

Association of Carotid Artery Disease with Various Risk Factors Among Patients Presenting with Ischemic Stroke

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ABSTRACT

Objective: To study the association of carotid artery disease with various risk factors among patients presenting with ischemic stroke.

Study Design: Cross-sectional study.

Place and Duration of Study: Department of Neurology, Pak Emirates Military Hospital Rawalpindi, from Jul to Feb 2019.

Methodology: A total of 300 patients with ischemic stroke diagnosed by a consultant neurologist were included in this study. A consultant radiologist assessed the presence of clinically significant carotid artery stenosis by performing an ultrasound examination of the carotid region. In addition, the relationship between age, gender, presence of diabetes mellitus, presence of hypertension and tobacco smoking was assessed with carotid artery stenosis among the patients with ischemic stroke.

Results: Out of 300 patients with stroke assessed through ultrasound Doppler, 171 (57%) showed the presence of significant carotid artery stenosis, while 129 (43%) had no clinically significant stenosis. Statistical analysis revealed that diabetes mellitus and hypertension had a statistically significant relationship (p -value <0.05) with the presence of significant occlusion in the carotid arteries of stroke sufferers.

Conclusion: Carotid artery disease should not be missed among patients with ischemic stroke, as many patients harbour this phenomenon. Patients with diabetes mellitus and hypertension may be at more risk of developing carotid artery disease than others.

Keywords: Carotid artery stenosis, Ischemic stroke, Risk factors.

How to Cite This Article: Nizami MA, Yousaf MA, Liaqat J, Nawaz KH, Hashmat A. Association of Carotid Artery Disease with Various Risk Factors Among Patients Presenting with Ischemic Stroke. *Pak Armed Forces Med J* 2022; 72(Suppl-2): S393-396.

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INTRODUCTION

The hospital burden in developing countries includes many patients suffering from various types of cerebrovascular events.¹ One of the most common cerebrovascular events which account for most mortality and morbidity is stroke.^{2,3} Though no single causative factor could be responsible for this event. However, many risk factors and systemic illnesses may increase the chances of stroke in an individual.^{4,5}

Various metabolic illnesses and physiological changes with ageing may increase the chance of carotid artery occlusion.^{6,7} Narrowing of these significant and big arteries may result from several disease processes, such as senile, endocrine or immunological.^{5,8} Narrowing of these arteries, which make a significant blood supply source to the brain, maybe the predisposing or precipitating factor for stroke in several patients.^{7,9}

Involvement of carotid arteries among patients suffering from stroke has not been a new phenomenon.

Researchers and clinicians from various specialities have been working on it worldwide. Fleherty *et al*, came up with a clear idea and mentioned that carotid artery occlusion might be a causative factor for the precipitation of ischemic stroke.¹⁰

Once the patient has suffered from a stroke, then its only tertiary prevention which could help the patient i.e., rehabilitation. However, this poses a significant burden on the health system, the family of the patient and the patient himself. Therefore, it would be beneficial if those risk factors could be identified, which lead to vasculopathy, including the carotid artery disease and prone the patient to the development of stroke. Therefore, we designed this study to study the association of carotid artery disease with various risk factors among patients presenting with ischemic stroke.

METHODOLOGY

This cross-sectional study was conducted at the Neurology Department of Pak Emirates Military Hospital Rawalpindi from July 2019 and February 2019. The sample size was calculated using the WHO sample size calculator using the population prevalence

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Received: 12 Jun 2020; revision received: 24 Aug 2020; accepted: 26 Aug 2020

proportion of carotid artery disease as 26%.¹¹ Non consecutive probability technique was used to gather the sample for the study.

Inclusion Criteria: The patients with ischemic stroke diagnosed by a consultant neurologist were included in this study.

Exclusion Criteria: Patients <40 years or >80 years of age or those with a past or current history of myocardial infarction or valvular heart disease, or with a past or current history of irradiation were excluded from the study. In addition, patients who had cancer or had a past history of brain damage due to any other medical, neurological or autoimmune illness or had a hemorrhagic stroke or were not ready to undergo Doppler ultrasound were also excluded from the study.

The screening was performed on all the patients with acute ischemic stroke confirmed on CT scan or MRI brain as advised by the treating neurologist. In addition, a consultant radiologist assessed the presence of clinically significant carotid artery stenosis by performing an ultrasound examination of the carotid region.

The definition of clinically significant stenosis varies from study to study, but a consensus exists on the range of 50-70% occlusion or above.^{12,13} Less than 50 % occlusion is not usually considered significant. A consultant radiologist has used the ultrasound Doppler technique to measure this parameter precisely.^{14,15}

Ethical approval for the study was obtained from the ethical review board committee of the military hospital Rawalpindi via IREB letter-number A/28/EC/73. After written informed consent, subjects were provided with a detailed description of the study and were inducted into the study. Subjects with confounding variables like the presence of other neurological illnesses or IHD were identified by detailed history taking and excluded from the study. A consultant radiologist performed a Doppler ultrasound to look for the clinically significant stenosis among these patients with ischemic stroke. Variables in the study included age, gender, diabetes mellitus, presence of hypertension and tobacco smoking.

The diagnosis of diabetes was based on the plasma glucose criteria, defined as either (i) a fasting plasma glucose level of ≥ 126 mg/dL, (ii) a 2-hour plasma glucose level of ≥ 200 mg/dL after a 75-g oral glucose tolerance test, or (iii) a glycosylated haemoglobin level of $\geq 6.5\%$.^{16,17} In addition, to reduce the

same bias, laboratory and radiological services were used to carry out the relevant investigations for all the patients.

All statistical analysis was performed using Statistics Package for Social Sciences version 23.0 (SPSS-23.0). Characteristics of participants and the distribution of the carotid artery stenosis were described using descriptive statistics. Participants were categorical compared by the presence and absence of clinically significant carotid artery stenosis. Chi-square was used to determine between-group variances in categorical correlates. Differences between groups were considered significant if *p*-values were ≤ 0.05 .

RESULTS

Three hundred patients underwent an ultrasound of the carotid region and were enrolled in the study after all the formalities and application of the set criterion. The mean age of the patients was 62.3 ± 6.642 years. Out of 300, 171 (57%) showed the presence of clinically significant carotid artery stenosis, while 129 (43%) had no significant stenosis of the carotid arteries. Table showed the distribution of the patients in the presence of clinically significant stenosis. DM and hypertension had a significant association with carotid artery stenosis when chi-square was applied (Table).

Table: Characteristics of the study group and carotid artery disease.

Socio Demographi Factors	No Significant Carotid Artery Stenosis (<50% Narrowing)	Clinically Significant Carotid Artery Stenosis (50-70% Narrowing)	<i>p</i> -value
Age (Years)			
50 or less	52 (64.7)	54 (53.2)	0.11
>50	77 (35.3)	117 (46.8)	8
Gender			
Male	69 (72.5)	91 (46.8)	0.96
Female	60 (27.5)	80 (53.2)	3
Diabetes Mellitus			
Absent	76 (54.9)	63 (59.6)	<0.0
Present	53 (45.1)	08 (40.4)	01
Hypertension			
No	78 (86.3)	77 (57.4)	0.00
Yes	51 (13.7)	94 (42.6)	8
Smoking			
Non Smoker	74 (90.2)	84 (91.5)	0.15
Smoker	55 (9.8)	87 (8.5)	7

DISCUSSION

This study planned to peep into the vascular and metabolic phenomenon linked with carotid artery disease that may predispose the individual toward the lethal stroke phenomenon. Various metabolic and

vascular factors may have led to an accelerated process of atherosclerosis, which might have narrowed the carotid arteries and prone the individual to develop the ischemia of the body's most vital organ. More than half of our study participants showed the presence of carotid artery disease, which means that patients with stroke have occluded carotid arteries in the background causing ischemia in the brain. This is similar to the other studies done on stroke patients by Flaherty *et al*, and Noh *et al*, in west.^{10,12} Afridi *et al*, published similar results in our part of the world.¹⁶ Various metabolic, physical and psychological pathways may be responsible for this phenomenon, which may be confounding variables in our study. Their exact association with the understudied phenomenon cannot be well established with this design.

Gurol *et al*, in 2018 reported that gender, advancing age and duration and severity of diabetes mellitus may affect the presence and severity of carotid artery disease and may lead to an increased chance of it among the individual.⁵ Noh *et al*, and Sun *et al*, expanded this idea further and came up with the finding that hypertension and lipid profile abnormalities may also have an impact on the carotid artery disease leading to ischemia of the brain and stroke.^{12,13}

A similar finding was replicated in a study in China, stating that carotid artery involvement has a significant relationship with the precipitation of stroke and even the post-stroke complications.¹¹ A large study done in Korea mentioned the presence of Diabetes mellitus as a risk factor for the presence of carotid artery disease and stroke both.¹² Presence and relationship of various vascular and metabolic factors causing carotid artery disease leading to ischemia in the brain have been discussed in various studies done worldwide.^{12,13} Prasad *et al*, published a comprehensive review in 2015, highlighting all the patho-physiological mechanisms linked with carotid artery occlusion and the management options for such patients according to the underlying mechanisms related to the causation of this phenomenon.¹⁴

Carotid atheromas have been an area of interest for researchers in our part of the world, but limited work has been done in order to explore the risk factors related to the presence of carotid artery disease and leading to the catastrophic phenomenon of stroke.^{15,7,18}

Wasey *et al*, in a recent local study, came up with the results from a total of 672 patients who underwent bilateral carotid Doppler ultrasound (1344 carotid

examinations). The findings revealed 0-50% stenosis in 526 (78%), 51-69% stenosis in 57 (8%), 70-99% stenosis in 82 (12%), and total occlusion in 7 patients (1%). Potentially surgically correctable disease, defined as 70-99% carotid artery stenosis, was present in only 79 (12%) patients, of whom 47 (60%) were ipsilateral symptomatic, 15 (20%) asymptomatic, and 17 (20%) had status unknown. Outcome information at ≥ 6 months follow-up was available for 36 of the 47 (76%) surgically correctable, and only 4 of these patients (12%) had undergone surgical or radiological intervention (carotid endarterectomy in 3 patients and carotid stenting in 1 patient).¹⁵ Results in our study supported their findings. However, our sample size was smaller than the sample size studied by Wasey *et al*.

Li *et al*, conducted an interesting study in 2017 in this regard. They concluded that high-grade stenosis of the carotid artery is positively correlated with post-stroke vascular cognitive impairment in patients with acute ischemic stroke.¹¹ Though we did not study cognitive impairment. However, our study's baseline findings were still similar to the findings of Li *et al*.

Lieu *et al*, did a study and published in 2015 with the conclusion that carotid atherosclerosis was independently associated with variation of blood pressure, especially with the coefficient of systolic blood pressure variation.¹⁹ Our study strengthened their findings as, after the statistical analysis, hypertension emerged as a strong factor related to the presence of carotid artery disease in our patients.

Studies by Noh *et al*, and Sun *et al*, showed the association of DM with carotid artery stenosis among the patients with ischemic stroke.^{7,13} Strong association between DM and carotid artery disease (p -value < 0.001) was observed in our study. This is an eye-opener that we could prevent carotid artery disease and lessen the chance of catastrophic events like stroke by controlling DM with fewer resources and efforts.

Gender and tobacco smoking was found unrelated to carotid artery disease in the study population. These findings were contrary to the findings reported in the study done by Noh *et al*,¹² More studies with a large sample size and better study design and controlling the confounders may generate different results.

CONCLUSION

Carotid artery disease should not be missed among ischemic stroke patients, as many patients harbour this

phenomenon. In addition, patients with diabetes mellitus and hypertension may be at more risk of developing carotid artery disease than others.

Conflict of Interest: None.

Authors' Contribution

MAN: Conception data collection article writing, MAY: Design data analysis, JL: Article writing, KHN:, AH: Data collection.

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