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Carotid Doppler Study Findings of High-Risk Elderly Patients

Dr. Mohammad Abdul Kadir[1*], Dr. Jannatul Ferdause[2], Dr. Sumon Dhar[3], Dr. Sanjida Tawrin[4], Dr. Afra Nawar[5], Dr. Tanusree Dakeua[6], Dr. Mosharaf Hossain Murad[7], Dr. Akib Abir Shoumik[8]

[1]Senior Consultant, Department of Medicine, Mugda Medical College Hospital, Dhaka, Bangladesh
[2]Junior Consultant, Department of Ophthalmology, Mugda Medical College Hospital, Dhaka, Bangladesh
[3]Junior Consultant Department of Medicine, Mugda Medical College Hospital, Dhaka, Bangladesh
[4]Assistant Registrar, Department of Medicine, Mugda Medical College Hospital, Dhaka, Bangladesh
[5]Medical Officer, Department of Medicine, Mugda Medical College Hospital, Dhaka, Bangladesh
[6]Assistant Registrar, Department of Medicine, Mugda Medical College Hospital, Dhaka, Bangladesh
[7]Medical Officer, Department of Medicine, Mugda Medical College Hospital, Dhaka, Bangladesh
[8]Medical Officer, Department of Gastroenterology, Mugda Medical College Hospital, Dhaka, Bangladesh

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***Corresponding author:** Dr. Mohammad Abdul Kadir
Senior Consultant, Department of Medicine, Mugda Medical College Hospital, Dhaka, Bangladesh

Abstract **Original Research Article**

***Background*:** Carotid artery stenosis is an atherosclerotic narrowing of the proximal internal carotid artery that significantly increases the risk of stroke, particularly in elderly individuals and those with associated vascular risk factors. The purpose of this study is to evaluate the degree of carotid artery stenosis and associated risk factors in high-risk elderly patients using carotid Doppler. ***Methods*:** This cross-sectional study at the Inpatient and Outpatient Departments of Medicine, Department of Vascular Surgery, and Institute of Nuclear Medicine and Ultrasound, Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, Bangladesh, included 100 elderly patients (>55 years) with ≥1 risk factor for carotid disease. Patients were evaluated clinically and via investigations, and data were analyzed in SPSS ($p < 0.05$) with ethical approval and informed consent. ***Results*:** In 100 high-risk elderly patients (mean age 65.6 ± 8.1 years; 64% male), sedentary lifestyle (89%), occasional exercise (96%), balanced diet (85%), and smoking (63%) were common. Hypertension (64%), dyslipidemia (58%), IHD (42%), TIA (39%), and diabetes/IFG/IGT (37%) were prevalent. Carotid stenosis occurred in 73% (60% mild, 7% moderate, 6% severe) and was significantly associated with hypertension, dyslipidemia, IHD, and TIA ($p < 0.05$). ***Conclusion*:** Colour Doppler sonography is a rapid, non-invasive, and effective tool for detecting carotid stenosis, particularly in high-risk patients, though its accuracy is operator-dependent and general population screening may not be cost-effective.

Keywords: Carotid Doppler, Carotid Artery Stenosis, Elderly Patients.

INTRODUCTION

Carotid stenosis is defined as the atherosclerotic narrowing of the proximal internal carotid artery exceeding 50% in moderate cases and 70% in severe cases. The prevalence of carotid stenosis increases with age and is higher in males. A recent Western European population study reported a prevalence of moderate asymptomatic stenosis at 4.2% and severe stenosis at 1.7%, with 12.5% of men diagnosed with moderate stenosis [1]. Population-based studies using carotid ultrasound estimate the prevalence of clinically important carotid artery stenosis (CAS, 60%–99%) in the general primary care population to be approximately 1% or less, and about 1% in those aged 65 years and older [2 ,3].

A "clinically important degree of CAS" corresponds to a substantially increased risk of stroke. Stroke risk depends not only on the degree of stenosis but also on the presence of other risk factors, making it difficult to define precise categories of risk in asymptomatic individuals. In the Cardiovascular Health Study of adults aged ≥65 years, the risk of stroke increased as stenosis exceeded 50%, with an estimated 5-year ipsilateral stroke risk of approximately 4% for CAS ≥50% and 8% for CAS ≥70% [4–6].

Most studies of CAS management consider stenosis ≥50% or ≥60% as clinically important. Fisher first described the pathophysiology of carotid atherosclerosis in 1951 [7], and it is now recognized as a major risk factor for stroke. A population-based study of

individuals aged >55 years found that severe carotid plaque burden increased the relative risk of non-lacunar anterior circulation infarction by 3.2 times and lacunar infarction by 10.8 times [8]. Consequently, asymptomatic carotid stenosis has become an important consideration for primary care physicians.

Diagnosis often begins in the outpatient setting, where primary care physicians may examine for carotid bruit, a sign of turbulent blood flow across a stenotic plaque. While the Framingham Heart Study showed that patients with a carotid bruit had double the stroke rate of controls, most strokes occurred in vascular territories unrelated to the stenosis [9]. Meta-analyses suggest that carotid bruit indicates generalized atherosclerotic disease rather than a direct marker of carotid risk [10]. A recent cohort study reported that bruit auscultation had a sensitivity of 56% and specificity of 98% for detecting clinically significant stenosis, indicating that further non-invasive testing should be considered in high-risk patients [11].

Non-invasive imaging modalities such as duplex ultrasonography (DUS), computed tomographic angiography (CTA), and magnetic resonance angiography (MRA) are commonly used to diagnose CAS. DUS is often the first-line screening tool due to its ease of use, absence of radiation, lack of contrast requirement, and low cost. DUS has demonstrated 86% sensitivity and 87% specificity for clinically significant (>70%) stenosis [12]. However, its accuracy is operator-dependent, and its utility in screening low-risk populations is limited. MRA has shown superior sensitivity (95%) and specificity (90%) for clinically significant stenosis [12, 13], and contrast-enhanced MRA achieves 94% sensitivity and 93% specificity compared to DUS, CTA, and non-contrast MRA. CTA sensitivity and specificity were 76% and 94%, respectively [13]. Although catheter angiography remains the gold standard for evaluating carotid stenosis, its invasive nature, cost, and risk of neurologic complications restrict its use to problem-solving when non-invasive modalities are inconclusive. In patients with known carotid disease, annual DUS may be reasonable to monitor interval changes [14]. The purpose of this study is to evaluate the degree of carotid artery stenosis and associated risk factors in high-risk elderly patients using carotid Doppler.

Objective

- To evaluate the degree of carotid artery stenosis and associated risk factors in high-risk elderly patients using carotid Doppler.

METHODOLOGY & MATERIALS

This descriptive, cross-sectional study was conducted at the Inpatient and Outpatient Departments of Medicine, Department of Vascular Surgery, and the Institute of Nuclear Medicine and Ultrasound at Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, Bangladesh, over a period of six months following protocol submission. A total of 100 elderly patients were included, selected using a convenient sampling method based on predefined inclusion and exclusion criteria, to evaluate the degree of carotid artery stenosis and identify high-risk patients for future stroke.

Inclusion Criteria

- Age > 55 years with one or more of the following risk factors: hypertension, diabetes mellitus, dyslipidemia, or family history of stroke.
- Both male and female patients.

Exclusion Criteria

- Patients or legal guardians who do not give consent.
- Age < 55 years.
- Presence of aneurysm or congenital anomalies of the carotid vessels.

Operational Definitions

- **Carotid Stenosis:** Atherosclerotic narrowing of the carotid artery exceeding 50% in moderate cases and 70% in severe cases.
- **Risk Group:** Patients presenting with one or more of the following risk factors: hypertension, diabetes mellitus, dyslipidemia, or family history of stroke.
- **Elderly Patients:** Individuals aged > 55 years.

Data Collection Procedure

- Patients were interviewed face-to-face by the researcher to collect demographic and clinical information.
- Each patient was examined for relevant clinical signs, recorded using a structured checklist.
- Necessary investigations were performed to support clinical diagnoses.

Data Analysis

Collected data were checked for consistency, edited, and coded before entry into SPSS software. Data cleaning, validation, and analysis were performed using SPSS, with results presented as mean, standard deviation, and percentages. Statistical significance was defined as $p < 0.05$.

Quality Assurance

The principal investigator supervised all aspects of the study, including case selection, data sheet completion, sample collection, record maintenance, data entry, analysis, and report writing. Each case was personally examined, and study procedures were guided and monitored to ensure accuracy and consistency.

Ethical Considerations

Participation was voluntary. Written informed consent was obtained after explaining the study in Bengali. Participants were informed of their right to refuse participation or withdraw at any stage. All responses were kept confidential, and interviews were conducted at convenient times and in private settings to ensure participant comfort and privacy.

RESULTS

Table 1: Demographic Characteristics of the Study Population (n = 100)

Variable	Frequency (n)	Percentage (%)
Age group (years)		
51–60	40	40.0
61–70	38	38.0
71–80	18	18.0
>80	4	4.0
Mean ± SD	65.63 ± 8.13	
Range	55–90	
Gender		
Male	64	64.0
Female	36	36.0
Occupation		
Service holder	8	8.0
Businessmen	17	17.0
Farmer	10	10.0
Housewife	36	36.0
Retired	27	27.0
Others	2	2.0
Socioeconomic status		
Low	8	8.0
Middle	52	52.0
High	40	40.0

The majority of participants were aged 51–60 years (40 patients, 40.0%), followed by 61–70 years (38 patients, 38.0%), 71–80 years (18 patients, 18.0%), and over 80 years (4 patients, 4.0%), with a mean age of 65.63 ± 8.13 years (range 55–90 years). Male participants predominated (64 patients, 64.0%), compared to 36 females (36.0%). Most participants were housewives (36 patients, 36.0%) or retired (27 patients, 27.0%), while service holders, businessmen, farmers, and others constituted smaller proportions. Regarding socioeconomic status, the majority belonged to the middle class (52 patients, 52.0%), followed by the high (40 patients, 40.0%) and low (8 patients, 8.0%) socioeconomic categories.

Table 2: Personal and Clinical History of the Study Population (n = 100)

Variable		Frequency (n)	Percentage (%)
Physical activity	Active	11	11.0
	Sedentary	89	89.0
Exercise	Regular	4	4.0
	Occasional	96	96.0
Dietary pattern	Balanced diet	85	85.0
	Overeating	15	15.0
Smoking status	Smoker	63	63.0
	Non-smoker	37	37.0
Hypertension (HTN)	Present	64	64.0
History of IFG/IGT/DM	Present	37	37.0
Dyslipidemia	Present	58	58.0
Ischemic heart disease (IHD)	Present	42	42.0
Transient ischemic attack (TIA)	Present	39	39.0

Most participants were sedentary (89 patients, 89.0%), with only 11 patients (11.0%) being physically active. Exercise habits were mostly occasional (96 patients, 96.0%) rather than regular (4 patients, 4.0%), and the majority followed a balanced diet (85 patients, 85.0%) while 15 participants (15.0%) reported overeating. Smoking was prevalent in 63 participants (63.0%). Regarding clinical risk factors, hypertension

was present in 64 participants (64.0%), history of impaired fasting glucose / impaired glucose tolerance / diabetes mellitus in 37 participants (37.0%), dyslipidemia in 58 participants (58.0%), ischemic heart disease in 42 participants (42.0%), and transient ischemic attack in 39 participants (39.0%).

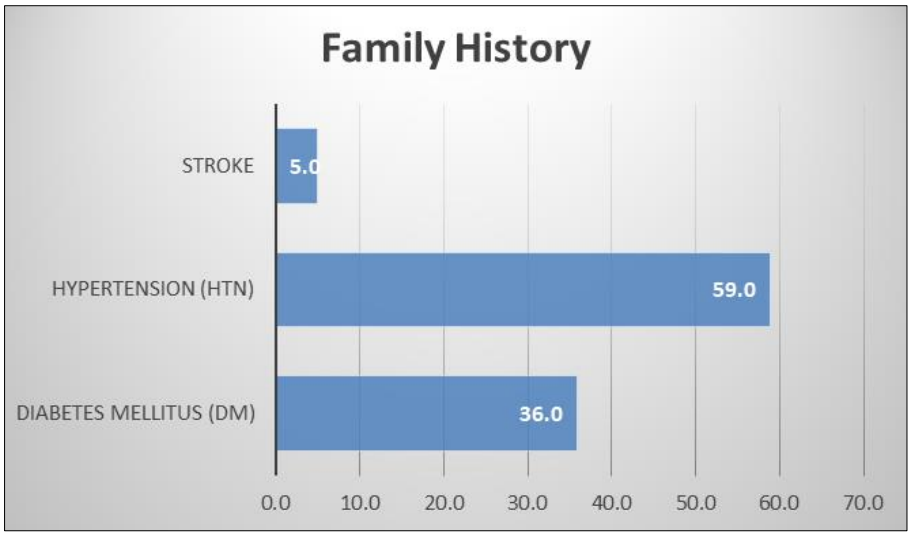

Figure 1: Family History of the Study Population (n = 100)

Family history was most frequently reported for hypertension (59 patients, 59.0%), followed by diabetes mellitus (36 patients, 36.0%) and stroke (5 patients, 5.0%).

Table 3: Degree of Carotid Artery Stenosis in the Study Population (n = 100)

Degree of Stenosis	Frequency (n)	Percentage (%)
Normal	27	27.0
Carotid stenosis present	73	73.0
Mild	60	60.0
Moderate	7	7.0
Severe	6	6.0

Carotid artery stenosis was present in 73 participants (73.0%), with 27 participants (27.0%) showing normal findings. Among those with stenosis, the majority had mild stenosis (60 patients, 60.0%), while moderate and severe stenosis were observed in 7 (7.0%) and 6 patients (6.0%), respectively.

Table 4: Association between Risk Factors and Carotid Artery Stenosis (n = 100)

Risk Factor	Carotid Stenosis Present (n = 73) n (%)	Carotid Stenosis Absent (n = 27) n (%)	Total (n)	p-value
Hypertension (HTN)	51 (69.9)	13 (48.2)	64	0.04
IFG/IGT/DM	24 (32.9)	14 (51.9)	38	0.08
Dyslipidemia	35 (48.0)	7 (25.9)	42	0.04
Ischemic Heart Disease (IHD)	36 (49.3)	6 (22.2)	42	0.01
Transient Ischemic Attack (TIA)	33 (45.2)	6 (22.2)	39	0.03

Significant associations were observed between carotid stenosis and several risk factors. Among participants with stenosis, 51 (69.9%) had hypertension, 35 (48.0%) had dyslipidemia, 36 (49.3%) had ischemic heart disease, and 33 (45.2%) had a history of transient ischemic attack, all with p-values < 0.05. Diabetes (IFG/IGT/DM) was less common among those with stenosis (24 patients, 32.9%), with no statistically significant difference ($p = 0.08$).

DISCUSSION

This cross-sectional study was conducted in the Inpatient and Outpatient Departments of Medicine, the Department of Vascular Surgery, the Department of Neuromedicine, and the Institute of Nuclear Medicine and Ultrasound at Bangabandhu Sheikh Mujib Medical University (BSMMU), including a sample size of 100 cases. The aim of the study was to determine the degree of carotid stenosis and to identify high-risk individuals who may have an increased chance of developing stroke in the future.

The mean age of the study population was 65.63 ± 8.13 years, with a range of 55–90 years. Age group distribution showed 51–60 years (40%), 61–70 years (38%), 71–80 years (18%), and >80 years (4%). Male participants predominated (64%) compared to females (36%), with a male-to-female ratio of 1.8:1. Bari *et al*., [15], reported 42 males and 8 females (F:M = 5.3:1) with a mean age of 50.7 ± 10.4 years (range 30–75 years). Taheri *et al*., [16], studied 352 patients, of whom 144 (41%) were female and 208 (59%) male, with a mean age of 67.5 ± 8.6 years (range 29–84 years); 4% were <50 years, 53.4% were 50–70 years, and 37.2% were >70 years, which is comparable to our findings. Chowdhury *et al*., [17], reported 12 patients in the 51–60 year age group, 16 in 61–70, and 10 in >70 years, with a mean age of 62 ± 10.32 years (range 45–80 years), including 36 males and 4 females.

Regarding socioeconomic status, most participants were middle class (52%), followed by high (40%) and low (8%) socioeconomic categories. In this study, 76% of participants were obese. Regarding personal history, 89% were sedentary, 11% were physically active, 96% exercised occasionally, 85% followed a balanced diet, and 15% reported overeating. Smoking was present in 63% of participants. Clinical history revealed that 64% had hypertension, 37% had IFG/IGT/DM, 58% had dyslipidemia, 42% had ischemic heart disease (IHD), and 39% had a history of transient ischemic attack (TIA). Chowdhury *et al*., [17], reported that 52.5% of patients had a history of TIA.

Smoking is widely recognized as an important risk factor for ischemic stroke in Western countries and is associated with the progression of carotid plaques. It affects fibrinogen levels, packed cell volume, macrophage activity, lipid biochemistry, and arterial wall stiffness. In the study by Shaikh *et al*., [18], smoking was present in 43.59% of cases.

Family history analysis showed that hypertension was most common (59%), followed by diabetes mellitus (36%) and stroke (5%).

Regarding carotid stenosis, 73% of participants had carotid artery stenosis, while 27% had normal findings. Among those with stenosis, 60% had mild, 7% had moderate, and 6% had severe stenosis. Bari *et al*., [15], reported carotid atherosclerosis in 68% of cases, similar to findings by Khoury *et al*., [19]. The frequency of carotid artery stenosis (CAS) in this study was 39%, compared to 44% reported by Ahmad *et al*., [20], and 48.5% by Atif *et al*., [21]. Khan *et al*., [22], reported CAS in 18.18% of patients; however, their study included only patients with stenosis >70%. Lower figures (8%) were reported by Tan *et al*., [23], from Taiwan and Alexandrova *et al*., [24], who reported stenosis ≥70% in 17% of 348 patients.

Significant associations were observed between carotid stenosis and hypertension (69.9%), dyslipidemia (48.0%), IHD (49.3%), and TIA (45.2%), all with $p < 0.05$. Diabetes (IFG/IGT/DM) was less common in patients with stenosis (32.9%, $p = 0.08$). The presence of carotid atherosclerosis among patients without coronary artery disease (CAD) was comparable to findings by Khoury *et al*., [19], who reported 47%. A strong correlation between the extent of CAD and progression of carotid atherosclerosis was also observed by Tanaka *et al*., [25]. Shaikh *et al*., [18], reported that hypertension was the most common risk factor, present in 76.9% of cases, either alone or in combination.

Diabetes is associated with an increased risk of coronary heart disease (CHD) risk factors, including hypertension, dyslipidemia, obesity, and hyperinsulinemia. Additional metabolic disturbances, such as elevated circulating glucose, advanced glycation end products, and oxidation of lipoproteins, may increase the risk and rate of atherosclerosis. Interestingly, diabetes was less common among patients with stenosis in our study. High LDL cholesterol levels are associated with a higher incidence of carotid atherosclerotic disease, whereas high HDL cholesterol levels have a protective role. In the study by Shaikh *et al*., [18], hyperlipidemia was observed in 25.6% of ischemic stroke patients with carotid artery stenosis.

Limitations of the Study

The study had a few limitations:

- The study was conducted in a single hospital, which may not represent the entire country.
- The sample size was relatively small.
- The study period was short.

CONCLUSION

Colour Doppler sonography is a significant advancement in carotid diagnosis. It is a non-invasive, cost-effective, and rapid modality for evaluating the extracranial course of the carotid vessels. It is useful in assessing the prognosis of patients with transient ischemic attacks and thromboembolic stroke, and in guiding immediate medical or surgical management. Carotid stenosis was found to be significantly associated with hypertension, dyslipidemia, ischemic heart disease, and transient ischemic attack. A limitation of Doppler ultrasonography is that it is operator-dependent, and the accuracy of results can vary with the operator's experience. Additionally, its utility for screening patients without risk factors for atherosclerotic disease is limited, and population-wide screening may not be cost-effective.

REFERENCES

1. de Weerd M, Greving JP, de Jong AW, Buskens E, Bots ML. Prevalence of asymptomatic carotid artery stenosis according to age and sex: systematic review

and metaregression analysis. Stroke. 2009 Apr 1;40(4):1105-13.
2. Colgan MP, Strode GR, Sommer JD, Gibbs JL, Sumner DS. Prevalence of asymptomatic carotid disease: results of duplex scanning in 348 unselected volunteers. Journal of vascular surgery. 1988 Dec 1;8(6):674-8.
3. Fine-Edelstein JS, Wolf PA, O'leary DH, Poehlman H, Belanger AJ, Kase CS, d'Agostino RB. Precursors of extracranial carotid atherosclerosis in the Framingham Study. Neurology. 1994 Jun;44(6):1046-.
4. Longstreth Jr WT, Shemanski L, Lefkowitz D, O'Leary DH, Polak JF, Wolfson Jr SK. Asymptomatic internal carotid artery stenosis defined by ultrasound and the risk of subsequent stroke in the elderly: the Cardiovascular Health Study. Stroke. 1998 Nov;29(11):2371-6.
5. Du X, McNamee R, Cruickshank K. Stroke risk from multiple risk factors combined with hypertension: a primary care based case-control study in a defined population of northwest England. Annals of epidemiology. 2000 Aug 1;10(6):380-8.
6. Hadjiev DI, Mineva PP, Vukov MI. Multiple modifiable risk factors for first ischemic stroke: a population-based epidemiological study. European Journal of Neurology. 2003 Sep;10(5):577-82.
7. Fisher M. Occlusion of the internal carotid artery. AMA Archives of Neurology & Psychiatry. 1951 Mar 1;65(3):346-77.
8. Hollander M, Bots ML, Del Sol AI, Koudstaal PJ, Witteman JC, Grobbee DE, Hofman A, Breteler MM. Carotid plaques increase the risk of stroke and subtypes of cerebral infarction in asymptomatic elderly: the Rotterdam study. Circulation. 2002 Jun 18;105(24):2872-7.
9. Wolf PA, Kannel WB, Sorlie P. Asymptomatic carotid bruit and risk of stroke: the Framingham Study. Jama. 1981 Apr 10;245(14):1442-5.
10. Pickett CA, Jackson JL, Hemann BA, Atwood JE. Carotid bruits as a prognostic indicator of cardiovascular death and myocardial infarction: a meta-analysis. The Lancet. 2008 May 10;371(9624):1587-94.
11. Ratchford EV, Jin Z, Di Tullio MR, Salameh MJ, Homma S, Gan R, Boden-Albala B, Sacco RL, Rundek T. Carotid bruit for detection of hemodynamically significant carotid stenosis: the Northern Manhattan Study. Neurological research. 2009 Sep 1;31(7):748-52.
12. Nederkoorn PJ, van der Graaf Y, Hunink MM. Duplex ultrasound and magnetic resonance angiography compared with digital subtraction angiography in carotid artery stenosis: a systematic review. Stroke. 2003 May 1;34(5):1324-31.
13. Wardlaw JM, Chappell FM, Best JJ, Wartolowska K, Berry E. Non-invasive imaging compared with intra-arterial angiography in the diagnosis of symptomatic carotid stenosis: a meta-analysis. The Lancet. 2006 May 6;367(9521):1503-12.
14. Baigent C, Keech A, Kearney P, Blackwell L, Buck G, Pollicino C, Kirby A, Sourjina T, Peto R, Collins R, Simes J. Efficacy and safety of cholesterol-lowering treatment: prospective meta-analysis of data from 90 056 participants in 14 randomised controlled trials of statins (vol 366, pg 1267, 2005). Lancet. 2008 Jun 21;371(9630).
15. Bari MS, Kabir MS, Haque SS, Islam MN, Sarma PK, Ahmed AF, Alam SN, Islam MN. Prevalence of Carotid Artery Arteriosclerosis among Patients Undergoing Coronary Angiography in National Institute of Cardiovascular Diseases.
16. Taheri MS. The prevalence of carotid artery disease in candidates of coronary artery bypass graft. Iranian Journal of Radiology. 2006 Jan 1;3(3).
17. Chowdhury RN, Rahman KM, Khan SU, Sarker R, Nabi S, Siddiqui MR, Mohammad QD. Digital Subtraction Angiogram (DSA) is superior to Duplex Ultrasound (USD) in diagnosis of extracranial carotid stenosis-a comparative study. Journal of Medicine. 2011;12(1):12-6.
18. Shaikh NA, Bhatty S, Irfan M, Khatri G, Vaswani AS, Jakhrani N. Frequency, characteristics and risk factors of carotid artery stenosis in ischaemic stroke patients at Civil Hospital Karachi. JPMA. The Journal of the Pakistan Medical Association. 2010 Jan 1;60(1):8-12.
19. Khoury Z, Schwartz R, Gottlieb S, Chenzbraun A, Stern S, Keren A. Relation of coronary artery disease to atherosclerotic disease in the aorta, carotid, and femoral arteries evaluated by ultrasound. The American journal of cardiology. 1997 Dec 1;80(11):1429-33.
20. Ahmad L. Hyperlipidaemia and its correlation with carotid artery occlusion in patients with ischemic stroke (Dissertation) Karachi. College of Physicians and Surgeons Pakistan. 2002;9:570-80.
21. Atif MA, Ali H, Mahmood T. Frequency of carotid atherosclerosis in cerebral infarction. Pak J Med Sci 2008; 24: 69-73.
22. Khan SN, Vohra EA. Risk factors for stroke: A hospital based study. Pak J Med Sci. 2007 Jan 1;23(1):17-22.
23. Tan TY, Chang KC, Liou CW, Schminke U. Prevalence of carotid artery stenosis in Taiwanese patients with one ischemic stroke. Journal of Clinical Ultrasound. 2005 Jan;33(1):1-4.
24. Alexandrova NA, Gibson WC, Maggisano R. Carotid artery disease and peripheral vascular disease. Stroke. 1995;26:175.
25. Tanaka H, Nishino M, Ishida M, Fukunaga R, Sueyoshi K. Progression of carotid atherosclerosis in Japanese patients with coronary artery disease. Stroke. 1992 Jul;23(7):946-51.