Research Article

Comparative Study Between Duplex US And CTA In Assessment Of Lower Limb Ischemia

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Abstract

Background: Peripheral artery diseases are serious health issue. Early and optimal diagnosis of these diseases is important in treatment and prevention of complications.
Methods: An observational cross-sectional study implemented in Radiology department of Cardiac center at Erbil city in duration of two years from 1st of March 2023, to 28th of February, 2025 on sample of fifty patients with suspected peripheral artery disease. Diagnosis and grading of peripheral artery disease were done in regard to international criteria.
Findings: A complete agreement between multidetector computed tomography angiography and duplex ultrasound was shown regarding infrrenal aorta stenosis, common iliac artery stenosis, external iliac segment, common femoral artery occlusion, deep femoral artery stenosis, right popliteal artery occlusion, andright tibioperoneal trunk artery stenosis (kappa=1.0). However, lower agreement was shown regarding superficial femoral artery left popliteal artery and peroneal artery (kappa<1).
Conclusions: The duplex ultrasound is good alternative for multidetector computed tomography angiography in diagnosis and severity grading of lower limb ischemia.

Keywords: Duplex ultrasound, Multidetector computed tomography angiography, Peripheral artery diseases.

Introduction

As a consequence of systematic atherosclerosis, peripheral arterial disease (PAD) is detected by a decreased ankle-brachial pressure index. The disease is caused by atherosclerotic blockages that form in a few places from the external iliac, superficial femoral artery, popliteal artery, and distal aorta, limiting blood flow to one or both lower extremities and resulting in ischemia during rest or even during exertion.[1] PAD is a serious health problem that is become increasingly common in developing nations due to high risk factors burden. Its complications range from minor limitations to limb loss. With mild to severe symptoms, lower extremity artery disease affects over 200 million people worldwide.[2, 3]
Ageing, cigarette smoking, and diabetes are the primary triggers for the occurrence of PAD. It is more common than coronary artery and cerebrovascular diseases, which are both on the decline[4]. As people age, their chance in developing PAD rises quickly; roughly five percent of those 40 years of age or older have the condition, and twelve percent of people over 70 have it.[5] Peripheral artery disease (PAD) is linked to numerous negative consequences that extend beyond the leg. The presence of PAD correlates with an increased risk of disease in other vascular regions, including the coronary and cerebral arteries.[6, 7]
Adults and older people are most affected by lower limb artery disorder, which manifested by intermittent claudication, ischemic rest discomfort, ulcers and gangrene. The gold-standard method for identifying these conditions has historically been intra-arterial contrasting angiography; however, it has known disadvantages, like the danger of artery perforation, exposure to radiation and the possible renal toxic consequences of ionized contrast substances. There are now alternate techniques for imaging.[8] Lower extremity artery disease can be graded using non-invasive imaging techniques like duplex ultrasound (DUS), multidetector computed tomography angiography (MDCTA) and magnetic resonance angiography (MRA). For identifying haemodynamically important lesions (>50% stenosis or occlusion), duplex ultrasonography offers a remarkable specificity of 95% and slightly decreased sensitivity of 88%.[9] Since technology is developing so quickly, computed tomography angiography is becoming progressively more appealing. MDCTA scanners have improved, allowing for faster acquisition periods, thinner slices, better spatial accuracy, and the ability to photograph the entire circulatory system in a brief span of interval while using fewer pixels of contrast material[10]. MDCTA is considered the most attractive technique for visualizing the lower limb arteries. It is a dependable noninvasive instrument for quantifying the extent and degree of stenosis.[11] Improvements in transducers manufacturing, picture resolution, strength of signal, spectral evaluation abilities, and subsequent processing have all contributed to the growing usefulness of DUS technologies in the non-invasive diagnosis of PAD. This study aimed to find out the agreement between DUS and MDCTA in diagnosis of lower limb ischemia.

Methods

During the course of two years, from March 1, 2023, to February 28, 2025, the Radiology department of Cardiac center in Erbil city, Kurdistan region, Iraq, hosted the current investigation, which was intended as an observational cross sectional design. The subject cohort consisted of patients referred to Radiology department with suspected peripheral artery disease. Adult age patients with suspicion or clinical diagnosis of peripheral artery disease with other related characteristics such as diabetes mellitus, hypertension, cardiac diseases and smoking were eligible to participate. Younger age patients with contraindication for CT scan and/or renal diseases and pregnancy for women were excluded. The study protocol received approval from the Kurdistan Higher Council of Medical Specialists Ethics Committee, hospital administration, and confidentiality of data. Following their eligibility for inclusion and exclusion criteria, fifty patients with suspected peripheral artery disease were chosen.

Researchers obtained the information from the patients who were enrolled directly and had them complete a prepared questionnaire. The researchers created the survey. The survey asked about the following: the general characteristics of patients (age, gender and body mass index); risk factors of peripheral artery disease (diabetes mellitus, hypertension, smoking, etc.), clinical presentation of patients, MDCTA findings of patients and the DUS findings of patients. The MDCTA and DUS were implemented by researchers in Radiology department. The MDCTA equipment was (ICT multi slice CT scan), while the DUS equipment was (Ultrasound machine-HD11 Ex-Phillips). Diagnosis and grading of peripheral artery disease were done Cardiologist and Radiologist in regard to International criteria.[2, 6] To statistically examine the collected data, the Statistical Package of Social Sciences software, version 26, was utilised. Continuous variables were examined using the independent sample t-test, while categorical variables were examined using the chi square or Fisher's exact tests. The study employed a significance threshold of 0.05 or below.

Results

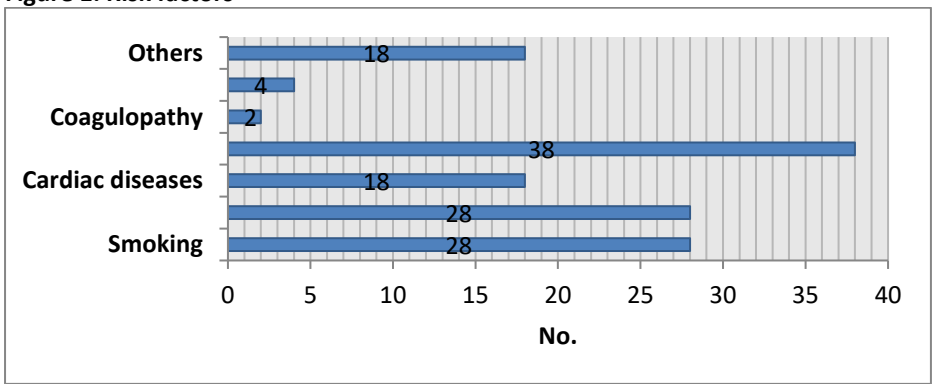
This study included fifty patients with suspected peripheral artery disease (PAD) presented with mean age of (64 years); 36% of them were in age group of 60-69 years. Male patients were more than females (68% vs. 32%). Mean body mass index of patients was (29.5Kg/m^2); 44% of them were obese. (**Table 1**)

Table 1: General characteristics of patients.

Variable	**No.**	**%**
Age mean±SD (64±11.9 years)		
40-49 years	8	16.0
50-59 years	8	16.0
60-69 years	18	36.0
≥70 years	16	32.0
Gender		
Male	34	68.0
Female	16	32.0
Body mass indexmean±SD (29.5±3.1 Kg/m^2)		
Normal	4	8.0
Overweight	24	48.0
Obese	22	44.0
Total	**50**	**100.0**

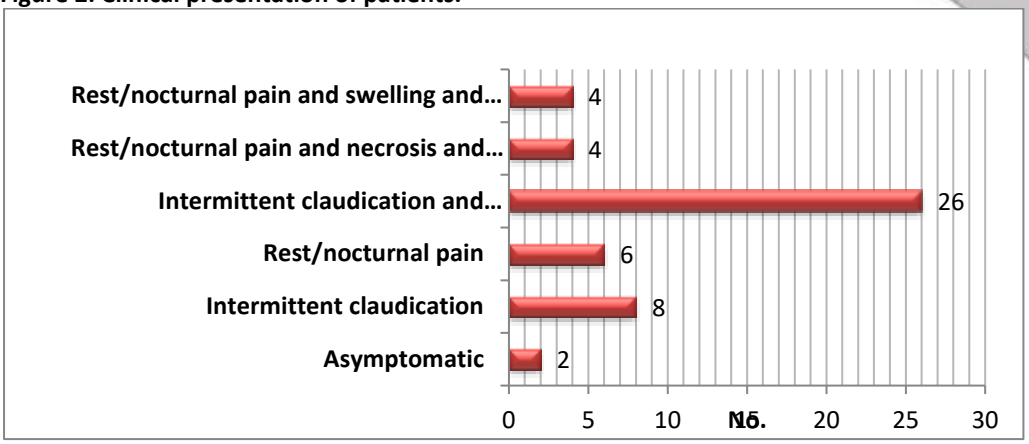
Common risk factors of PAD were diabetes mellitus (76%), hypertension (56%), smoking (56%), cardiac diseases (36%), others like hyperlipidemia (36%), etc. (**Figure 1**)

Figure 1: Risk factors



Only two patients were asymptomatic, while 52% of them were presented clinically with rest/nocturnal pain and swelling with redness below knee. (**Figure2**)

Figure 2: Clinical presentation of patients.



According to Kappa statistics, complete agreement between MDCTA and DUS was shown regarding infrrenal aorta stenosis, right common iliac artery stenosis, right external iliac segment, right common femoral artery occlusion, right deep femoral artery stenosis, right popliteal artery occlusion, andright tibioperoneal trunk artery stenosis (kappa=1.0), while lower agreement was shown regarding right superficial femoral artery, right posterior tibial artery and right peroneal artery (kappa=0.86). No significant agreement was reported between MDCTA and DUS was shown regarding right anterior tibial artery. (**Table 1**)

Table 1: Comparison between CTA and CDUS in right side.

Area		MDCTA	DUS	Kappa	P
Infrarenal aorta	Normal	46	46	1.0	**<0.001**[S]
	Mild	4	4		
Right common iliac artery segment	Normal	40	40	1.0	**<0.001**[S]
	Mild	8	8		
	Moderate	2	2		
Right external iliac segment	Normal	42	42	1.0	**<0.001**[S]
	Mild	4	4		
	Moderate	2	2		
	Severe	2	2		
Right common femoral artery	Normal	36	36	1.0	**<0.001**[S]
	Mild	8	8		
	Moderate	4	4		
	Occluded	2	2		
Right superficial femoral artery	Normal	16	16	0.89	**<0.001**[S]
	Mild	12	14		
	Moderate	6	6		
	Severe	8	6		
	Occluded	8	8		
Right deep femoral artery	Normal	46	46	1.0	**<0.001**[S]
	Mild	4	4		
Right popliteal artery	Normal	18	18	1.0	**<0.001**[S]
	Mild	20	20		
	Moderate	4	4		
	Severe	6	6		
	Occluded	2	2		
	Normal	30	30	1.0	**<0.001**[S]

Right ibioperoneal trunk artery	Mild	14	14		
	Moderate	2	2		
	Severe	2	2		
Right posterior tibial artery	Normal	12	14	0.89	**<0.001**[S]
	Mild	16	14		
	Moderate	2	2		
	Severe	10	8		
	Occluded	8	10		
Right anterior tibial artery	Normal	10	10	-	**-**
	Mild	14	14		
	Moderate	0	2		
	Severe	18	16		
	Occluded	6	6		
Right peroneal artery	Normal	18	22	0.86	**<0.001**[S]
	Mild	24	20		
	Severe	6	6		

S=Significant.

According to Kappa statistics, complete agreement between MDCTA and DUS was shown regarding left common iliac artery, left external iliac segment, left common femoral artery stenosis, left deep femoral artery, left posterior tibial artery and left anterior tibial artery (kappa=1.0), while lower agreement was shown regarding left superficial femoral artery left popliteal artery and left tibioperoneal trunk artery and peroneal artery (kappa<1). (**Table 2**)

Table 2: Comparison between clinical and ultrasound diagnosis in left side.

Area		MDCTA	DUS	Kappa	P
Left common iliac artery segment	Normal	36	36	1.0	**<0.001**[S]
	Mild	8	8		
	Moderate	2	2		
	Severe	2	2		
	Occluded	2	2		
Left external iliac segment	Normal	38	38	1.0	**<0.001**[S]
	Mild	8	8		
	Severe	2	2		
	Occluded	2	2		
Left common femoral artery	Normal	38	38	1.0	**<0.001**[S]
	Mild	10	10		
	Severe	2	2		
Left superficial femoral artery	Normal	24	26	0.93	**<0.001**[S]
	Mild	16	14		
	Severe	2	2		
	Occluded	8	8		
Left deep femoral artery	Normal	42	42	1.0	**<0.001**[S]
	Mild	8	8		
Left popliteal artery	Normal	20	24	0.82	**<0.001**[S]
	Mild	18	14		
	Moderate	6	4		
	Severe	6	8		
Left tibioperoneal trunk artery	Normal	24	26	0.86	**<0.001**[S]
	Mild	16	16		
	Moderate	4	2		
	Severe	2	2		
	Occluded	2	2		
Left posterior tibial artery	Normal	20	20	1.0	**<0.001**[S]
	Mild	14	14		
	Severe	6	6		
	Occluded	8	8		
	Normal	16	16	1.0	**<0.001**[S]
	Mild	14	14		

Left anterior tibial artery	Moderate	2	2		
	Severe	10	10		
	Occluded	6	6		
Left peroneal artery	Normal	20	22	0.93	**<0.001**[S]
	Mild	16	14		
	Severe	6	6		
	Occluded	6	6		

S=Significant.

More than half of patients underwent surgical treatment, while 40% of them underwent medical treatment and 8% of them had no treatment. Abdominal ultrasound for infrarenal aorta was normal in 88% of patients, mild stenosis in 8% of patients and moderate stenosis in 4% of them. Abdominal ultrasound for common iliac artery was normal in 76% of patients, mild stenosis in 12% of patients, moderate stenosis in 8% of them and severe stenosis in 4% of them. (**Table 3**)

Table 3: Treatment and abdominal ultrasound findings.

Variable	No.	%
Treatment		
No	4	8.0
Medical	20	40.0
Surgical	26	52.0
Abdominal US infrarenal aorta		
Normal	44	88.0
Mild	4	8.0
Moderate	2	4.0
Abdominal US common iliac artery		
Normal	38	76.0
Mild	6	12.0
Moderate	4	8.0
Severe	2	4.0
Total	**50**	**100.0**

Figure 3: 68 year old male patient with peripheral arterial disease and intermittent claudication of both leg. Color doppler shows multiple signs of right femoral artery stenosis such as monophasic flow , spectral broadening, and elevated PSV.

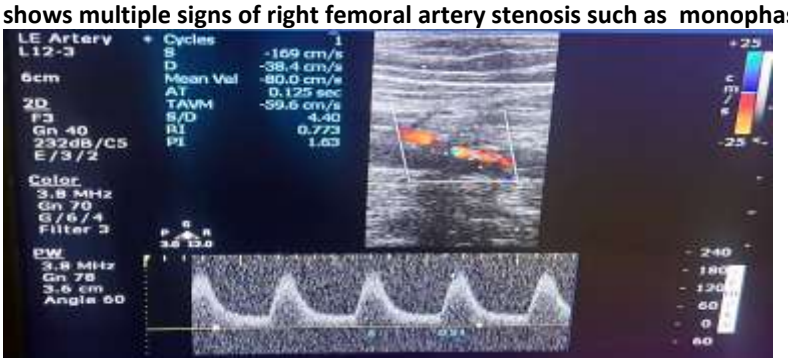


Figure 4:3D CT angiogram of 57 year old male patient, diabetic and smoker , show multiple area of diseased arteries.Stenosis of Left common iliac artery , bilateral superficial femoral artery and left anterior tibial artery. Also there is significant occlusion of right anterior tibial and peroneal artery.

Discussion

Limb ischemia is a vascular emergency that carries a significant risk of mortality and limb loss. The initial evaluation should concentrate on determining the severity of ischaemic injury and the likelihood of limb preservation.[12]

In current study, mean age of patients with lower limb ischemia was (64 years) with predominance of male gender. These findings are close to results of recent prospective follow up study in United States of America which revealed that mean age of patients with lower limb ischemia was (64.2 years) and 64% of them were males.[13] Our study showed that44% of patients with lower limb ischemia were obese. Consistently, different authors regarded the obesity as a risk factor of with lower limb ischemia.[14] In our study, common risk factors of lower limb ischemia were diabetes mellitus, hypertension, smoking, cardiac diseases, others like hyperlipidemia. These findings are similar to results of Iraqi cross sectional study which reported that diabetes mellitus, hypertension, smoking and hyperlipidemia are main risk factors of lower limb ischemia. [15] Main symptoms of patients with lower limb ischemia in our study were rest/nocturnal pain and swelling with redness below knee. These findings are close to results of different literatures. [15, 16]

The present study found a complete agreement between MDCTA and DUS regarding infrrenal aorta stenosis, right common iliac artery stenosis, right external iliac segment, right common femoral artery occlusion, right deep femoral artery stenosis, right popliteal artery occlusion, andright tibioperoneal trunk artery stenosis (kappa=1.0). These findings are close to results of recent comparative study conducted in India which revealed higher agreement between MDCTA and DUS in regard to infrrenal aorta stenosis, iliac arteries, femoral artery, popliteal artery andtibioperoneal trunk artery.[11] However, our study showed lower agreementbetween MDCTA and DUS regarding right superficial femoral artery, right posterior tibial artery and right peroneal artery (kappa=0.86) with no significant agreement between CTA and CDUS regarding right anterior tibial artery. These findings coincide with results of Italian study which reported lower agreement between MDCTA and DUS for vessels below knee joint. [17]

Current study revealed complete agreement between MDCTA and DUS regarding left common iliac artery, left external iliac segment, left common femoral artery stenosis, left deep femoral artery, left posterior tibial artery and left anterior tibial artery (kappa=1.0), while lower agreement was shown regarding left superficial femoral artery left popliteal artery and left tibioperoneal trunk artery and peroneal artery (kappa<1).Similarly various authors found higher agreement between MDCTA and DUS regarding left iliac and femoral arteries with lower agreement between them in regard to left popliteal, tibioperoneal trunk and peroneal arteries. [8, 18] In general, the agreement between MDCTA and DUS regarding lower limb ischemia in our study was high. Consistently, many literatures reported higher validity findings of DUS in comparison to MDCTA in screening and diagnosis of lower limb ischemia.[8, 19]

In conclusion, the duplex ultrasound is good alternative for multidetector computed tomography angiography in diagnosis and severity grading of lower limb ischemia. This study recommended further multi-centers studies on role of duplex ultrasound in lower limb ischemia evaluation.

Acknowledgment

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Conflict of interest

Declared none.

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