Carotid Doppler and lipid profile findings in ischemic stroke patients – A hospital based study

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ABSTRACT

A prospective study was carried out during 2010 - 2011 in the Department of Radiology & Imaging of Nepal Medical College and Teaching Hospital, Jorpati, Kathmandu and Om Hospital and Research Centre, Chabahil, Kathmandu in which a total of 45 patients with clinically and CT scan diagnosed ischaemic cerebrovascular accident (CVA) underwent carotid Doppler study. During the hospital stay these patients also underwent lipid profile estimation to see for presence or absence of hyperlipidemia. Of these 45 patients, CT scan showed left middle cerebral artery (MCA) infarctions in 12, right MCA infarction in 12, lacunar infarctions in 10, watershed territory infarction in 4, posterior circulation infarction in 1 and venous infarction in 1 patient. Carotid Doppler study showed more than 50% stenosis in 31 patients. Among these 31 patients, 28 had hyperlipidemia where as blood cholesterol and triglyceride values in 3 patients were normal. The present study like several other studies done in the past showed association between carotid stenosis and hyperlipidemia, leading to CVA.

Keywords: Stroke, carotid Doppler, stenosis, hyperlipidemia

INTRODUCTION

Cerebrovascular accident or stroke is the sudden onset of focal neurologic deficit from a vascular mechanism. Stroke, after coronary artery disease and cancer, is the most common cause of death in western countries (10.6%) and has a frequency of 200 in every 100,000 deaths.[1] In addition, it may lead to many disabling sequelae in patients including paresis or plegia of one or more limbs, facial palsy, aphasia, amnesia, and one or more focal neurological deficits. It is note worthy to point that many patients had no obvious health related manifestations before the onset of CVA.

Carotid Doppler study is valuable to assess the cause, localization, extent and severity of extracranial arterial stenosis. The gray scale images provide information about the locaction and to some degree, the type of disease present. By combining the gray scale findings with the Doppler shift frequencies and colour Doppler characteristics, information about the severity of stenosis is obtained.[2]

Vascular disorders that lead to stroke are occlusion and disruption of vessels which may lead to certain changes in brain tissue because of ischemia with or without tissue necrosis, and bleeding. The most known risk factors are hypertension, diabetes, alcohol and tobacco use, hyperlipidemia and oral contraceptive pills.[3] Carotid ischaemic stroke is commonly attributed to atherosclerosis of the extracranial carotid arteries, with subsequent embolic or haemodynamic cerebral ischaemia.[4] Atherosclerosis afflicts multiple vascular beds, accounting for nearly all

of coronary heart disease and some proportion of ischemic strokes. Although the role of cholesterol subfractions in acute coronary syndromes is well documented, it is still unclear whether the lipid profile plays an important etiologic role in ischemic stroke.5

MATERIALS AND METHODS

This study was a prospective study conducted in 45 patients with CVA who were admitted in Nepal Medical College Teaching Hospital, Attarkhel, Jorpati, Kathmandu or in Om Hospital and Research Centre, Chabahil, Kathmandu over a one and half year period (2010 June to 2011 December). Their illness was diagnosed based on their clinical presentations and on CT Scan findings of infarctions. Patients with CT scan findings of old infarctions and hemorrhagic stroke were not included in the study. All the patients underwent carotid Doppler study by Nemio 30 colour Doppler Toshiba Ultrasound Unit using 8 MHz linear probe. Measurement of the intimo-media thickness and determination of presence or absence of atheromatous plaques along with the characterization of the nature of the plaque was done. Stenosis of vessel lumen was determined by combined cross-section area and diameter measurements of the vessel lumen and also by spectral Doppler velociometric studies.[6] All findings were included in the carotid Doppler study of common carotid arteries and internal carotid arteries of both sides. Note was also made of Doppler findings of bilateral vertebral arteries and bilateral external carotid arteries as a part of complete carotid Doppler study.

Table-1: CT Scan findings

CT Scan findings	n. (%)
Left MCA infarction	17 (38)
Right MCA infarction	12 (27)
Lacunar infarction	10 (22)
Watershed zone infarctions	4 (9)
Posterior circulation infarction	1 (2)
Venous infarction	1 (2)
Total	45 (100)

Table-2: Carotid Doppler study findings

Carotid Doppler findings	n.	Percentage
Normal	2	(4)
Less than 50% stenosis	12	(27)
50 to 69% stenosis	12	(27)
70 to 79% stenosis	11	(25)
80 to 89% stenosis	5	(11)
Complete occlusion	3	(6)
Total	45	(100)

Table-3: Association between carotid stenosis and hyperlipidemia

	Carotid stenosis > 50 %	Carotid stenosis < 50%	Total
Hyperlipidemia	28	8	36
No hyperlipidemia	3	6	9
Total	31	14	45

During the hospitalization period, an overnight fasting 5ml venous blood sample was obtained from the patients and sent to the laboratory to determine the lipid profile. Hyperlipidemia was defined when fasting blood cholesterol level was more than or equal to 200 mg/dL and/or triglyceride level was more than or equal to 150 mg/dL.[7]

Information about age and sex and past medical history of hypertension, diabetes and smoking was obtained from the family of the patient and listed in the information list.

All cases with more than 50 % carotid stenosis and all cases meeting criteria of hyperlipidemia were tabulated against those not meeting the criteria. Data was entered into a Microsoft Excel 2003 spreadsheet and imported to SPSS version 17.0 for windows for analysis. The data was analyzed using Chi-square test to determine the correlation between the patients having more than 50% stenosis of carotid artery on carotid Doppler study and hyperlipidemia. P value of less than 0.05 was considered significant.

RESULTS

Altogether 45 patients with clinically and CT diagnosed stroke between the ages of 33 years and 84 years (mean age of study participants being 62 ± 11 years), with M:F ratio of 2.2:1, underwent carotid Doppler studies and lipid profile estimations during their hospital stay. Out of these 45 patients, CT scan showed left MCA infarction in 17, right MCA infarction in 12, lacunar infarction in 10, watershed territory infarct in 4, posterior circulation infarction in 1, and venous infarct in 1 patient. Carotid Doppler study was normal in 2 patients; showed minimal age related changes with intimo-media thickening with less than 50 % stenosis in 12 patients, 50 to 69% stenosis in 12, 70 to 79% stenosis in 11, 80 to 89% stenosis in 5, and complete occlusion in 3 patients. All carotid stenoses were included in the analysis, irrespective of the laterality to the symptomatic hemisphere or its unilateral or bilateral presence, or the presence of solitary or multiple stenoses in one or more vessels. The above grading of percentage stenosis of carotid artery was done on the basis of NASCET criteria.[6]

Out of the total 45 patients, 36 patients were found to have hyperlipidemia and the remaining 9 patients had normal blood cholesterol and triglyceride levels. Among these 36 patients with hyperlipidemia, 28 patients had carotid stenosis above 50% and 8 patients had either normal carotid Doppler study or negligible stenosis below 50%. Using Chi-square test, the p value was calculated and it was found that the association between hyperlipidemia and carotid stenosis above 50% was statistically significant. (p=0.02)

DISCUSSION

The present study showed significant positive correlation between atherosclerotic carotid stenosis and hyperlipidemia. This finding corroborates the result of previous study carried out by Poli A *et al*.[8] Calculation of Doppler shift frequency made it possible to detect the flow velocity which is used to assess luminal narrowing and degree of flow restriction. Carotid Doppler is an accurate, safe and non-invasive method of assessing arterial caliber and monitoring the progression of disease.[9] Ultrasound can illustrate all three layers of aterial wall. Significant undulation and thickening of the intima indicate plaque deposition, or more rarely fibromuscular hyperplasia.[10-12] The primary role of carotid sonography is the detection and assessment of carotid stenosis. Nonetheless, much has been made of the ability of ultrasound to characterize plaque. In general terms, plaque can be characterized as low, medium or high in echogenicity and as homogenous or heterogenous. [13,14,15,16]

Ischemic stroke involves a heterogeneous pathophysiological entity in which vastly different pathways might lead to indistinguishable clinical presentations. Well-recognized mechanisms of ischemic stroke include cardiac or artery-to-artery embolism, atherothrombosis of an extracranial carotid or intracranial artery, and non-atherosclerotic disease of small diameter penetrating arteries. However, it is generally accepted that atherosclerosis of extracranial or intracranial arteries accounts for a substantial proportion of clinical ischemic strokes via artery-to-artery embolization of plaque associated thrombi or in situ (distal) atherothrombotic occlusion.

However, data from stroke registers indicate that even after accounting for all carotid and cardiac disease, the etiology in most cases remains unexplained.[17,18] Atherosclerosis has been regarded as an important etiological factor of ischaemic CVA.[19] Recent studies have shown that severe carotid atherosclerotic stenosis is associated with an increased risk of ischaemic stroke.[20]

Risk factors of carotid atherosclerosis have been evaluated in previous studies, and age, gender, hypertension, diabetes, smoking and hyperlipidemia were correlated with extracranial carotid atherosclerosis.[21,22]

Accordingly, known contributors to atherogenesis, often studied in the context of coronary disease, are assumed to be determinants of ischemic stroke.[23]

Executive committee for the Asymptomatic Carotid Atherosclerotic Study and study conducted by Su *et al* have suggested an association between hyperlipidemia and extracranial carotid stenosis. In general, the relationship between high total and LDL cholesterol and low HDL, as has been demonstrated in coronary artery disease has been difficult to establish in stroke. Several studies, however, have shown an increased risk of thrombotic stroke with low HDL.[24,25]

Recently, lipoprotein a or so called lp(a) has been associated with stroke risk but confirmation in larger studies has not been convincing. In Asian studies low serum cholesterol has been associated with increased risk of intracranial hemorrhage. This observation has been met with skepticism but received support from at least one large study in Caucasian males in Multiple Risk Factor Intervention Trial (MRFIT) study.[26] The reason for such an association is unclear. There is recent evidence that the newer agents that reduce cholesterol decrease stroke as well as cardiovascular events. This is true for Simvastatin and Pravastatin. Relative risk reduction is on the order of 30-50%. Although a few questions remain it is becoming clear that lipids abnormalities predispose to adverse cerebrovascular as well as cardiovascular events.[27]

In conclusion, atherosclerosis being one of the important causes of CVA, can be easily assessed in extracranial carotid arteries by carotid Doppler study. Carotid Doppler study for carotid artery stenosis has become the first line examination in most cases, both the macroscopic appearance of the artery as well as flow characteristics. Determination of this parameter using a non-invasive technique may represent an important tool to monitor in vivo progression and / or the regression of atherosclerosis.

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