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Role Of CT Angiogram Of Peripheral Arterial Disease In Comparison With Colour Doppler Ultrasonogram.

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ABSTRACT

Atherosclerotic plaque in the arteries of the lower limbs is a symptom of peripheral artery disease (PAD). One macrovascular consequence of type 2 diabetes mellitus is PAD. Lower limb CT angiography provide information about the stenosed artery and improves the delineation of adjacent structures both before and after surgery. PAD in earlier stage without imminent limb ischemia could prevent patient progress into severe complication. This study is done to assess the role of CT angiography in comparison with colour doppler in patients with peripheral vascular disease. In our study 40 consecutive patients with lower limb PAD after clinical or USG Doppler study during one year period from Jan 2023 to Jan 2024 were included in this study. Patients were advised NPO for 4-6 hours and written consent was taken prior to CTA. About 100-150 ml of non- ionic water-soluble contrast medium was injected into the antecubital vein at 4-5 ml/ second through an auto injector. Scan was taken from the level of T12 till the foot. Doppler assessment revealed varying proportions of abnormal findings across different arterial locations, with PAD diagnosed in 72% of cases. The number of involved arteries ranged from 1 to 16, with a mean of 6.51 ± 7.56. CT angiography identified abnormal findings in 86.56 % of cases, with varying numbers of involved arteries. The mean number of involved arteries was 7.12 ± 7.25. For overall evaluation (n=756 arteries), as compared to CT, Doppler assessment was 74.6% sensitive and 89.5% specific. The positive and negative predictive values were 92.1% and 94.9% respectively. There was an agreement on 88.2% findings between CT and Color Doppler. This was evaluated in 40 cases who underwent surgery and we did follow up with the on-table findings. The current study used Colour Doppler flowmetry and CT angiography to analyze 756 arteries by evaluating 40 individuals for 8 lower limb arterial anomalies for peripheral vascular disease on each limb. The current investigation led us to the conclusion that Colour Doppler evaluated abnormalities in a smaller percentage of instances than CT Angiography and that there were more underdiagnoses cases with colour Doppler than over diagnosis cases.
Keywords: CT Angiography, Colour Doppler, peripheral arterial disease.

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INTRODUCTION

Atherosclerotic plaque in the arteries of the lower limbs is a symptom of peripheral artery disease (PAD). One macrovascular consequence of type 2 diabetes mellitus is PAD. Only 20% of patients with symptomatic PAD had diabetes, according to the Framingham Heart study. The asymptomatic patient, who is probably more than anticipated, is not included in the figure. According to the study, at least half are asymptomatic, one-third experience claudication, and the other individuals are classified as having severe PAD [1].

Clinical tests are important to determine the next diagnostic and management steps. To the best of our knowledge, there was no clinical study performed regarding the association of ankle brachial systolic index and pulse oximeter gradient for PAD screening in our geographical location.

One of the most prevalent circulatory conditions is peripheral arterial disease. The primary cause of PAD is artery narrowing, which reduces blood flow to the patient's limbs. Atherosclerotic plaque of fatty deposits within the vessel's mural lining is one risk factor linked to peripheral artery disease. The brain, kidneys, and heart's coronary artery were all affected by the lack of blood flow or perfusion, in addition to the limbs. Claudication symptoms are exacerbated by the lower limbs' inability to meet the demands of walking due to a reduced supply. According to biology, vascular inflammation, abnormalities in the cellular components of the vasculature, changes in blood cells, and haemostatic variables can all contribute to proatherogenic development in diabetes.

The most basic, repeatable, portable, and accessible clinical tool for screening PAD symptoms and indicators should be found in the majority of general medical clinics. One of the tools is the non-invasive technique of utilizing an automated or manual sphygmomanometer to measure the ankle brachial systolic index. When assessing the gradient oxygen saturation or perfusion of peripheral fingers or toes, pulse oximetry is likewise the most effective method.

The ratio of the brachial systolic peak pressure to the ankle systolic peak pressure is known as the ankle brachial systolic index, or ABSI. The most effective method for identifying asymptomatic PAD in the general population is ABSI [2]. This clinical test is straightforward, affordable, painless, repeatable, and simple to conduct [3]. Handy Pulse Oximetry (PO) has been used in a number of articles to identify peripheral skin saturation gradients between the tips of the fingers and the toes in patients with PAD. PO only needs to be applied to the finger and toes to reflect the severity of the affected areas [4-6]. A finger-to-toe SaO_2 gradient value of more than 2% is deemed sick, per Javier Ena et al [7].

Lower limb CT angiography provide information about the stenosed artery and improves the delineation of adjacent structures both before and after surgery. Although digital subtraction angiography, MR angiography, and ultrasound are also helpful methods for gathering data, we selected CT angiograms as the gold standard in this investigation. However, the radiologist's interest in a particular facility, the availability of imaging technologies, the background of the patient's comorbidities, and the skilled technologist all influence the imaging decision [8]. Because of its high spatial resolution and comparatively low operator reliance, CT angiography is the diagnostic tool of choice for us. This indicates that CT angiography is more sensitive and selective for detecting artery occlusions than stenosis.

PAD in earlier stage without imminent limb ischemia could prevent patient progress into severe complication. This study is done to assess the role of CT angiography in comparison with colour doppler in patients with peripheral vascular disease.

MATERIALS AND METHOD

In our study, 40 consecutive patients with lower limb PAD after clinical or USG Doppler study during one-year period from Jan 2023 to Jan 2024 were included in this study. Patients with acute trauma, renal impairment, contrast allergy and those with previous history of PAD & amputation were excluded. Detailed history was taken (in particular smoking, diabetes, hypertension, dyslipidemia) and patients were divided into groups according to their clinical presentation. Patients were advised NPO for 4-6 hours and written consent was taken prior to CTA. About 100-150 ml of non- ionic water-soluble contrast medium was injected into the antecubital vein at 4-5 ml/ second through an auto injector. Scan was taken from the level of T12 till the foot. Image reconstructions were done using software like

multiplanar reconstruction, maximum intensity projection and volume rendering technique. Data were analyzed using SPSS Version 24. Results were analyzed using appropriate statistical methods. Statistical analysis was done with Chi-Square Test.

RESULTS

The present study was carried out to evaluate the efficacy of Color Doppler and CT Angiography in assessment of peripheral artery disease of lower limb. For this purpose, 40 patients fulfilling the eligibility criteria were enrolled in the study.

Age of the patients ranged from 35-75 years. Almost half the patients were aged between 35 and 49 years (n=22) and remaining 18 were aged between 50 and 75 years. Mean age of patients was 47.52 ± 12.54 years. Majority of patients were males (n=27). There were 13 females.

Body mass index of patients ranged from 24 to 32 kg/m². Only 3 patients were in BMI category 18.5-24.9 kg/m² and 9 had BMI $\geq$30 kg/m². Rest 19 cases had BMI in 25.0-29.9 kg/m² range. Mean BMI of patients was 26.54 ± 2.24 kg/m². The majority of patients had history of diabetes mellitus (66.7%) followed by hypertension (38.9%), heart disease (31.5%) and respiratory disease (27.8%). No any history of any significant medical illness was reported.

Pain in legs (88.9%) was the leading presenting complaint. All the other complaints were seen in 7.4% to 22.2% of patients and included cramps (22.2%), ulcers (18.5%), hair loss (11.1%), thinning skin and cool skin (7.4% each).

Overall, both methods detected PAD, with CT angiography showing a slightly higher detection rate and a marginally higher mean number of involved arteries compared to Doppler assessment.

Table 1: Findings of Color Doppler and MD CT angiography.

Variables	Color Doppler examination (%)		CT angiography (%)	
Abnormal arteries detected (n=756)				
Number of abnormal arteries	275	36%	356	47%
Number of normal arteries	481	64%	400	53%
Mean ± SD	6.51 ± 7.56		7.12 ± 7.25	

For overall evaluation (n=756 arteries), as compared to CT, Doppler assessment was 74.6% sensitive and 89.5% specific. The positive and negative predictive values were 92.1% and 94.9% respectively. There was an agreement on 88.2% findings between CT and Color Doppler. This was evaluated in 40 cases who underwent surgery and we did follow up with the on-table findings.

DISCUSSION

Peripheral arterial disease (PAD) develops gradually due to the accumulation of atherogenic material in blood vessels, leading to arterial narrowing and blockages. Detecting PAD early allows effective treatment strategies to slow or reverse progression. Color Doppler ultrasound, alongside B-mode ultrasound, has long served as a non-invasive method for assessing vascular changes [9, 10].

However, CT angiography has emerged as a valuable alternative in recent years, offering 3-D imaging and post-processing capabilities [11].

Although CT angiography is now the gold standard for evaluating PADs, Colour Doppler is more accessible. There is ongoing discussion on the accuracy of Colour Doppler in comparison to MDCT, with several research attempting to draw similarities. Examining cost-effective methods like Colour Doppler is essential for clinical utility given resource limitations in many contexts, particularly in economically constrained countries that prioritize inexpensive healthcare. Therefore, the purpose of our study was to compare MDCT angiography with Colour Doppler flowmeter for PAD evaluation.

We assessed 40 patients for lower limb arterial abnormalities, evaluating a total of 756 arteries using both techniques. Doppler assessment was 74.6% sensitive and 89.5% specific. The positive and

negative predictive values were 92.1% and 94.9% respectively. Comparisons with previous studies showed varying results in sensitivity, specificity, and accuracy rates, with Doppler generally exhibiting accuracy within the 80-90% range. Studies referenced as Ali et al, Dev et al, Yadav, and Khanduri et al [12-14].

Patients having a clinical suspicion of PAD, mostly in the early stages, were included in this study. Our emphasis on early-stage patients may have affected our findings, in contrast to research demonstrating strong Doppler sensitivity. Doppler sensitivity may be higher in high-risk patients, such as diabetics.

For the diagnosis of PAD, CT angiography is still the recommended non-invasive diagnostic technique due to its excellent sensitivity and specificity. However, in low-resource areas where MDCT angiography is not available, Colour Doppler provides a feasible substitute due to its affordability and ease of use. Additional research is necessary to confirm our findings.

CONCLUSION

The current study used Colour Doppler flowmetry and CT angiography to analyze 756 arteries by evaluating 40 individuals for 8 lower limb arterial anomalies for peripheral vascular disease on each limb. The current investigation led us to the conclusion that Colour Doppler evaluated abnormalities in a smaller percentage of instances than CT Angiography and that there were more underdiagnoses cases with Colour Doppler than over diagnosis cases.

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