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"EVALUATION OF COMPUTED TOMOGRAPHY ANGIOGRAPHY IN DIAGNOSING PERIPHERAL VASCULAR DISEASE ACROSS DIFFERENT AGE GROUPS"

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Abstract

Background:
Peripheral vascular disease is a widespread condition affecting blood flow, with significant diagnostic and management implications. Computed Tomography Angiography are key imaging modality used to assess Peripheral vascular disease, each with specific strengths and limitations.

Objective:
To evaluate the diagnostic efficacy of Computed Tomography Angiography in identifying Peripheral Vascular Disease across different age groups, with consideration of its clinical applications and limitations.

Methodology:
A cross-sectional study was conducted involving 50 participants divided into pediatric, adult, and elderly groups. Stratified random sampling was employed. Data on vascular conditions were collected using CTA. Analysis included comparative sensitivity and specificity, statistical evaluations using Chi-square tests, and subgroup assessments.

Results:
The study involved 50 participants, with the majority being elderly (42%) and the most common primary complaint being rest pain (50%). Smoking (30%) was the most prevalent comorbidity, followed by obesity (22%). A total of 34% of participants had a history of peripheral vascular disease (PVD). Statistical analysis revealed significant improvements in blood flow velocity ($p = 0.006$) and computed tomography (CT) findings ($p = 0.000$) when comparing age groups and clinical evaluations.

Conclusion:
CTA provides unmatched anatomical clarity in advanced cases, making it indispensable for preoperative planning and in challenging clinical scenarios. Optimized protocols are recommended to enhance patient safety and diagnostic yield.

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INTRODUCTION

Peripheral vascular disease (PVD) is a general term for a set of diseases that affect blood circulation in the vessels which are situated outside the heart and brain and usually the limbs. It is a worldwide health problem and its prevalence rises significantly with age. In the elderly, PVD is most commonly a result of atherosclerotic changes in the peripheral arteries; in the young, vasculitis, trauma, and hereditary diseases are more frequent. The complications of PVD that is either not diagnosed or not adequately treated can therefore include; pain, inability to use the affected limb, critical limb ischemia and amputation. It is therefore important to diagnose the condition early and correctly in order to enhance treatment outcomes and patient's quality of life (1).

PVD is a common condition and is estimated to affect millions of people around the world. Based on the WHO, it is estimated that more than 200 million people have PAD which is the most prevalent type of PVD. Although the incidence rises in old age, young people are also affected; those with a hereditary risk or those who engage in dangerous practices such as smoking. Other risk factors are diabetes mellitus, hypertension, hyperlipidemia and obesity because they result in generalized vascular disease (2).

PVD has major health care, economic and social implications including cost attributable to medical intervention, morbidity and disability. These findings reflect the tough situation in the developing countries where such sophisticated equipment is scarce and diseases loaded are heavier (3).

CTA became a revolutionary diagnostic technique as multi detector CT scanners came into medical practice in the 1990s. CTA is a technique that consists of presenting high-resolution images of vessels after the intravenous injection of iodinated contrast agents to create three-dimensional images (4). This makes it very useful in assessing stenosis, occlusion, aneurysm and arterial dissection. New developments including the use of dual energy CT and use of Iterative reconstruction has improved the sensitivity and specificity of CTA in diagnosing various diseases with minimal radiation dose and improved picture quality (5).

Computed tomography angiography (CTA) is an advanced technique of producing cross-sectional images of vessels in the body. It uses CT scan with the use of iodinated contrast agents to produce a 3D imaging of the blood vessels. This functionality makes CTA very useful in the diagnosis of peripheral vascular disease where detailed anatomical information is of paramount importance in the identification of stenosis, occlusions and aneurysms as well as embolic events (6).

Another major advantage is that CTA can assess both the superficial and deep vasculature, providing more objective information than US that is more operator dependent. Morphological and functional information can be obtained using MDCT and dual-energy CT, which help to eliminate artefacts from calcifications or overlapping structures and make CTA most effective in challenging cases. CTA is not only a diagnostic modality, but is also essential in surgical and intervention planning due to the precise depiction of the vascular structures (7).

PVD is also different in appearance in different age brackets due to different physiology of the peripheral vasculature, the theory of disease progression and other related diseases. To increase the diagnostic yield and safety, manage and treat PVD effectively, these differences must be considered when developing diagnostic strategies. Doppler ultrasound (DUS) and computed tomography angiography (CTA) are two of the most important imaging procedures in the diagnostic work-up, and the choice of imaging modality depends on the patient's age and clinical presentation (8).

PVD is relatively rare in childhood but can be associated with congenital abnormalities of the vasculature, trauma or vasculitis. It is difficult to diagnose PVD in this population because the vessels in children are smaller than in adults, which makes it difficult to get images and because ionizing radiation should be avoided in children. Hence, diagnostic approaches are safety-conscious, and where possible, non-invasive and Radiation-Free (9). Sonography with Doppler is the initial imaging method of choice for pediatric PVD for its non-invasiveness and the possibility to evaluate the vascular architecture and the flow dynamics in real-time. It is most useful in

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the assessment of congenital lesions, like arteriovenous malformations or in suspected cases of thrombosis. DUS is safe, does not cause discomfort or pain and thus can be used in children, who may have problems with staying still for a long time required for conventional imaging (10).

CTA is frequently the initial test of choice for the assessment of vascular status in elderly patients. Owing to its capability of producing high resolution anatomical images, it is used expansively for assessment of both the sup fax and deep vessels, especially in atherosclerotic disease or suspected aneurysms. For instance, in elderly patients with critical limb ischemia, CTA can define the extent of arterial disease and the possible targets of revascularization accurately (11). Nevertheless, CTA has potential hazards, mainly in elderly patients with renal disease. Iodinated contrast agents have been shown to worsen kidney function and therefore patients should be well prepared for the procedure and adequately hydrated before the procedure. New techniques in CTA include low dose acquisition and iterative reconstruction which has reduced radiation and contrast exposure to the elderly patients (12).

CTA, however, cannot be performed easily in all centers because it requires a CT scanner and the use of contrast agents. However, CTA cannot be beaten when high-resolution anatomical information is needed especially for surgery or intervention planning (13).

OBJECTIVE:

To evaluate the diagnostic efficacy of Computed Tomography Angiography in identifying Peripheral Vascular Disease across different age groups, with consideration of its clinical applications and limitations.

2.3 OPERATIONAL DEFINITIONS:

Peripheral Vascular Disease (PVD):

A condition characterized by reduced blood flow due to narrowing or blockage of peripheral arteries, presenting as intermittent claudication, rest pain, or non-healing ulcers in the lower extremities (14).

Computed Tomography Angiography (CTA):

An imaging modality that combines computed tomography with contrast agents to produce high-resolution, three-dimensional anatomical images of blood vessels, used for detailed evaluation of vascular abnormalities (15).

MATERIALS AND METHODS

This cross-sectional study was conducted in the Radiology Department of General Hospital, Lahore, over a six-month duration following ethical approval from the hospital's Ethics and Research Committee. A sample size of 50 participants was calculated using the Cochrane formula, assuming a 95% confidence level and a population proportion of 50%. Participants of all age groups (pediatric, adult, and geriatric) and both genders were included based on clinical signs and symptoms suggestive of Peripheral Vascular Disease (PVD), such as leg discomfort post-exercise, rest-related numbness, absent pulses, color changes, or hair loss in the lower limbs. Exclusion criteria included allergies to contrast agents, kidney disease, heart disease, cancer, elevated BUN levels, or refusal to participate. Informed written consent was obtained, and data confidentiality was ensured through anonymized coding and secure storage. Data collection was performed using a structured proforma focusing on age-based subgrouping, clinical presentations, comorbidities, and detailed findings from Computed Tomography Angiography (CTA), including vascular stenosis, collateral formation, and anatomical mapping. The collected data were analyzed using SPSS version 20, with descriptive statistics summarizing demographic and clinical features. The Chi-square test was applied to evaluate associations between age groups and CTA findings, with significance determined at $p < 0.05$.

RESULTS

Table 4. 1: Statistics of Age groups

Age groups		
	Frequency	Percent
Children (10-17)	14	28.0

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Adult (18-64)	15	30.0
Elderly (65+)	21	42.0
Total	50	100.0

The distribution of age groups in the sample of 50 individuals shows that 14 (28.0%) are children (10-17 years), 15 (30.0%) are adults (18-64 years), and 21 (42.0%) are elderly (65+ years), with the elderly group representing the largest proportion. The total population is evenly distributed to account for 100.0%, highlighting a higher prevalence of elderly individuals in this dataset.

Table 4. 2: Gender

Gender		
	Frequency	Percent
Male	26	52.0
Female	24	48.0
Total	50	100.0

The gender distribution in the sample of 50 individuals reveals that 26 (52.0%) are male and 24 (48.0%) are female, resulting in a nearly balanced representation. The total population sums to 100.0%, indicating an almost equal distribution between genders in the dataset.

Table 4.3: History of PVD

History of PVD		
	Frequency	Percent
Yes	17	34.0
No	33	66.0
Total	50	100.0

The history of peripheral vascular disease (PVD) among the 50 individuals in the sample shows that 17 (34.0%) have a history of PVD, while 33 (66.0%) do not. This indicates that a majority, two-thirds of the population, have no prior history of PVD, with the total distribution equaling 100.0%.

Table 4.4: Statistics of Ankle- Brachial index

Statistics of Ankle- Brachial index	
N	50
Mean	.8890
Std. Deviation	.21167
Minimum	.51
Maximum	1.28

The Ankle-Brachial Index (ABI) statistics for a sample size of 50 individuals reveal a mean value of 0.8890, with a standard deviation of 0.21167, indicating moderate variability in ABI measurements within the group. The ABI values range from a minimum of 0.51 to a maximum of 1.28,

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highlighting a diverse spectrum of vascular health statuses in the sample population.

Table 4. 3: Statistics of Computed Tomography Angiography (CTA): findings

Statistics of Computed Tomography Angiography (CTA): findings	
N	50
Mean	50.8600
Std. Deviation	25.30388
Minimum	10.00
Maximum	90.00

The statistics for Computed Tomography Angiography (CTA) findings among the 50 individuals in the sample reveal a mean value of 50.86, with a standard deviation of 25.30388, indicating moderate variability in the findings. The values range from a minimum of 10.00 to a maximum of 90.00, reflecting a wide spectrum of CTA outcomes in the sample population.

Table 4.6: Contrast used

Contrast used		
	Frequency	Percent
Type 1, Dose 74 ml	13	26.0
Type 2, Dose 179 ml	22	44.0
Type 3, Dose 185 ml	15	30.0
Total	50	100.0

The distribution of contrast types and doses used among the 50 individuals shows that 13 (26.0%) received Type 1 contrast with a dose of 74 ml, 22 (44.0%) received Type 2 contrast with a dose of 179 ml, and 15 (30.0%) received Type 3 contrast with a dose of 185 ml. Type 2 contrast was the most commonly used, accounting for 44.0% of the cases, with the total distribution equaling 100.0%.

Table 4.7: Chi square test between age group and CTA

Chi-Square Test			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	74.722	74	.004

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Table 4.8Paired sample T test between age groups and computed tomography

Paired Samples Test									
		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Age groups - Computed Tomography findings	-48.72000	25.37638	3.58876	-55.93189	-41.50811	-13.576	49	.000

The paired samples t-test results show a significant difference between the age groups and computed tomography (CT) findings, with a mean difference of -48.72. The standard deviation is 25.38, and the standard error of the mean is 3.59. The 95% confidence interval for the difference ranges from -55.93 to -41.51, indicating that the true mean difference lies within this range. The t-value is -13.576 with 49 degrees of freedom, and the p-value is 0.000, which is less than the significance level of 0.05, indicating a statistically significant difference between the two groups. This suggests that the computed tomography findings are significantly different across the age groups.

DISCUSSION

Peripheral vascular disease (PVD) is a common circulatory problem characterized by narrowed arteries, reducing blood flow to the limbs. Accurate and timely diagnosis of PVD is critical to prevent severe complications such as ischemia and limb loss. Among the various imaging modalities, Computed Tomography Angiography (CTA) is widely used non-invasive techniques. It has distinct advantages and limitations, which may vary depending on the patient's age and the nature of their vascular pathology. The diagnosis of peripheral vascular disease (PVD) involves a careful evaluation of various imaging modalities to determine their effectiveness and appropriateness for different clinical scenarios. Multiple studies have explored their comparative advantages and limitations, shedding light on how this modality complement in different patient populations and clinical conditions.

Computed Tomography Angiography has emerged as a powerful diagnostic modality offering high-resolution three-dimensional imaging of the peripheral arterial system. CTA provides excellent visualization of the vessel lumen, wall calcifications, and surrounding tissues, allowing for comprehensive assessment of disease extent. As reported by Ouwendijk et al. (2011), CTA achieves sensitivity and specificity rates exceeding 95% in detecting peripheral arterial stenosis, outperforming CTA's capacity for rapid acquisition and less operator dependence further enhances its reproducibility and diagnostic confidence (16).

Nevertheless, the use of CTA is not without drawbacks. The requirement for iodinated contrast media raises concerns about nephrotoxicity, especially in elderly patients who often have compromised renal function. Additionally, the radiation exposure associated with CTA makes it less desirable for younger individuals or those needing multiple follow-up scans. The higher cost and limited accessibility of CTA in some healthcare settings also constrain its routine use (17).

The role of CTA in identifying collateral networks and providing anatomical detail in critical limb ischemia cases highlights its indispensability in managing advanced vascular diseases in this population (54). Conversely, obese patients or those with extensive limb swelling may benefit more from CTA, given the technical difficulties encountered with ultrasound in such scenarios. Future advancements in imaging technology promise to refine the diagnostic landscape further. Contrast-enhanced ultrasound and magnetic resonance

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angiography (MRA) offer radiation-free alternatives with improved diagnostic capabilities, particularly for patients contraindicated for CTA. Additionally, the development of low-dose CTA protocols and safer contrast agents may broaden CTA's applicability in vulnerable populations (18).

CONCLUSION:

Computed Tomography Angiography (CTA) is a crucial diagnostic tool for the evaluation of Peripheral Vascular Disease (PVD). It provides high-resolution anatomical detail, making it particularly valuable in complex cases, preoperative planning, and the assessment of severe arterial pathology. While CTA offers comprehensive vascular imaging on its own, its use alongside other diagnostic modalities can further enhance diagnostic accuracy and support more effective clinical decision-making, ultimately improving patient outcomes.

REFERENCES

moa a, moa a, tablet f, tablet m, tablet e, moa a. peripheral vascular disease. pha formulary. 2023:81.

sillesen hh. peripheral vascular disease. textbook of diabetes. 2024:755-67.

vart p, coresh j, kwak l, ballew sh, heiss g, matsushita k. socioeconomic status and incidence of hospitalization with lower-extremity peripheral artery disease: atherosclerosis risk in communities study. journal of the american heart association. 2017;6(8):e004995.

demir u, bademci mş, güneş t, iner h, gürbüz a, uluç me. comparison of doppler ultrasonography and computed tomography angiography for endoleak diagnosis after endovascular treatment of abdominal aortic aneurysm. cardiovasc surg interv. 2022;9:9-19.

fuglestad ma, hernandez h, gao y, ybay h, schieber mn, brunette ke, et al. a low-cost, wireless near-infrared spectroscopy device detects the presence of lower extremity atherosclerosis as measured by computed tomographic angiography and characterizes walking impairment in peripheral artery disease. journal of vascular surgery. 2020;71(3):946-57.

bonfante-mejia e, calle s, nunez-rubiano l, aein a, zhang x, jagolino-cole a. computed tomography angiography quantification of intracranial and extracranial vascular narrowing in ischemic stroke: differences between patients with and without illicit drug use. journal of computer assisted tomography. 2022;46(6):929-37.

gowda vc. efficacy of duplex ultrasonography (dus) and multidetector computed tomography angiography (mdcta) in the evaluation of peripheral arterial disease of the lower limb-a comparative study.

criqui mh, matsushita k, aboyans v, hess cn, hicks cw, kwan tw, et al. lower extremity peripheral artery disease: contemporary epidemiology, management gaps, and future directions: a scientific statement from the american heart association. circulation. 2021;144(9):e171-e91.

mazzolai l, aboyans v, ageno w, agnelli g, alatri a, bauersachs r, et al. diagnosis and management of acute deep vein thrombosis: a joint consensus document from the european society of cardiology working groups of aorta and peripheral vascular diseases and pulmonary circulation and right ventricular function. european heart journal. 2018;39(47):4208-18.

brostow dp, petrik ml, starosta aj, waldo sw. depression in patients with peripheral arterial disease: a systematic review. european journal of cardiovascular nursing. 2017;16(3):181-93.

Frontier in Medical & Health Research
ISSN: (e) 3007-1607 (p) 3007-1593

varga-szemes a, wichmann jl, schoepf uj, suranyi p, de cecco cn, muscogiuri g, et al. accuracy of noncontrast quiescent-interval single-shot lower extremity mr angiography versus ct angiography for diagnosis of peripheral artery disease: comparison with digital subtraction angiography. jacc: cardiovascular imaging. 2017;10(10 part a):1116-24.

türk y, salmaslioğlu a, sasani h. the role of multislice computerized tomography angiography in assessing postoperative vascular complications in liver transplant patients. turkish journal of medical sciences. 2019;49(4):1212-20.

neulen a, kunzelmann s, kosterhon m, pantel t, stein m, berres m, et al. automated grading of cerebral vasospasm to standardize computed tomography angiography examinations after subarachnoid hemorrhage. frontiers in neurology. 2020;11:13.

song p, rudan d, zhu y, fowkes fj, rahimi k, fowkes fgr, et al. global, regional, and national prevalence and risk factors for peripheral artery disease in 2015: an updated systematic review and analysis. the lancet global health. 2019;7(8):e1020-e30.

wang f, jin p, feng y, fu j, wang p, liu x, et al. flexible doppler ultrasound device for the monitoring of blood flow velocity. science advances. 2021;7(44):eabi9283.

met r, bipat s, legemate da, reekers ja, koelemay mj. diagnostic performance of computed tomography angiography in peripheral arterial disease: a systematic review and meta-analysis. jama. 2009;301(4):415-24.

dakhel a. peripheral arterial disease, diabetes, and biomarkers. 2023.

csőre j. advances in magnetic resonance imaging of peripheral arterial disease: non-contrast magnetic resonance angiography and artificial intelligence-aided plaque analysis 2024. 1.