# Role of recent imaging modalities in the evaluation of lower limb vascular diseases in diabetic patients

**Essay**
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*In **Radio diagnosis***

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بسم الله الرحمن الرحيم

# وقُلِ اعْمَلُوا فَسَيَرَى اللَّهُ عَمَلَكُمْ ورَسُولُهُ والْمُؤْمِنُونَ

صدق الله العظيم

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**Mohamed Mustafa Abd El Aziz**

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# List of Abbreviations

| | |
|---|---|
| **ABI** | Ankle brachial index |
| **2D** | Two dimension |
| **3D** | Three dimension |
| **ABPI** | Ankle brachial pressure index |
| **ASL** | Arterial spine labeling |
| **CA** | Conventional angiography |
| **CE** | Contrast enhanced |
| **CeMRA** | Contrast enhanced magnetic resonance angiography |
| **CIA** | Common iliac artery |
| **CIN** | Contrast induced nephropathy |
| **CIV** | Common iliac vein |
| **CT** | Computed tomography |
| **CTA** | Computet tomographic angiography |
| **CVD** | Cardiovascular diseases |
| **DM** | Diabetes millitus |
| **DSA** | Digital substraction angiography |
| **ECG** | Electro cardiac gated |
| **EIA** | Eternal iliac artery |
| **FSE** | Fast asymmetric enhancement |
| **FSE** | Fast spine echo |
| **HDL** | High-density lipoproteins |
| **HMPAO** | Hexamethylpropyleneamine oxime |
| **IIA** | Internal iliac artery |
| **IV** | Intravenous |
| **IVC** | Inferior vena cava |
| **LDL** | low density lipoproteins |
| **LEBS** | lower extremity bypass surgery |
| **MHZ** | Megahertz |
| **MIP** | Maximum intensity projection |
| **MRA** | Magnetic resonance angiography |
| **MRI** | Magnetic resonance imaging |

# List of Abbreviations (Cont.)

| | |
|---|---|
| **NSF** | Nephrogenic systemic fibrosis |
| **PAD** | Peripheral arterial disease |
| **PC** | Phase contrast |
| **PFA** | Profunda femoris artery |
| **PI** | Pulstality index |
| **PSA** | Pseudoanurysm |
| **PSV** | Peak systolic velocity |
| **PTA** | Percutaneous transluminal angioplasty |
| **QISS** | Qiescentinterval single shot |
| **RI** | Resistivity index |
| **SFA** | Superficial femoral artery |
| **SSD** | Shaded surface display |
| **TC-99** | Technetium-99 |
| **TE** | Echo time |
| **TOF** | Time of flight |
| **TR** | Repetition time |
| **TS** | Transverse |
| **US** | Ultrasound |
| **Vr** | Velocity ratio |
| **VR** | Volume rendering |

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# Introduction

Diabetes mellitus (DM) is a metabolic disorder characterized by hyperglycemia and dyslipidemia. The abnormalities in nutrient metabolism and vascularity resulting from DM lead to infection, foot ulcers and impairment of wound healing. Diabetic lower limb ischemia often leads to limb necrosis ***(Tsai et al., 2009).***

The risk for ulceration and amputation is much higher in diabetics compared to the non-diabetics. The lifetime risk of a diabetic individual to develop an ulcer is as high as 25%. Peripheral neuropathy, arterial disease and foot deformities are the main factors accounting for this increased risk. Age and sex as well as social and cultural status are contributing factors ***(Richard and Schuldiner, 2008).***

Delayed wound healing in diabetic patients without large- vessels disease has been attributed to micro vascular dysfunction and abnormal cellular and inflammatory responses ***(Krishnan et al., 2007).***

Duplex ultrasonography has multiple advantages for the assessment of lower limb vascular diseases. It is the least expensive modality, provides physiologic data in addition to imaging, and can easily be performed in the office as well as in the angiosuite or operating room, especially with the newer, more portable machines now available. It is completely noninvasive and does not require the use of potentially nephrotoxic contrast agents. It has been used successfully as a screening tool to decrease the necessity for contrast angiography and may also be used as the single preprocedural imaging modality prior to intervention in approximately 90% of patient ***(El Gzyri et al., 2008).***

The use of CTA for evaluation of the lower limb arterial tree has significantly advanced with the advent of increased multidetector scanners, CTA also gives an evaluation of the arterial wall and surrounding tissue, including the detection of peripheral aneurysms, as well as of plaque characteristics, calcification, ulceration, thrombus or soft plaque, intimal hyperplasia, in-stent restenosis and stent fracture ***(Shareghi et al., 2010)***.

Magnetic resonance angiography (MRA) has several advantages for visualizing the lower limb arterial tree. There is no ionizing radiation exposure to the patient, and the gadolinium-based contrast agent is less nephrotoxic than the iodinated contrast agents used for CTA and DSA. The sensitivity and specificity of arterial stenosis using contrast-enhanced MRA compared with DSA are in the 80–90% range, respectively, anatomic detail regarding the arterial wall, such as aneurysm diameter and thrombus or plaque characteristics may be obtained from examination of the source images ***(Bui et al., 2009)***.

# Aim of the Work

This work aims to highlight the role of color Doppler ultrasound, Computed Tomographic Angiography and Magnetic Resonance Angiography in evaluation of lower limb vascular diseases in diabetic Patients.

# Anatomy of the Lower Limb vascular system

## -1- Arterial System

Arterial supply of the lower extremities is originating from the abdominal aorta which bifurcates to give the iliac vessels. Its external iliac branches continue downwards as common femoral arteries to supply the lower limbs.

### The Abdominal Aorta:

The abdominal aorta **(Fig. 1)** begins at the aortic hiatus of the diaphragm, infront of the lower border of the body of the last thoracic vertebra and descending in front of the vertebral column, ends on the body of the fourth lumbar vertebra, commonly a little to the left of the middle line, by dividing into the two common iliac arteries ***(Gray, 2000).***

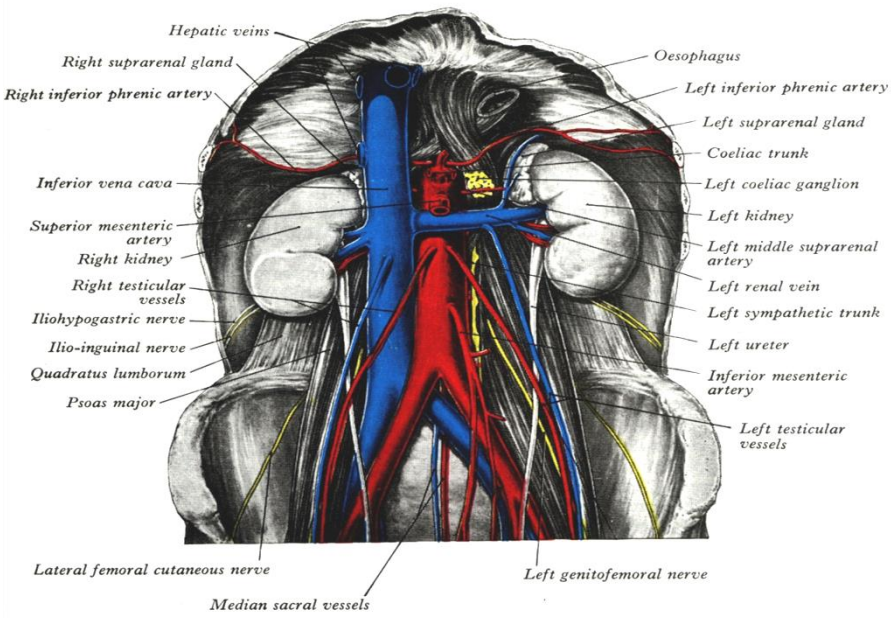


**Fig. (1):** The abdominal aorta anatomy ***(Gray, 2000).***

## Branches:

The branches of the abdominal aorta may be divided into three sets: visceral, parietal and terminal (**Table 1)**.

**Table (1): Branches of abdominal aorta**

| Visceral branches | Parietal branches |
|---|---|
| Celiac | Inferior Phrenics. |
| Superior Mesenteric | Lumbars. |
| Inferior Mesenteric | Middle Sacral. |
| Middle Suprarenals | |
| Renals | |
| Internal Spermatics | **Terminal branches** |
| Ovarian (in the female) | Common iliacs and median sacral. |

## Collateral Circulation:

The collateral circulation would be carried on by the anastomoses between the internal mammary and the inferior epigastric; by the free communication between the superior and inferior mesenterics, if the ligature were placed between these vessels; or by the anastomosis between the inferior mesenteric and the internal pudendal, when (as is more common) the point of ligature is below the origin of the inferior mesenteric; and possibly by the anastomosis of the lumbar arteries with the branches of the hypogastric ***(Gray, 2000).***

## Surface Anatomy of the Abdominal Aorta:

It is represented by vertical band about 2 cm wide from a median plane, extending from 2.5 cm above the transpyloric plane, down to about 1 cm below and to the left of the umbilicus ***(Williams et al., 2001).***