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Comparison of lower extremity arterial doppler angiography with multi-detector computed tomography angiography: A prospective study

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Abstract
Introduction: A common cause of Peripheral vascular Disease is the atheromatous constriction or blockage of an artery or arteries in the leg. Symptoms such as gangrene, sores, rest pain, and claudication episodes are all possible.
Methods: Comparing Duplex Ultrasound with MDCT angiography for accuracy is the goal of this prospective study. Patients presenting to the radiology division for CT angiography were one of 20 with lower limb ischemia sickness, either unilaterally or bilaterally. Between November 2018 and October 2019, the research was place at the Department of Radiology at the RVS Institute of Medical Sciences in Chittoor, Andhra Pradesh, India.
Results: The study had 20 participants. Twenty-six patients were in the 40-and 60-year-old age groups. Amputations below the knee were necessary for two patients. Only 806 segments of 830 arteries from 67 limbs were usable for comparison, despite the fact that both methods were applied to them.
Conclusion: Thus, Duplex Ultrasound is a crucial tool for studying peripheral vascular disease since it is safe, inexpensive, non-invasive, widely available, and has great diagnostic accuracy.

Keywords: Angiography, multi-detector, arterial doppler, and tomography angiography

Introduction

Gangrene, ulceration, intermittent claudication, and ischemic rest discomfort are some of the possible symptoms seen with this condition. Patients who are experiencing vascular disease in their lower limbs have a variety of therapy options available to them to evaluate and select from [1-3]. In the treatment of intermittent claudication, conservative methods are typically utilized; however, in cases when limb-threatening ischemia is evident, angioplasty, surgical revascularization, or amputation may be required. The severity of the condition determines the treatment choices that are available, which may involve a combination of different modalities [2-4].

Accordingly, in order to formulate a treatment strategy for patients who are suffering from limb-threatening ischemia, it is required to conduct a full evaluation. Intra-arterial contrast angiography is the procedure that is considered to be the most reliable when it comes to examining leg artery disease [3-5]. Ionizing radiation, arterial puncture, and nephrotoxicity caused by iodinated contrast chemicals are all examples of potential hazards. There are a number of imaging modalities that can be applied, such as magnetic resonance imaging (MRI), computed tomography angiography, and duplex ultrasonography [5-7].

Magnetic resonance imaging (MRI) and computed tomography (CT) angiography both expose patients to potentially hazardous levels of ionizing radiation and have concerns related with the contrast chemicals that are used. However, duplex ultrasound does not expose patients to these dangers. The diagnostic application of duplex ultrasound for the non-invasive examination of peripheral artery disease has increased as a result of developments in post-processing, transducer technology, picture quality, signal strength, and spectrum analysis [6-8].

It has been demonstrated in a number of studies that Multi-Detector CT Angiography has the potential to map the vascular tree in a non-invasive manner by making use of contrast material. When it comes to the diagnosis of peripheral artery disease, there is a scarcity of high-quality clinical trials that compare CT angiography, duplex ultrasonography, and magnetic resonance imaging (MRI). Within the scope of this prospective study, the

researchers want to investigate the diagnostic efficacy of MDCT angiography and Duplex Ultrasound in determining the presence of obstructive arterial lesions in the lower limbs and assessing the extent of these lesions [7-9].

Materials and Methods

This prospective study will assess the accuracy of Duplex Ultrasound compared to MDCT angiography. The study population consisted of 20 patients with unilateral or bilateral lower limb ischemia who presented to the radiology division for CT angiography. The study was conducted in the Department of Radiology, RVS Institute of Medical Sciences, Chittoor, Andhra Pradesh, India, from November 2018 to October 2019.

Inclusion criteria

- Any age range is taken into account.
- Unilateral or bilateral lower limb arterial disease.
- Acute or chronic lower limb arterial disease.

Exclusion Criteria

- Individuals with serious ulcerations and gangrene.
- Contrast reaction sufferers.
- Individuals experiencing excruciating lower limb

Results

Twenty patients took part in the study. Six of these patients were sixty years old or older, and twenty-six were forty years old or older. Two people had to have their lower limbs amputated. There was one case of popliteal artery cystic adventitial disease, seven cases of atherosclerosis, one case of traumatic acute thrombosis, and seven cases of TAO. In addition to 2 persons experiencing rest pain and occasional claudication, 20 patients showed signs of trophic changes, ulceration, and gangrene.

Table 1: Above the Renal Veins

	CT positive	CT negative	Total
Doppler positive	1	3	4
Doppler negative	1	15	16
	2	18	20

Table 2: Popular kappa test

	CT positive	CT negative	Total
Doppler positive	3	4	7
Doppler negative	1	12	13
	4	16	20

Table 3: Testing the external iliac artery with Kappa

	CT positive	CT negative	Total
Doppler positive	3	1	4
Doppler negative	2	14	16
	5	15	20

Table 4: Common Femoral Artery Region

	CT positive	CT negative	Total
Doppler positive	7	0	7
Doppler negative	3	10	13
	10	10	20

Table 5: Position Adjacent to the Superior Femoral Epicondyle

	CT positive	CT negative	Total
Doppler positive	3	10	13
Doppler negative	7	0	7
	10	10	20

Table 6: The Anterior Superficial Femoral Artery: A Structure to Understand

	CT positive	CT negative	Total
Doppler positive	7	0	7
Doppler negative	1	12	12
	8	12	20

Table 7: Middle Femoral Artery (Superficial)

	CT positive	CT negative	Total
Doppler positive	8	1	9
Doppler negative	2	9	11
	10	10	20

Discussion

Three participants needed amputations below the knee out of twenty who were part in the study. In seven out of thirty instances, the infra renal aorta was blocked by bowel gas. The majority of the segments were either normal or had minimal effects on hemodynamics; only one patient out of twenty-six showed significant stenosis. Using CT angiography, the results were confirmed. There was a flawless performance of Doppler in evaluating the infra renal aorta, with a positive predictive value, specificity, and sensitivity of 100% [10-12].

Doppler identified seven of the eight segments with hemodynamically significant stenosis out of fifty-six. The test failed to detect stenosis in a single subject with a calcific plaque. The patient may have gotten a false negative result because CT angiography overestimates stenosis in arteries with calcific plaques. This reduced Doppler's sensitivity to an accuracy of 87.5%. Doppler and CT angiography were shown to be highly concordant, according to kappa data. Intestinal gas blocked six of the external iliac artery's sixty-eight segments [12-14].

It is probable that CT angiography exaggerated the stenosis caused by calcific plaque, as Doppler did not find hemodynamically significant stenosis in the remaining 62 segments of the same patient. We attained complete specificity and a reduced sensitivity of 87.5%. A good level of agreement was shown by the kappa value when comparing Doppler to CT angiography. Doppler can detect 9 hemodynamically significant stenosis in the common femoral artery with 100% sensitivity and specificity. Using kappa statistics, the degree of agreement between Doppler and CT angiography was remarkably high [14-16].

Doppler was able to detect 26 cases of hemodynamically severe stenosis in the proximal femoral artery and 29 cases in the middle superficial femoral artery with complete sensitivity and specificity, respectively. Because the distal superficial femoral artery was difficult for sonographers to see, only 62 out of 68 segments could be used for comparison. The subjects under assessment experienced false positives with Doppler over about two segments with hemodynamically modest stenosis. The patients were mistakenly classified with hemodynamically severe stenosis when they showed signs of monophasic flow in the distal SFA, which was actually caused by long segment disease in

the proximal and intermediate SFA [17-19].

The study only evaluated the proximal portion of Profunda femoris because its distal portion and its branches were unavailable. Of the 68 segments, all of them had hemodynamically severe stenosis, as revealed by Doppler. Additionally, it produced an inaccurate positive result for six segments that actually had non-significant hemodynamic stenosis. These areas had larger peak systolic velocities because, when the SFA was blocked, more blood flowed via them to the distal leg. Consequently, when evaluating the proximal profunda femoris, Doppler's specificity of 89.83% was lower than its sensitivity of 100% [20-22].

For patients with long segment disease in the proximal and mid-section of SFA, resulting to monophasic flow in the distal SFA, Doppler overestimated two segments with hemodynamically insignificant stenosis, but it did not miss any hemodynamically critical stenosis in the popliteal artery. While evaluating the popliteal artery, Doppler was 100% sensitive and 92% specific. The presence or absence of blood flow through the infra popliteal arteries was assessed using Doppler flow measurement and contrast-enhanced CT angiography [21-23].

During CT angiography, seven segments of the anterior tibial artery, six segments of the posterior tibial artery, thirteen segments of the peroneal artery, and five segments of the dorsalis pedis were opacified with contrast; however, Doppler could not detect blood flow in any of these segments. In patients with femoropopliteal blockage, it was difficult to localize the reformation of the intrahospital vessels due to the presence of numerous collateral vessels in the leg. Even though the primary arteries are accompanied by venae commutants instead of collaterals, tracing them proved to be somewhat tough [22-24].

Doppler might still pick up on intrahospital arteries that weren't made opaque by contrast. In three individuals who had proximal significant stenosis, Doppler revealed monophasic flow but no contrast opacification in the infrapopliteal arteries. This could be because the opacification of the crural vessels varies in CT angiography or because there is no opacification farther away from an obstruction28. The results imply that using Doppler in conjunction with CT angiography can decrease the occurrence of false positive occlusions [23-25].

Color Doppler imaging has shown mixed results in terms of sensitivity and specificity in earlier research. This study proved that Doppler offers numerous advantages over CT angiography. There is some doubt about the diagnostic utility of CT angiography in situations when there are substantial calcifications in the vessel, as it tends to overstate the lesion. By revealing that the calcific plaque, which seems to have caused more than 50% stenosis, has not really produced a hemodynamically significant stenosis, Doppler proves that MDCT is overstating the problem. Doppler can reveal blood flow through the infrapopliteal arteries when CT is unable to identify opacification with contrast owing to proximal severe stenosis [24-27].

Conclusion

Nobody should be surprised if it wrongly labels an entire limb as "normal," blocking the patient from getting the follow-up treatment they need. Patients with little symptoms may be able to avoid costly and needless diagnostic tests with the use of Duplex Ultrasound, thanks to its high negative predictive value. Using MDCT angiography in conjunction with Duplex Ultrasound improves its diagnostic accuracy. Because of its great diagnostic accuracy, low cost, lack of invasiveness, wide availability, and lack of danger, duplex ultrasound is an essential tool for studying peripheral vascular disease.

Conflict of Interest

None

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Nil

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