Original Research Paper

Volume - 10 | Issue - 11 | November - 2020 | PRINT ISSN No. 2249 - 555X | DOI : 10.36106/ijar

Radiology

MULTIDETECTOR COMPUTED TOMOGRAPHIC ANGIOGRAPHY VERSUS COLOUR DOPPLER ULTRASONOGRAPHY IN DIAGNOSIS OF PERIPHERAL ARTERIAL DISEASE

Dr. Jinal G. Gajjar	3rd Year Resident, Department of Radiology, Smt. S.C.L. General Hospital, Smt. N.H.L. Municipal Medical College, Ahmedabad
Dr. Jivneshvari D. Rajat*	2nd year Resident Department of Radiology, Smt. S.C.L. General Hospital, Smt. N.H.L. Municipal Medical College, Ahmedabad. *Corresponding Author
Dr. Viplav Gandhi	Professor & HOD, Department of Radiology, Smt. S.C.L. General Hospital, Smt. N.H.L. Municipal Medical College, Ahmedabad.

ABSTRACT

BACKGROUND AND OBJECTIVE Imaging plays a crucial role in the management of patients with peripheral arterial disease. Due to its limitations color doppler ultrasonography is replaced by multidetector computed tomography angiography prior to any vascular intervention in PAD. In view of this we evaluated the efficacy of MDCT angiography and color Doppler ultrasonography to diagnose peripheral arterial disease in lower limb. **MATERIAL AND METHODS** A comparative study included 40 patients with PAD who underwent color Doppler ultrasonography and MDCT angiography at the department of Radio-Diagnosis at Smt. S.C.L. general hospital following which their data was compared and analyzed with respect to the collateral flow, extent of diameter reduction, length of stenosis and the detection rate of thrombosis. **RESULTS** In our study involving 40 patients in finding the agreement between Doppler and MDCT of the lower limb arteries, there was no statistically significant variation collateral flow with a p value more than 0.005 but the delineation of the arterial tree was better including the collaterals in the MDCT. Detection of rate of hemodynamically significant stenosis, thrombosis and the length of segment involved were significantly better in MDCT with a p value < 0.005. **CONCLUSION** MDCT is needed to be performed before any vascular intervention is planned. Doppler is also an effective tool which can detect the lesions to a comparable extent when no intervention is planned.

KEYWORDS : MDCTA , PVD ,ARTERIAL DOPPLER

INTRODUCTION

Peripheral arterial disease is a very important health problem in the developing world which is increasing in its incidence due to the increase in the predisposing factors. Peripheral arterial disease is diffuse in nature and contributes significantly towards the morbidity and mortality in the industrialized world. Peripheral arterial disease is mostly due to Atheromatous narrowing or occlusion of an artery or arteries. The first manifestation of symptomatic PVD patients is often intermittent claudication, which eventually progresses to critical limb ischemia i.e. rest pain and tissue necrosis.

Imaging plays a crucial role in the management of patients with peripheral arterial disease. Color Doppler ultrasonography is the initial imaging modality of choice for PVD investigation, despite its wide use; it has lower sensitivity than MDCT angiography which is considered as an upcoming modality in the evaluation of lower extremity PVD.

MDCT angiography is regarded to be a promising modality in lower extremity arterial imaging. It is a reliable non invasive tool in quantifying the length, number and grade of stenosis. It mainly delineates the presence or absence of significant obstruction to the blood flow, the site and anatomical extent of obstruction, the status of collaterals and distal vasculature which is crucial for planning the treatment as well as to monitor the results of therapy and disease progression.

The aim of our study was to compare color Doppler ultrasonography findings with MDCT angiography in patients with peripheral arterial disease in the lower extremity.

MATERIALS AND METHODS

SOURCE OF DATA:

The study was a comparative study done on 40 patients with signs and symptoms of peripheral arterial occlusive disease referred for evaluation by imaging by color Doppler ultrasonography and MDCT angiography to the department of Radio diagnosis at Smt. S.C.L. general hospital were included in the study .The study was done for a period of 1 year from August 2019 to August 2020.

METHOD OF COLLECTION OF DATA:

INCLUSION CRITERIA:

- Patients presenting with intermittent claudication.
- Patients with gangrene.
- Patients with absent peripheral pulses.

EXCLUSION CRITERIA:

- Polytrauma patients with suspected acute arterial injury.
- Patients whom contrast cannot be given
- Patients not willing to participate in the study.

All color Doppler ultrasonography were performed using Toshiba Nemio MX ultrasound equipment and the arterial system of the lower limb were scanned with a linear phased array (5-12MHZ) transducer.

For performing the Doppler scanning of the lower limb arterial system the patient was made to expose both the lower limbs in the supine position on the scanning couch.

The distal common femoral artery was imaged and the Doppler waveform assessment was done visually for any loss of triphasic flow or rounding of the waveform due to significant iliac disease in the presence of this finding the iliac arteries were assessed for the evidence of atherosclerotic disease using the curvilinear probe and the abdominal vascular setting. The scan was continued distally from the common femoral artery assessing the superficial femoral artery and popliteal artery in the longitudinal plane, using the linear probe and the lower limb arterial scan pre-set. The extent and severity of the arterial disease was assessed using triplex mode by measuring the peak systolic velocity from the Doppler waveform just proximal to and through the stenosis. The severity of the disease was then classified using the following standard criteria mentioned in the table below.

Grade	% Block	Peak systolic velocity ratio
Grade 0	0-19%	Equal to or less than 1.5
Grade I	19-49%	greater than or equal to 1.5 but less than 2.5
Grade II	50-74%	greater than or equal to 2.5
Grade III	75-99%	greater than or equal to 2.5 plus an end-diastolic velocity of greater than 60 cm/sec,
Grade IV	No Doppler signal	Occlusion

Doppler grading of arterial stenosis

A complete occlusion was confirmed by reducing the color scale and/or using the power Doppler. Arteries were evaluated for calibre, lumen, flow velocity and spectral wave pattern. The average scan time was 15 to 30 minutes for each limb. The data collected from the patient was classified according to the level of atherosclerotic disease present by triplex imaging. In patients whom at least one stenosis was present in the lower limbs of between 50-70% were classified as having moderate disease and placed into the moderate disease group, in patients whom at least one stenosis between 70-99% were classified as having significant disease and placed into the Significant group and in patients whom an occlusion were placed in the occlusive group.

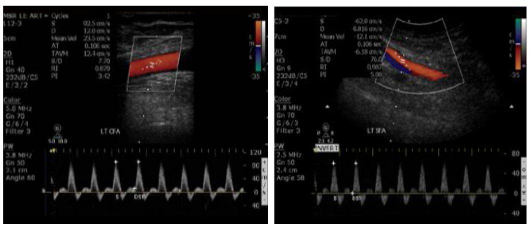
The 16 slice MDCT angiography was performed following assessment by an arterial color Doppler The scan direction was craniocaudal from the level of infrarenal aorta to the pedal arch. The 150 ml of non ionic contrast media was injected at a rate of 4 ml/s with a pressure injector. The images were then acquired with a slice thickness of 1.25 mm and collimation of 1.00 mm with a table feed of 27mm/s and a gantry rotation period of 0.8s.The tube voltage is 140kv with mAs between 250 and 300, and the average scan time was 30 to 40 s. Images were analyzed for plaques, extent and pattern of luminal narrowing and for the collateral flow. The grading was done based on the below scale:-

CT grading of arterial stenosis

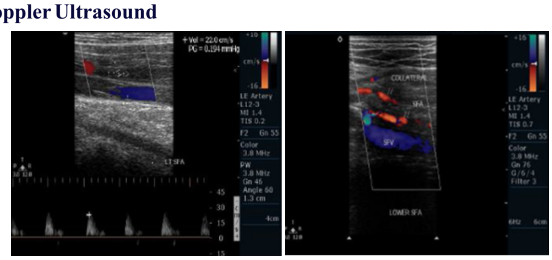
Grade of stenosis- CT grading	% block
Grade 0	Normal
Grade I	1-49%
Grade II	50-74%
Grade III	75-99%
Grade IV	100%

STATISTICAL ANALYSIS

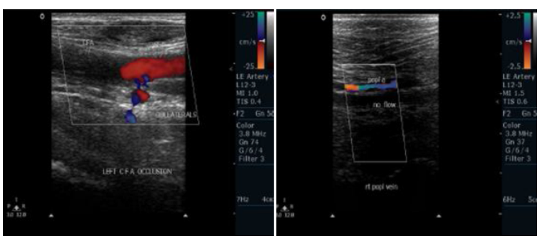
All statistical analyses were conducted by using Statistical Package for the Social Sciences (SPSS V.15.0) and the results were interpreted with kappa statistics.



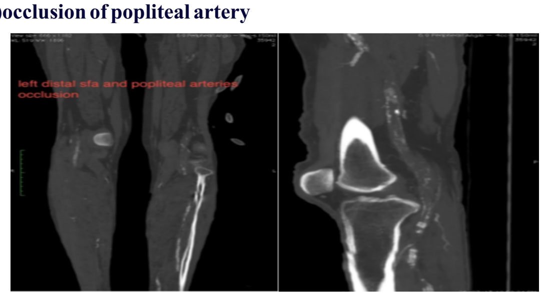
Normal Velocity and Spectral Wave Form Pattern On Colour Doppler Ultrasound



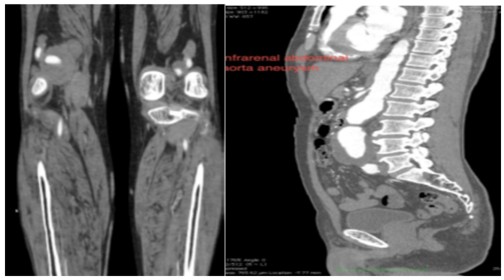
Color Doppler Ultrasound (a) reduced biphasic flow in SFA (b) Stenosis SFA with collaterals



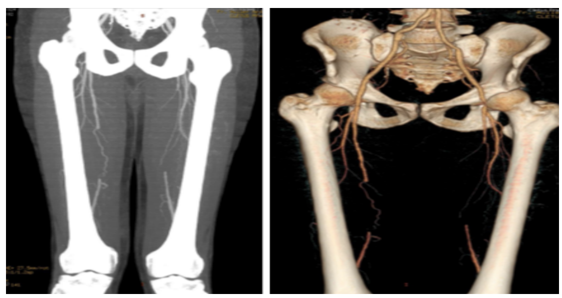
Colour Doppler Ultrasound (a) Stenosis CFA with collaterals (b)occlusion of popliteal artery



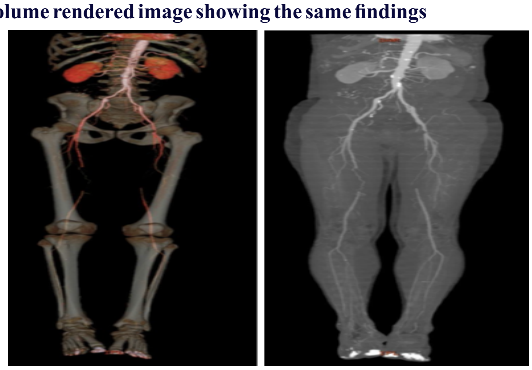
(A) Coronal reconstructed images showing Left Distal SFA and Popliteal Arterial Occlusion (B) Sagittal reconstructed images showing Distal Superficial Artery Occlusion



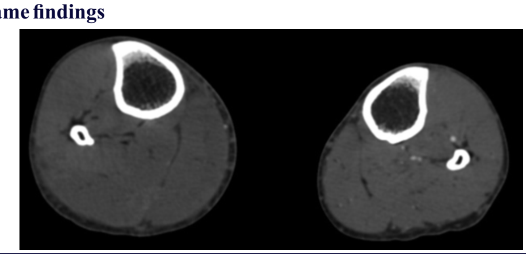
(A) Coronal reconstructed images showing Bilateral Popliteal Arterial Occlusion(B) Coronal reconstructed images showing Infra Renal Abdominal Aortic Aneurysm



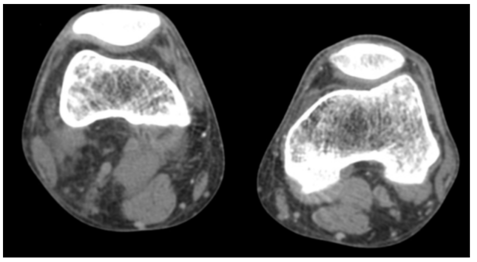
(A)MIP image of CTA showing bilateral mid SFA occlusion (B) 3D Volume rendered image showing the same findings



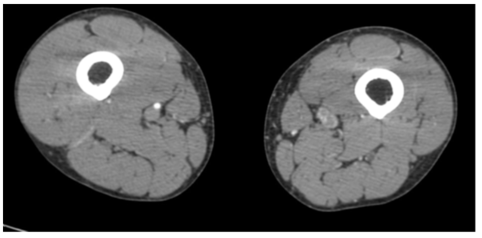
(A)3D Volume Rendered CTA image of abdominal aorta and bilateral Lower limb arterial system showing bilateral Mid SFA occlusion (B) CTA image With auto bone extraction showing the same findings



Axial Section Showing Complete Occlusion of Right ATA, PTA and Peroneal Arteries



Axial Section Showing Complete Occlusion of Bilateral Popliteal Arteries



Axial Section Showing Complete Occlusion of Left Distal SFA

RESULT

1. DEMOGRAPHIC DATA

SEX DISTRIBUTION		
SEX	NO OF PATIENTS	PERCENTAGE
MALE	30	75
FEMALE	10	25
TOTAL	40	100

In our study of CT correlation with arterial colour doppler USG, we studied 40 patients, out of these 40 patients 30 (75%) were male patients and 10 (25%) were female patients.

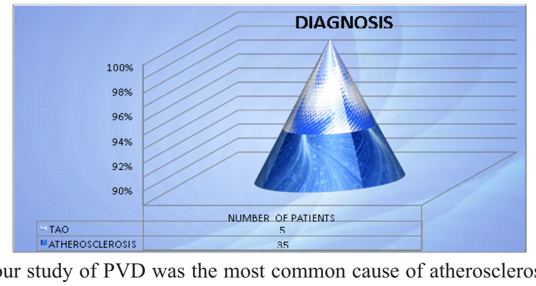
AGE DISTRIBUTION

AGE GROUP	NO OF PATIENTS	PERCENTAGE
LESS THAN 40	2	5
40-50	9	22
51-60	6	15
61-70	17	43
MORE THAN 70	6	15
TOTAL	40	100

Age Distribution

In our study of CT correlation with arterial color Doppler USG, we studied 40 patients, out of these 40 patients most of the patients belonged to the age group 61-70 years 17 (43%) patients, followed by 41-50 years with 9 (22%), patients, and 6 patients(15%), each in the age groups 51-60 years(43%),, and more than 70 years. Less than 40 years age group had the least number of patients with 2 patients (5%) suggesting that peripheral vascular disease is seen rarely in the younger age group.

DIAGNOSIS



In our study of PVD was the most common cause of atherosclerosis affecting the patients with PVD followed by Burgers Disease.

DOPPLER USG CHARACTERISTICS SPECTRAL WAVE FORM

COMMON FEMORAL ARTERIES	NO OF PATIENTS	PERCENTAGE
MONOPHASIC	16	20
BIPHASIC	25	31.2
TRIIPHASIC	37	46.2
CANT ASSES	2	2.5
TOTAL	80	100
SUPERFICIAL FEMORAL ARTERY	NO OF PATIENTS	PERCENTAGE
MONOPHASIC	17	22.2
BIPHASIC	25	31.2
TRIIPHASIC	21	26.2
CANT ASSES	17	21.2
TOTAL	80	100
DEEP FEMORAL ARTERY	NO OF PATIENTS	PERCENTAGE
MONOPHASIC	24	30
BIPHASIC	34	42.5
TRIIPHASIC	18	22.5
CANT ASSES	4	5
TOTAL	80	100
POPLITEAL ARTERY	NO OF PATIENTS	PERCENTAGE
MONOPHASIC	26	32.5
BIPHASIC	29	36.2
TRIIPHASIC	6	7.5
CANT ASSES	19	23.8
TOTAL	80	100
ANTERIOR TIBIAL ARTERY	NO OF PATIENTS	PERCENTAGE
MONOPHASIC	33	41.2
BIPHASIC	23	28.8
TRIIPHASIC	6	7.5
CANT ASSES	18	22.5
TOTAL	80	100

POSTERIOR TIBIAL ARTERY	NO OF PATIENTS	PERCENTAGE
MONOPHASIC	39	48.8
BIPHASIC	19	23.8
TRIIPHASIC	6	7.5
CANT ASSES	16	20
TOTAL	80	100
PERONEAL ARTERY	NO OF PATIENTS	PERCENTAGE
MONOPHASIC	36	45
BIPHASIC	27	33.8
TRIIPHASIC	6	7.5
CANT ASSES	11	13.8
TOTAL	80	100
DORSALIS PEDIS ARTERY	NO OF PATIENTS	PERCENTAGE
MONOPHASIC	38	47.5
BIPHASIC	15	18.8
TRIIPHASIC	2	2.5
CANT ASSES	25	31.2
TOTAL	80	100

MDCT VERSUS COLOUR DOPPLER USG

		SFA-MDCT				Total	Kappa	Pvalue
		+	-	LS	SS			
SFA-USG	+	2	0	0	0	2	0.903	< 0.001**
	-	0	52	0	0	52		
	LS	0	0	17	1	18		
	SS	0	0	3	5	8		
Total	2	52	20	6	80			

Extent of Involved Segment in the Vessel As Detected By MDCT Versus Colour Doppler USG SFA

From the above table in comparison of color Doppler ultrasound versus MDCT, there is statistically significant difference in the detection of the extent of segment involvement in SFA.

	DFA-MDCT				Total	Kappa	Pvalue
	+	-	LS	SS			

DFA-USG	+	4	0	0	0	4	1.000	< 0.001 **
	-	0	70	0	0	70		
	LS	0	0	3	0	3		
	SS	0	0	0	3	3		
Total	4	70	3	3	80			

Extent of Involved Segment in the Vessel As Detected By MDCT Versus Color Doppler USG DFA

From the above table in comparison of color Doppler ultrasound versus MDCT, there is statistically significant difference in the detection of the extent of segment involvement in DFA.

		POP-MDCT				Total	Kappa	pvalue
		+	-	LS	SS			
POP-USG	+	3	0	0	0	3	0.925	< 0.001 **
	-	0	53	0	0	53		
	LS	0	0	17	3	20		
	SS	0	0	0	4	4		
Total	3	53	17	7	80			

Extent of Involved Segment in the Vessel As Detected By MDCT versus Color Doppler USG Popliteal.

From the above table between color Doppler ultrasound and MDCT, there is significant difference in the detection of the extent of segment involvement in popliteal artery.

		ATA-MDCT				Total	Kappa	Pvalue
		+	-	LS	SS			
ATA-USG	+	2s	0	0	0	2	0.913	< 0.001 **
	-	0	58	0	0	58		
	LS	0	0	15	3	18		
	SS	0	0	0	2	2		
Total	2	58	15	5	80			

Extent of Involved Segment in the Vessel As Detected By MDCT versus Color Doppler USG ATA.

In comparison of colour doppler ultrasound versus MDCT, there is statistically extremely significant difference in the detection of the extent of segment involvement in ATA.

		PTA-MDCT				Total	Kappa	pvalue
		+	-	LS	SS			
PTA-USG	+	1	0	0	0	1	0.922	< 0.001 **
	-	0	55	0	0	55		
	LS	0	0	14	0	14		
	SS	0	0	3	7	10		
Total	1	55	17	7	80			

Extent of Involved Segment in the Vessel As Detected By MDCT versus Color Doppler USG PTA

From the above table in comparison of color Doppler ultrasound versus MDCT, there is statistically extremely significant difference in the detection of the extent of segment involvement in PTA.

		PA-MDCT				Total	Kappa	pvalue
		+	-	LS	SS			
PA-USG	+	1	0	0	0	1	0.963	< 0.001 **
	-	0	64	0	0	64		
	LS	0	0	11	0	11		
	SS	0	0	1	3	4		
Total	1	64	12	3	80			

Extent of Involved Segment in the Vessel As Detected By MDCT Versus Colour Doppler USG PA.

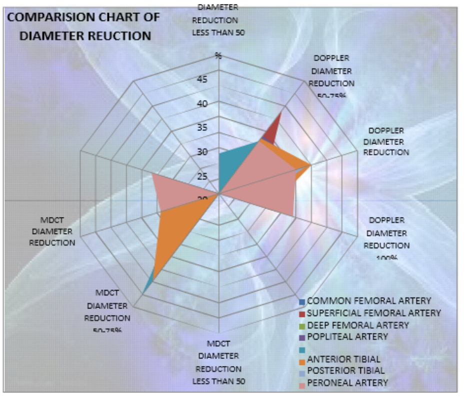
From the above table in comparison of color Doppler ultrasound versus MDCT, there is statistically extremely significant difference in the detection of the extent of segment involvement in peroneal artery.

		DPA-MDCT				Total	Kappa	Pvalue
		+	-	LS	SS			
DPA-USG	+	1	0	0	0	1	0.749	< 0.001 **
	-	0	57	0	0	57		
	LS	0	0	11	4	15		
	SS	0	0	5	2	7		
Total	1	57	16	6	80			

Extent of Involved Segment in the Vessel As Detected By MDCT versus Color Doppler USG DPA

From the above tables in comparison of color Doppler ultrasound versus MDCT, there is statistically significant difference in the detection of the extent of segment involvement in ATA.

Comparison of Diameter Reduction B/N MDCT & Color Doppler USG



Comparison of Diameter Reduction In MDCT & Color Doppler USG

There is statistically significant difference in detecting the number of hemodynamically significant stenosis by MDCT than in Doppler as depicted in the above graph with 0 p valve < 0.01

CONCLUSION

In our study we concluded that

- MDCT is better than Doppler in detecting the length of stenosis in the arterial System.
- MDCT is better than Doppler in detecting the presence of thrombosis especially In the infra-popliteal segment.
- Doppler is also an effective tool which can detect the lesions to a comparable Extent when no intervention is planned and only medical therapy is considered.

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