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Comparison of Color Doppler and computed tomography angiography (CTA) in arterial disease in patients with lower limb ischemia.

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ABSTRACT… Objective: To compare the diagnostic accuracy of color Doppler ultrasound with computed tomography angiography in patients with lower limb ischemia and to assess the severity of stenosis. **Study Design:** Cross Sectional Analytical study. **Setting:** Shalamar Hospital, Lahore. **Period:** May 2020 to October 2020. **Material & Methods:** Data were collected according to the Age, Height, Weight, BMI, Duration of diabetes, Total Cholesterol, LDL, HDL, Triglyceride, Gender, Socioeconomic status, Diabetes, Hypertension, Stenosis, Collateral, calcification. Sample size of46 patients were included in this research comprising 32 males (69.6%) and 14 females (30.4%).Data entry and analysis will be done by using SPSS version-23. **Results:** Total numbers of 46 patients were included in this research comprising 32 males (69.6%) and 14 females (30.4%). According to the result analysis 34 patients had shown peripheral arterial disease at color Doppler and 12 patients had not shown peripheral arterial disease at color doppler. 38 patients had shown peripheral arterial disease at CTA and 8 patients had not shown peripheral arterial disease at CTA. **Conclusion:** This study concludes that computed tomography angiography for detection of peripheral arterial disease as the gold standard, MDCT angiography shows higher sensitivity (82.6%) than color-coded Doppler ultrasonography (73.9%) in the assessment of peripheral arterial disease.

Key words: Atherosclerosis, Angiography, Diabetes, Doppler Ultrasound, Smoker.

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INTRODUCTION

Imaging modalities such as CTA, Conventional angiography and Doppler ultrasound are used for assessing PAD in the lower limb arteries. Atherosclerotic calcification and extent of stenosis in arteries which maybe detect through three dimensional computed tomography angiography and also provide more information about blockage of arteries. Some advantage of CTA which has short examination time, capability to assess iliac artery and it is less exaggerated by operator's experience. Vascular intervention such as angioplasty and stent application for treatment of peripheral arterial disease can be done. CDUS does not require preparation for patient before examination, or non-ionization.[1,2] Contras (CDUS) Color Doppler Ultrasound is non-invasive method for tentative finding of Peripheral arterial disease.[3,4] CD-US detect arterial flow spectrum and also identities stenosed or blockedparts.[5,6] Doppler Ultrasound can display the particular flow velocity of each artery and show the grade of stenotic area which found on an analysis of the spectral waveform.[7] Ultrasonographic anatomy of the lower limb and the equivalent anatomical landmarks are important for color Doppler ultrasound.[8] Lower extremity arteries are noticeable through associated vein, encompassing from the iliac to the popliteal area.[9] Common iliac artery divide into the internal iliac artery and the external iliac artery. The inguinal ligament is a landmark for the connection of the external iliac artery and common femoral artery. The CFA is a usually about 4 cm long, SFA and DFA are arise from common femoral artery and pass deep medially and laterally.[10] Superficial femoral artery enters the adductor canal at distal thigh, than after adductor hiatus common femoral artery name become popliteal artery in popliteal fossa.[11]

Branches of blood vessels arise from popliteal artery are tibial artery which pass anteriorly and Tibioperoneal trunk which pass posteriorly behind the calf muscles.[12] Tibioperoneal trunk divide into tibial artery(posterior) which pass medially descend to the foot and peroneal pass laterally.[13]

This study is planned to compare for diagnosis of various grades of stenosis to assess the benefits and drawbacks of each modality by learning the spectral flow patterns in color Doppler ultrasonography with contrast pacification and diameter reduction in CT angiography. This study will also help in generating local data which can be helpful later on regarding choice of modality for diagnosis of arterial disease in patients with lower limb ischemia.

MATERIAL & METHODS

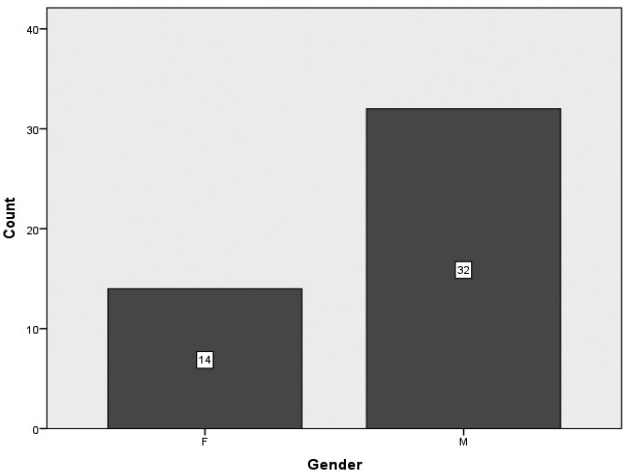
A cross sectional analytical study was conducted at Shalimar hospital, Lahore. Data were collected according to the Age, Height, Weight, BMI, Duration of diabetes, Total Cholesterol, LDL, HDL, Triglyceride, Gender, Socioeconomic status, Diabetes, Hypertension, Stenosis, Collateral, calcification. Inclusion and exclusion criteria in which Patients include Age of 18 to 80 years, both genders, presenting with clinically diagnosed or suspected lower limb arterial ischemic disease and excluded the patients having any contraindication for contrast study such as severe renal impairment and contrast allergy, Trauma patients and patient with any abscess in the region of lower limbs. Sample size of 46 patients were included in this research comprising 32 males (69.6%) and 14 females (30.4%). Data entry and analysis will be done by using SPSS version-23.

RESULTS

Analysis of data showed that out of 46 patients, Total numbers of 46 patients were included in this research comprising 32 males (69.6%) and 14 females (30.4%). According to the result analysis out of the total number of 46 patients, 34 patients had shown peripheral arterial disease at color Doppler and 12 patients had not shown peripheral arterial disease at color Doppler. 38 patients had shown peripheral arterial disease at CTA and 8 patients had not shown peripheral arterial disease at CTA.

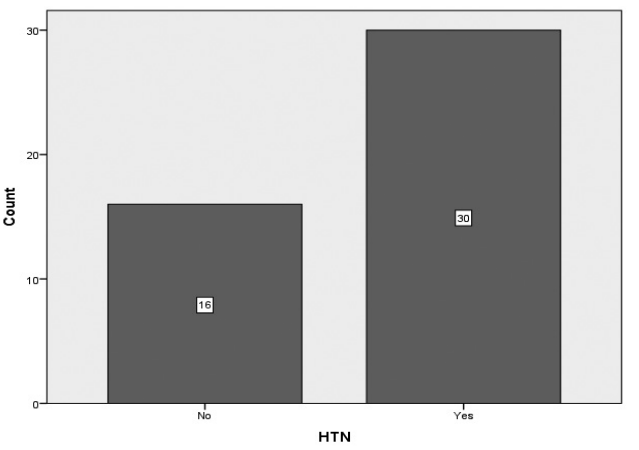
Gender		
	Frequency	Percent
Females	14	30.4
Males	32	69.6
Total	46	100.0

Table-I. Total numbers of 46 patients were included in this research comprising 32 males (69.6%) and 14 females (30.4%).



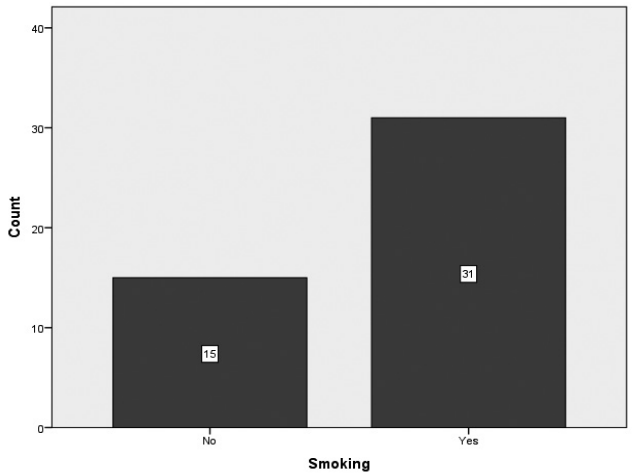
HTN		
	Frequency	Percent
No	16	34.8
Yes	30	65.2
Total	46	100.0

Table-II. Shows the result of frequency distribution of hypertension. Total number of 46 patients, in which 30 patients (65.2 %) had hypertension and 16 patients (34.8%) had no hypertension.



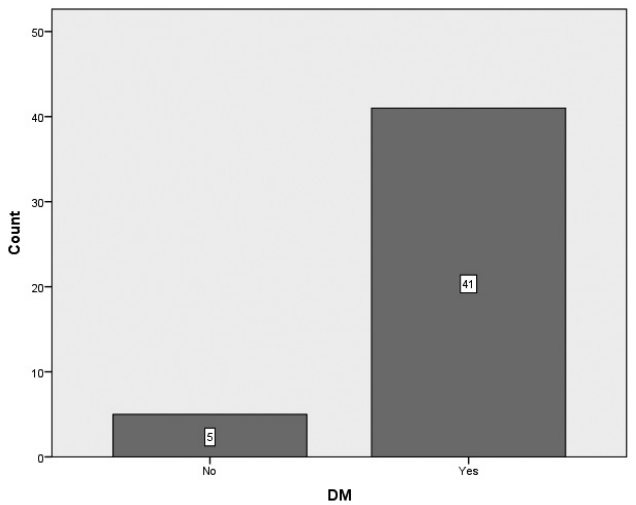
Smoking		
	Frequency	Percent
No	15	32.6
Yes	31	67.4
Total	46	100.0

Table-III. Shows the result of frequency distribution of smoking. Total number of 31 patients, in which 31 patients (67.4%) had smoking and 15 patients (32.6%) had no smoking.



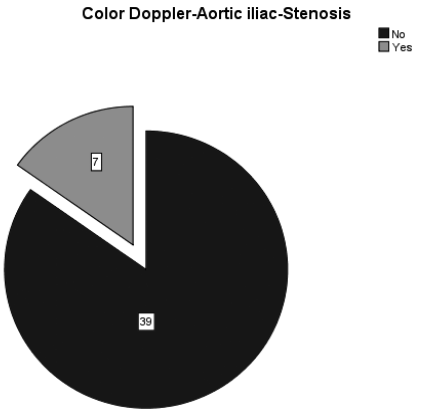
Diabetes Mellitus		
	Frequency	Percent
No	5	10.9
Yes	41	89.1
Total	46	100.0

Table-IV. Shows the result of frequency distribution of diabetes Mellitus. Total number of 46 patients, in which 41 patients (89.1 %) had diabetes mellitus, 5 patients (10.9%) had no diabetes mellitus.



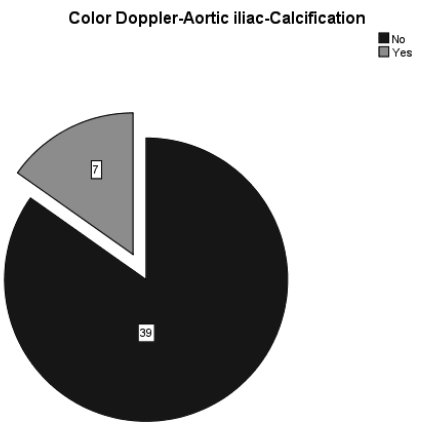
Color Doppler-Aortic iliac-Stenosis		
	Frequency	Percent
No	39	84.8
Yes	7	15.2
Total	46	100.0

Table-V. shows the frequency distribution of color Doppler aortic iliac stenosis in which have total number of 46 patients, 7 patients had shows aortic iliac stenosis at color Doppler and 39 patients had not shows aortic iliac stenosis at color Doppler.



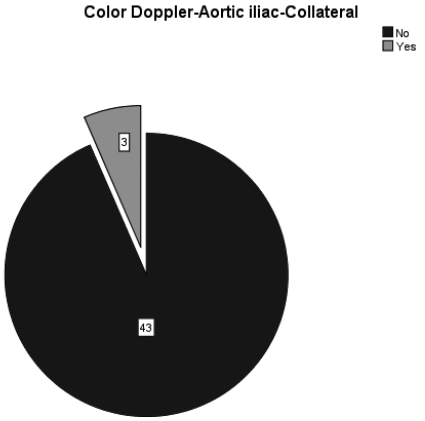
Color Doppler-Aortic iliac-Calcification		
	Frequency	Percent
No	39	84.8
Yes	7	15.2
Total	46	100.0

Table-VI. shows the frequency distribution of color Doppler aortic iliac calcification in which have total number of 46 patients, 7 patients had shows aortic iliac calcification at color Doppler and 39 patients had not shows aortic iliac calcification at color Doppler.



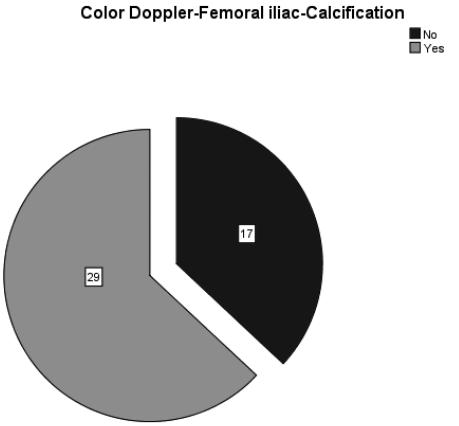
Color Doppler-Aortic iliac-Collateral		
	Frequency	Percent
No	43	93.5
Yes	3	6.5
Total	46	100.0

Table-VII. Shows the frequency distribution of color Doppler aortic iliac collateral in which have total number of 46 patients, 3 patients had shows aortic iliac collateral at color Doppler and 43 patients had not shows aortic iliac collateral at color Doppler.



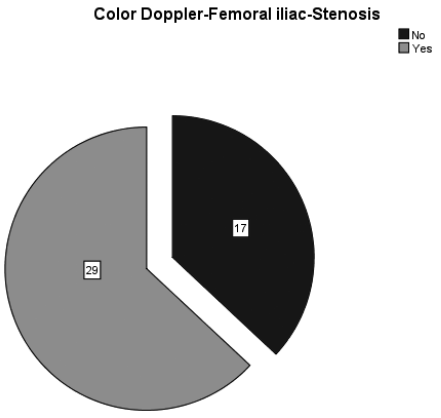
Color Doppler-Femoral iliac-Calcification		
	Frequency	Percent
No	17	37.0
Yes	29	63.0
Total	46	100.0

Table-IX. Shows the frequency distribution of color femoral iliac calcification in which had total number of 46 patients, 29 patients had shows femoral iliac stenosis at color Doppler and 17 patients had not shows aortic iliac calcification at color Doppler.



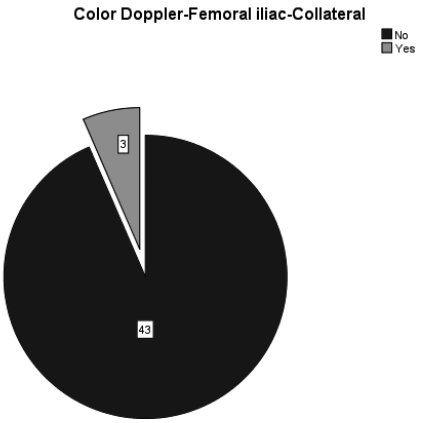
Color Doppler-Femoral iliac-Stenosis		
	Frequency	Percent
No	17	37.0
Yes	29	63.0
Total	46	100.0

Table-VIII. Shows the frequency distribution of color femoral iliac stenosis in which had total number of 46 patients, 29 patients had shows femoral iliac stenosis at color Doppler and 17 patients had not shows aortic iliac calcification at color Doppler.



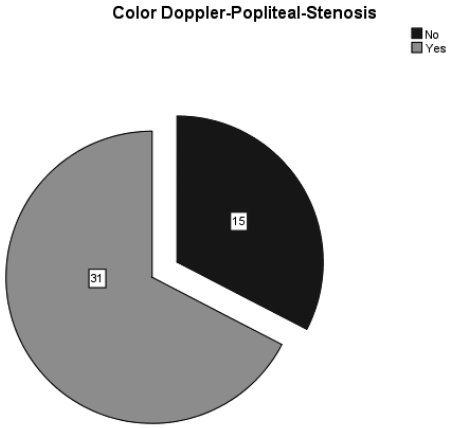
Color Doppler-Femoral iliac-Collateral		
	Frequency	Percent
No	43	93.5
Yes	3	6.5
Total	46	100.0

Table-X. Shows the frequency distribution of color femoral iliac collateral in which had total number of 46 patients, 3 patients had shows femoral iliac collateral at color Doppler and 43 patients had not shows aortic iliac collateral at color Doppler.



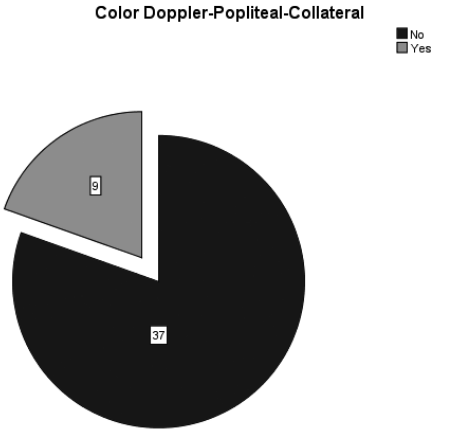
Color Doppler-Popliteal-Stenosis		
	Frequency	Percent
No	15	32.6
Yes	31	67.4
Total	46	100.0

Table-XI. Shows the frequency distribution of color Doppler popliteal stenosis in which had total number of 46 patients, 31 patients had shows popliteal stenosis at color Doppler and 15 patients had not shows popliteal stenosis at color Doppler.



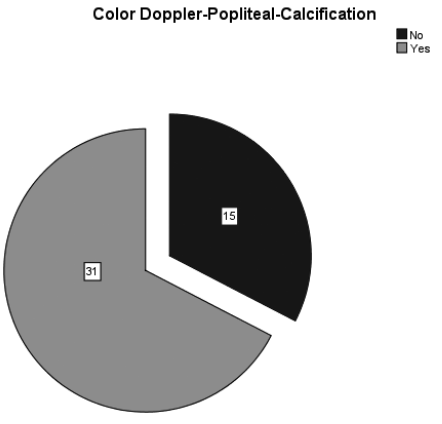
Color Doppler-Popliteal-Collateral		
	Frequency	Percent
No	37	80.4
Yes	9	19.6
Total	46	100.0

Table-XIII. Shows the frequency distribution of color Doppler popliteal collateral in which had total number of 46 patients, 9 patients had shows popliteal collateral at color Doppler and 37 patients had not shows popliteal collateral at color Doppler.



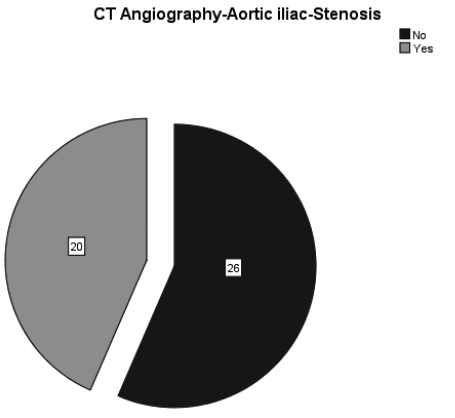
Color Doppler-Popliteal-Calcification		
	Frequency	Percent
No	15	32.6
Yes	31	67.4
Total	46	100.0

Table-XII. Shows the frequency distribution of color Doppler popliteal calcification in which had total number of 46 patients, 31 patients had shows popliteal calcification at color Doppler and 15 patients had not shows popliteal calcification at color Doppler.



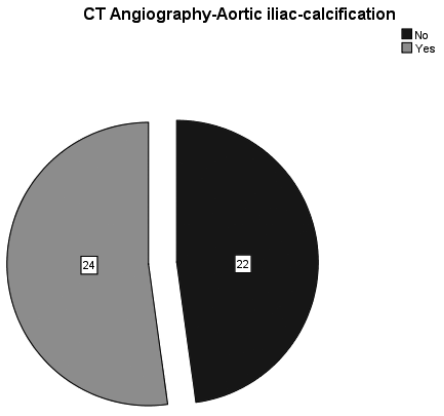
CT Angiography-Aortic iliac-Stenosis		
	Frequency	Percent
No	26	56.5
Yes	20	43.5
Total	46	100.0

Table-XIV. Shows the frequency distribution of CT angiography aortic iliac stenosis in which have total number of 46 patients, 20 patients had shows aortic iliac stenosis at CTA and 20 patients had not shows aortic iliac stenosis at CTA.



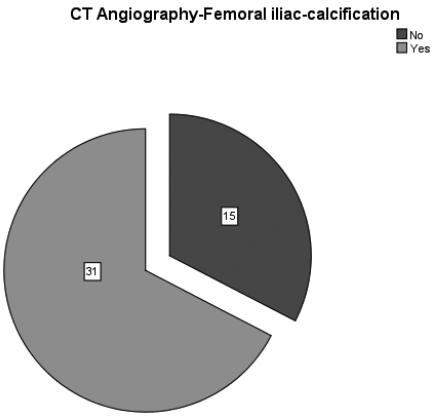
CT Angiography-Aortic iliac-calcification		
	Frequency	Percent
No	22	47.8
Yes	24	52.2
Total	46	100.0

Table-XV. shows the frequency distribution of CT angiography aortic iliac calcification in which have total number of 46 patients, 24 patients had shows aortic iliac calcification at CTA and 22 patients had not shows aortic iliac calcification at CTA.



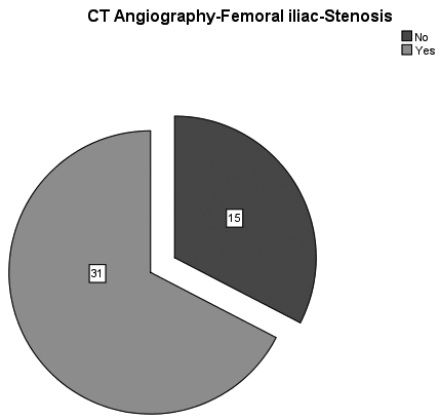
CT Angiography-Femoral iliac-calcification		
	Frequency	Percent
No	15	32.6
Yes	31	67.4
Total	46	100.0

Table-XVII. Shows the frequency distribution of CT angiography femoral-iliac calcification in which have total number of 46 patients, 31 patients had shows femoral-iliac calcification at CTA and 15 patients had not shows femoral- iliac calcification at CTA.



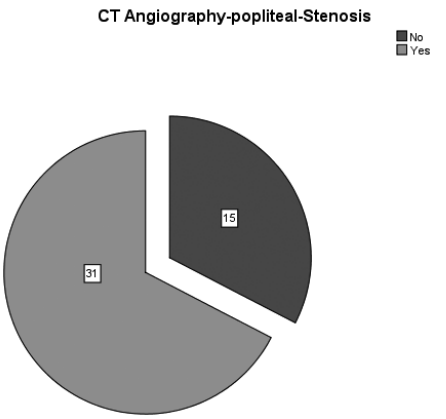
CT Angiography-Femoral iliac-Stenosis		
	Frequency	Percent
No	15	32.6
Yes	31	67.4
Total	46	100.0

Table-XVI. Shows the frequency distribution of CT angiography femoral-iliac stenosis in which have total number of 46 patients, 31 patients had shows femoral-iliac stenosis at CTA and 15 patients had not shows femoral- iliac stenosis at CTA.



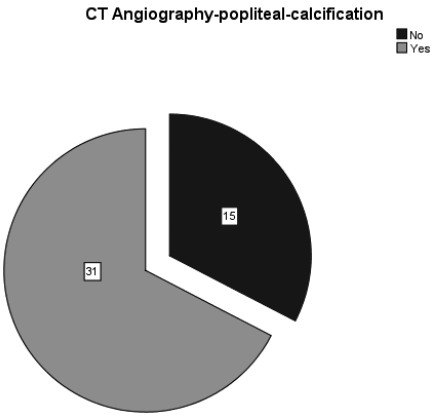
CT Angiography-popliteal-Stenosis		
	Frequency	Percent
No	15	32.6
Yes	31	67.4
Total	46	100.0

Table-VIII. shows the frequency distribution of CT angiography popliteal stenosis in which have total number of 46 patients, 31 patients had shows femoral-iliac calcification at CTA and 15 patients had not shows popliteal stenosis at CTA.



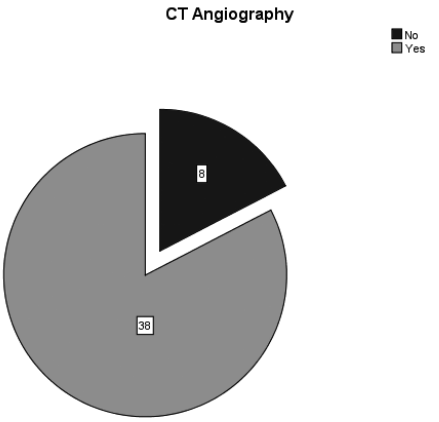
CT Angiography-popliteal-calcification		
	Frequency	Percent
No	15	32.6
Yes	31	67.4
Total	46	100.0

Table-XIX. Shows the frequency distribution of CT angiography popliteal calcification in which have total number of 46 patients, 31 patients had shows femoral-iliac calcification at CTA and 15 patients had not shows popliteal calcification at CTA.



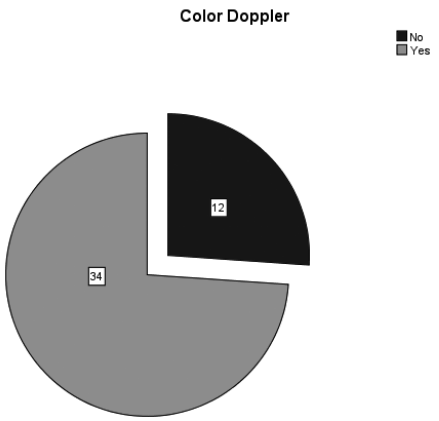
CT Angiography		
	Frequency	Percent
No	8	17.4
Yes	38	82.6
Total	46	100.0

Table-XXI. Shows the frequency distribution of CT angiography in which have total number of 46 patients, 38 patients had shows peripheral arterial disease at CTA and 8 patients had not shows peripheral arterial disease CTA.



Color Doppler		
	Frequency	Percent
No	12	26.1
Yes	34	73.9
Total	46	100.0

Table-XX. Shows the frequency distribution of color doppler in which have total number of 46 patients, 34 patients had shows peripheral arterial disease at color Doppler and 12 patients had not shows peripheral arterial disease at color doppler.



DISCUSSION

This study was designed to compare the diagnostic accuracy of Color Doppler ultrasound with CT angiography in arterial disease in patients with lower limb ischemia and also to assess the severity of stenosis and also to define the various grades of stenosis on Color Doppler and CT angiography taking as gold standard.

In current study attempt was made compare the diagnostic accuracy of Color Doppler ultrasound with CTA in PAD. Data was collected according to the age gender, risk factors such as hypertension, diabetes mellitus, types, duration of DM, smoking, and peripheral arterial disease stenosis or calcification was detecting on both color Doppler ultrasound and computed tomography angiography. Data were collected of 46 patients, out of total number of patients 32 males (69.6%) and 14 females (30.4%) had peripheral artery disease.

A study was conduct by Aly et al, they study about

both CTA and DUS, total number of 90 patients include 177 legs and 3108 arterial section (630 aroto-iliac, 531femoral-artery, 885 popliteal and 1062 legs and ankles blood vessels). In their study, sensitivity and specificity of femoral-artery were shown 100 and 99 on color Doppler ultrasound respectively, For aorto-iliac, femoro-popliteal and more distal stenosis, the sensitivity values were shown percentage 88, 9 and 82, while specificity shown percentage 99 for all these parts. Their study conclude that Doppler-US had an general sensitivity of 92 and a specificity of 99 for stenosis by CTA L.L, which were quite comparable to those invasive methods. In my study the sensitivity values were 86.84 and specificity value was 87.50. And overall sensitivity 95.59% and specificity was 99.68%.[15,16]

In similar studies Doppler ultrasound had difficulty in diagnosis 99% stenosis from complete occlusion. Presence of obese patient's body habitus may limit examination of arteries. Underneath the knee the sensitivity and specificity of arteries were found to be 75-83% and 77-95%, respectively.[17] Another study was conduct by Rieker et al, they study the CTA of lower limb arterial part from groin to the lower calf. According to their study accuracy of CTA in the finding of substantial stenosis, finding a sensitivity of 67 for the tibial and peroneal arteries.[18] In another study was conduct Lawrence et al. that the sensitivity of 92.2% for the detection of 50% stenosis posterior tibial arteries and corresponding arteries from groin to midcalf. In result of my study the sensitivity of 95.96% for the detection of stenosis at CTA.PAD is more common in smoker and more predicator risk factor for cause of PAD. In other similar studies which may show the variable of measurement of smoking, include categories of smoking status (current, past, or never).[19]

According to the study of Fowkers et al, they found 36 smoker to be associated with a significantly higher risk for peripheral arterial disease compared with cardiovascular disease. Smoking is traditional risk factors for cause of CVD. Which may shown the odd ratio of PAD and CVD. According to data, smoking is the most common risk factor for presence of PAD with a population attributable fraction of 44% in US male professionals.[20,21] In result of my study smoking as risk factors for cause of PAD was 67.4%. peripheral arterial disease of lower extremity in smoker at an earlier age compared to non-smokers, which may show the severity of disease is correlate to the cigarettes consumed heavy smoker have a 4-8 fold risk of developing symptomatic PAD lower extremity as compared to non-smoker.

Atherosclerosis in smoker's patients increase risk 2-3 times more to cause PAD in lower extremity as compared to Chronic Heart Disease. According to the study of Binu. M et al, they conduct study in 2011 at tertiary care center in Kulasekharam Tamil, Nadu India.[22] They selected 100 non diabetic women as a control group.19% had significantly high prevalence of PAD in asymptomatic diabetic's patients than the control group which was only 3%. In my study, patients had risk factors of diabetes mellitus which shows that 41(89.1%) had diabetes mellitus out of total number of 46 patients. In other study conduct by Hatsukami TS et al, they found that Color Doppler ultrasound is an non-invasive and most accurate examination tool for evaluation of the PAD.[23] In another study by Joshi A, Nimbkar A et al in 2004, they found that CT angiography is more accurate modality for diagnosis of calcified plaque.[20] In result of similar studies a total of 120 (7.1%) segments on CDS and 178 (10.5%) segments on CTA showed calcification. CT angiography diagnosis occlusion in more number of positive segments than Color Doppler ultrasound.[24] In a study by Romano et al, they study about in the evaluation of peripheral vascular disease in detecting the femoropopliteal occlusion, CT was able to detect the disease to a statistically significant level.[25] In my study result shows that compared CTA and Color Doppler sonography for peripheral arteries shows the frequency distribution of CT angiography aortic iliac calcification in which have total number of 46 patients, 24 patients had shows aortic iliac calcification at CTA and 22 patients had not shows aortic iliac calcification at CTA and shows the frequency distribution of CT angiography aortic iliac stenosis in which have total number of 46 patients, 20 patients had shows aortic iliac

stenosis at CTA and 20 patients had not shows aortic iliac stenosis at CTA In Color Doppler sonography shows the frequency distribution of color Doppler aortic iliac stenosis in which have total number of 46 patients, 7 patients had shows aortic iliac stenosis at color Doppler and 39 patients had not shows aortic iliac stenosis at color Doppler, 7 patients had shows aortic iliac calcification at color Doppler and 39 patients had not shows aortic iliac calcification at color Doppler. In detection of femoral iliac stenosis at Color Doppler 46 patients, 29 patients had shown femoral iliac stenosis at color Doppler and 17 patients had not shown femoral iliac calcification as compared to CT angiography femoral-iliac stenosis in which have total number of 46 patients, 31 patients had shown femoral-iliac stenosis at CTA and 15 patients had not shown femoral- iliac stenosis at CTA., 31 patients had shown femoral-iliac calcification and 15 patients had not shown femoral- iliac calcification at CTA. In my study, when color Doppler ultrasound was compared to MDCT in detecting the femoropopliteal region, lesser segments were identified for occlusion by CDS compared to MDCTA.

CONCLUSION

This study concludes that computed tomography angiography for detection of peripheral arterial disease as the gold standard, MDCT angiography shows higher sensitivity (82.6%) than color-coded Doppler ultrasonography (73.9%) in the assessment of peripheral arterial disease. MDCT angiography is an outstanding, fast, accurate, and non-invasive imaging test in the evaluation of patients with PAD. Doppler ultrasound though being the initial imaging modality has certain limitations like in the evaluation of aortoiliac and femoropopliteal arterial segments. It is an operator-dependent modality with a variable learning curve and it does not provide a proper arterial map a more definite imaging modality is required especially before surgical intervention has to be offered to the patients.

LIMITATION

There were some limitations to study. Sample size was small due to time constraint. Many Patients did not come to hospital due COVID-19 pandemic because the hospital from which collected data drain patients from many cities.

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