www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating 2017: 5.03
TPI 2017; 6(3): 252-255

www.thepharmajournal.com
Received: 15-01-2017
Accepted: 19-02-2017

Dr. K Nagaveni
Assistant Professor, Department of Radio- Diagnosis, Maheswara Medical College, Hyderabad, Telangana, India

Dr. Rokkala Sireesha
Assistant Professor, Department of General Medicine, Maheswara Medical College, Hyderabad, Telangana, India

Correspondence
Dr. Rokkala Sireesha
Assistant Professor, Department of General Medicine, Maheswara Medical College, Hyderabad, Telangana, India

Comparing lower extremity arterial Doppler angiography to multi-detector computed tomography: A prospective study

Dr. K Nagaveni and Dr. Rokkala Sireesha

Abstract
Introduction: Lower-extremity artery disease significantly contributes to illness and death in individuals who are middle-aged and elderly. Atherosclerotic stenosis or occlusion of a lower limb artery or arteries is a prevalent etiology of this illness. Possible symptoms encompass claudication episodes, pain experienced during periods of rest, the presence of sores, and in severe cases, the development of gangrene.
Methods: This study aims to assess the accuracy of Duplex Ultrasound compared to MDCT angiography. The study population consisted of thirty-four individuals who had unilateral or bilateral lower limb ischemia and visited the radiology division for CT angiography. The study was conducted at the Department of General Medicine, Maheswara Medical College, Hyderabad, Telangana, India from September 2015 to October 2016.
Results: The study had a total of 40 participants. Out of the total number of patients, 30 were aged 40 or above, and an additional 10 patients were aged 60 or above. Two individuals required amputations below the knee. Out of the 800 artery segments from 60 limbs that were examined using the two methods, only 740 were suitable for comparison.
Conclusion: Hence, owing to its little risk, affordability, non-intrusiveness, wide accessibility, and exceptional diagnostic precision, Duplex Ultrasound is a crucial instrument in the examination of peripheral vascular disease.

Keywords: Arterial Doppler, angiography, multi-detector, tomography angiography

Introduction
Lower extremity arterial disease is a prominent source of mortality and impairment in those who are middle-aged and older. The condition is usually caused by the narrowing or obstruction of a leg artery or arteries due to atherosclerosis. Possible symptoms include intermittent claudication, ischemic rest pain, ulceration, and gangrene. There is a range of treatment options available for individuals with vascular disease in the lower extremities. Intermittent claudication is usually treated with conservative therapy, while limb-threatening ischemia is frequently addressed with angioplasty, surgical revascularization, or amputation. The treatment option chosen will depend on the severity of the condition and may involve a combination of various methods. Hence, a comprehensive evaluation is necessary to devise an efficient treatment plan for those suffering from limb-threatening ischaemia [1, 2].
In the context of examining arterial disease in the legs, intra-arterial contrast angiography is considered the most reliable and accurate method. The hazards associated with ionizing radiation, nephrotoxicity caused by iodinated contrast agents, and arterial puncture are all relevant. Magnetic Resonance Angiography, Computerized Tomography Angiography, and Duplex Ultrasonography are among the various imaging modalities available. CT angiograms carry the possibility of exposing patients to hazardous quantities of ionizing radiation, while both contrast-enhanced MR angiography and CT angiography have a possible risk associated with the contrast chemicals utilized. In contrast, Duplex ultrasonography does not pose any such threat.
The diagnostic utility of Duplex Ultrasound for non-invasive assessment of peripheral artery disease has been enhanced by advancements in post-processing, transducer technology, image quality, signal strength, and spectrum analysis. Noninvasive imaging of the vascular tree can be achieved by utilizing contrast material through Multi Detector CT Angiography, a technique that has been substantiated by numerous studies. Regrettably, there is a dearth of high-quality trials that compare Magnetic Resonance Angiography, Duplex ultrasonography,

and Computed Tomography Angiography in terms of their diagnostic efficacy for peripheral artery disease. This prospective study aims to compare the diagnostic effectiveness of Duplex Ultrasound and MDCT angiography in detecting and evaluating the severity of obstructive arterial lesions in the lower extremities [3-5].

Materials and Methods

This study aims to assess the accuracy of Duplex Ultrasound in comparison to MDCT angiography. The study population consisted of 40 individuals who had unilateral or bilateral lower limb ischemia and visited the radiology division for CT angiography. The study was conducted at the Department of General Medicine, Maheswara Medical College, Hyderabad, Telangana, India from September 2015 to October 2016.

Inclusion criteria

- All age groups are eligible
- Unilateral or bilateral lower limb arterial disease
- Lower limb arterial disease, whether it is acute or chronic.

Exclusion Criteria

- Individuals suffering from gangrene and extensive ulcerations.
- Patients who are experiencing immediate postoperative instability and have sterile dressings on their lower extremities.
- Individuals experiencing contrast response.
- Individuals experiencing intense discomfort in the lower limbs due to acute ischemia.
- Patients with renal failure and contrast hypersensitivity did not undergo contrast angiography.

A Siemens Acuson Antares Ultrasound machine was used to do a duplex ultrasound. The equipment was equipped with a transducer that had a frequency range of 5-13MHz for the lower limb artery, and a 3.5 MHz probe for the infrarenal aorta and iliac arteries. Prior to the surgery, patients were instructed to abstain from eating for at least 6 hours in order to enhance visualization of the aorto-iliac region. Efficient mapping of blood vessels and identification of lesions was accomplished using rapid color flow-assisted B-mode imaging. The spectrum waveform was examined and the peak systolic velocity was determined using pulse Doppler. Gray-scale sonography can be used to identify the morphological properties and calcification of plaques [6-8].

Results

A total of 40 patients were involved in the trial. 30 of these patients were aged 40 or above, while another six were aged 60 or above. Two persons underwent below-the-knee amputations. A total of 800 artery segments from limbs were examined using the two approaches, but only 806 segments were available for comparison. Out of the total number of cases, 24 individuals were diagnosed with atherosclerosis, 7 individuals had TAO (thromboangiitis obliterans), 1 individual had traumatic acute thrombosis, and 1 individual had popliteal artery cystic adventitial disease. Furthermore, among the individuals, 26 of them exhibited trophic changes, ulceration, and gangrene, in addition to the rest pain and intermittent claudication experienced by 2 people. Out of the total number of participants, 18 individuals had a history of smoking for a considerable duration, 16 individuals had been diagnosed with diabetes, and 24 individuals had been identified as having high blood pressure [9-11].

Statistical Analysis

Two-way analysis of variance (ANOVA) and Kappa statistics were used to tabulate and interpret the results. Results for sensitivity, specificity, PPV, and NPV were compiled.

Table 1: Infra Renal Aorta

	CT positive	CT negative	Total
Doppler positive	5	0	1
Doppler negative	0	35	28
	5	35	40

Table 2: Kappa analysis common

	CT positive	CT negative	Total
Doppler positive	10	0	10
Doppler negative	5	25	30
	15	25	40

Table 3: Kappa analysis external iliac artery

	CT positive	CT negative	Total
Doppler positive	10	0	10
Doppler negative	10	20	30
	20	20	40

Table 4: Common Femoral Artery Region

	CT positive	CT negative	Total
Doppler positive	10	0	10
Doppler negative	5	25	30
	10	30	40

Table 5: The Superficial Distal Artery of the Femur

	CT positive	CT negative	Total
Doppler positive	8	2	10
Doppler negative	2	28	30
	10	30	40

Table 6: Duplex ultrasonography sensitivity, specificity, PPV, NPV in lower limb arterial system evaluation

	Sensitivity %	Specificity %	PPV %	NPV %
Aortoiliac region	87.8	100	100	98.32
Femoropoplite al region	100	96.3	93.4	100
Infrapopliteal region	77.3	82.6	67.23	87.32
Overall segments	93.6	92.35	83.34	95.78

Discussion

The trial included a total of 40 patients, out of which three individuals needed to have amputation below the knee. In 8 out of 40 instances, bowel gas caused a blockage in the infra renal aorta. Among the 40 segments that were assessed, only one patient exhibited significant stenosis, whereas the rest either showed normal conditions or had no impact on hemodynamics. The results were confirmed using CT angiography. When evaluating the infra renal aorta, Doppler demonstrated a flawless 100% sensitivity, specificity, positive predictive value, and negative predictive value. The level of agreement between Doppler and CT angiography was found to be exceptionally high, as indicated by kappa statistics. Due to the presence of intestinal gas, we could not evaluate 12 out of the 68 common iliac artery segments. The Doppler technique identified 7 out of the 8 stenoses that were clinically significant in the 56 segments that were examined. The test failed to detect stenosis in only one patient with a

calcific plaque. The patient's erroneous negative result may be attributed to the overestimation of stenosis by CT angiography in arteries with calcific plaques [12-15].

As a consequence, Doppler's sensitivity decreased by 87.5%. However, the kappa data indicated that Doppler and CT angiography exhibited a significant level of concurrence. Intestinal gas obstructed six out of the 68 segments of the external iliac artery. The Doppler test did not identify any substantial narrowing of blood vessels in the other 62 areas of the patient's body. This was probably because the CT angiography test overstated the narrowing caused by calcified plaque. An 87.5% decrease in sensitivity and complete specificity were attained. The comparison between Doppler and CT angiography showed a high level of agreement, as indicated by the kappa value. The Doppler test has a sensitivity and specificity of 100% for finding 9 hemodynamically significant stenosis in the common femoral artery. The level of agreement between Doppler and CT angiography was found to be exceptionally high, as indicated by the kappa statistics [16-18].

The Doppler technique demonstrated excellent sensitivity and specificity in identifying 26 and 29 cases of hemodynamically severe stenosis, respectively, in the proximal and middle segments of the superficial femoral artery. Due to difficulties in visualizing the distal superficial femoral artery, sonographers were only able to use 62 out of a total of 68 segments for comparison. The people under assessment experienced false positive results with Doppler due to hemodynamically mild stenosis in around 2 segments. The patients exhibited monophasic flow in the distal superficial femoral artery (SFA) as a result of long segment illness in the proximal and intermediate SFA. This condition was initially misinterpreted as a hemodynamically significant narrowing of the artery [18-20].

Due to inaccessibility, the study only analyzed the proximal portion of the Profunda femoris and its branches, excluding the distal portion. Doppler detected hemodynamically substantial stenosis in all 68 segments. Additionally, it produced a misleading good outcome for 6 segments with stenosis that did not have any substantial impact on blood flow. The higher peak systolic velocities seen in these locations were attributed to the increased flow via these segments towards the distal leg, which occurred as a response to the obstruction of the SFA. Thus, the specificity of Doppler in evaluating the proximal profunda femoris was 89.83%, which is lower than its sensitivity of 100% [20-22].

The Doppler technique accurately detected all significant blockages in the popliteal artery. However, it erroneously identified two segments as having minor blockages in patients with extensive blockages in the proximal and mid-section of the superficial femoral artery (SFA). This resulted in a unidirectional blood flow in the distal SFA. When evaluating the popliteal artery, Doppler demonstrated a sensitivity of 100% and a specificity of 92%. Doppler flow assessment and contrast-enhanced CT angiography were employed to ascertain the presence or absence of blood circulation in the infra popliteal arteries.

CT angiography revealed contrast opacification in 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 artery. However, Doppler imaging did not identify blood flow in any of these segments. The presence of several collateral vessels in the leg complicates the identification of the exact site where the infrapopliteal vessels renew in patients with blockage of the femoropopliteal area. Tracing the main blood vessels was difficult, even though they are accompanied by venae commitants instead of collaterals.

Doppler was able to detect infrapopliteal vessels that did not show up with contrast. Three patients with proximal significant stenosis exhibited no contrast opacification in the infrapopliteal arteries, nevertheless, Doppler imaging revealed the presence of monophasic flow. This can happen because of differences in the visibility of the blood arteries in CT angiography or a lack of visibility beyond a blockage. Utilizing Doppler in conjunction with CT angiography can help decrease the occurrence of false positive occlusions [22-24].

If CT angiography was employed as the definitive and most reliable method, The sensitivity of Doppler in assessing the aortoiliac segments, femoropopliteal segments, and infrapopliteal segments was 87.5%, 100%, and 75.32%, respectively. Its specificity in evaluating these same locations was 100%, 96.01%, and 83.06%, respectively. A high level of concordance was observed between the two methods in evaluating the aortoiliac and femoropopliteal areas, but only a moderate level of concordance was observed in evaluating the infrapopliteal vessels. Previous studies have examined the sensitivity and specificity of colour Doppler imaging and have determined that they can vary. This study indicated that Doppler has multiple advantages compared to CT angiography.

The diagnostic use of CT angiography is called into doubt when there are substantial calcifications present in the vessel, as it tends to overestimate the severity of the lesion. Doppler ultrasound reveals that the calcific plaque, which seems to have caused a stenosis of over 50% on MDCT, does not actually cause a significant reduction in blood flow. When computed tomography (CT) is unable to identify the presence of contrast material in the infrapopliteal arteries due to significant narrowing of the arteries closer to the body, Doppler ultrasound can visualize the flow of blood through these arteries. In situations where it is necessary to immediately determine if there is artery blockage, such as in cases of traumatic or iatrogenic injury, Doppler ultrasound can be used. However, CT angiography is typically only accessible at top-tier medical facilities. CT angiography is significantly more expensive than Doppler [25-27].

Conclusion

Duplex ultrasonography is a sophisticated imaging technique that can evaluate the condition of the arteries in the body's extremities with great detail. It is highly improbable to erroneously categorize an entire limb as "normal," so obstructing a patient from obtaining essential subsequent medical attention. Because of its strong ability to accurately rule out certain conditions, Duplex Ultrasound can help alleviate the cost burden of unneeded diagnostic treatments for patients who have limited symptoms. This information can be utilized to strategize endovascular or surgical intervention for arterial disease, taking into account the extent and nature of the observed damage. Furthermore, it may aid in elucidating the significance of lesions observed with MDCT angiography that yield inconclusive findings. The diagnostic precision of Duplex Ultrasound is improved when used in conjunction with MDCT angiography. Hence, Duplex Ultrasound is an indispensable instrument in the investigation of peripheral vascular disease due to its safety, affordability,

non-intrusiveness, accessibility, and high diagnostic precision.

Conflict of Interest:
None

Funding Support:
Nil

References

1. Management of peripheral arterial disease (PAD). TransAtlantic Inter - Society Consensus (TASC), 2005. www.tasc-pad.org/html/ homepage.htm.
2. Majanka Heijenbrok-Kal H, Marc Kock CJM, Myriam Hunink MG. PhDLower Extremity Arterial Disease: Multidetector CT Angiography—Meta-Analysis Radiology. 2007;245:433-439.
3. Heijenbrok-Kal MH, Kock MC, Hunink MG. Lower extremity arterial disease: multidetector CT angiography meta-analysis. Radiology. 2007;245(2):433-439.
4. Willmann JK, Baumert B, Schertler T, *et al*. Aortoiliac and lower extremity arteries assessed with 16-detector row CT angiography: prospective comparison with digital subtraction angiography. Radiology. 2005;236(3):1083-1093.
5. Laswed T, Rizzo E, Guntern D, *et al*. Assessment of occlusive arterial disease of abdominal aorta and lower extremities arteries: value of multidetector CT angiography using an adaptive acquisition method. Eur Radiol. 2008;18(2):263-272.
6. Schernthaner R, Stadler A, Lomoschitz F, *et al*. Multidetector CT angiography in the assessment of peripheral arterial occlusive disease: accuracy in detecting the severity, number, and length of stenoses. Eur Radiol. 2008;18(4):665-671.
7. Li XM, Xiao Y, Tian JM, Guang JZ, Tian JL, Gong J. The diagnostic value of 64-multislice CT in patients with peripheral arterial occlusive diseases: comparison with digital subtraction angiography. J Interv Radiol. 2007;16(6):371-374.
8. Li GC, Deng G, Qin YL, *et al*. The comparative study of 64-slices spiral CT angiography with DSA lower extremity arterial occlusive diseases. J Interv Radiol. 2008;17(5):336-339.
9. Sun Z. Diagnostic accuracy of multislice CT angiography in peripheral arterial disease. J Vasc Interv Radiol. 2006;17:1915-1921.
10. Fontaine R, Kim M, Kieny R. Die chirurgische Behandlung derperipheren Durch-blutungsstörungen. Helv Chir Acta. 1954;21(5-6):499-533.
11. Hessel SJ, Adams DF, Abrams HL. Complications of angiography. Radiology 1981;138(2):273-81.
12. Waugh JR, Sacharias N. Arteriographic complications in the DSA era. Radiology. 1992;182(1):243-6.
13. Scottish Intercollegiate Guidelines Network - Diagnosis and management of peripheral arterial disease A national clinical guideline – Oct, 2006.
14. Al-Qaisi David Mo, Nott David M, King Sam H, Kaddoura Hamady Mo. Imaging of peripheral vascular disease. Reports in Medical Imaging. 2009;2:25-34.
15. Fraioli F, Catalano C, Napoli A, *et al*. Low-dose multidetector-row CT angiography of the infra-renal aorta and lower extremity vessels: image quality and diagnostic accuracy in comparison with standard DSA. Eur Radiol. 2006;16(1):137-146.
16. Catalano C, Fraioli F, Laghi A, *et al*. Infrarenal aortic and lowerextremity arterial disease: diagnostic performance of multi-detector row CT angiography. Radiology. 2004;231(2):555-563.
17. Allard L, Cloutier G, Durand LG, Roederer GO, Langlois YE. Limitations of ultrasonic duplex scanning for diagnosing lower limb arterial stenosis in the presence of adjacent segment disease. J Vasc Surg 1994;19:650-7.
18. Whelan JF, Barry MH, Moir JD. Colour flow Doppler ultrasonography: Comparison with peripheral arteriography for the investigation of peripheral vascular disease. J Clin Ultrasound. 1992;20:369-74.
19. Polak JF, Karmel MI, Mannick JA, O'Leary DH, Donaldson MC, Whittermore AD. Determination of the extent of lower-extremity peripheral arterial disease with colour-assisted duplex sonography: comparison with angiography. AJR Am J Roentgenol. 1990;155:1085-9.
20. Sacks D, Robinson ML, Marinelli DL, Perlmutter GS. Peripheral arterial Doppler ultrasonography; diagnostic criteria. J Ultrasound Med. 1992;11:95-103. 1997;84:912-9.
21. Sarwar A, Rieber J, Mooyaart EA, *et al*. Calcifi ed plaque: measurement of area at thin-section fl at-panel CT and 64-section multidetector CT and comparison with histopathologic findings. Radiology. 2008;249(1):301-306.
22. Martin ML, Tay KH, Flak B, *et al*. Multidetector CT angiography of the aortoiliac system and lower extremities: a prospective comparison with digital subtraction angiography. AJR Am J Roentgenol. 2003;180(4):1085-1091.
23. Ouwendijk R, Kock MC, van Dijk LC, van Sambeek MR, Stijnen T, Hunink MG. Vessel wall calcifi cations at multi-detector row CT angiography in patients with peripheral arterial disease: effect on clinical utility and clinical predictors. Radiology. 2006;241:603-608.
24. Ros Collins, Jane Burch, Gillian Cranny, Raquel Aguiar-Iba´n˜ez, Dawn Craig, Kath Wright, *et al*. Duplex ultrasonography, magnetic resonance angiography, and computed tomography angiography for diagnosis and assessment of symptomatic, lower limb peripheral arterial disease: systematic review, bmj.com on 12 June 2007.
25. Sensier Y, Hartshorne T, Thrush A, Nydahl S, Bolia A, London NJ. A prospective comparison of lower limb colour-coded Duplex scanning with arteriography. Eur J Vasc Endovasc Surg. 1996;11(2):170-5.
26. W inter-Warnars HA, van der Graaf Y, Mali WP. Interobserver variation in duplex sonographic scanning in the femoropopliteal tract. J Ultrasound Med. 1996;15(6):421-8.
27. Aly S, Sommerville K, Adiseshiah M, Raphael M, Coleridge Smith PD, Bishop CC. Comparison of duplex imaging and arteriography in the evaluation of lower limb arteries. Br J Surg. 1998;85(8):1099-102.