

M. Sanei Taheri MD¹
 H.R. Haghhighatkah MD²
 M. Hassan Tash MD³
 R. Bakhshian MD⁴
 M. Shakiba MD⁵
 A.H. Jalali MD⁵

1. Assistant Professor, Department of Radiology, Loghman Hakim Hospital, Shahid Beheshti University of Medical Sciences, Tehran, Iran.
 2. Assistant Professor, Department of Radiology, Shohada Hospital, Shahid Beheshti University of Medical Sciences, Tehran, Iran.
 3. Radiologist, Niavaran Imaging Center, Tehran, Iran.
 4. Assistant Professor, Department of Cardiology, Jamaran Hospital, Baghiat-Allah University of Medical Sciences, Tehran, Iran.
 5. Research Unit, Medical Imaging Center, Imam Khomeini Hospital, Tehran University of Medical Sciences, Tehran, Iran.

Corresponding Author:
 Morteza Sanei Taheri
 Address: Department of Radiology,
 Loghman Hakim Hospital, Tehran, Iran.
 Telefax: 009821-55411411
 E-mail: saneim@yahoo.com

Received March 24, 2006;
 Accepted after revision July 21, 2006.

Summer 2006; 4:221-224

The Prevalence of Carotid Artery Disease in Candidates of Coronary Artery Bypass Graft

Background/Objective: Patients with concomitant coronary artery disease and carotid artery disease are at risk of developing serious neurologic events in pre- and post-coronary artery bypass graft (CABG) operation. The objective of this study was to determine the carotid Doppler ultrasonography findings in candidates for CABG.

Patients and Methods: Between September 2004 and October 2005, we performed pre-operative Doppler study of carotid vessels in all candidates for CABG admitted to our hospital. We evaluated the level of stenosis, and the type, site and nature of the plaque for all patients according to the Nicoladis guideline.

Results: Mean±SD age of patients studied was 67.5±8.6 (range: 29-84) years. Among 352 patients undergoing CABG, 143 (40.3%) had carotid disease. Stenosis >50% was observed in 10.5% of females and 5% of males (P=0.07). Significant stenosis (≥50%) was seen in 32 (9.1%) of patients, while 13 (3.8%) had critical stenosis (≥70%); 2 (0.6%) had complete occlusion of the left internal carotid artery. The prevalence of carotid stenosis and atherosclerotic plaques was higher in patients aged >60 years (P=0.002).

Conclusion: The frequency of carotid stenosis in our patients is similar to other reports. Age is the important associated factor for carotid artery disease in candidates of CABG.

Keywords: coronary artery bypass grafting, carotid stenosis, color Doppler ultrasonography

Introduction

Coronary artery disease is the main cause of mortality in the world. The most frequently performed heart surgery nowadays is coronary artery bypass graft (CABG).

In many patients, atherosclerotic narrowing of the coronary and carotid artery occurs simultaneously. The simultaneous involvement of these two anatomic sites is reported to be from 2.3% to 54% in different reports.¹⁻⁵

More than 300,000 patients require CABG every year in the North America.⁶ Patients with coronary artery disease and carotid artery disease are at risk of developing serious neurologic events in the pre and post CABG operation period.⁷ The pre-operative diagnosis and then management of carotid artery disease is therefore, of paramount importance.

There is a lack of pre-operative guidelines for the necessary vascular investigations that should be performed on CABG candidates before they undergo the operation. To the best of our knowledge, the prevalence of carotid artery disease in candidates of CABG has not still been determined in Iran. The objective of this study was to determine the frequency of pathologic findings in the carotid Doppler ultrasonography in candidates of CABG.

Patients and Methods

Of all patients attended Jamaran Baghiat-Allah Hospital for CABG, were

investigated by Doppler ultrasonography to determine the degree and characteristics of atherosclerotic involvements.

Data regarding age and sex were recorded in data collection forms. Doppler examination was performed with a linear probe at 7.5 MHz (Hitachi 525, Japan, Model 2003).

Carotid arteries were evaluated in postero-lateral and antero-lateral approaches and the best view was reported.

First, we assessed carotid arteries in supine position using a gray-scale. The intima-media thickness (IMT) >1 mm was considered as increased IMT. The presence of plaque in carotid arteries was also evaluated. The common carotid, carotid bifurcation, internal carotid artery (ICA) and the external carotid artery (ECA) were evaluated for the type, site and nature of the plaque. We measured the level of stenosis according to the Nicoladis guideline.⁸

We fed the data to SPSS® version 11.5. Student's t, one-way ANOVA and χ^2 tests were used for statistical analyses. A P-value <0.05 was considered significant.

Results

Out of 352 patients studied, 144 (41%) were female and 208 (59 %) were male. The mean±SD age of patients was 67.5±8.6 (range: 29–84) years; 14 (4%) were <50 years; 188 (53.4 %) between 50 and 70; and 131 (37.2%) were >70 years. The mean age of males and females did not differ significantly (P=0.25).

Carotid ultrasonography showed carotid disease in 207 (58.8%) patients; unilateral in 70 (19.9%) and bilateral in 138 (38.9%) patients. Carotid color Doppler examination showed right carotid disease in 175 (49.7%) and left carotid disease in 172 (48.9%) patients. An increase in IMT was observed in 79 (22.5 %) patients; 72 (20.5%) had bilateral and seven had unilateral disease.

Atherosclerotic plaque was observed in 114 (32.4%) patients in the right and in 106 (30.1%) in the left carotid artery.

Characteristics of these plaques are shown in Table 1.

In our study, we found that 63 (17.8%) patients had bilateral stenosis (six with bilateral stenosis >50%; 13 with unilateral stenosis >50%; and 44 with bilateral

stenosis <50%). Eighty-nine (25.3%) patients had unilateral stenosis (seven with >50% and 82 with <50%).

The mean±SD age of those who had no plaque was 65.8±9.5 years; in patients with unilateral plaque was 69.8±6.9; and in those with bilateral plaque was 69±6.6 years (P<0.0001).

Among our patients, two (0.6 %) had complete obstruction of the left carotid artery. Stenosis >50% was observed in 10.5% of females and 5% of males (P=0.07).

The severity of carotid stenosis is shown in Table 2.

Overall, 26 (7.4%) patients had at least one stenosis >50%.

Twohundred and eighty-nine (82.1%) patients were ≥60 years old. The prevalence of carotid stenosis and atherosclerotic plaques in these patients was higher than in patients aged <60 years (Table 3).

Discussion

Atherosclerosis is one of the most common causes

Table 1. Characteristics of the right and left carotid artery plaques: (%)

	Right	Left	P Value
Plaque Nature	Fibrous (10.2)	37 (10.5)	0.99
	Calcified (6.3)	20 (5.7)	0.7
	Fibro-calcified (15.6)	49 (13.9)	0.5
Plaque Type	Linear (19.6)	63 (17.9)	0.52
	Circumferential (12.2)	41 (11.6)	0.73
Plaque Site*	Carotid bulb (14.2)	40 (11.4)	0.25
	Origin of internal carotid (17)	59 (16.8)	0.77
Ulcer	1 (0.3)	0	

*Other plaques were located in other sites such as common carotid artery.

Table 2. Severity of carotid stenosis in Doppler: (%)

	Right	Left	P Value
<50%	96 (27.3)	87 (24.7)	0.43
50%–59%	4 (1.1)	5 (1.4)	0.73
60%–69%	5 (1.4)	5 (1.4)	1

of mortality in western nations.^{9,10} Cardiovascular complications including stroke following CABG increase the post-operative mortality.¹¹⁻¹³

Coronary revascularization in patients without evidence of carotid artery disease carries a risk of stroke of around 1%–2%; in the presence of major carotid artery stenosis, the risk of perioperative stroke is estimated at 14%.¹⁴⁻¹⁷

Carotid angiography is the gold-standard diagnostic modality for the detection of carotid artery disease. Carotid Doppler study is diagnostic in 90%–95% of patients; in 5%–10% of them, however, it fails to diagnose the disease. This can be due to 1) short neck, 2) disease in the distal part of the ICA, 3) presence of proximal critical disease in the common carotid artery, reducing the flow, and 4) kinking in the vessels.¹⁶

The noninvasive nature of ultrasound allows us to design this study to determine the prevalence and characteristics of carotid artery disease in candidates of CABG.

So far, many studies have emphasized the role of carotid ultrasound for prediction of stroke in older patients.^{1,18,19} The Cardiovascular Health Study showed that an increase in the carotid wall thickness causes higher risk for coronary disease and stroke in an elderly population.^{4,20}

Our study confirms that 59.7% of candidates of CABG had some carotid lesions (19.9% unilateral and 38.9% bilateral) which are similar to the report of Cirilo, et al.⁶

The prevalence of carotid artery stenosis >50% in

candidates of CABG varies between 2% and 18% in different studies.^{7, 21, 22} In our study, significant carotid artery stenosis ($\geq 50\%$) was observed in 9.1% of patients; 3.8% had critical ($\geq 70\%$) stenosis. These findings are in keeping with many other published western and Asian reports.^{7,21-23}

Shirani et al. in their investigation on 1045 candidates of CABG found that 6.9% of them had significant carotid stenosis, which is almost similar to our results.²⁴ However, 12.5% of their patients aged >65 years, had significant stenosis which is slightly higher than the rate we observed (8.5% for patients over 60 years of age). This difference may be in part due to the lower age cut-off point we selected (60 vs 65 years). It may also be due to different enrollment set up of our patients; our study was done in a private hospital while Shirani's study was done in a governmental hospital. Different randomization techniques used might be another source of difference.

Our patients were approximately four years older than those in western populations (67.5 ± 8.6 vs 63.5 ± 9.2 years) ($P=0.0001$).¹⁴

This study had some limitations. We did not investigate the relationship between the levels of coronary artery stenosis and carotid artery stenosis. We did also not determine the rate of stroke or other cardiovascular events occurred during CABG. We believe by resolving these limitations, we can establish a protocol for management of candidates of CABG who may have concurrent carotid artery disease.

In conclusion, the prevalence of carotid artery stenosis in our patients is not different from other

Table 3. Comparison of carotid pathologies in patients greater and lower than 60 years old.

Carotid problem		Age group		P-Value
		<60 years old	≥ 60 years old	
Normal carotid	Both side problem	12(27.3%)	115(40.2%)	<0.0001
	One side problem	2(4.5%)	65(27.8%)	
	Normal	30(68.2%)	106(37.1%)	
Intima-Media thickness	Both side	7(15.9%)	60(20.8%)	0.74
	One side	1(2.3%)	5(1.7%)	
	Normal	36(81.8%)	224(77.5%)	
Stenosis	At least one side greater than 50%	2(4.5%)	24(8.5%)	0.002
	All stenosis lower than 50%	6(13.6%)	112(38.8%)	
	No stenosis	36(81.8%)	154(53.3%)	
	Both side	5(11.4%)	55(19%)	

reports. Age is an important associated factor for carotid artery disease in candidates of CABG. Also, gender is a clinically significant associated factor for carotid artery disease in candidates of CABG.

Acknowledgment

The authors wish to thank Marjan Beigee for her excellent assistance in this study.

References

- Berens ES, Kouchoukos NT, Murphy SF, Wareing TH. Preoperative carotid screening in elderly patients undergoing cardiac surgery. *J Vasc Surg* 1992; 15: 313-323
- Sanguigni V, Gallu M, Strano A. Incidence of carotid artery atherosclerosis in patients with coronary artery disease. *Angiology* 1993; 44: 34-38
- Loop FD. Changing management of carotid stenosis in coronary artery surgery patients. *Ann Thorac Surg* 1988; 45: 591-592
- Brener BJ, Brief DK, Alpert J, Goldenkranz RJ, Parsonet V, Feldman S et al. A four year experience with preoperative noninvasive carotid evaluation of 2,026 patients undergoing cardiac surgery. *J Vasc Surg* 1984; 1: 326-328
- Hertzer NR, Loop FD, Beven KG, O'Hara PJ, Krajewski. Surgical staging for simultaneous coronary and carotid disease. A study including prospective randomization. *J Vasc Surg* 1989; 9: 455-463
- Cirilo F, Renzulli A, Leonardo G, Romano G, de Feo M, Corte AD et al. Incidence of Carotid Lesions in Patients Undergoing Coronary Artery Bypass Graft. *Heart Views* 2000; 1: 402-407
- Rath PC, Agarwala MK, Dhar PK, Lakshmi G, Ahsan S, Deb T et al. Carotid Artery Involvement in Patients of Atherosclerotic Coronary Artery Disease Undergoing Coronary Artery Bypass Grafting. *Indian Heart J* 2001; 53: 761-765
- Nicolaidis AN, Shifrin E, Bradbury A, Dhanjil S, Griffin M, Belcaro G et al. Angiographic and duplex grading of internal carotid stenosis: can we overcome the confusion? *J Endovasc Surg* 1996; 3: 158-165
- Reddy KS, Yusuf S. emerging epidemic of cardiovascular disease in developing countries. *Circulation* 1998; 97: 596-601
- Ross R. The pathogenesis of atherosclerosis, a perspective for the 1990s. *Nature* 1993; 362: 801-809
- Rao V, Christakis GT, Weisel RD, Ivanov J, Peniston CM, Ikonomidis JS et al. Risk factors following coronary bypass surgery. *J Card Surg* 1995; 10: 468-474
- Higgins TL, Estafanous FG, Loop FD, Beck gj, Blum jm, Paranandi L. Stratification of morbidity and mortality outcome by preoperative risk factors in coronary artery bypass patients. *JAMA* 1992; 267: 2344
- Reed GL, Singer DE, Picard EH, DeSanctis RW. Stroke following coronary artery bypass surgery. *N Engl J Med* 1988; 319: 1246-1250
- Faggioli GL, Curl GR, Ricotta JJ. The role of carotid screening before coronary artery bypass. *J Vasc Surg* 1990; 12: 724-729
- Rizzo RJ, Whittemore AD, Couper GS, Donaldson MC, Aranki SF, Collins JJ et al. Combined carotid and coronary revascularization: the preferred approach to the severe vasculopath. *Ann Thorac Surg* 1992; 54: 1099-1108
- Dawson DL, Zierler RE, Strandness DE, Clowes AW, Kohler TR. The role of duplex scanning and arteriography before carotid endarterectomy: a prospective study. *J Vasc Surg* 1993; 18: 673-680
- Pillai L, Gutierrez IZ, Curl GR, Gage AA, Balderman SC, Ricotta JJ. Evaluation and treatment of carotid stenosis in open-heart surgery patients. *J Surg Res* 1994; 57: 312-315
- Salonen JT, Salonen R. ultrasonographically assessed carotid morphology and the risk of coronary artery disease. *Arteriosclerosis Thromb* 1991; 10: 1245-1249
- Salasidis GC, Letter DA, Steinmatz OK, Blair JF, Graham AM. Carotid artery duplex scanning in pre-operative assessment for coronary artery revascularization: the association between peripheral vascular disease, carotid artery stenosis, and stroke. *J Vasc Surg* 1995; 25: 154
- O'Leary DH, Polak JF, Kronmal RA, Kittner SJ, Bond MG, Wolfson SK et al. Distribution and correlates of sonographically detected carotid artery disease in Cardiovascular Health Study. *Stroke* 1992; 23: 1752
- Gnasso A, Irace C, Mattioli PL, Pujia A. carotid intima-media thickness and coronary heart disease risk factors. *Atherosclerosis* 1996; 119: 7-15
- Cosgrove DM, Hertzer NR, Loop FD. Surgical management of synchronous carotid and coronary artery disease. *J Vasc Surg* 1986; 4: 690-692
- Schultz RD, Sterpetti AV, Feldhaus RJ. Early and late results in patients with carotid disease undergoing myocardial revascularization. *Ann Thorac Surg* 1988; 45: 603-609
- Shirani Sh, Boroumand MA, Maghsodi N, Shakiba M, Abbasi H, Esfandbod M. Preoperative Carotid Artery Evaluation in 1045 Patients Undergoing Coronary Artery Bypass Graft Surgery. *Iran J Radiol*; 2005 3:49-54