

How to Cite:

Naseer, M., Farzana, M., Khan, M. A. A., Nasir, A., Ahmad, A., Javed, S., Sarfraz, S., & Ahmad, S. (2023). Routine assessment of carotid plaques on Doppler USG and associated presenting symptoms at a Tertiary Care Centre, Lahore. *International Journal of Health Sciences*, 6(S9), 4720–4728. <https://doi.org/10.53730/ijhs.v6nS9.13996>

Routine assessment of carotid plaques on Doppler USG and associated presenting symptoms at a Tertiary Care Centre, Lahore

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Abstract--Objective: To determine the frequency of carotid plaques on Doppler USG and associated presenting symptoms at Tertiary Care Centre, Lahore. Methods: A cross-sectional study of 366 individuals was conducted from January 2020 to November 2020 at the Radiology Department of Shiekh Zayed Hospital, Lahore, Pakistan. A consultant radiologist scanned both sides of the extra-cranial carotid artery tree. The DUS of carotid arteries was done with a GE Voluson Expert 730 Doppler ultrasound machine, using a linear probe with a transducer

frequency of 6-12.5MHz. Results: A total of 366 patients underwent bilateral carotid Doppler ultrasound examinations. Our findings showed carotid plaques in 156 (42.62%) patients; the majority were males 105(67.53). The mean age recorded was 61.17 ±9.54 years and the mean body mass index was 25.43±3.40 Kg/m². The highest number of plaques were noted in the left carotid artery 64 (41.03%), the main location was the common carotid artery 88 (56.41%) and, the majority were homogenous plaques 88 (56.41%).The majority of patients presented with headaches 177 (48.36%). Associated comorbidities were diabetes mellitus, hypertension, and dyslipidemia. Conclusion: The accuracy of diagnosing Carotid artery plaques has greatly increased over time payable to radiological innovation. Carotid Doppler ultrasound is a cheap noninvasive modality to detect carotid artery plaques due to its sensitivity, precision, and reliability. Since there is a high frequency of carotid plaques noted in middle age male adults, appropriate screening with prophylactic management can save many diseases from a lower middle-income class.

Keywords---Carotid artery Plaques, Doppler ultrasound, Atherosclerosis.

Introduction

Cardiovascular disease (CVD), including ischemic heart disease (IHD) and stroke, is a leading cause of death in both developed and developing nations worldwide. There is a substantial global burden of carotid atherosclerosis 1, 2. Atherosclerosis is the main pathological process, which can begin early in life and, remain asymptomatic for a long time before presenting clinically. In apparently healthy adults, early detection of atherosclerosis in peripheral and carotid arteries can save a lot of disease burden 3, 4.

Duplex Doppler ultrasonography (DUS) is a cheap widely used noninvasive technique to screen and diagnose atherosclerotic carotid plaques (CP), and, intima-media thickness (IMT). DUS visualizes luminal surfaces and measures the sternness of carotid walls 5. DUS asses Doppler indices like blood flow velocity (BFV), end-diastolic velocity (EDV), peak systolic velocity (PSV), and PSV ratio. The measurement of IMT is a reproducible and quantitative tool to asses atherosclerosis 6-9. Different stages of atherosclerosis include plaque formation, stenosis, and occlusion as shown in figs 1 & 2. Miscellaneous studies from different regions of the world have shown associations between CP and CVD risk factors, such as age, sex, hypertension, diabetes, hyperlipidemia, obesity, smoking status, and alcohol consumption 10-13. Carotid atherosclerotic lesions in diabetics appear prematurely, substantially involve vasculature, and frequently complicate with superimposed ulceration, calcification, and thrombosis14,15.

The strengths of this study are there is scant literature on the frequency of CP, the most common location in the carotid tree, and the most commonly encountered symptoms in the lower-middle-income class population. We aim to

determine the frequency of CP, its prime location, and associated symptoms in an urban tertiary care center, in Lahore.

Materials and Methods

Ethical approval for the study was obtained from the review committee of the Shaikh Zayed Hospital Lahore via IREB letter number SZMC/IRB/Internal/MD/100/18, dated 09 /11 /2019. After written informed consent, subjects were explained with a detailed description of the study and were inducted into the study. A total of 366 patients were calculated by nonprobability convenient sampling. Categorical variables i.e. age, gender, weight, height, and body mass index were measured. After explaining the procedure to the patients, DUS was performed in the supine position using GE Voluson Expert 730 machine and probe ranging from 6-12 MHz linear array transducer. A consultant radiologist placed the probe on the medial side of the sternocleidomastoid muscle and identified and screened both extra-cranial carotid artery trees with a special focus on the common carotid artery, bifurcation of the common carotid artery, internal and external carotid arteries in the transverse and longitudinal planes.

Inclusion criteria

Patients of both sexes between 45-75 years of age were included.

Exclusion criteria

Patients with clinical evidence of stroke, angina pectoris, peripheral vascular disease, and myocardial infarction with stenosis were excluded.

Statistical analysis

The data were processed by using Statistical Package for Social Sciences (SPSS) version 23.0. Categorical variables such as gender, carotid plaques, diabetes, hypertension, smoking, dyslipidemia, and obesity were presented in the form of frequencies and percentages.

Results

The study was carried out on 366 patients presented at the Radiology Department of Sheikh Zayed Hospital for a one-year from January 2020 to November 2020. The main demographical data and findings of DUS are described in Table 1

Table 1 Main demographical data and findings on DUS

Average	Age	
61.17±9.54		
Average BMI	25.43±3.40 kg/m ²	
	No.	%
Men	209	57.1
women	157	42.9
• Risk factors		
Dyslipidemia	239	65.3
Hypertension	176	48.1
Diabetes	145	39.6
Smoking	131	35.79
Obesity	107	29.23
• Presenting symptoms		
Headache	177	48.36
Vertigo	62	16.94
Dizziness	46	12.57
Numbness	44	12.0
Syncope	37	10.11
• Site of Carotid plaques		
Left carotid artery	64	41.03
Right carotid Artery	50	32.05
Bilateral involvement	42	26.92

Table 2 Multivariate analysis showing the association of referral Symptoms with risk factors

		Referral symptoms					Total	P-Value
		Dizziness	Headache	Numbness	Syncope	Vertigo		
Dyslipidemia	Yes	30	121	28	19	41	239	0.408
	No	16	56	16	18	21	127	
Hypertension	Yes	26	81	17	17	35	176	0.280
	No	20	96	27	20	27	190	
Diabetes	Yes	16	71	16	16	26	145	0.909
	No	30	106	28	21	36	221	
Smoking	Yes	19	70	19	10	13	131	0.042
	No	27	107	25	27	49	235	

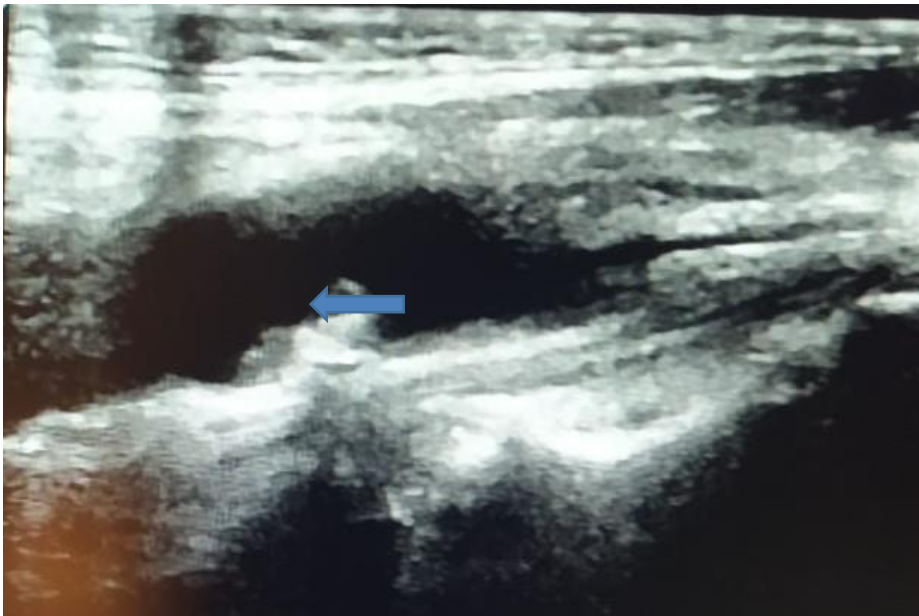


Fig 1 Sonographic image of axial view shows heterogeneous plaques in the common carotid artery of a left carotid artery causing stenosis < 70%. (Highlighted by blue arrows)

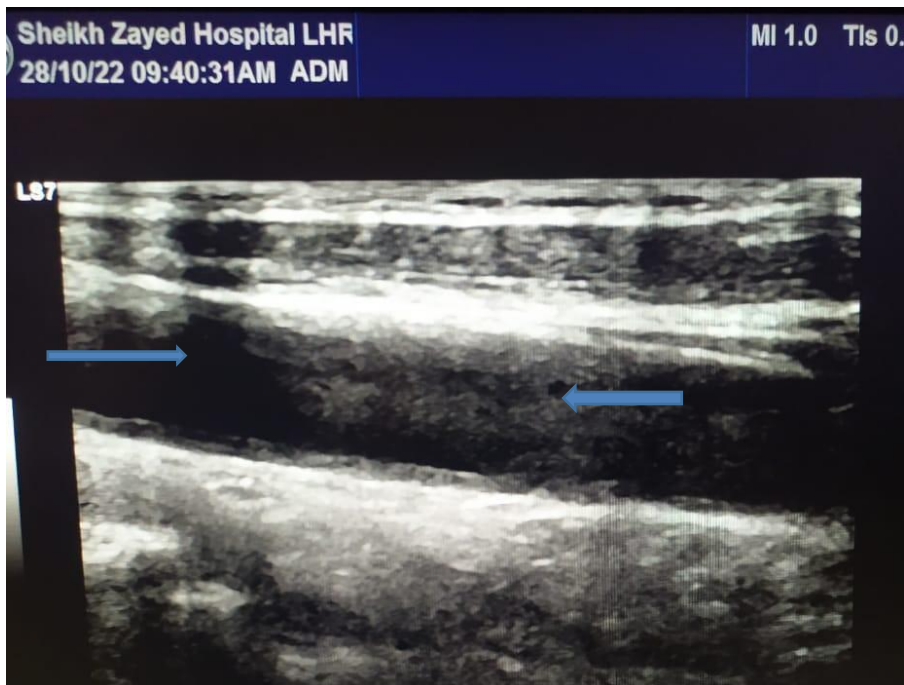


Fig 2 Sonographic image of axial view shows homogenous plaques in the carotid bulb of a right carotid artery causing stenosis < 70%. (Highlighted by blue arrows)

Discussion

The present report is a single urban center study consisting of 366 subjects with CP diagnosed with DUS. With a high degree of consistency and accuracy, DUS detects atherosclerosis giving a valid and trustworthy assessment of CP. DUS of carotid arteries with sufficient visualization of carotid wall structures offers the potential diagnostic tool for the effective evaluation of CP 9.

Since there is limited literature from the Pakistani population regarding the CP burden, our study showed 42.6% of CP cases only. There has been an overall increase in the CP burden around the entire globe from America to Asia, recorded in the urban population to the rural population. The Asian population has relatively less CP burden due to ethnic diversity and socioeconomic status 16, 17. Wang et al reported 60.3% and Yang et al reported 58.0% CP burden in asymptomatic patients 5, 18. In contrast, Kwon TG reported 30.3% of the CP burden in the Korean population 19.

In our study, the total age ranged from 45-81 years with a mean age of 61.17±9.54 years, and the mean total body mass index (BMI) was 25.43±3.40 kg/m² (Table 1) which is comparable to other author's 20-24. Our study showed a significantly higher prevalence in men (57.1%) than in women (42.9%) coincides with other studies 20, 24, 25. In our study majority of the plaques were located in the common carotid artery of the left carotid artery similar to Kwon TG et al and Khattak et al. 19, 26 In contrast to Gul Z et al, and Thatipamula MK et al, showed a majority of plaques were located in the left carotid bulb 25.8% 27.

The majority of our patients had all the risk factors for developing CP i.e older age, male gender, familial hypercholesterolemia, hypertension, and diabetes. The hemodynamic disturbances and dysfunctional endothelial cells strengthen the interaction between leukocytes and endothelial cells. The oxidation reaction and glycosylation of low-density lipoprotein and a series of chain reactions caused by the deposition of advanced glycosylation end products result in CP formation. This finding is comparable to all other studies done on Asian and American reports. 28-31.

Conclusion

Ultrasonography is a noninvasive, simple-to-use imaging technique, for mass screening and properly identifying CP. It is also affordable, secure, and dependable. A multicenter study in several areas of Pakistan is needed to evaluate the prevalence of CP in the Pakistani population for primary prevention and management of CP. The most pressing need is to conduct high-quality epidemiological investigations on CP and its global burden in Pakistan. As we are reporting the frequency of CP from an urban tertiary care center, it is imperative for stakeholders to must develop effective strategies for primary prevention and disease management.

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