International Journal of Radiology and Diagnostic Imaging

E-ISSN: 2664-4444
P-ISSN: 2664-4436
www.radiologypaper.com
IJRDI 2021; 4(2): 83-85
Received: 04-07-2019
Accepted: 19-08-2019

Dr. Mahendra Shrestha
Associate Professor, Department of Radiology, Vedanta Institute of Medical Science, Dahanu, Palghar, Maharashtra, India

Dr. Partha Pratim Som
Associate Professor, Department of Radiology, Shri Ramkrishna Institute of Medical Sciences and Sanaka Hospital, Durgapur, West Bengal, India

Corresponding Author:
Dr. Mahendra Shrestha
Associate Professor, Department of Radiology, Vedanta Institute of Medical Science, Dahanu, Palghar, Maharashtra, India

Comparative evaluation of color Doppler and conventional digital subtraction angiography in arterial disease

Dr. Mahendra Shrestha and Dr. Partha Pratim Som

DOI: http://dx.doi.org/10.33545/26644436.2021.v4.i2b.201

Abstract
Introduction: Peripheral Arterial Occlusive Disease (PAOD) leads to narrowing and hardening of arteries which leads to increased risk of lower extremity amputation. Hence, the accuracy of non-invasive diagnostic methods such as Color Doppler (CD) needs to be assessed in comparison to the conventional digital subtraction angiography (CDSA).
Objective: To compare color Doppler and conventional digital subtraction arteriography in patients of infragenicular arterial disease. To evaluate and correlate the findings of CD with arteriography as the gold standard, in PAOD of the lower extremities in supra-genicular part and to define whether color Doppler, is an alternative or an adjunct to DSA.
Methods: In this study 60 patients suspected of lower limb PAD aged between 40 and 70 years were included. All these patients with symptoms suggestive of PAOD underwent color Doppler study of lower limb arterial system. Afterward, 55 patients of PAOD formed the subjects and their affected lower limbs evaluated by CD and arteriography, for localization and grading of lesion in the arteries, into normal/insignificant stenosis and occlusion. The sensitivity, specificity, and positive and negative predictive values of CD as compared to CDSA in arterial disease were calculated. Results were analyzed by two way contingency tables, using calculator, and SSP software.
Results: As compared to conventional digital subtraction angiography, Doppler assessment was more sensitive specific with greater diagnostic accuracy.
Conclusion: CD is better than conventional digital subtraction angiography in diagnosis of Grade 1 &2 cases, with better assessment of soft plaques, segmental flow and recanalization in PAD and CD performed well compared with conventional digital subtraction angiography. Hence color Doppler can be an alternative to conventional digital subtraction angiography in diagnosing peripheral arterial occlusive diseases in supragenicular part of lower limb arteries.

Keywords: Digital subtraction angiography, color Doppler, peripheral arterial occlusive disease

Introduction
Peripheral Arterial (PAD) is one of the most common causes of limb pain, especially in elderly patients and in which plaque builds up in the distal arteries, constricting circulation and blood flow [1]. PAD has also been referred to previously as peripheral vascular disease or peripheral artery occlusive disease. Lower-extremity PAD refers to atherosclerosis of arteries distal to the aortic bifurcation and most commonly occurs in the legs [2]. The term PAD is also used more broadly to encompass a larger range of non-coronary arterial diseases or syndromes that are caused by the altered structure or function of arteries to the brain, visceral organs, and limbs [3].
The occurrence of peripheral arterial disease increases with age. Population studies have found that about 20% of people aged over 60 years have some degree of peripheral arterial disease. Extent is also high in people who smoke, people with people with coronary artery disease and diabetes. Most common risk factors for peripheral vascular disease are age >50 years, diabetes, smoking and bad cholesterol (Gupta, 2015). Diagnosis of peripheral arterial disease is based on history, physical examination, and various diagnostic tool [1, 2]. Today, there are different diagnostic methods available for determining the degree of PAD and evaluation of the severity of the PAD, such as Color Doppler (CD) ultrasound examination, computed tomography angiography (CT angiography), magnetic resonance angiography (MRA) and digital subtraction angiography (DSA).

The choice of diagnostic method depends on the indication and availability of these methods in the hospital.

Conventional angiography is the gold standard study for PAD diagnosis while other modalities such as duplex ultrasound, MRI angiography, and CT angiography provide great anatomical details and thus useful in interventions [5]. Duplex ultrasound (DUS) is a noninvasive technique for evaluation of vascular disease. DUS is frequently used to quantify arterial disease, particularly in the lower limb arteries. The severity and length of arterial lesions can be measured, and DUS provides anatomical and physiological information about the arterial segment [6, 7]. In many institutions, DUS is the basis for planning lower limb revascularization procedures. Within controlled studies and clinical trials, excellent agreement between DUS and digital subtraction angiography (DSA) has been reported. Furthermore, DUS is a commonly applied tool to quantify restenosis after percutaneous peripheral interventions and tends to replace follow-up angiography for study purposes. On the other hand, today color Doppler is used as an initial diagnostic method since it is readily available, cost-effective, and non-invasive [6]. CD is a good modality for assessment of supragenicular arterial system, however infragenicular arteries are many times cannot be examined properly because of their deeper position. Patient suffering from infragenicular peripheral arterial occlusive disease is not an uncommon clinical scenario. In our setup Buergers Disease and Atherosclerotic disease are the most common cause of arterial insufficiency, particularly in middle aged smokers of low socioeconomic status apart from vasculitis, thromboembolism and trauma.

Aim of the study was to compare the efficacy of color Doppler sonography and conventional digital subtraction angiography as recent, non or minimally invasive techniques for investigating the lower limb arterial disease [8].

Material and Method

This study conducted on 60 patients suspected of lower limb peripheral arterial disease for a period of 18 months on patients aged between 30 and 70 years with normal kidney function and symptoms suggestive of PAD such as pain, fatigue, burning, or discomfort in the muscles (feet, calves, or thighs), dark or blue looking skin of legs, non-healing sores, low or absent pulse of leg, withered or atrophied calf muscles, loss of hair over lower limbs, and painful non-bleeding sores of toe or toes. Those patients who with deranged kidney function test, allergic to contrast and an active skin infection over lower limb were excluded from the study [4].

In all patients color Doppler sonography and multi-detector CT angiography was performed and comparison was undertaken.

The following patients were kept out from the study

- Patients having blood dyscrasias/diasthesis.
- Pregnant patients.
- Patients sensitive to contrast agents used for angiography.
- Patients with history of previous vascular surgery or endovascular procedure.
- Mentally retarded and uncooperative psychiatric patients.

The collected data was analyzed with the aid of calculator and SPSS software.

Results and Discussion

Age & Sex Distribution

This study included 60 patients (36 males and 24 females). The age range was of 30–70 years (Mean age = 52 years). We have classified patients based on the risk factors (Table 1) and according to site of complaint (Table 2). We observed that males were affected more commonly than females. Most common risk factor for the PAD was smoking (80%), diabetes (75%) and hyperlipidaemia (60%). These risk factors are well known and previously reported for the PAD [9]. The main presenting symptoms of cases were intermittent lameness and rest pain. 50% patients had complaints in left lower limb and 25% in right lower limb. 22% had bilateral lower limb pain which was more on the left side (12%). Right limb was involved more than left limb followed by bilateral limb. Most of the lesions involved superficial femoral artery, followed by popliteal and more so on right side.

Table 1: Case distribution according to risk factors

Risk Factors	No. of Patients	Percentage of cases
Smoking	32	80
Diabetes mellitus	30	75
Peripheral neuropathy	12	30
Hyperlipidemia	24	60
Renal disease	5	12.5
Cardiac disease	12	30

Table 2: Case Distribution according to site of complaint

Site of Patient's Complaint	Number of Patients	% of Patients
Right lower limb	10	25
Left lower limb	20	50
Bilateral lower limb (more on the right)	4	10
Bilateral lower limb (more on the left)	5	12
Abdominal pain	1	3

Case Distribution according to site of complaint

In aorta-iliac region we have scanned infra-renal aorta and common iliac artery using these two techniques. CDUSG has a higher incidence of detection of Grade 1 and 2 disease. In Grade 3 & 4 disease almost, similar values were obtained. In femoral region we have scanned common, superficial, and deep femoral artery. CDUSG has a higher no. of case detection in Grade 1 disease. With CT ANGIO we have detected 2 extra cases of Grade 3 severity. Both techniques were effective in detecting Grade 4 disease at a similar detection rate. In tibio-peronial region, in Grade 1 and 2 disease a higher no. of cases were detected by CDUSG. In Grade 3 disease there was a marginal increase in cases detected by CT ANGIO.

Table 3: Case distribution in Aorto-iliac region, femoral and tibial region

	Grade	0	1	2	3	4
Aorta-Iliac region	**Infra-renal aorta**					
	CD USG	42	5	4	1	0
	CT Angiography	45	2	2	1	0
	Common Iliac artery					
	CD USG	38	6	5	1	0
	CT Angiography	39	2	3	1	0
Aorta-Iliac region	**Common femoral artery**					
	CD USG	34	7	5	1	1
	CT Angiography	36	3	4	3	1
	Superficial femoral artery					
	CD USG	35	5	5	2	1
	CT Angiography	37	1	3	4	1
	Deep femoral artery					
	CD USG	39	6	3	1	2
	CT Angiography	43	2	2	3	2
Tibial region	**Tibio Peronial Trunk**					
	CD USG	31	4	3	1	0
	CT Angiography	35	1	1	1	0
	Peroneal artery					
	CD USG	29	5	5	1	0
	CT Angiography	34	2	3	1	0

There was a higher sensitivity of CDUSG in diagnosing Grade 1 and 2 cases. Interestingly, CT ANGIO was highly sensitive in detecting Grade 0 disease. This suggest that CT ANGIO can be an additional indirect pointer towards a lesser sensitivity of CT ANGIO in detecting Grade 1 disease. In some cases, CT ANGIO was effective in detecting grade 3 disease and proved to be marginally better. On the other hand, it was comparable with CDUSG in sensitivity to detect Grade 4 cases.

The ultrasound findings provide information on the extent and severity of the disease, soft tissue plaques, thrombosis, Segmental flow analysis, Segmental length analysis, Collateral circulation, Recanalization, Pre & post-operative flow evaluation. With the advent of USG contrast agents (HIGH COST!!) it is now possible to have a better flow assessment in complicated cases complicated cases with the advantage of no radiation exposure and allergic reactions in comparison to CT Angiography [10].

The few limitations for CDUSG need to consider such as operator dependency, time consumption, oedema, bowel gas and obesity as compared to CT angiography which is minimally invasive (need only an intravenous injection of contrast medium but also involves radiation exposure) and an inherent risk of allergic reactions [11].

Conclusion

After preliminary physical examination CDUSG is mostly indicated for initial diagnostic modality as a cost effective, noninvasive modality with a good clinical impact. On the other hand, CT Angiography is useful approach for segmental length assessment, collateral circulation along with providing a road-map reproduction of the arterial system. CDUSG is better than CT angiography for detecting early grade of disease (Grade 1 and 2).

References

1. Hiatt WR, Goldstone J, Smith SC Jr, *et al*. Atherosclerotic Peripheral Vascular Disease Symposium II: nomenclature for vascular diseases. Circulation 2008;118(25):2826–9.
2. Chinmay P, Parthiv B, Chandra Raychaudhuri, *et al*. Efficacy of color doppler imaging over CT angiography in peripheral arterial disease. J Integr Health Sci, 2017, 5(1).
3. Cooke JP, Chen Z. A Compendium on Peripheral Arterial Disease. Circ Res 2015;116(9):1505–1508.
4. Yadav V, Khanduri S, Yadav P, *et al*. Diagnostic Accuracy of Color Doppler and Calcium Scoring versus Dual-Energy Computed Tomography Angiography in the Assessment of Peripheral Arterial Diseases of Lower Limb. J Clin Imaging Sci, 2020, 10(45).
5. Willner S. The Role of Imaging in Peripheral Arterial Disease. Peripheral Arterial Disease - A Practical Approach, Nishtha Sareen and Abhishek Ojha, Intech Open, DOI: 10.5772/intechopen.75675.
6. Rustempasic N, Gengo M. Assesment of Carotid Stenosis with CT Angiography and Color Doppler Ultrasonography. Med Arch. 2019;73(5): 321–325.
7. Begelman SM, Jaff MR. Noninvasive diagnostic strategies for peripheral arterial disease. Cleve Clin J Med 2006;73(4):S22-9.
8. Rooke TW, Hirsch AT, Misra S, Sidawy AN, Beckman JA, Findeiss LK, *et al*. 2011 ACCF/AHA focused update of the guideline for the management of patients with peripheral artery disease (updating the 2005 guideline): a report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines. J Am Coll Cardiol 2011;58(19):2020–45.
9. Song P, Rudan D, Zhu Y, Fowkes FJ, Rahimi K, Gerald F, *et al*. Global, regional, and national prevalence and risk factors for peripheral artery disease in 2015: an updated systematic review and analysis. Lancet Glob Health 2019;7(8):e1020-e1030.
10. Hyodo T, Kumano S, Kushihata H, Okada M, Hirata M, Tsuda T, *et al*. CT and MR cholangiography: advantages and pitfalls in perioperative evaluation of biliary tree. Br J Radiol 2012;85(1015):887–896.
11. Mohler E III, Giri J. Management of peripheral arterial disease patients: comparing the ACC/AHA and TASC-II guidelines. Curr Med Res Opin 2008;24(9):2509–22.