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Carotid artery Disease Assessed by Color Doppler Flow Imaging: Comparison between Smokers and Non-Smokers Patients

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ABSTRACT

Most frequently, people with renal insufficiency and smokers will both have carotid artery disease. When compared to non-smokers, smokers have a higher incidence of carotid artery stenosis. Moreover, smoking has been connected to the development of high-risk atheroma as well as an increase in carotid intima media thickness in an elderly population. Extracranial internal carotid artery stenosis higher than 50% is linked to around 8–15% of ischemic strokes [2].

Objective: To compare the color Doppler findings for assessment of carotid artery disease in smokers and non-smokers.

Methodology: A cross-sectional study was performed on 120 patients, with clinically suspected carotid artery disease at the university ultrasound clinic, Green town Lahore by Doppler ultrasonography (Toshiba XARIO XG), with linear probe of 5-7.5 MHz frequency used. The data was analyzed with the help of SPSS version 25.0. Variables like age and Intima-media thickness were reported and the mean ± standard deviation of pulsatility index, resistive index, peak systolic velocity, and end diastolic velocity were calculated. An independent

KEY WORDS

Carotid artery disease / carotid artery stenosis / carotid plaque / smoking / Ultrasonography / vascular ultrasound.

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t-test was applied with a significant p-value, which was less than 0.05.

Results: Data was collected from 120 patients. The mean ± SD of age of 120 patients were 43.10 ± 14.44 years. IMT of right carotid artery and PSV of right and left carotid artery, were observed to be statistically significant in smokers and non- smokers.

Conclusion: This study concluded that smoking is considered as one of the most important risk factor that shows a significant association with carotid IMT thickening.

Introduction:

One of the main causes of death in the globe is smoking cigarettes. Globally, smoking is said to be responsible for 6.2 million deaths every year. The early detection and primary prevention of atherosclerotic disease are some of the most crucial topics in the contemporary era of cardiovascular medicine since atherosclerotic disease plays a major role in smoking-related CVD. Carotid intima-media thickness (CIMT) measures have recently been utilized to characterize subclinical atherosclerosis and show that it is a predictor of CVD. Additionally, smoking was linked to both an increase in CIMTs in an aged population as well as the development of high-risk atheroma [1]. About 8–15 percent of ischemic strokes are associated with extracranial internal carotid artery stenosis greater than 50%. The prevalence of carotid artery stenosis (CAS) among smokers is increasing [2]. Any blockage of the carotid arteries reduces blood flow to the brain, resulting in severe lasting damage to the brain. The carotid artery narrows as a result of atherosclerosis or cholesterol deposition. Depending on where the blocked brain blood vessel is located, carotid artery disease symptoms may vary. Numbness in the arms or legs, loss of vision in one eye, slurred speech, and numbness on one side of the face are among the signs of carotid artery disease [3]. The carotid arterial wall alters structurally with advancing age. Due to the accumulation of stiff chemicals like collagen and calcification, the vessel's flexibility reduces [4]. The primary blood veins in the brain are blocked, which causes strokes. Age, family history, sex, and race are the non-modifiable risk factors for stroke. Carotid stenosis, transient ischemic attack, heart illness, hypertension, diabetes mellitus, hyperlipidemia, alcohol misuse, physical inactivity, and cigarette smoking are among the modifiable risk factors [5].

For assessing and describing adaptive vascular changes such artery walls thickening and atherosclerotic development, Doppler ultrasound is an easy, safe, succinct, and repeatable technique [6]. IMT and arterial lumen narrowing can both be measured with high accuracy using ultrasound. Numerous studies have found a substantial correlation between smoking and carotid intima-media thickness (CIMT) and stenosis [7].

Cigarette smoking is well known to be a major risk factor for atherosclerosis in both men and women. Smoking's impact on atherogenesis is still not fully understood, especially at the early stages of vascular disease. Smoking is known to influence how the arterial wall responds to large artery intima-media thickness (IMT), a hallmark of early arterial alteration [8]. Smoking damages the lining of the blood vessels and makes cholesterol deposits more likely to form. Smoking can be linked to nearly 1 of every 4 strokes in the United States. Stopping smoking is extremely important to keep carotid artery blockages from worsening and to prevent stroke [9].

This study benefits from the discovery of a significant correlation between carotid IMT and smokers and non-smokers. Only a few studies are published in the literature, most of which are done only on smoking, but our main objective is to focus on both groups [smokers and non-smokers]. This study contributes to the early detection of stenosis in the carotid artery in smokers and non-smokers subjects.

Methodology

The study was performed at the university ultrasound clinic in Green Town for duration of 7 months. A total of 120 patients were examined, out of which 22 were smokers and 98 were not. All patients (males and females) clinically suspected of having carotid artery disease were included. Unwilling and non-cooperative patients were excluded from this study. A convenient sampling technique was performed. All patients were examined by Doppler ultrasonography using the Toshiba Xario XG, which features a linear probe of 5–7.5 MHz frequency. The data was analyzed with the help of SPSS version

25.0. The variables like age, gender, location of stenosis, severity of disease, and IMT were reported using frequencies, percentages, histograms, pie charts, and bar charts for graphical representation. The mean ± standard deviation of age, PI, RI, PSV, EDV, and IMT were calculated. An independent t-test was applied to compare Doppler indices in smokers and non-smokers subjects. The p-value is less than 0.05, which is significant.

Discussion:

Main objective of current study was to assess carotid artery stenosis, which is a major cause of stroke and early warning sign in both smokers and non-smokers. We had two patient groups 22 smokers and 98 non-smokers - each with risk indicators that could be detected by Doppler ultrasound. Our results suggest that the main risk factors for carotid stenosis are smoking, hypertension, high cholesterol and increasing age.

There is a strong association between IMT and smoking as proven in our study (Table 2). The chemicals in cigarette can cause damage to inner lining of carotid arteries, increasing their susceptibility to atherosclerosis as a result IMT becomes thicker over time. IMT thickening begins at the bulb and is noticeably worse in people who smoked for up to 15 years [10]. IMT increased with smoking duration over time. Additionally, the number of cigarettes smoked had a dose-response effect on IMT, which several studies confirmed [11, 12].

Pulsatility index is considered as a strong risk factor for carotid artery disease in our study (Table 2). Many studies narrated that high PI indicates that blood flow in carotid arteries is more pulsatile which can be an indication of developing stenosis or any cardiovascular or cerebrovascular disease [13, 14].

Diabetes and smoking are closely related when it comes to their impact on carotid system as shown in our study. Smoking can increase insulin resistance which can worsen blood sugar control in diabetic individuals. On the other hand, high glucose levels can cause damage to arteries, increasing the risk of developing stenosis. A study by Baki Go ksan et al. found that diabetes, which was found to be significantly associated with carotid artery stenosis, had a prevalence of 13.6%, with the highest percentage occurring between the ages of 65 and 74, at 21.4%, and links to other risk factors such as age, stroke, and obesity [15].

Table 1. Cross tabulation Between Age and Smoking

		Smoking		Total
No		Yes		
Age (years)	<= 34.00	28	4	32
	35.00 - 41.00	23	5	28
	42.00 - 53.50	24	6	30
	53.51+	23	7	30
Total		98	22	120

Obesity had a prevalence of 25% and was more prevalent in people between the ages of 55 and 64; it was associated with atherosclerosis and getting older [16]. Increasing age was found to be significant variable in our study (Table 1). Smoking exacerbates the natural process of the arteries becoming less elastic with age by further damaging them and making them more susceptible to fatty deposits. Numerous studies have discovered that male gender and advancing age, which amplifies the impact of other risk factors, lead to carotid artery stenosis [17, 18].

Hypertension, is a major risk factor for carotid artery disease as shown in our study, because it increases the blood's force on the artery walls, which causes damage over time [19]. When hypertension and smoking combined, the risk of developing CAD is even higher.

The most important variable that was discovered to be linked with CAD was smoking was proven to be a significant variable in our study. Smoking is significantly linked to atherosclerosis disease in the elderly, which may be measured in three different ways: arterial lumen narrowing, thickening of the internal and common carotid artery walls [20]. Between never smokers, former smokers, and current smokers, there were connections with thicker walls and higher degrees of stenosis [21]. Smoking cigarettes increases the risk of clinical cardiovascular events, possibly in part because it raises fibrinogen levels, hemoglobin concentrations, and myocardial oxygen demand [22]

Smoking may contribute to the atherogenic process by influencing other variables such as high plasma to-

Table 2. Group Statistics

							95% Confidence Interval of the Difference	
	Smoking status	N	Mean	Std. Deviation	Std. Error Mean	Sig. (2-tailed)	Lower	Upper
R.IMT	Yes	22	.6682	.16729	.03567	.027	.00922	.15368
	No	98	.5867	.15172	.01533	.045	.00208	.16081
R.RI	Yes	22	.6336	.23210	.04948	.205	-.03276	.15085
	No	98	.5746	.18793	.01898	.275	-.04961	.16770
R.PI	Yes	22	1.3995	1.23684	.26369	.093	-.04683	.60245
	No	98	1.1217	.50619	.05113	.312	-.27839	.83401
R.PSV	Yes	22	-54.7045	44.80496	9.55245	.031	1.51253	31.01715
	No	98	-70.9694	27.89900	2.81822	.115	-4.25662	36.78631
R.EDV	Yes	22	-23.8909	20.77446	4.42913	.190	-3.44724	17.17767
	No	98	-30.7561	22.34477	2.25716	.177	-3.25041	16.98084
L.IMT	Yes	22	.6455	.15954	.03402	.111	-.01277	.12204
	No	98	.5908	.14075	.01422	.149	-.02079	.13006
L.RI	Yes	22	.6323	.11820	.02520	.747	-.05771	.08021
	No	98	.6210	.15324	.01548	.706	-.04858	.07109
L.PI	Yes	22	1.1545	.36716	.07828	.621	-6.20350	3.71728
	No	98	2.3977	11.70937	1.18282	.297	-3.59557	1.10935
L.PSV	Yes	22	-53.6682	30.09867	6.41706	.011	3.43846	26.58436
	No	98	-68.6796	23.45949	2.36977	.037	.97580	29.04702
L.EDV	Yes	22	-19.7682	19.02508	4.05616	.137	-1.64538	11.83555
	No	98	-24.8633	13.22364	1.33579	.244	-3.68734	13.87750

tal cholesterol, low-density lipoprotein cholesterol, and low HDL cholesterol that encourage a cholesterol flow into the arterial wall. Accelerated atherosclerosis formation may also be caused by an increase in white blood cell count and plasma fibrinogen concentration [23]. Furthermore, it has been suggested that smoking affects the pattern of arterial blood flow and stiffens artery walls.

Conclusion:

Smoking is considered as significant contributor to the development of carotid IMT and is major risk factor for stroke and other cardiovascular diseases. Quitting smoking can help to reduce the risk of developing stroke and other health problems.

Recommendation:

The current study can be interpreted as a significant step in a research on smoking effects. However, the results of this study should be treated with caution due to small sample size and lack of details regarding the participant' characteristics.

Future research should be a case control study and included equal cases of smokers and non-smokers patients.

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Results

In this study, 120 patients at the University Ultrasound Clinic Green Town, Lahore were enrolled. Patients were divided into 2 groups. The smokers group consisted of 22 patients. The non-smokers group consisted of 98 patients. Main risk factors for carotid artery stenosis are smoking and increasing age. Ischemic heart disease, were observed in 50% of patients. 18.3% were smokers.

Increasing age was found to be significant as it was associated with atherosclerosis. Cross tabulation between age and smoking shows that more smokers were found at the age of 53 or above and had more chances of IMT thickening (Table 1).

Mean and standard deviation of IMT of right carotid artery was 0.67 ± 0.17 in smokers while 0.59 ± 0.15 in non-smoker patients respectively with p-value = 0.027 < α =0.05, indicating a statistically significant. Mean and standard deviation of RI of right carotid artery was 0.63 ± 0.23 in smokers while 0.57 ± 0.18 in non-smoker patients respectively with p-value =0.205 > α =0.05, indicating a statistically non-significant. Mean and standard deviation of PI of right carotid artery was 1.4 ± 1.24 in smokers while 1.12 ± 0.51 in non-smoker patients respectively with p-value =0.093 > α =0.05, indicating a statistically non-significant. Mean and standard deviation of PSV of right carotid artery was -54.70 ± 44.80 in smokers while -70.97 ± 27.90 in non-smoker patients respectively with p-value = 0.031 < α =0.05, observed statistically significant. Mean and standard deviation of EDV of right carotid artery was -23.90 ± 20.77 in smokers while -30.76 ± 22.34 in non-smoker patients respectively with p-value =0.190 > α =0.05, observed statistically non-significant. Mean and standard deviation of IMT of left carotid artery was 0.65 ± 0.16 in smokers while 0.60 ± 0.14 in non-smoker patients respectively with p-value = 0.111 > α =0.05, indicating a statistically non-significant. Mean and standard deviation of RI of left carotid artery was 0.63 ± 0.12 in smokers while 0.62 ± 0.15 in non-smokers patients respectively p-value = 0.747 > α = 0.05, indicating a statistically non-significant. Mean and standard deviation of PI of left carotid artery was 1.15 ± 0.37 in 7smokers while 2.40 ± 11.71 in non-smoker patients respectively with p-value = 0.62 > α = 0.05 indicating a statistically non-significant. Mean and standard deviation of PSV of left carotid artery was -53.67 ± 30.10 in smokers while -68.68 ± 23.46 in non-smokers patients respectively with p–value =0.011 < α =0.05, observed statistically significant. Mean and standard deviation of EDV of left carotid artery was -19.77 ± 19.03 in smokers while -24.86 ± 13.22 in non-smoker patients respectively with p-value = 0.137 > α =0.05, observed statistically non-significant. (Table 2) **R**

IMT: Intima-Media Thickness, PSV: Peak Systolic Velocity, EDV: End Diastolic Velocity ,PI: Pulsatility Index, RI: Resistive Index

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