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THE VALUE OF DOPPLER STUDY OF SUPERFICIAL FEMORAL ARTERY OCCLUSION IN PATIENTS WITH PERIPHERAL VASCULAR DISEASE, IN COMPARISON TO CT ANGIOGRAPHY

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Abstract

One noninvasive technique that shows promise in the detection of superficial femoral artery blockage in peripheral vascular disease is Doppler sonography.Methods The 50 patients included in this prospective study had Doppler sonography and multidetector CT scans performed at the Cardiac Center in Al-Sadir Medical City, Al-Najaf, over the course of eight months, beginning in December 2011 and ending on August 2012. Results reveal that the Doppler study's sensitivity(92.5%), specificity(100%), positive predictive value(100%), negative predictive value(76.9%), and accuracy (94%). All of these metrics are consistent with previous work on the identification of stenosis in patients. Conclusion: duplex scanning has several benefits, such as being noninvasive, inexpensive, capable of doing multilayer evaluations, and assessing wall morphology, surrounding structures, intraluminal structures, and plaque.It would suggest that individuals with peripheral artery occlusive disease may be reliably and accurately assessed by multi-detector row CT angiography. Aim of study: The purpose of this research is to compare the

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diagnostic accuracy of Doppler sonography and CT angiography for the detection of superficial femoral artery (SFA) blockage.

Keyword: Femoral artery, PVD, Doppler of femoral artery, CT angiography of femoral artery.

Introduction

1.1 Diseases of the Peripheral Vascular System (PAD, Obliterative Arteriosclerosis, and Perivascular Arterial Disease)

Section 1.1.1: "Peripheral Arterial Disease" A condition known as arteriosclerosis of the extremities causes the arteries that provide blood to the legs and feet to constrict and harden. Nerves and other tissues are vulnerable to injury due to the reduction in blood flow caused by this. Men over the age of 50 are more likely to suffer from this prevalent condition. A increased risk is associated with a history of diabetes, smoking, hypertension, renal illness requiring hemodialysis, cerebrovascular disease (CVD), coronary artery disease (CAD), or stroke, whether it runs in the family or not (1).

1.1.2Anatomy of the Peripheral Arteries

The common iliac arteries branch out from the abdominal aorta on both sides. The internal iliac arteries branch out from the common iliac arteries to supply the pelvis, and the external iliac arteries provide blood to the rest of the body. After passing underneath the inguinal ligament, the external iliac arteries transform into the common femoral arteries. The profunda femoral artery divides off from the common femoral artery just as the superficial femoral artery keeps going. After entering the popliteal fossa, the superficial femoral artery is rechristened the popliteal artery. The anterior tibialis artery, which originates in the popliteal fossa, branches off into three smaller arteries as it leaves the bone: the dorsalispedis, posterior tibialis, and peroneal (2, 3).

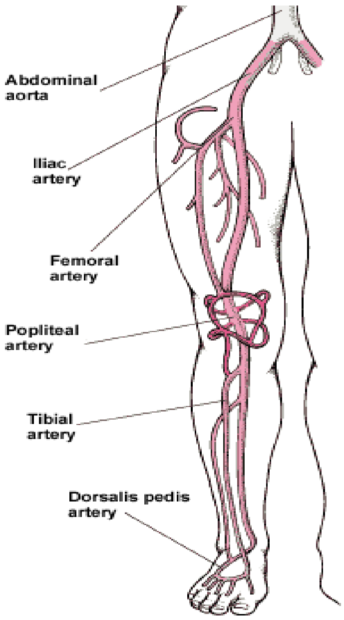

Fig.1: Leg arteries (3

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1.1.3Pathogenesis of Atherosclerosis:

Atherosclerosis develops when the endothelium's typical homeostatic characteristics are disrupted as a consequence of an overreaction to various vascular insults, which causes an overactive inflammatory and fibroproliferative response. Increased endothelial permeability to lipoproteins and other plasma components, upregulation of leukocyte adhesion molecules, upregulation of endothelial adhesion molecules, and migration of leukocytes into the artery wall are the earliest alterations that occur in the endothelium prior to the formation of atherosclerosis lesions. Afterwards, if the insulting agents cannot be neutralized or removed by the inflammatory response, then the inflammatory response will trigger the migration and proliferation of smooth-muscle cells. These cells, along with lipid-laden monocytes, macrophages (foam cells), and T lymphocytes, contribute to the formation of fatty streaks in atherosclerosis. When inflammation persists, more macrophages and lymphocytes are produced, which can then move from the circulation and proliferate within the lesion. When these cells get activated, they secrete a cascade of substances that cause further harm and, in the end, localized necrosis. the third As the lesion grows and changes in shape due to this pathologic process, a fibrous cap forms and covers a core of lipid, leukocytes, and necrotic tissue. Apoptosis, necrosis, elevated proteolysis activity, and lipid buildup are all manifestations of the necrotic core. the third Last but not least, the fibrous cap thins because activated macrophages continue to flood the area, releasing proteolytic enzymes such as metalloproteinases. Thrombosis or accelerated plaque development can ensue swiftly if the fibrous cap ruptures or the fibrous plaque ulcerates in locations where the fibrous cap covering the advanced disease is beginning to thin. An very complex inflammatory disease, atherosclerosis has several stages and is caused by multiple genes. Enzymes, growth factors, cytokines, and lipids all play important roles in atherogenesis, which is characterized by the induction of a prothrombotic milieu in the arterial wall, vasoconstriction, cell-mediated inflammation, and the buildup and oxidation of lipids (3, 4).

1.1.4 Clinical finding

1.1.4 Results in the clinic

Symptoms: As a rule, symptoms only manifest on one side of the body. Typically, the severity of arteriosclerosis varies between the two limbs when it is present. Leg discomfort, also known as intermittent claudication, is worse when you move (like walking) and becomes better when you relax.

-Resting numbness in the lower extremities
-Foot or leg colds
-Discomfort in the lower extremities
-Hair thinning on the lower body
-Legs that have changed color
-Uneven skin tone (cyanosis)
-Limb pulse that is faint or nonexistent
-Disorders of gait or walking (2)

Signs and tests: During the examination, it is possible to hear a whooshing sound, known as an arterial bruit, as well as notice a diminished or nonexistent pulse in the limbs, a drop in blood

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pressure in the afflicted limb, and the presence of ulcers. Blood testing can reveal elevated cholesterol levels (1).

1.1.5 Causes: The most major modifiable cause of PVD on a global scale is smoking, which includes all forms of tobacco usage. The relative risk for PVD increases by as much as tenfold in smokers, with the impact increasing with dosage. A two- to fourfold increase in the likelihood of developing diabetes mellitus is associated with .PVD. Approximately 30% of non-traumatic amputations occur within 5 years for a known diabetic who smokes, and up to 70% of these amputations are done on diabetics. A dyslipidemia, which includes elevated levels of total cholesterol, low density lipoprotein [LDL] cholesterol, and triglycerides, has been linked to hastened PAD. An increased risk of developing PAD is associated with hypertension, which is defined as a high blood pressure.
Trauma. C-reactive protein, homocysteine, and other levels of inflammatory mediators are among the other risk variables that are now under investigation. Over-50-year-old males, those who are overweight, and those who have a personal or family history of vascular illness, cardiovascular disease, or stroke are at a higher risk of PAD (4).

1.2 Diagnostic Tests:
1.2.1 Angiography using Digital Subtraction: The reliance on catheter-based angiography for primary diagnostic purposes has decreased due to the increased availability of noninvasive vascular imaging techniques. The use of catheters in angiography, however, eliminates motion artifacts and permits targeted viewing of individual veins. In addition to visualizing the endothelium of vessels and athermanous plaques using intravascular ultrasonography, this method can give immediate functional information via pressure gradients (5, 6). in the thousands, millions, and trillions.

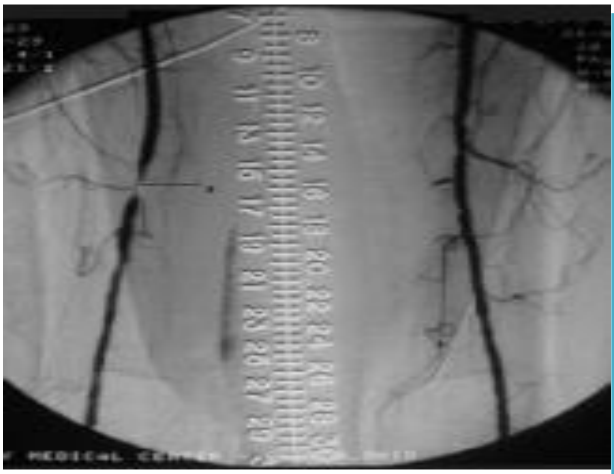

Fig.2Digital subtraction angiogram (DSA) illustrates a high-grade short-segment stenosis of the lumen of the right superficial femoral artery (a) [6].

- **Advantages**:

The gold standard for artery testing is still an arteriography. As far as diagnostic tools go, arteriography shines (7).

- **Limitations:**

This diagnostic procedure is seen as intrusive. The risk of complications, such as a hematoma at the puncture site, is connected with this evaluation. The intravenous contrast material presents a

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higher risk of nephrotoxicity compared to radiation exposure or intimal flap dissection or artery wall rupture. This is especially concerning given the typical correlation of LE PAD with renal arterial disease and renal illness, which increases the risk of complications. Hence, arteriography is restricted for use solely in preoperative evaluations (7, 8).

Duplex ultrasonography (1.2.2):

You may learn about the anatomy and function of the investigated artery segments with duplex ultrasonography, which combines real-time brightness (B-mode/gray scale) imaging with color pulsed-wave Doppler ultrasonography (9).

Section 1.2.1.1: Duplex Scanning

The term "Duplex Scanner" describes the common combination of PW Doppler and a 2D, real-time, B-mode scanner. Duplex scanning was initially proposed by F.E. In 1974 (10), Barber et al. detailed their use of pulsed wave Doppler in conjunction with B-mode ultrasound. A two-dimensional picture was created from the Doppler data by use of a multi-gated system. The "duplex image" was created by superimposing the Doppler image on top of the B-mode image, and the bright spots on the screen represented blood flow. The Doppler sample volume's position may be fine-tuned and tracked using the B-mode picture. Color flow Doppler imaging techniques use color encoding of the Doppler frequency shift to show the flow velocity in the picture as a color flow map (10). Colors are used to indicate variations in blood flow. Blood flow velocity and insonation angle are represented by the hue. The colors are darker for Doppler angles that are closer to the transducer and lighter for those that are farther away. Since there is no Doppler shift (cos 90° = 0) when insonation is perpendicular to the vessel (90°), the color signal is empty (11).

Fig.3

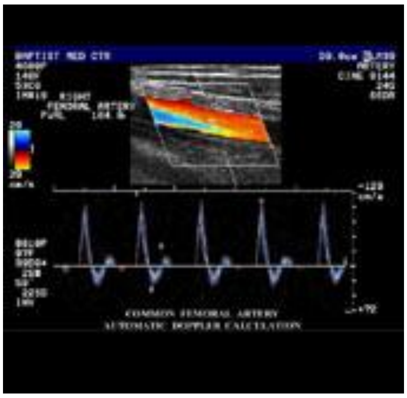

Fig.4

Fig.3 Gray-scale sonogram demonstrates the SFA artery, which is located between the calipers. It measures 0.62 cm in diameter. Findings are normal in this study [11].

Fig.4 Doppler spectral waveform from a normal right femoral artery. The Doppler signal was obtained from a longitudinal view and with the Doppler sample volume placed in middle of the lumen. The characteristic triphasic Doppler signal shows a fast upstroke to peak systole (1), reversal of blood flow during early diastole (2), and a forward flow component during late diastole (3) [12].

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When it comes to detecting large lesions, duplex ultrasonography has a high sensitivity of 92% and a specificity of 97%. An even higher level of specificity (99%) and sensitivity (95%) is achieved for complete occlusions. Grayscale imaging of atherosclerotic plaques and visual resolution of artery wall layers are both made possible by B-mode imaging. We can measure the plaque density by using the gray-scale median. The addition of flow velocities in arteries and across stenotic lesions by pulsed-wave Doppler ultrasonography to B-mode imaging gives physiological information that is lacking in the latter. By seeing flowing blood and detecting turbulence, color Doppler ultrasonography enhances the data acquired by B-mode and pulsed-wave Doppler ultrasonography (13).

- **Advantages:**

When evaluating patients for PAD, the affordable and widely accessible Doppler ultrasonic scan (US) is an invaluable diagnostic tool for a number of reasons: The primary goal is to identify hemodynamically significant lesions when pulse volume and segmental limb pressure data are inconclusive.The second reason is to show the patient the disease's anatomy so they can be advised on the chances of a long-term success with endovascular or surgical revascularization (differentiating between stenosis and occlusion, measuring the occlusion's length, and checking the profunda femoral artery and other collateral vessels). The third reason is to keep an eye on patients following revascularization surgeries (14, 15).

Limitation

The length, severity, and type of the diseased part of the artery cannot be accurately described with
1-Doppler US. These details are essential for surgical or endoluminal intervention planning.
2-Although vascular mapping may be used to assess the iliac arteries and femoropopliteal artery segments, it is physically demanding and can take up to two hours for an assessment.
3-It relies on the operator.
4-When it comes to evaluating the tiniest, most distant arteries, including those in the foot, duplex ultrasonography isn't very helpful (16).

1.2.1.2The degree of stenosis:

There are typically four ways to classify the severity of vascular disease in the legs: These range from "normal" (no stenosis at all) to "total occlusion" (100 percent stenosis). The following categories were used to classify stenosis: 0%-19% stenosis was indicated by a PSV ratio less than 1.5; 20%-49% stenosis was indicated by a PSV ratio greater than 1.5 but less than 2.5; 50%-74% stenosis was indicated by a PSV ratio greater than 2.5; 75%-99% stenosis was indicated by a PSV ratio greater than 2.5 plus an end-diastolic velocity greater than 60 cm/sec; and no Doppler signal indicates occlusion (16, 17).

Technical mistake, vascular calcifications, or blockage might be the cause of no flow signal. Typically, echogenic material in the artery indicates thrombosis. Numerous research have examined the femoropopliteal segment, and their findings suggest that large collateral branches may point to high-grade stenosis or more distant blockage. When it came to identifying segmental arterial lesions, the sensitivity was over 85% and the specificity was over 92% (16). Typically, duplex ultrasound has a moderate to high sensitivity and specificity of 70% to 90% when it comes to detecting and grading PAD (17). Hence, for the detection of mid- and distal SFA lesions, duplex ultrasonography is very sensitive, specific, and accurate (16, 18).

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Criteria for arterial stenosis:

Spectral analysis:

Fig. 5 A, B show the location of the stenosis.

Boost intrastenotic flow acceleration, or PSV.

• An expanding spectrum.

• A softer spectral line, characterized by a less pronounced systolic upstroke.

• The spectral window is being gradually filled in, and the lower frequency band is becoming brighter.

• A negative frequency is present because the flow is turbulent.

Downstream, decrease PSV.

• A harsh sound is heard in cases of pre-occlusive stenosis, while high-pitched noises are heard in cases of stenosis itself.

The sensitivity and specificity of duplex ultrasonography for the detection of substantial lesions is high (92% and 97%, respectively). For total occlusions, sensitivity (95%) and specificity (99%) are even better. B-mode imaging permits visual resolution of arterial wall layers and characterization of atherosclerotic plaques by gray-scale imaging. The density of the plaque can be quantified by measuring the gray-scale median. Pulsed-wave Doppler ultrasonography adds physiological information not provided by B-mode imaging because it provides flow velocities in vessels and across stenotic lesions. Color Doppler ultrasonography complements the information obtained by B-mode and pulsed-wave Doppler ultrasonography, as it visualizes moving blood and detects turbulence [13].

- **Advantages:**

Doppler US is a valuable diagnostic test; it is inexpensive and widely available and useful in assessing patients with PAD, for several reasons:

Firstly, to determine if a hemodynamically important lesion is present when the data from segmental limb pressure measurement and pulse volume recording are ambiguous.

Secondly, to demonstrate the anatomy of the disease (to distinguish stenosis from occlusion, to measure the length of the occlusion, or to assess the status of collateral vessels such as the profunda femoral artery) so that the patient can be counseled on the likelihood of a successful and durable result with endovascular or surgical revascularization.

Thirdly, for surveillance after surgical revascularization procedures [14, 15].

- **Limitation:**

1-Doppler US does not offer detailed description of the length, severity, or type of the diseased portion of the vessel, all of which help in planning surgical or endoluminal intervention.

2-Although vascular mapping can be performed to evaluate the iliac vessels and the femoropopliteal arterial segments, it is time and labor consuming (with examinations sometimes requiring as long as 2 h).

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3-It is operator dependent.
4- Duplex ultrasonography has limited utility in providing the detail necessary for assessment of the most distal, smallest vessels, such as those in the foot [16].

1.2.1.2The degree of stenosis:
The degree of arterial disease in the lower extremities is often classified into four categories:- 'Normal' (0% stenosis), '1-49% stenosis, '50-99% stenosis', and 'total occlusion' (100% stenosis).
Stenosis scale categories were as follows: A PSV ratio of less than 1.5 indicated 0%–19% stenosis; a PSV ratio of greater than or equal to 1.5 but less than 2.5, 20%–49% stenosis; a PSV ratio of greater than or equal to 2.5, 50%–74% stenosis; a PSV ratio of greater than or equal to 2.5 plus an end-diastolic velocity of greater than 60 cm/sec, 75%–99% stenosis; and no Doppler signal, occlusion [16, 17].
The absence of a flow signal may represent occlusion, vascular calcifications, or technical error. Thrombosis is usually seen as echogenic material in the artery. Large collateral branches are likely to indicate high-grade stenosis or more distal occlusion Multiple published studies evaluated the femoropopliteal segment. The reported sensitivity was more than 85%, and the specificity was more than 92% in detecting segmental arterial lesions [16] .
The sensitivity and specificity of duplex US for the detection and grading of PAD are generally moderate to high, ranging from 70%–90% [17].
Therefore Duplex ultrasonography is highly sensitive, specific, and accurate for detecting SFA lesions in the mid and distal SFA [16, 18].

Criteria for arterial stenosis:
Spectral analysis:

- **At site of stenosis:(Fig.5 A, B)**
- Increase PSV (intrastenotic flow acceleration).
- Spectral broading.
- Loss of sharpness of spectral line (flattened systolic upstroke).
- Progressive obliteration of the spectral window and increase brightness in the lower frequency band.
- Presence of negative frequency due to turbulent flow.
- Reduce PSV further downstream.
- Stenosis results in high-pitched sounds, and pre-occlusive stenosis presents with a harsh sound.

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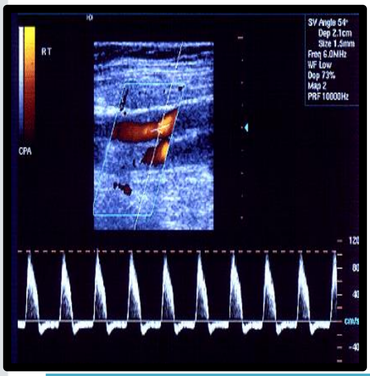

Fig. (5) A

(Color and spectral analysis, normal femoral artery)

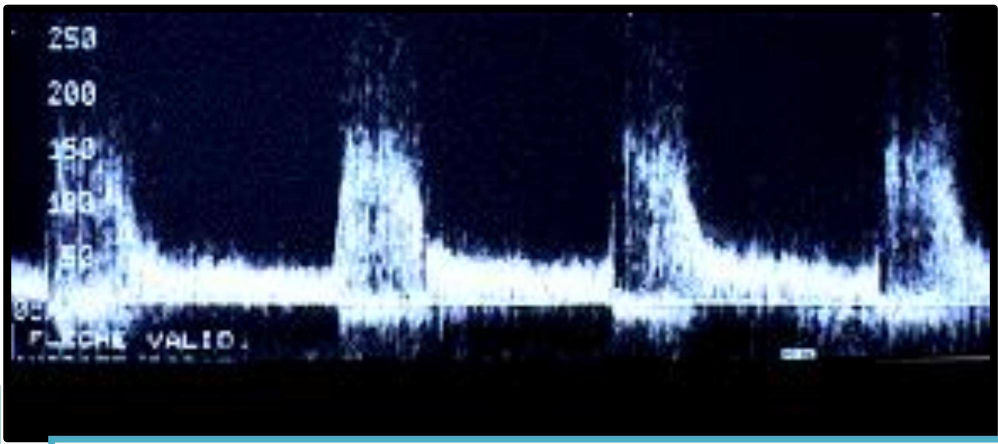

Fig. (5) B

Intra stenotic segment pulse wave show very high PSV of 200 cm/s associated with spectral widening & turbulent flow [18].

❖ **Proximal to a stenosis or occlusion:(Fig. 6)**

- Increase resistance to forward flow.
- Decrease amplitude of spectral waveform especially diastolic flow.
- Diastolic flow reversal is decreased or absent.
- Systolic peak is narrow.
- The vascular resistance is increased.

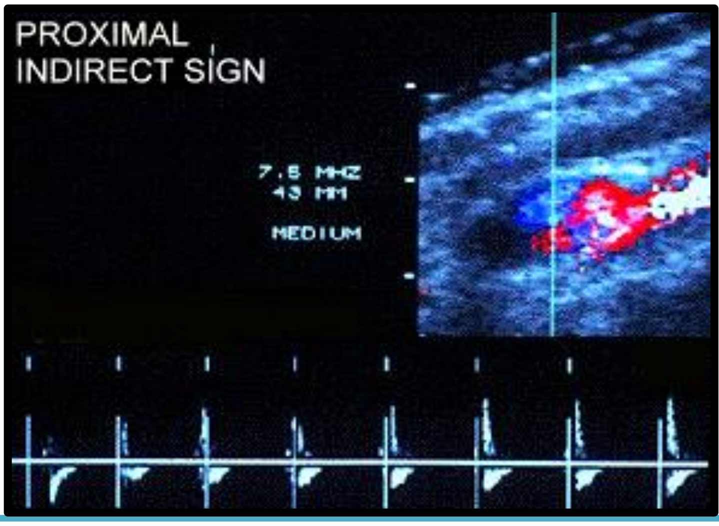

Fig. 6

Prestenotic segment pulse wave showed decrease amplitude of spectral wave and narrow systolic peak [18].

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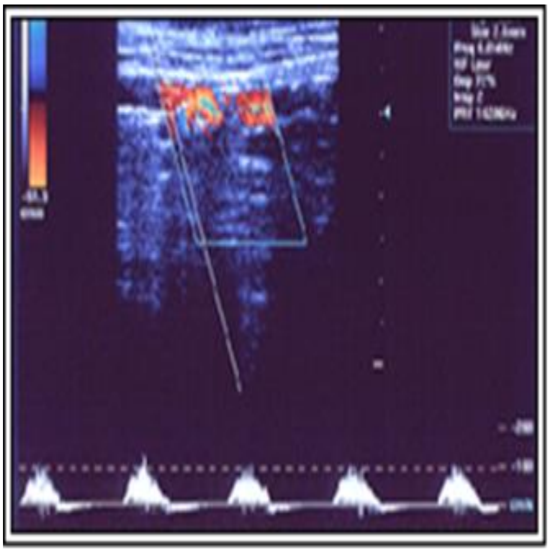
❖ **Distal to stenosis or occlusion: (Fig 7A & B)**

- Loss of the triphasicpattern.
- Decreased amplitude of the systolic component (dampening flow with dome shape appearance of PSV).
- Widened and rounded systolic peak (increase the time to PSV “sinusoidal appearance" or "parvustardus").
- Increased forward diastolic flow at rest. This occurs secondary to distal vasodilatation.
- In cases of discordant findings, exercise or ischemic maneuvers must be performed
- Collateral flow may compensate for severe stenosis
- Lower-pitched sounds during systole, and presence of sound during diastole.[19]



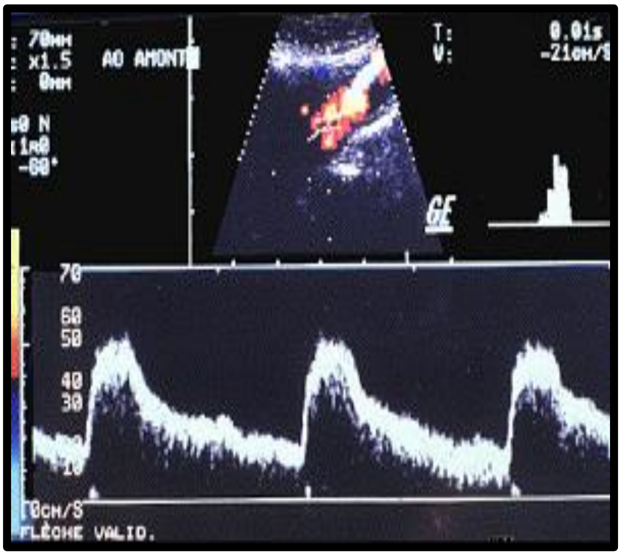


Fig. 7A

Post stenotic segment flow wave showed decreased PSV, spectral widening & mono phasic wave form.

Fig. 7B

Tardus -parvus wave seen distal to sever stenosis [19].

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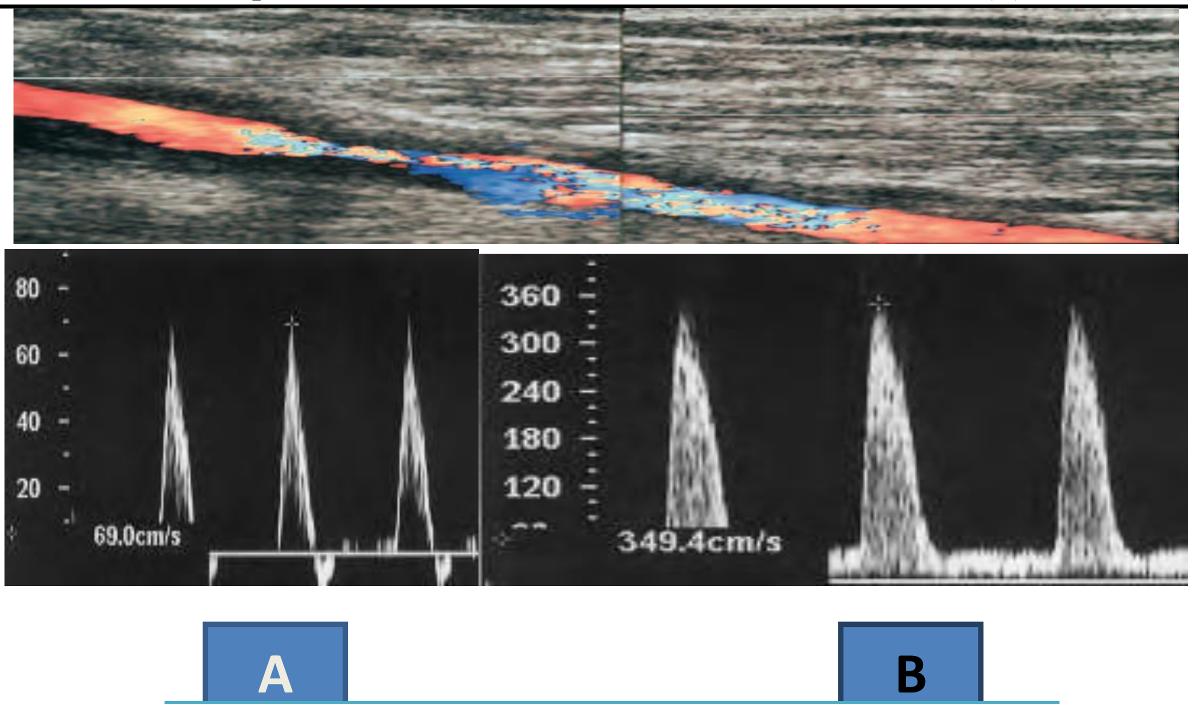

Fig.8

SFA stenosis is assessed using spectral Doppler.

A: Measurement of the peak systolic velocity just proximal to the stenosis.

B: Measurement of the peak systolic velocity across the stenosis.

The peak systolic velocity ratio is calculated by dividing B by A, producing velocity ratio of 5. ....This would indicate a severe stenosis [18].

1.2.3 Magnetic Resonance Arteriography:

The first method of magnetic resonance imaging (MRA) used time-of-flight imaging without contrast enhancement. Patient motion artifacts, long acquisition durations, and tiny image volumes were problems with this method. In a standard contrast-enhanced magnetic resonance angiography (MRA) examination of the lower limbs, a bolus of intravenous gadolinium or a continuous infusion of gadolinium is sequentially chased down over three arterial segments: the aortoiliac, femoral-popliteal, and infrapopliteal segments (20). Time-of-flight imaging also had trouble resolving retrograde arterial flow in collateral and reconstituted vessels located distant from stenotic lesions.

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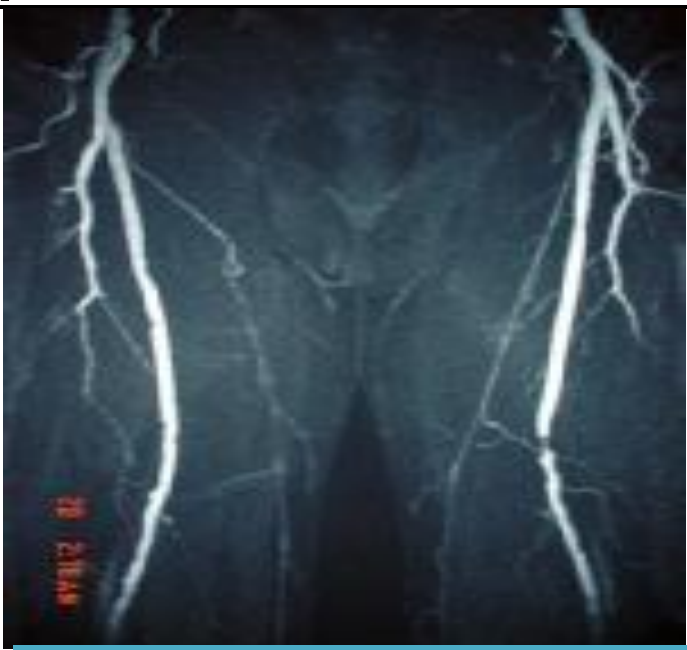

Fig. 9

This magnetic resonance angiogram (MRA) of the lower extremities was obtained by using the bolus-chase technique. A short-segment high-grade stenosis is present in the middle of the left superficial femoral artery. Note the collateral arterial supply [20].

- **Advantages**:

The contrast agent utilized in magnetic resonance imaging (MRA) is comparatively non-nephrotoxic, and the procedure itself does not involve ionizing radiation (20).

- **Limitations**:

Some of the drawbacks of this imaging technique are its high price tag, restricted accessibility, difficulty in depicting tiny arteries, potential for overestimating stenosis severity, and contraindications (20).

1.2.4 CT Angiography: When compared to single slice "conventional" CT, computed tomography (CT), which was commercially introduced over ten years ago, was a revolutionary improvement (1990) The utilization of multi-detector CT for vascular applications was made possible with the 1998 release of 4-slice CT scanners that have a temporal resolution of 0.5 s. The ongoing competition for additional slices reached a new level with the introduction of 64-slice CT systems in 2004. In a relatively recent development, computed tomography (CT) angiography has been able to produce high-resolution vascular pictures in addition to precise views of the surrounding soft tissues and bone. The contrast material is injected into a peripheral vein, making it a very non-invasive procedure. On top of that, the three-dimensional reformatting provides a great view of the connections between bones, soft tissues, and the vascular system.

• Patients with difficulty holding their breath will benefit from CT's speed. CT scanning is a safe, accurate, and noninvasive option. Among CT's many benefits is its capacity to provide simultaneous images of bone, soft tissue, and blood vessels (21). A noninvasive and quick way to evaluate the peripheral artery vasculature is with multidetector computed tomography (CTA). Compared to traditional angiography, computed tomography (CTA) offers a number of benefits for patients with peripheral artery disease (PAD), including improved detection of soft-tissue details, thrombosed aneurysms and dissections, wall-thickening in large artery vasculitis, cystic adventitial disease, popliteal artery entrapment syndrome, and cystic adventitious disease (21, 22). Presently, several image post-processing methods, including "multi-planar reconstruction," "maximum-intensity projections," the "volume-rendering technique," and, to a lesser extent, "shaded-surface display," are employed for the purpose of visualizing and analyzing lower extremity artery obstruction. "Curved multiplanar reconstruction" is another image reformatting tool available on most 3D workstations; this method shows the whole length of an object's vessel in a single plane (23, 24). Additionally, CTA resolved differences found by duplex scanning and could distinguish between significant stenosis and occlusion. To verify the accuracy of duplex scanning assessment of SFA stenosis, CTA is a suitable substitute technique. There are less risks compared to traditional angiography, and it can effectively assess lumen stenosis and see plaque morphology (25).Delineation of the femoropopliteal segment and inflow and outflow arteries, including lengths, lesion numbers, stenosis diameters and morphologies, neighboring normal arterial caliber, degree of calcification, and status of distal runoff vessels, may be obtained by CT angiography (26).

Advantages:

• Looking for signs of severe claudication, ulceration, or gangrene to determine the extent of ischemia.

• Evaluation of vascular diseases, including aneurysms, dissections, AV malformations and fistulas, intramural hematomas, and vasculitis.

• Syndrome of arterial entrapment.

venous thrombosis, in cases where previous investigations have failed to establish a diagnosis.

· A tumor's ability to invade or displace blood vessels (27).

Limitations:

When it comes to evaluating individuals with peripheral artery occlusive disease, multi-detector row CT angiography has a few key limitations:

1-Ionizing radiation like this.

2-Consider the possibility that some patients with impaired renal function may not be able to tolerate iodinated contrast agents when making decisions about their usage.

3-The present software's low utility for MIP image creation is a key restriction of CT angiography, particularly in cases when thick calcifications are present (28, 29).

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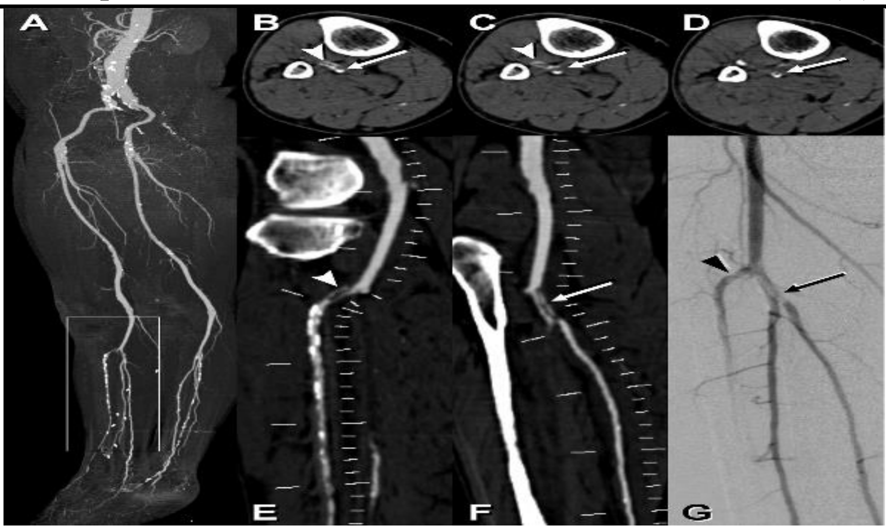

Fig.10 (a) Oblique (45° left anterior oblique) MIP image of entire data set. Box indicates magnified views. (b–d) axial CT images through the right proximal calf show embolic filling defects in the anteriortibial artery (arrowheads) and the tibioperoneal trunk (arrows). (E, f) Corresponding CPR images from the popliteal artery through the anterior tibial artery (e) and posterior tibial artery (f) display intraluminal filling defects. DSA confirms CT angiography findings (g) [28].

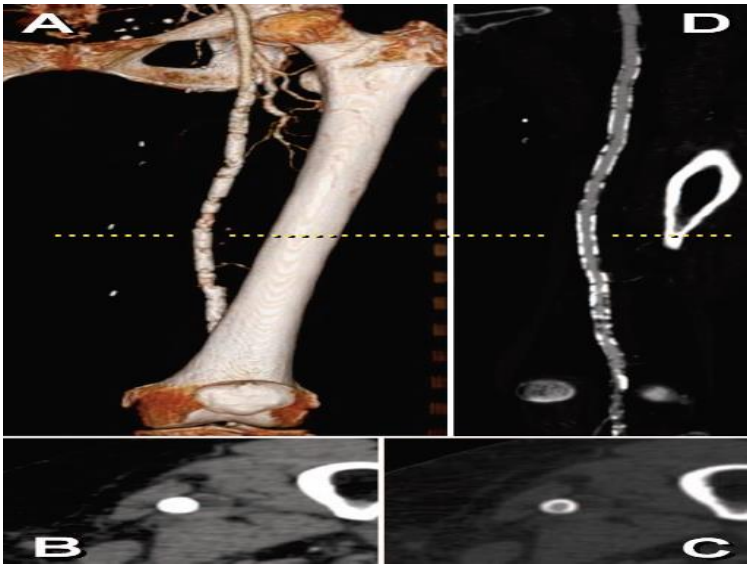

Fig. 11

(a) VR image of the left superficial femoral artery shows excessive vessel wall calcifications, precluding the assessment of the flow channel.

(b) Does not allow us to distinguish between opacified vessel lumen and vessel calcification, which can be distinguished only when an adequately wide window width (300 HU/1,200 HU) is used

(c).Similar wide window settings are also used for a CPR through the same vessel (d), displaying several areas of wall calcification with and without stenosis [30].

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Materials & methods

3.1 study design & Patients selection

From December 1, 2011, to August 1, 2012, fifty patients referred to the CTA unite at the Cardiac center at AL-Sader Medical City, Najaf, Iraq, with signs and symptoms of peripheral artery disease were included in this prospective research.Prior to doing CTA, all patients underwent a Doppler US examination after their agreement was obtained,A board-certified radiologist performed the examination with the same equipment (a 2009 Philips HD11XE unit for the sonography investigations).Then, a radiologist who is unfamiliar with Doppler results reported the results of the computed tomography angiography (CTA) using the Aquillon 64, V4.51 ER 010, Toshiba Medical Systems, Tochigi, Japan, and the data was compared statistically using the Stasis Package for the Social Sciences (SSPS).

Fig. 12.HD11XE Philips 2009 U/S& color Doppler unit, AL-Sadir medical city

3.2 Doppler Technique :

The examination began by positioning the patient on their back with their legs rotated outward to capture images of the superficial fascia and patellar tendon. The next step was to roll them over onto their backside and raise their legs 20 degrees to see the popliteal artery. used a transducer operating at a high frequency (7.5-10 MHz).In order to thoroughly evaluate the arteries and the kind of plaque, the scan was initiated using B-mode in both the longitudinal and transverse planes. Color Doppler was applied to each artery in turn to ascertain:-

• The extent to which the stenotic segment narrows the artery's cross section in comparison to its pre-stenotic segment. Where the narrowing occurs , Does the illness exist in several forms? The duration of every lesion. The number seventy-seven is an identifier for the number seventy-seventh magic number.

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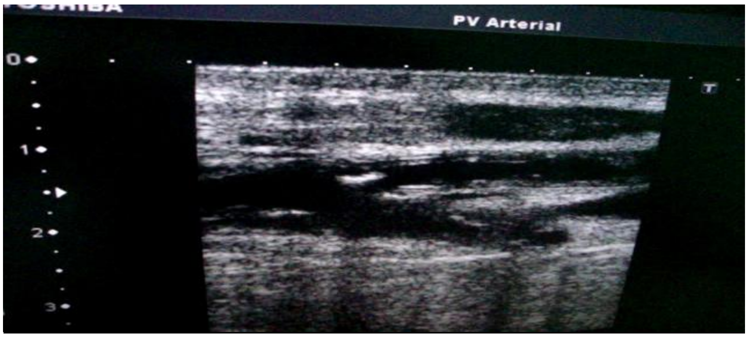

Fig.13

Shows area of calcification in origin of SFA

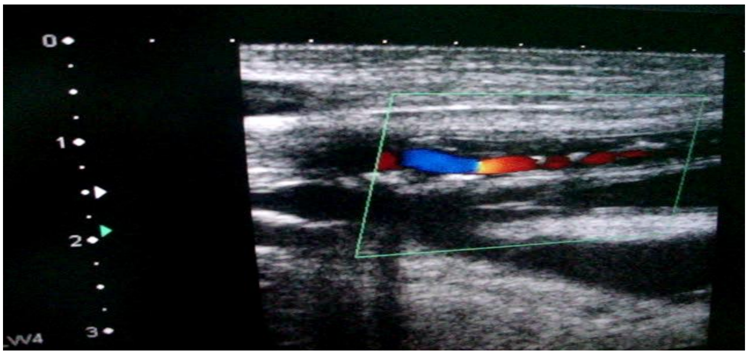

Fig. 14

Shows area of calcification& moderate stenosis in color Doppler study

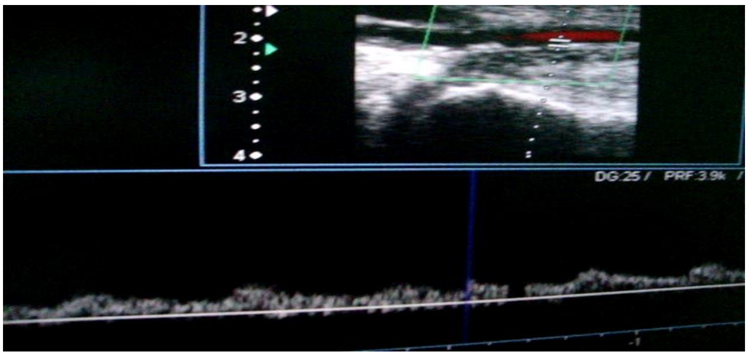

Fig. 15

Shows post stenotic slow flow (damped flow)

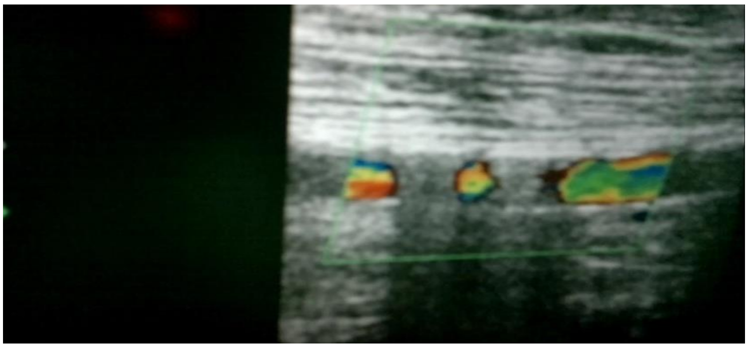

Fig.16

Shows area of stenosis at distal portion of SFA in color Doppler study

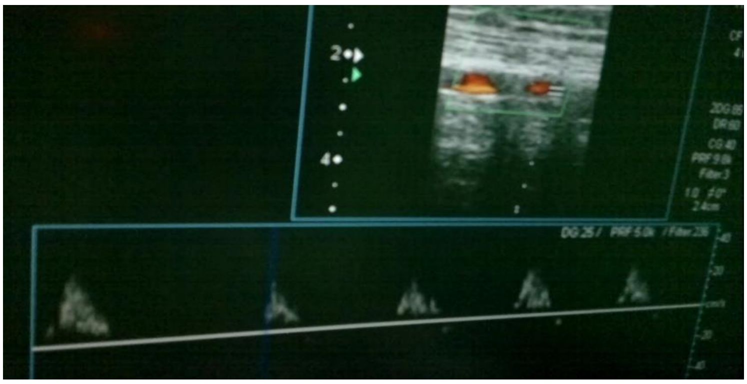

Fig. 17

Shows post stenotic slow flow (damped flow)

Diagnostic criteria for venous stenosis of the lower extremities:
A definitive diagnosis of occlusion is made when there is:
There is no spectral or color Doppler signal in the portion that is obstructed.
A spectral signal with a high resistance close to the stenotic section.
Distal to the stenotic section, there is a spectral signal with a low amplitude.
A branch that branches out from the artery at its uppermost point.
There is a collateral that re-enters the artery near the base.
Progressive pan systolic widening and post-stenotic turbulence are visible on the stenotic segment waveform.
Possible thick calcified plaque with acoustic shadowing or hypoechoic plaque that is not calcified, either one or more.
Next, patients were categorized based on the severity of stenosis using the following table (no.1) (23).

Table (1) show the degree of stenosis

Degree of stenosis	Area of stenosis	Comments
Mild	0-49%	Waveform is triphasic but mild spectral broadening and an increase in end diastolic velocities are recorded as the degree of narrowing approaches 49%
Moderate	50-74%	Waveforms tend to become biphasic or monophasic; there is an increase in end diastolic velocity; spectral broadening is present; flow disturbance andsome damping are recorded distal to the stenosis
Sever Or Occluded	75-100%	Waveform is usually monophasic with a significant increase in end diastolic velocity; marked turbulence and spectral broadening are demonstrated; flow is damped distal to the Doppler waveforms proximal to an occlusion often demonstrate a high resistance flow patternstenosis

3.3 CTA technique:

We began by taking a thorough medical history, paying specific attention to any allergies the patient may have had to contrast media, oral hypoglycemic medications, renal illness, or B-blockers. Reviewing clinical data including blood urea, s. glucose and creatinine levels. Following the insertion of a cannula gauge 18 into a significant superficial vein (in the antecubital fossa), the next step is to acquire a topography of the patient's back, hips, and legs. Then, a 140 mL injection of iohexole (350 mg I/ml) was given using a 4 mL/sec flow rate automated dual-head injector. then inject 30 milliliters of saline. Section for bolus tracking at L2 level with the distal abdominal aorta as the designated region of view .The scan was automatically started with a 5-second break when the ROI hit the 180-HU threshold. Using 0.75 mm thick sections, a table feed of 11 mm per rotation, and a 0.5 second gantry rotation time, data collecting was carried out in the cranio-caudal

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direction. A current of 200 mAs was applied to the tubes, and the voltage was fixed at 120 kV (24, 25).

3.4 Image analysis

Visual Images Inc.'s Vitrea 2 workstation in Plymouth, Minnesota, USA, was used for image analysis after images were rebuilt utilizing the run off methodology. Beginning with the axial sections, the assessment of the vasculature was carried out using post-processing methods such as curved planar reformat (CPR), thin-slab maximum intensity projection (thin MIP), and volume-rendering technique (VRT) with clear backdrop display.

Determination of Stenosis: Obtaining MPR pictures perpendicular to the highest stenosis and more normally looking vessels proximal and distal to the focal narrowing allows one to ascertain the percentage of stenosis. On the basis of CT angiography, lesions are categorized into four categories corresponding to the degree of stenosis: Normal, Mild, Moderate, and Sever or Occluded. The severity of the stenosis is determined by the CT scan.

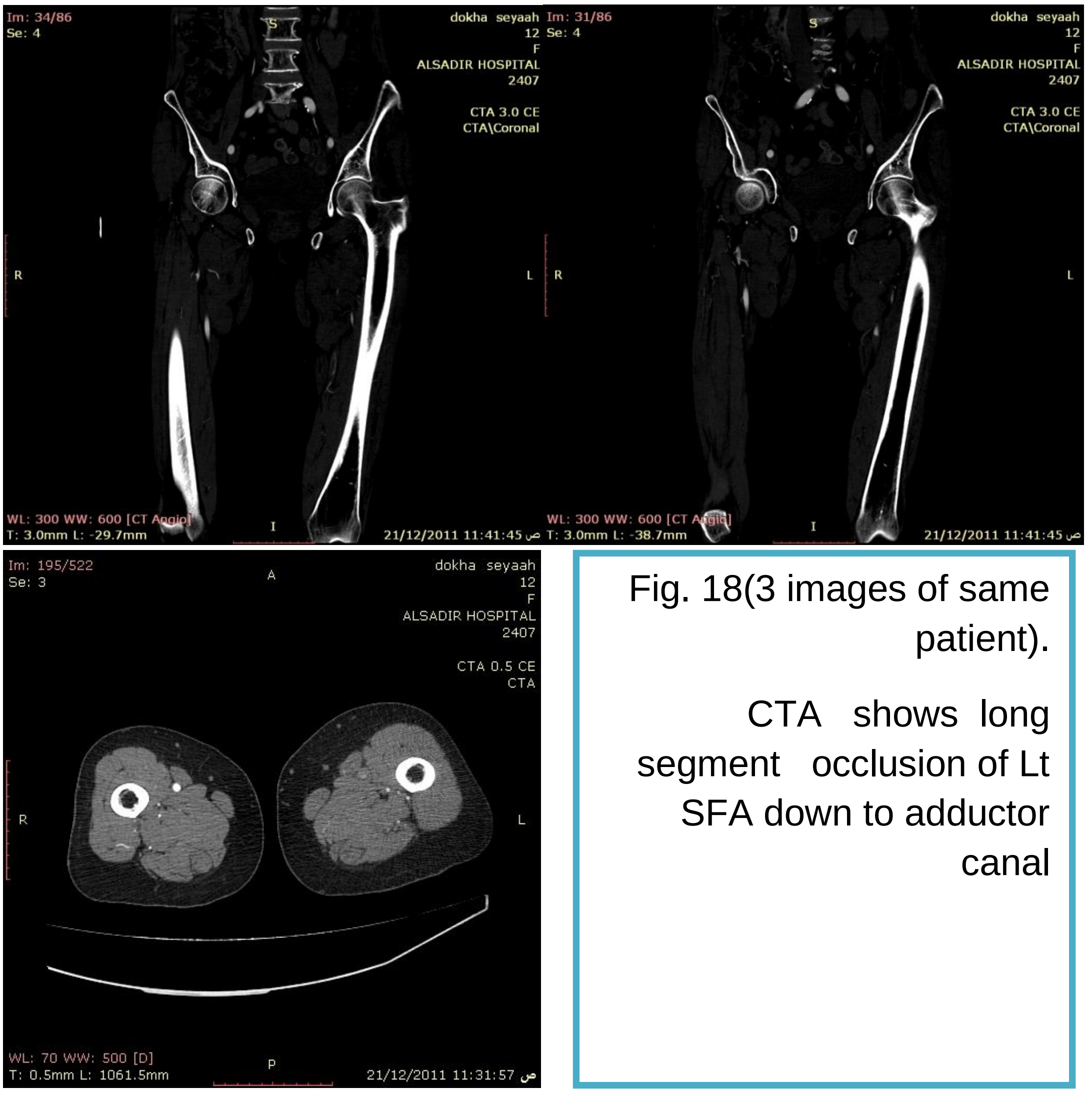

Fig. 18(3 images of same patient).

CTA shows long segment occlusion of Lt SFA down to adductor canal

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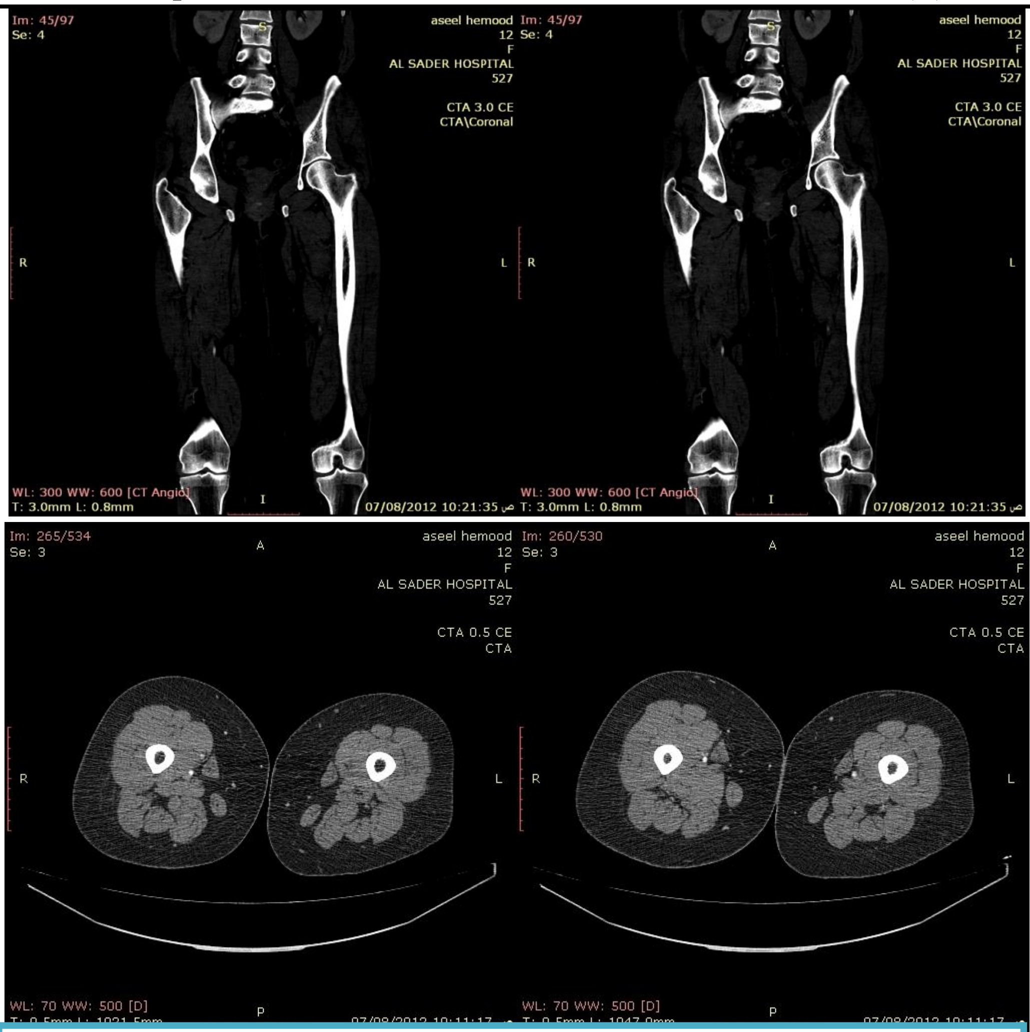

Fig.19 (4 images of the same patient)

CTA shows short segment occlusion of Lt SFA at mid portion

3.5 Data Collection and questionnaire

Data was collected in especial forma according to information card and then analysis statically used.

Result

Fifty individuals with lower limb peripheral artery disease made up the outcomes of our investigation. As seen in figure 20, twelve patients (or 24%) were female and thirty-eight (or 76% of the total) were male. Patients' average ages ranged from 59.4 to 59.9 years.

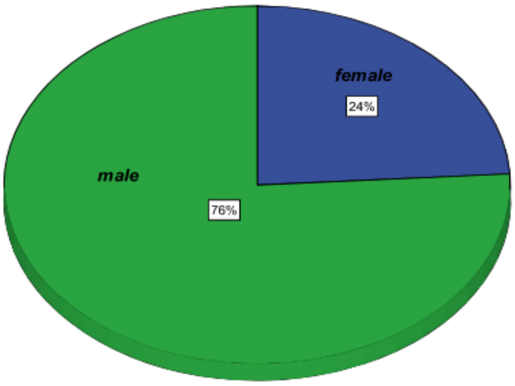

Fig. (20) Gender distribution of studied sample.

Table (2) Validity of Doppler in comparison with CTA in diagnosing SFA stenosis

		CTA		Total
		Positive	Negative	
Doppler	Positive	37	0	37
	Negative	3	10	13
Total		40	10	50

- Sensitivity=92.5%
- Specificity=100%
- Positive predictive value=100%
- Negative predictive value=76.9%
- Accuracy=94%

Table (3)

Comparison between Doppler and CTA in diagnosing degree of stenosis among those with positive results.

Degree of stenosis	CTA	Doppler
Mild (1-49%)	5(12.5%)	3(9%)
Moderate (50-74%)	7(17.5%)	7(18%)
Sever or occlusion (75-100%)	28(70%)	27(73%)
Total	40(100%)	37(100%)

P=0.963

In table 3 there is no difference between CTA and Doppler in detecting the degree of stenosis.

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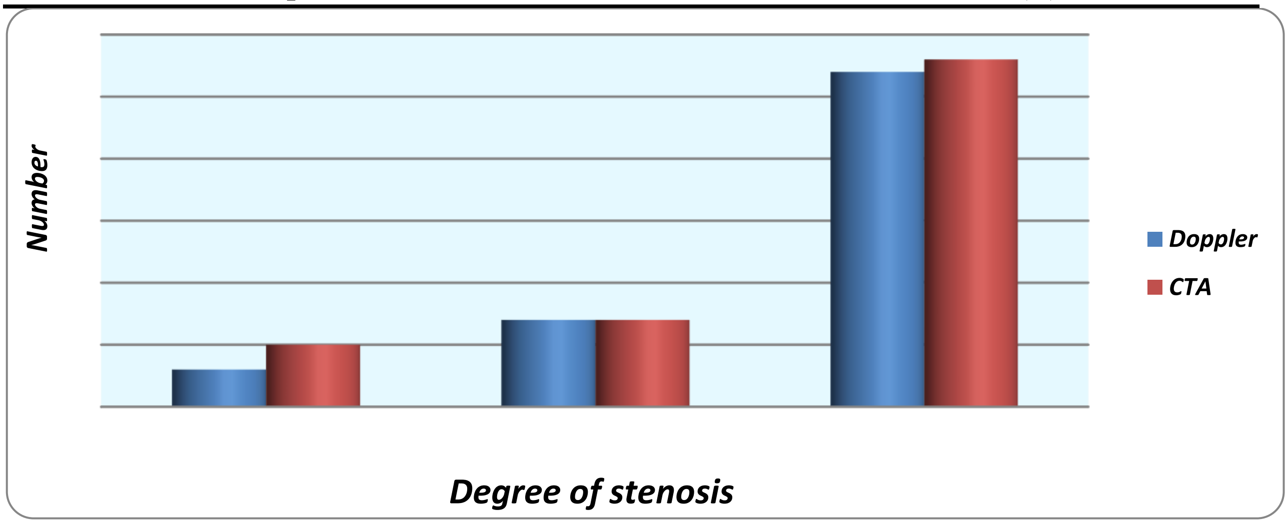

Fig. (21) Comparison between Doppler and CTA in diagnosing degree of stenosis.

Table (4)

Comparison between CTA and Doppler in detecting site of stenosis among those with positive results.

Site of stenosis	CTA	Doppler
Proximal SFA	11(27.5%)	10(27%)
Mid SFA	4(10%)	3(8%)
Distal (Adductor canal)	22(55%)	22(59%)
Others	3(7.5%)	2(6%)
Total	40(100%)	37(100%)

P=0.964

In table 4 also there is no difference between CTA and Doppler in detecting site of stenosis so all those detected in Doppler as proximal or mild or distal or others had been detected in CTA.

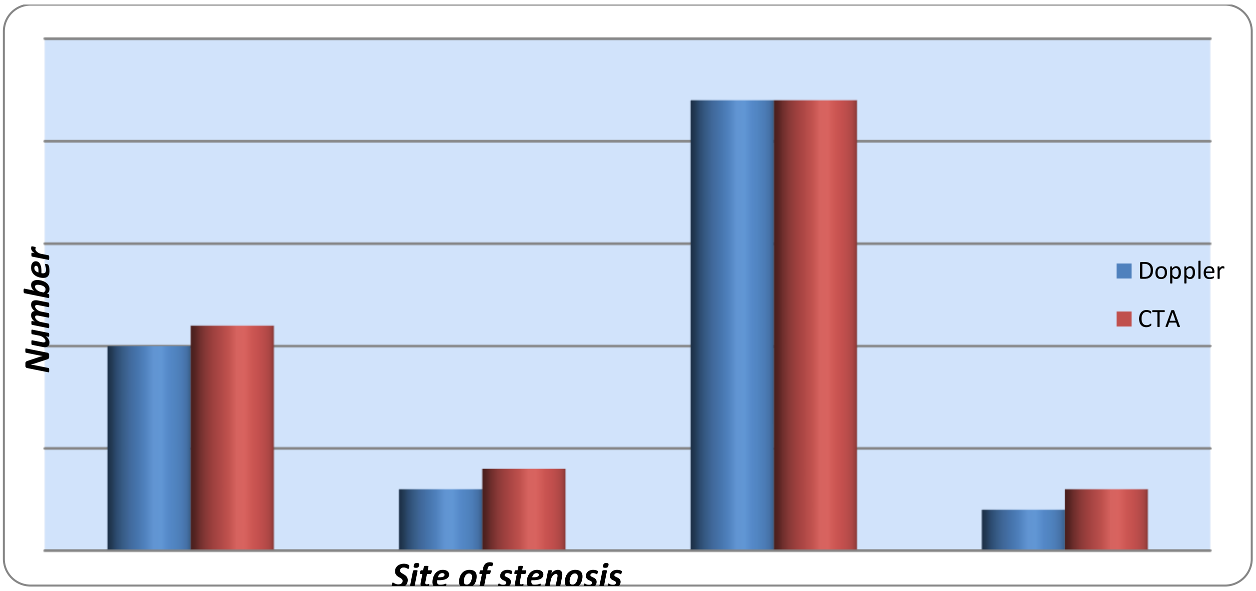

Fig. (22) Comparison between CTA and Doppler in detecting site of stenosis

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Table (5)

Comparison between CTA and Doppler in detecting length of stenosis among those with positive results.

length of stenosis	CTA	Doppler
Long segment	35(87.5%)	30(81.1%)
Short segment (less than 5 cm)	5(12.5%)	7(18.9%)
Total	40(100%)	37(100%)

In table 5 there is a difference in detecting length of stenosis between CTA and Doppler where the Doppler detects two of those with long segment on CTA as short segment and this make the number of short segment on Doppler is 7.

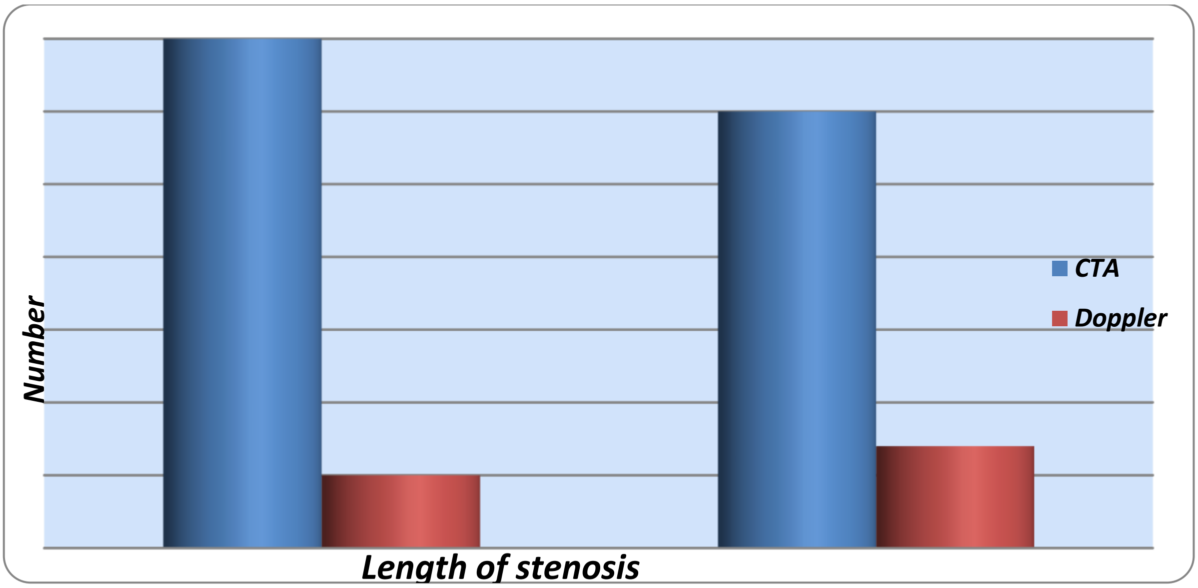

Fig. (23) Comparison between CTA and Doppler in detecting length of stenosis.

Discussion

Typically affecting males over the age of 50, artery disease of the limbs is a prevalent medical condition. A increased risk is associated with a history of diabetes, smoking, hypertension, renal illness requiring hemodialysis, cerebrovascular disease (CVD), coronary artery disease (CAD), or stroke, whether it runs in the family or not (1). The infra inguinal segment, particularly the femoropopliteal area, is a common site of PVD in the lower extremities. When evaluating a patient for possible PAD, CTA should be the imaging modality of choice. With an accuracy rate of 94% to 98% (10, 11, &27), CTA is a dependable and accurate examination. The purpose of CTA in PAD is to identify the length, quantity, severity, and location of stenosis. The results of the CTA, together with the patient's symptoms, could be useful in deciding on a course of treatment (conservative, interventional, or surgical). Since CTA isn't always an option, Doppler sonography is being investigated as a backup method of evaluation; however, further research is needed to determine how accurate Doppler is. Consistent with a study by Carlo Catalano et al.(11), which examined fifty patients with peripheral arterial occlusive disease using multi-detector CT angiography and duplex sonography, this study found that PAD was more common in males (38

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males, or 76% of the total) than in females (12 females, or 24%). In a study conducted by Tim Leiner et al., who examined 295 patients using duplex ultrasound and computed tomography angiography (CTA) and found an average age of 63 years with a standard deviation of 10 (95 women and 200 men), the mean age of PAD patients in this study was 59.4±10.9 years, which is similar to the current study (31). In a recent study, 37 out of 50 patients (76%) were found to have SFA stenosis using Doppler. Contrasting this, computed tomography (CTA) revealed that 40 out of 50 patients (80%) had narrowing. The overall accuracy of the Doppler study was 94%, with a sensitivity of 92.5%, a specificity of 100%, a positive predictive value of 100%, and a negative predictive value of 76.9%. These results are in line with those of previous research by Joe F. Lau et al., who studied 300 patients with PAD using Doppler. In their study, they found that duplex ultrasonography had a sensitivity of 92% and a specificity of 97% for detecting substantial lesions, respectively. The sensitivity for complete occlusions was 95% and the specificity was 99.99 percent (32). Doppler ultrasonography had a sensitivity of 74% and a specificity of 83% for the diagnosis of SFA stenosis in a research by Elisabetta Favaretto et al., which examined 24 patients with symptomatic lower extremities artery occlusive disease using MD-CT (33). The current study's results are very similar to those of another study that looked at 238 SFA and found that duplex US had a sensitivity of 88%, specificity of 95%, and accuracy of 93% (31). Tim Leiner et al. also found that duplex US had a sensitivity of 88%, specificity of 93%, and accuracy of 89% (31). In terms of the sensitivity of Doppler sonography in diagnosing the degree of stenosis of the SFA, the current study found that it is less sensitive than CTA in detecting mild stenosis (Doppler detected 3 patients while CTA detected 5 patients), but both methods were equally sensitive in detecting moderate and severe degrees of stenosis. This finding is in line with previous research by ArdaKayhan et al. and Joe F. Lau et al., which also found that Doppler was less sensitive than CTA in detecting mild degrees of stenosis, and reported that the sensitivity of Doppler increases as the degree of stenosis increases (30,32).The study found that 59% of cases involved the distal SFA rather than the proximal SFA (27%). while 8% of the middle area was impacted, which is in line with the findings of a research by J F Polak, M I Karmel, et al. For the purpose of identifying stenosis or blockage in any of the 238 SFA (34). Doppler was less accurate than CTA in establishing the length of the stenosed segment; although 35 patients had lengthy segments shown by CTA, only 30 patients exhibited it using Doppler. When it comes to calculating occlusion length, Wilhelm Schberle proved that duplex scanning is quite precise. A correlation of 96% was shown between CT angiography and duplex ultrasonography in his investigation of 40 patients with femoropopliteal occlusion (29).

Conclusion:

• The SFA scan using ultrasonography yields fairly reliable results in terms of stenosis location, length, and severity. Furthermore, it can be utilized as an initial scan modality for the diagnosis of SFA illness.

• In addition to being noninvasive and inexpensive, duplex scanning has other benefits, such as the ability to evaluate wall morphology, surrounding structures, intraluminal structures, and plaque on several levels.

Recommendation:

First, digital subtraction angiography results should be corroborated with Doppler tests of SFA stenosis. The second step is to suggest more research on the infrapopileatal artery Doppler scan's accuracy.

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