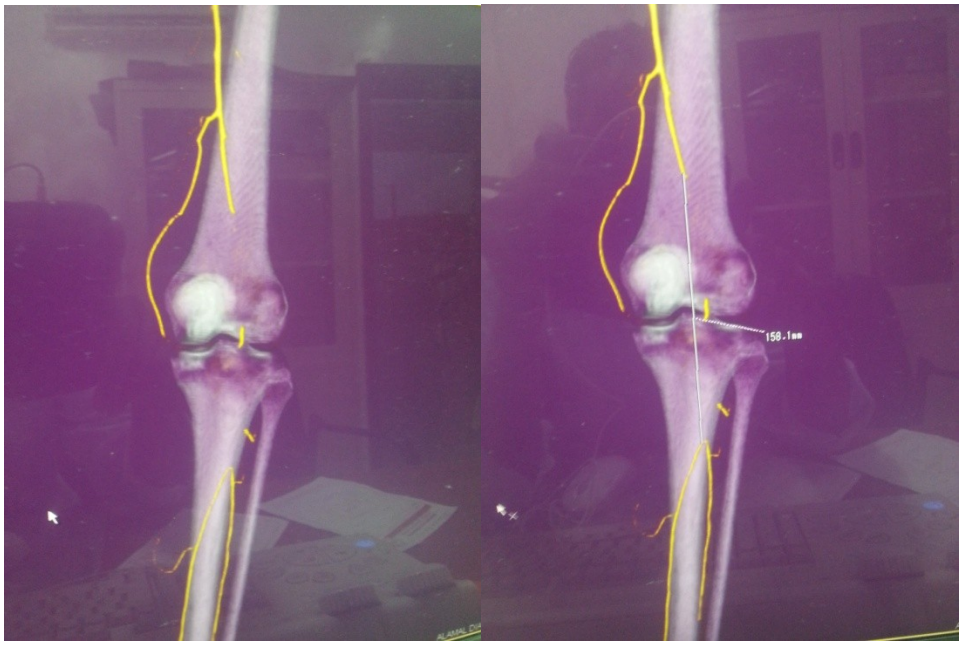


Image (A)

Image (B)

Image (A) VR MDCT images of a 62-year-old patient the findings is stenotic, calcifications in the bilateral lower limb arteries and show occlusion ,stenosis .

Image(B) VR MDCT images of a57-year-old patient the findings is massive vascular lesion .



Image(A)

A 61-year-old male with right-sided MDCTA, This volume-rendered posterior view demonstrates a long occlusion of the right distal superficial femoral artery (SFA) and popliteal artery with a short segment of popliteal reconstitution.

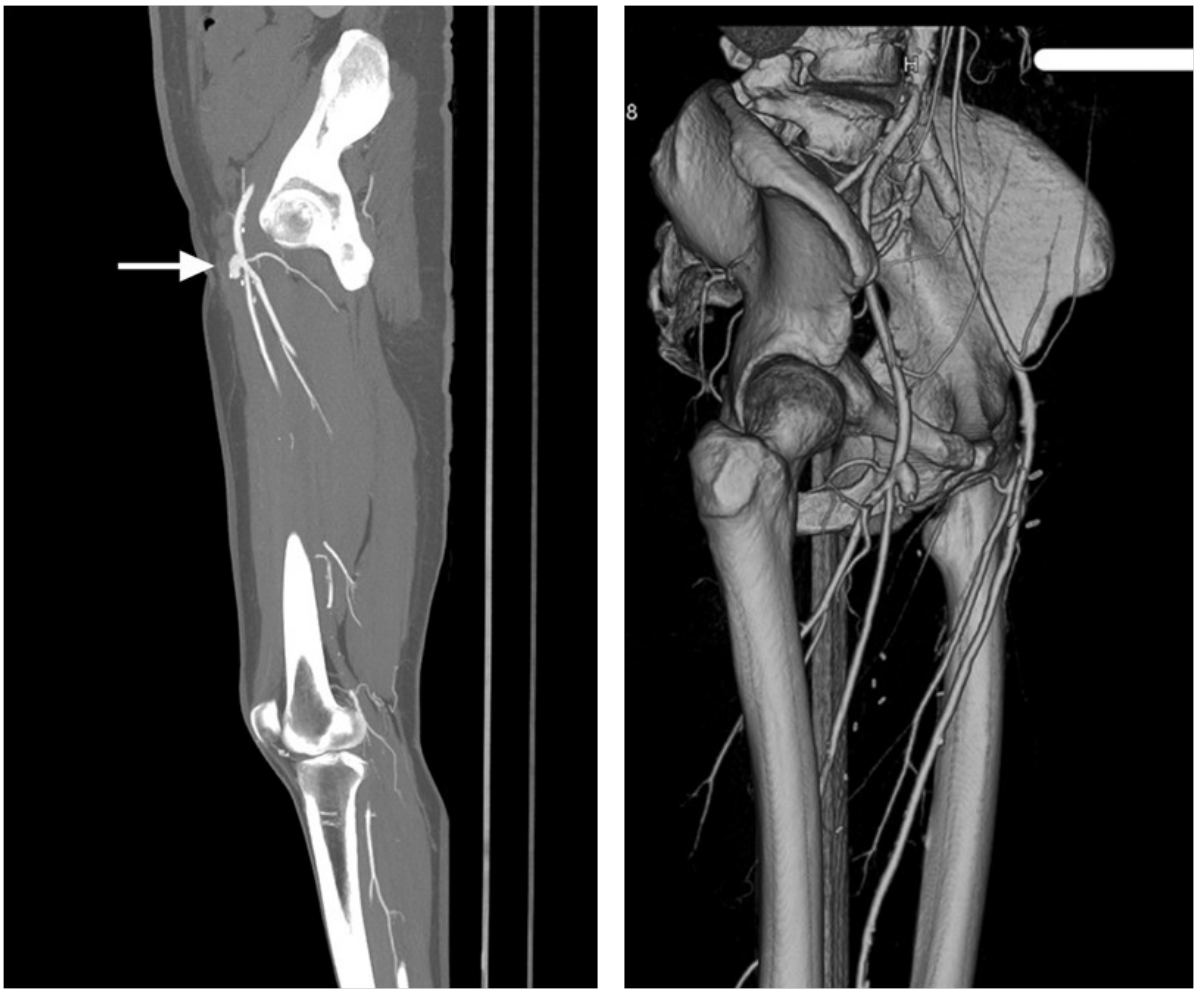


Image (A) **Image (B)**

Image (5) A 40-year-old male with peripheral artery disease . This sagittal maximum intensity projection MDCTA image demonstrates a right common femoral arterial pseudoaneurysm (arrow), A volume-rendered view demonstrating the right common femoral arterial pseudo aneurysm.

Image (A)

Toshiba **Aquilion 64** CT machine

Image (A)

Medrad® Stellant® CT **injection** system