



Assessment of lower limb arteries by doppler sonography in diabetic patients

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Abstract:

Background: Peripheral vascular disease is a major cause of morbidity and mortality especially affecting the elderly population. In patients with diabetes mellitus, the incidence of small arteriolar occlusive disease is common with more peripheral arteries being more commonly affected. The main non-invasive test now used commonly to assess the location of disease is duplex sonography. In practice the advent of duplex sonography has reduced the need for arteriography in the management of patients requiring an interventional procedure. **Aim:** To reflect the value of duplex sonography in evaluating patients with suspected peripheral vascular arterial disease in lower limb vessels. **Materials and Methods:** Sixty known diabetic patients with clinical suspicion of peripheral vascular disease were evaluated using SDU 1200, Diagnostic Ultrasound System from SHIMDZU with a 5-10 MHz linear array transducer. Using various transducer positions lower limb arteries were assessed for presence of plaques, luminal narrowing, intima media thickness and flow disturbances. **Results:** Sixty patients including both sexes were evaluated and all showed some degree of atherosclerotic disease. Dorsalis pedis artery most commonly showed luminal narrowing (in 36 % on right side & in 41% on left side) followed by anterior & posterior tibial arteries. Femoral artery was the most common artery involved by atherosclerotic plaques. **Conclusion:** Duplex sonography provides an effective non-invasive investigation for assessment of peripheral vascular system for presence of atherosclerotic disease

Key words: Diabetes, Duplex Sonography, Peripheral vascular disease.

Introduction:

Peripheral vascular disease (PVD) is a major cause of mortality and morbidity affecting especially the elderly population. The prevalence of PVD is multifold higher in patients with diabetes mellitus compared with and sex matched non- diabetic subjects. This may be because of hyperglycemia, hypertension, hyperlipidemia, platelet factors and other factors, which are increased in diabetic subjects. WHO estimates show that India already has the largest number of people suffering from diabetes- mellitus [1,2].

Since patients usually do not present early with symptoms of peripheral arterial disease, changes of chronic arterial insufficiency like poor wound healing are the presenting features. Acute embolic events originating from a more proximal arterial lesions, such as from either ulcerated plaques or thrombosing popliteal aneurysms can cause extensive tissue loss; including loss of affected limb, unless intervention is performed [3]. In patients with diabetes, the incidence of small arteriolar disease especially involving more peripheral tibioperoneal arteries is more common.

The main investigation now used to investigate the location and extent of disease is duplex sonography [4,5]. It is good at identifying occlusions, discriminating between and grading large (>50%) and small (<50%) stenosis. As compared to arteriography, duplex sonography has a sensitivity of 71-98% and specificity of 91-100% for grading of stenosis. In routine clinical practice duplex scanning has reduced the need for arteriography in the management of patients including those requiring interventional procedures [6-8].

Doppler studies provide direct information about the arterial disease by analyzing the haemodynamically significant arterial stenosis changes in the arterial flow velocity, velocity pulse wave contour, disruption of laminar flow and turbulence [9].

The objective of our study was to evaluate the lower limb arteries (including external and internal iliac arteries, common femoral, superficial femoral, profundafemoris, popliteal artery, anterior tibial, posterior tibial and the peroneal arteries) by color doppler sonography in diabetic patients for intimal medial thickness and patterns & incidence of changes in walls& dynamics of these vessels.

Materials and Methods

Known diabetics of either sex of all age groups with clinical symptoms like intermittent claudication, rest pain, ischemia and trophic disturbances like necrosis or moist gangrene were evaluated with color Doppler flow imaging. A written informed consent was taken from all patients. A total of 60 patients were studied on

SDU 1200, Diagnostic Ultrasound System from SHIMDZU with a 5-10 MHz linear array transducer. Various transducer positions used were lateral, posterolateral, anterior and transverse. Transducer frequency of 10MHz was used for superficial arteries like superficial femoral artery, whereas 5 MHz frequency was required for deeper arteries e.g. tibio- peroneal arteries.

Scanning of lower limb arteries was performed in supine position using a linear array transducer placed directly over the vessel at an angle of incidence of 45 to 60 degrees.

Arteries were examined from cephalad to caudal position first for any localization of plaque deposition and their surface & internal characteristics.

For intimal medial thickness maximum measurements were taken at the level of the straight segment of the femoral artery. The Maximum intima media thickness (and not the mean) was taken into consideration. Raised lesion and plaques were excluded while calculating the maximum intima media thickness.

Peak systolic velocities were measured and degree of post stenotic flow disturbances was calculated.

Results

A total of 60 patients including both sexes (35 males & 25 females) were evaluated using duplex sonography. Maximum number of patients was in the age group of 40-49 years (26 patients) followed by 50-59 years (23 patients) and 60-75 years (11 patients) respectively. The oldest patient was a 73 years old female. Females were less as compared to males in all age groups. Most number of females belonged to 40-49 years age group (12/25; 48%) whereas maximum number of males was from 50-59 years age group (15/35; 42.8%).

Mean intima media thickness of femoral arteries in the diabetic patients was 0.789 mm.

Highest number of plaque positive patients was from the 50-59 years age group with all of twenty- three patients having plaques followed by 40-49 years age group (19/ 26). Overall 44% patients had atherosclerotic plaques. Femoral artery was the most common site of plaque deposition, with left femoral artery being more commonly affected than right femoral artery, however overall more plaques were seen on right side as compared to left side. No plaque was seen in popliteal arteries. Out of a total of fifty plaques, twenty-eight showed evidence of calcification within them, thirteen showed fibro fatty echotexture and only two plaques were purely fatty in appearance.

Luminal narrowing with irregular concentric wall calcifications were most commonly found in dorsalis pedis arteries, more so in left sided arteries (in 36 % on right side & in 41% on left side). Anterior tibial

(in 30 % on right side & in 31% on left side) and posterior tibial(in 30 % on right side & in 31% on left side) arteries were the next most commonly involved arteries showing luminal narrowing with concentric wall calcifications.

In femoral artery, the most common range of velocity in all age group was 55-69 cm/sec (52.4%). Next common range of velocity was 70-84 cm/sec (28.6%).

Low resistance pattern s/o distal ischemia was observed more commonly in dorsalis pedis artery (25.5%) followed by anterior tibial (23%) and posterior tibial (21.5%) artery.

Discussion

Peripheral arterial disease is a part of more generalized involvement of the arteries by atherosclerosis with symptoms appearing usually after 50 years of age and many patients suffer from peripheral arterial disease before seeking medical assistance. This is because of development of collateral channels that are often sufficient to maintain perfusion to the extremities, which is generally maintained until the individual does not exercise or ambulate too vigorously [9].

The earliest signs (grey scale) of atherosclerotic disease are thickening of intima and media followed by wall changes (luminal narrowing and soft or hard plaques) and turbulence & flow irregularities on color doppler flow images [10].

Many authors have described and compared the diagnostic parameters of duplex sonography as a method for evaluation of lower limb arteries.

In 1987 Rubba et al published the first comparative study between catheter angiography and duplex ultrasound [DUS] and concluded that DUS seemed to be a promising method for the evaluation of aorto-iliac segment [4].

In our study we observed that all the patients had some degree of atherosclerotic disease in lower limb arteries with highest number of plaque positive patients occurring in the age group of 50-59 years. The involvement of lower limb arteries is usually asymmetrical to the presence of diabetes mellitus in the body. In their study in 2009 Rahman et al also demonstrated greater prevalence of atherosclerotic disease in lower limb arteries as compared to clinically diagnosed disease [11]. They had clinically correlated 30 patients and found that whereas clinical examination revealed vasculopathy in 17/30 patients and duplex sonography showed presence of disease in 19/30 patients. Rahman et al had also found the higher prevalence of disease in patients aged > 50 years. Authors have proposed reasons for this asymptomatic

involvement of arteries in diabetics and have proposed lack of awareness, poor glycemic control and duration of diabetes as the main causes [12, 13].

The most common artery with luminal narrowing in our study was dorsalis pedis followed by anterior & posterior tibial arteries. Shaheen et al had evaluated one hundred clinically and biochemically proven cases of diabetes and found out that dorsalis pedis was the most commonly affected site on peripheral vascular sonography with 24% patients being affected [14].

As a part of sonological examination grey scale imaging provides extensive information about the plaques. In our study we found three types of plaques with 28/50 of them showing calcification within them. Femoral artery most frequently showed presence of plaques in our study. Michael et al in their study in 2000 also highlighted the significance of grey scale imaging in diagnosis and characterization of arterial plaques [15]. Turini et al have also written that presence of plaques is most commonly found in femoral artery. They did a comparative study of digital subtraction angiography (DSA) and duplex sonography using a shortened color doppler study (CDS) protocol and found 13 plaques in proximal superficial femoral artery on DSA and 8 on CDS in a study of 67 patients [16].

Duplex sonography is a useful technique for assessment of peripheral arterial system in routine clinical practice. Its major advantages are non-invasive, cheap, easy reproducibility, visualization of lesions, potential for plaque characterization and no risk of complications, whereas the major limitation of this investigation is difficult technique and inter-observer variability.

We hereby conclude by saying that in patients with clinical suspicion of peripheral vascular disease duplex sonography can provide as the initial/ first imaging modality of investigation.

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Table 1: Age Distribution of Patients

Age Group	Number of Volunteers	Percentage
40-49	26	43.33%
50-59	23	38.33%
60-69	11	18.33%

Table 2: Sex Distribution of Patients

Age Group (Years)	Females		Males	
	Number	Percentage	Number	Percentage
40-49	12	48%	14	40%
50-59	08	32%	15	42.80%
60-69	05	20%	06	17.14%
Total	25	41.66%	35	58.33%

Table 3: Distribution of Plaques in Vessels

Vessels	Number of Plaques	
	Right	Left
Femoral Artery	16	18
Popliteal Artery	0	0
Anterior Tibial Artery	06	04
Posterior Tibial Artery	04	02
	26	24

Table 4: Low Resistance Spectral Pattern in Vessels, S/O Distal Ischemia.

Vessels	Right Limb		Left Limb	
	Number of Patients	Percentage	Number of Patients	Percentage
Femoral Artery	04	06%	03	05%
Popliteal Artery	05	08.3%	05	8.3%
Anterior Tibial Artery	12	20%	16	26%
Posterior Tibial Artery	14	23%	12	20%
Dorsalis Pedis Artery	15	25%	16	26%

Table 5: Distribution of Luminal Narrowing with Irregular Concentric Wall Calcifications

Vessels	Right Limb		Left Limb	
	Number	Percentage	Number	Percentage
Femoral Artery	15	25%	18	30%
Popliteal Artery	16	26%	17	28%
Anterior Tibial Artery	18	30%	19	31%
Posterior Tibial Artery	18	30%	19	31%
Dorsalis Pedis Artery	22	36%	25	41%

Figure 1: Normal Intima Media Thickness, Femoral Artery.

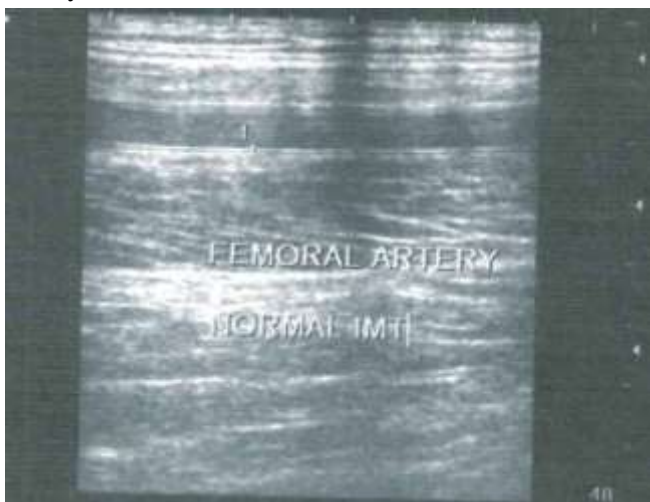


Figure 2: Mildly Increased Intima Media Thickness, Femoral Artery.



Figure 3: Moderately Increased Intima-Media Thickness, Femoral Artery.



Figure 4: Markedly Increased Intima Media Thickness, Femoral Artery.

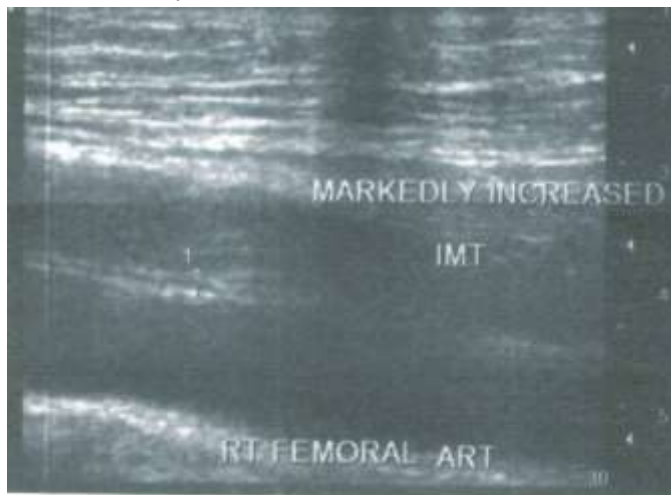


Figure 5: Luminal Narrowing with Irregular Wall Calcifications Associated with Wall Thickening.



Figure 6: Fibro-fatty Plaque in Femoral Artery.



Figure 7: Normal Triphasic Spectral Pattern in Femoral Artery.

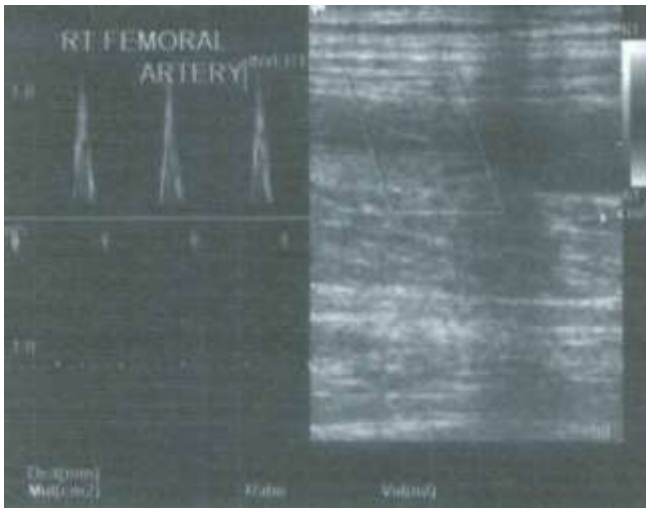


Figure 8: Normal Triphasic Spectral Pattern in Anterior Tibial Artery.

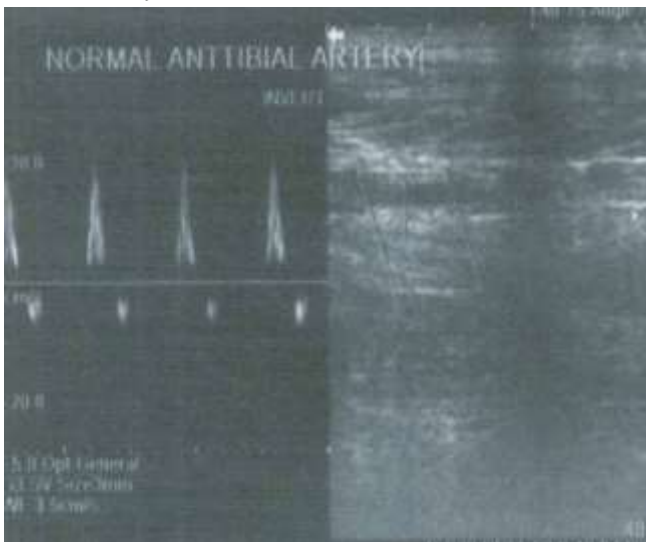


Figure 9: Low Resistance Pattern; Single Systolic Peak with Continuous Forward Diastolic Filling in Femoral Artery S/O Distal Ischemia

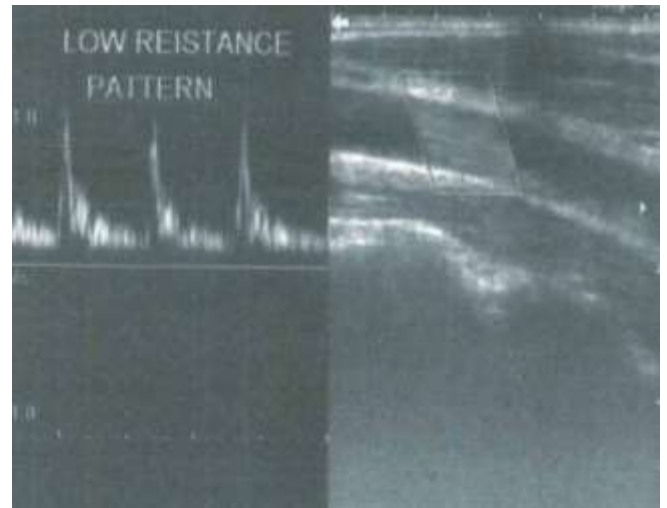


Figure 10: ParvusTardus Pattern, Biphasic Spectral Pattern in Posterior Tibial Artery Distal Part S/O Proximal Obstruction.

