

Prevalence of carotid artery stenosis in ischaemic heart disease patients in Bangladesh

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Abstract

Background: Concurrent carotid artery stenosis and ischaemic heart disease rates are increasing day by day in Bangladesh. Moreover, carotid artery stenosis has been identified as a high-risk factor for postoperative ischaemic cerebral inconvenience following coronary artery bypass graft surgery.

Methods: This observational cross-sectional study was performed to evaluate 200 study patients from July 2017 to June 2018. Patients with coronary artery disease scheduled for isolated elective coronary artery bypass graft surgery were included in the study, excluding those with coexisting valvular or congenital heart disease and emergency coronary artery bypass graft surgery.

Results: About two-thirds of the study patients were 50–59 years old, with a mean age of 57.7 ± 3.06 years. Approximately 70% patients were male; the male:female ratio was 2.1:1. Most of the patients (74.5%) were Muslim. The majority of patients (59.0%) were overweight, and severe carotid artery stenosis was significantly higher in obese patients ($p \leq 0.05$). Furthermore, hypertension and diabetes mellitus were significantly associated with moderate to severe carotid artery stenosis ($p \leq 0.05$). Multi-vessel coronary artery disease was significantly associated with the severity of carotid artery stenosis. Bilateral carotid artery stenosis was significantly associated with the severity of carotid artery stenosis ($p \leq 0.05$).

Conclusion: Routine duplex screening will identify significant carotid artery disease and will subsequently reduce the risk of perioperative stroke in ischaemic heart disease patients undergoing coronary artery bypass graft surgery.

Keywords

Carotid artery stenosis, ischaemic heart disease, coronary artery bypass graft surgery

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Introduction

Approximately 30% of all cases of global mortality are due to cardiovascular diseases, and only 10% are due to cerebrovascular disease.¹ Among these, the major risk factors are hypertension, smoking, increased blood lipid profile, and diabetes. Moreover, these factors play a part in the pathogenesis of cardiovascular disease and in its treatment prognosis.² Carotid stenosis is an associated factor for perioperative ischaemic stroke in patients undergoing myocardial revascularization surgery.³ Ischemic heart disease patients who are undergoing surgical myocardial revascularization have significant carotid artery stenosis (CAS).⁴ Chen et al.⁵ observed that in carotid artery ultrasound scans of ischaemic heart disease (IHD) patients before isolated coronary artery bypass graft surgery (CABG), significant CAS (>75% stenosis)

was identified in 13% of patients. In studies that examined all patients undergoing CABG, $\geq 50\%$ CAS was detected in approximately one-third of study patients.⁶ The proportion of CAS ($\geq 50\%$ stenosis) in CABG patients in Western countries increased from 12.8% to 22%. However, the prevalence of significant CAS (>70% stenosis) ranged from 7% to 11% in IHD patients.⁷

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A current meta-analysis study of CAS and stroke after CABG observed that the probability of perioperative stroke ranges from 2% to 7%.⁸ A survey found that the prevalence of $\geq 50\%$ CAS was 25.4% in a Japanese study population, and the prevalence of CAS in CABG cohort was 23.9% in Korean patients.⁹ In China, studies of concurrent IHD and carotid artery disease (CAD) patients showed that only 2% patients had $\geq 50\%$ carotid stenosis involving common carotid arteries, while the rate was higher in case of internal carotid artery involvement.^{10,11} It was recommended that all Japanese CABG patients undergo the preoperative CAS screening regardless of age.¹¹ Recent European and American CABG guidelines recommend CAS screening among the patients who are ≥ 65 and ≥ 70 years of age.¹² In previous studies of CABG of the patients who suffered from 50% to 80% CAS, the incidence for ischaemic stroke varied from 3% to 10%, and the incidence was higher, approximately 22%, among the patients having $\geq 80\%$ carotid stenosis.¹³

There are some independent risk factors of significant CAS, especially age, sex (female sex), hypertension, dialysis, prior stroke, left main coronary artery disease, and peripheral vascular disease (PVD). Several studies have found that there is an increased risk of significant neurological deficits in IHD patients who also have significant CAS and are undergoing CABG using cardiopulmonary bypass.^{8–15} The aim of this study was to investigate the current proportion and to determine the associated risk factors of CAS in IHD patients.

Patients and methods

This cross-sectional study was carried out among patients with a history of IHD at the Department of Cardiac Surgery, Bangabandhu Sheikh Mujib Medical University, Shahbagh, Dhaka, Bangladesh, from July 2017 to June 2018. Ethical clearance for the study was granted from the relevant departmental academic and technical committee. All patients enrolled in this study were briefed about the nature and the purpose of the study and about the questionnaire to be used for the study. An informed written consent was collected from all the participants. Patients with coronary artery disease scheduled for isolated CABG were included in the study. Patients with coexisting valvular heart disease, congenital heart disease, or emergency CABG were excluded. Haemodynamically unstable patients were also excluded.

Convenience purposive sampling techniques were used to include all available respondents based on recently published paper.¹² Investigational findings including duplex study of neck vessels and blood sampling were also included. A standardized semi-structured data collection sheet was used to collect necessary information on the study subjects, and grading of CAS (mild $< 50\%$ lesion, moderate 50%–70% lesion, severe $> 70\%$ lesion) done depending on recent Gray-Scale and Doppler US Diagnosis criteria by Society of Radiologists in Ultrasound Consensus Conference.¹⁵ All

relevant data were collected from each respondent by use of interviews, measured parameters and investigations in a predesigned format.

Statistical analysis

All of the relevant collected data were compiled on a master chart first and organized by using standard statistical formulas. Percentages were calculated to determine the proportion of the findings. Further statistical analyses were done by the computer software Statistical Package for Social Sciences (SPSS). A chi-square test was performed, and a *p* value of ≤ 0.05 was considered statistically significant.

Result

This study evaluated sociodemographic variables of the study population and observed that a majority of (72.0%) the patients were 50–59 years of age and 28.0% of patients were 60–70 years of age. The mean age was 57.7 ± 3.06 years, and approximately 70% of patients were male. About one-third of patients were service workers (31.5%) or businessmen (28.0%), while 16.5%, 12.0%, and 12.0% of patients were housewives, farmers, and teachers, respectively. Most of the patients (74.5%) were Muslim, 16.0% were Hindu, 5.0% were Buddhist, and 4.5% were Christian. Furthermore, only 36.5% patients were university graduates. A majority of patients (59.0%) were overweight or obese (34.5%). The mean body mass index (BMI) of the overall respondents was 29.57 ± 4.51 kg/m². Regarding demographic characteristics, age and sex were not statistically significantly associated with the extent of CAS. However, severe and moderate CAS was significantly higher in obese patients (Tables 1 and 2).

Most of the study patients (82.0%) had insignificant (mild) CAS ($< 50\%$ stenosis). However, 18% of patients had significant moderate (50%–69% stenosis) or severe ($> 70\%$ stenosis) CAS. Furthermore, approximately 80% of patients had unilateral CAD among the significant CAS population. Most patients (71.5%) had triple or more coronary artery disease associated with risk factors such as hypertension (58.0%), diabetes mellitus (20.0%), and hyperlipidaemia (5.0%); 17.0% of patients had multiple risk factors. Regarding risk factor analysis, severe ($> 70\%$ stenosis) and moderate (50%–69% stenosis) CAS were significantly associated with all of the above risk factors. Moreover, triple vessel or greater coronary artery disease was also significantly associated with the severity of CAS (Table 3).

Discussion

This retrospective study demonstrated the severity of CAS associated with majority male (70%) elderly patients with a mean age of 57.7 ± 3.06 years. A total of 59.0% patients were overweight, and severe CAS was significantly higher in obese patients. In patients with severe CAS, the proportion of

Table 1. Socio-demographic characteristics of the study patients.

Socio-demographic characteristics	Frequency	Percentage
Age group (years)		
50–59	144	72.0
≥60	56	28.0
Mean ± SD	57.7 ± 3.06	
Sex		
Male	136	68.0
Female	64	32.0
Occupation		
Businessman	56	28.0
Farmer	24	12.0
Housewife	33	16.5
Service worker	63	31.5
Teacher	24	12.0
Religion		
Muslim	149	74.5
Hindu	32	16.0
Buddhist	10	5.0
Christian	9	4.5
Educational status		
Primary	24	12.0
SSC	42	21.0
HSC	33	16.5
University graduate	73	36.5
Masters	28	14.0
BMI level (kg/m ²)		
Normal weight	13	6.5
Overweight	118	59.0
Obese	69	34.5
Mean BMI (kg/m ²)	29.57 ± 4.51	

SD: standard deviation; BMI: body mass index.

patients with hypertension and diabetes mellitus was higher. Furthermore, there was a significant association between bilateral CAS (>50% lesion) with the severity of coronary artery disease.

A cross-sectional study was conducted by Kayani et al.¹⁵ at the Rawalpindi Institute of Cardiology, where 140 patients were evaluated with mean age of 59.6 ± 7.1 years. However, 56.6% of patients had insignificant CAS (<50% lesion), while 10.7% of patients had significant carotid stenosis (>50% lesion), and only 8.5% of patients had critical (>70% lesion) carotid stenosis.¹⁵ The 2011 European peripheral artery disease (PAD) strategies extended their recommendation for preoperative duplex scan for CAS in CABG patients to include patients more than 70 years of age or those with evidence of carotid bruit, multi-vessel CAD, cerebrovascular disease, or PAD class I evidence.¹⁶ DaRosa et al.¹⁷ noted that the perioperative risk of stroke after cardiac surgery was 3.8%–7.4% among the patients with more than 50% CAS; moreover, they reported increasing prevalence with more than 70% carotid lesion, which is similar to our study results. In a retrospective cohort of 1558 Chinese patients who underwent CABG, the prevalence of CAS with ≥50% and ≥70% stenosis were 21.2% and 6.7%, respectively.¹⁸ The incidence of perioperative stroke among CABG patients was remarkably higher in study patients having severe or significant CAS, which is also concordant with other articles.^{15,18–20}

In Bangladesh, a study by Ranjan et al.²¹ observed that the majority (46.66%) of patients had significant (75%–90%) CAS associated with complex coronary artery disease. Moreover, approximately 40% of patients experienced right-sided, though 53.33% experienced left-sided and only 6.66% had bilateral carotid endarterectomy in Bangladesh, which is also similar to this study.²¹ However, Fukuda et al.

Table 2. Association of demographic characteristics with carotid artery stenosis based on Duplex scan.

Demographic data	Mild stenosis (n = 164)		Moderate stenosis (n = 24)		Severe stenosis (n = 12)		p value
	N	%	N	%	N	%	
Age (years)							
50–59	120	73.2	15	62.5	8	66.7	0.518 ^{ns}
≥60	44	26.8	9	37.5	4	33.3	
Sex							
Male	110	67.1	16	66.7	10	83.3	0.501 ^{ns}
Female	54	32.9	8	33.3	2	16.7	
Body Mass Index (BMI)							
Normal weight	13	7.9	0	0.0	0	0.0	
Overweight	115	70.1	1	4.2	2	16.7	<0.001 ^s
Obese	36	22.0	23	95.8	10	82.3	

n: number of subjects; ns: not significant; s: significant.

Mild stenosis ≤50% lesion, moderate stenosis = 50%–69% lesion and severe stenosis ≥70% lesion. The percentage of carotid lesion was calculated from the Carotid Duplex Scan findings. Mild carotid stenosis indicates clinically insignificant lesion.

A chi-square test was performed to determine the association; p values ≤0.05 were considered statistically significant.

Table 3. Association of carotid artery stenosis with associated factors and number of carotid artery involvement.

Variables	Mild stenosis (n= 164)		Moderate stenosis (n= 24)		Severe stenosis (n= 12)		p value
	N	%	N	%	N	%	
Risk factors							
Hypertension	113	68.9	3	12.5	0	0.0	<0.001 ^s
DM	38	23.2	1	4.2	1	8.3	0.054 ^s
Hyperlipidaemia	8	4.9	1	4.2	1	8.3	0.852
Multiple comorbidity	5	3.0	19	79.2	10	83.3	0.618
Coronary artery involvement							
Single vessel	7	4.3	3	12.5	0	0.0	0.187
Double vessel	47	28.7	0	0.0	0	0.0	0.001 ^s
Triple or more	110	67.1	21	87.5	12	100.0	0.004 ^s
Number of the carotid artery stenosis							
Bilateral	7	4.3	22	91.7	12	100.0	<0.001 ^s
Unilateral	157	95.7	2	8.3	0	0.0	

DM: diabetes mellitus; n: number of subjects; s: significant.

A chi-square test was performed to determine the association, and p values ≤ 0.05 were considered statistically significant.

observed that the prevalence of severe carotid stenosis (>70%) to be 4.1%–13.3% which also remains in concordance with other study findings.^{22,23} Furthermore, study by Durand et al. also identified elderly age, female gender, PVD, prior stroke, left main coronary disease, multi-vessel CAD, hypertension, and DM as risk factors associated with significant carotid artery lesion, which is also similar to other published articles.^{15,18,20–25}

This study also similarly observed that these risk factors are the strongest predictors of CAS in association with IHD. Patients with concurrent carotid artery and coronary artery disease were demonstrated to have an advanced stage of atherosclerosis involving multiple vascular systems. The occurrence of CAS in patients with IHD disease is more frequent, especially with multi-vessel coronary artery disease. This study investigated several sociodemographic variables and clinical risk factors that are pathognomonic for atherosclerosis, which might demonstrate the necessity for preoperative carotid artery screening in patients undergoing isolated CABG.

Limitations of the study

1. This study design was an observational cohort study, and preventive measures were not analysed in this study.
2. This study was a non-interventional study.
3. The sample size was small, and the follow-up period was too short.

Conclusion

Multi-vessel coronary artery disease patients, especially elderly patients, are frequently associated with significant

CAS. Routine carotid artery screening will identify these high-risk patients and may reduce the risk of perioperative stroke if properly managed with either concurrent or staged carotid procedure along with CABG.

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Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Ethical approval

Ethical approval for this study was obtained from the members of the Thesis Defence Committee, Department of Public Health, North South University, Bangladesh (ID: 1715044080).

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Informed consent

Written informed consent was obtained from all subjects before the study.

Trial registration

This study was registered at the School of Health Science and Life Science, North South University, Bangladesh (ID: 1715044080).

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Supplemental material

Supplemental material for this article is available online at <https://drive.google.com/file/d/1FUgQ8uInKa0q6Ix1jQ60B8wIhluZivY/view>.

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