Original Article

Screening of Carotid Artery Stenosis in Coronary Artery Bypass Grafting Patients

Abbas Salehiomran, MD*, Shapour Shirani, MD, Abbasali Karimi, MD, Hossein Ahmadi, MD, Mehrab Marzban, MD, Namvar Movahedi, MD, Naghmeh Moshtaghi, MD, Seyed Hesameddin Abbasi, MD

Tehran Heart Center, Tehran University of Medical Sciences, Tehran, Iran.

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Abstract

Background: *We sought to evaluate the routine echo-Doppler screening of carotid artery stenosis in patients undergoing coronary artery bypass grafting.*

Methods: *A total of 2179 consecutive patients who underwent coronary artery bypass grafting alone or with other cardiac surgery at Tehran Heart Center, Tehran-Iran, between January 2005 and January 2006 were included in this retrospective study. Carotid Doppler was performed for 1604 (81.48%) of these patients.*

Results: *The patients' age ranged between 20 and 84 years (mean: 58.33, SD: 10.08 years). Of the 1604 patients studied, 1186 (73.9%) were men, 592 (36.9%) had diabetes, 598 (37.3%) were smokers, and 194 (12.1%) cases had significant left main stenosis. Twenty-one (1.3%) patients had significant carotid stenosis (> 60% stenosis), which constituted 0.9% of all the bypass surgery candidates. Post-operative cerebrovascular accident was not detected in any of the patients with significant carotid stenosis, but cerebrovascular accident occurred in 22 (1.4%) of the patients without carotid stenosis. Magnetic resonance angiography (MRA) was conducted in 15 patients. In our univariate analysis, female gender (p value = 0.023), hypertension (p value = 0.055), peripheral vascular disease (p value < 0.001), and age (p value = 0.001) were significant in the development of carotid stenosis.*

Conclusion: *Pre-operative duplex carotid screening seems to be necessary in patients when there is hypertension, peripheral vascular disease, female gender, and advanced age.*

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Introduction

Coronary artery bypass grafting (CABG) is one of the most common operations in the field of cardiovascular surgery today. Despite the increasing number of high-risk patients among CABG candidates, a decrease in mortality in CABG has been observed in recent years. Unfortunately, this improvement does not encompass patients with acute coronary syndrome. With all this, morbidity of stroke after CABG remains relatively high due to advanced age and diffuse atherosclerotic disease in candidates for CABG.[1] Advanced age,[2-4] peripheral vascular disease,[4, 5] prior history of cerebral ischemia,[2-4] and atherosclerosis of the ascending aorta[6] have been identified as risk factors for cerebral infarction after CABG.

Excluding intra-operative death, stroke is the most dreaded peri-operative complication in patients undergoing coronary bypass surgery. The incidence of stroke is 2.1-5.2% in bypass

*Corresponding Author: ***Abbas Salehiomran,*** *Assistant Professor of Cardiac Surgery, Tehran University of Medical Sciences, Tehran Heart Center, North Kargar Street, Tehran, Iran. 1411413138. Tel: +98 21 88029256. Fax: +98 21 88029256. Email: abbasomran2006@yahoo.com.*

surgery patients with a mortality of 0-38%.[7] The profound impact of stroke after cardiac surgery is demonstrated by a nearly fivefold increase in hospital mortality (19% versus 4%) and a length of intensive care unit stay reaching more than twice that of uncomplicated operations.[8, 9]

The shedding of debris from carotid or aortic atherosclerotic plaques, embolization of the intracardiac clot, and decrease in perfusion pressure to < 60 mmHg are the etiologic causes of stroke associated with bypass surgery.[10] Moreover, there is still a lack of guidelines as regards pre-operative vascular investigations in patients undergoing CABG: whereas some authors tend to limit pre-operative vascular investigations to patients with symptoms and/or clinical signs of associated vascular disease (e.g. carotid bruit or peripheral pulse losses),[11] others are liable to routinely opt for pre-operative Echo-Doppler screening of carotid vessels.[12]

The present study sought to investigate the routine Echo-Doppler screening in all patients undergoing CABG.

Methods

A total of 2179 consecutive patients who underwent CABG alone or with other cardiac surgery at Tehran Heart Center, Tehran-Iran, between January 2005 and January 2006 were included in this retrospective analysis of prospectively collected data. For 1604 (81.48%) cases of these patients, carotid Doppler was performed by an expert radiologist who had been practicing Doppler studies on a daily basis for over 5 years. The device utilized was a Toshiba Eccocee with linear 7.5-MHZ and convex 3.75-MHZ transducers. A standard protocol based on the Nicolaides criteria was applied to all the patients.[13] In keeping with the American Heart Association (AHA), in this study significant carotid stenosis was considered > 60%.[14]

The patients' data included the following variables: age, sex, smoking, hyperlipidemia (whether the patient had a history of hyperlipidemia diagnosed and/or treated by a physician and/or patient had been assured previously of (a) TG > 200, (b) LDL ≥ 130, (c) HDL < 30, and (d) admission cholesterol > 200 mg/dl), hypertension, peripheral vascular disease (whether the patient had peripheral vascular disease as indicated by claudication either on exertion or at rest, amputation for arterial insufficiency, aorto-iliac occlusive disease reconstruction, peripheral vascular bypass surgery, angioplasty, or stent), diabetes mellitus (defined as a history of diabetes regardless of the duration of disease or need for anti-diabetic agents), left main coronary artery stenosis ≥ 50%, peri-operative cerebral vascular accident (whether or not the patient had a post-operative stroke), and in-hospital mortality (death occurred within 30 days after CABG). The study protocol was approved by the Ethics Committee of Tehran Heart Center.

The numerical variables were presented as mean±SD, and the categorized variables were summarized by percentages. Univariate and multivariate analyses were performed. The groups were assessed according to the following statistical tests: Student's t-test to compare normally distributed continuous variables, Mann-Whitney's U test to compare non-normally distributed variables, and chi-square or Fisher's exact test to compare categorical variables. Predictors exhibiting a statistically significant relation with sternal wound infection (SWI) in the univariate analysis were taken for a multivariate step-wise logistic regression analysis to investigate their independence as predictors. Odds ratio (OR) and 95% confidence interval (CI) were evaluated; p values of 0.05 or less were considered statistically significant. All the statistical analyses were carried out using SPSS 13.0 and SAS 9.1 for Windows.

Results

The patients' age ranged between 20 and 84 years (mean: 58.33, SD: 10.08 years). All the patients were coronary bypass candidates; however, some were concomitantly undergoing another surgery. Of the 1604 patients studied, 1186 (73.9%) were men, 592 (36.9%) had diabetes, 598 (37.3%) were smokers, and 194 (12.1%) cases had significant left main stenosis. Other variables are listed in Table 1.

Table 1. Pre-operative characteristics of patients with carotid duplex screening

Variables	n = 1604 (81.48%)
Female	26.1%
Smoking	37.5%
Diabetes	36.9%
Hypercholesterolemia	76.1%
Hypertension	66.0%
Peripheral vascular disease	4.1%
Family history	30.4%
Left main disease	12.1%
Age (mean±SD) (y)	61±8.80
Ejection fraction (mean±SD)	48.47%±10.92

In patients with atheromatous plaques, 3 had total occlusion of the left internal carotid and 4 had occlusion of the right internal carotid artery. In total, 21 (1.3%) patients had significant carotid stenosis (> 60% stenosis), which constituted 0.9% of all the bypass surgery candidates. Of these patients, 19 had unilateral and 2 had bilateral significant stenosis. Post-operative cerebrovascular accident (CVA) was not detected in any of the patients with significant carotid stenosis, but CVA occurred in 22 (1.4%) of the patients without carotid stenosis. Among these 21 patients, carotid stenting was done in one case pre-operatively. Brain magnetic resonance angiography (MRA) was obtained in 15 patients, but in the remaining cases (n=6) MRA was not considered

because the patients showed no neurological symptoms in their neurological consultation session. In these 15 patients, carotid stenosis was confirmed by MRA. Endarterectomy was not done because of total occlusion of the carotid artery in 7 cases and neurological consultation in 4 patients. Carotid stenting was conducted in 4 cases. In the univariate analysis, female gender (p value = 0.023), hypertension (p value = 0.055), peripheral vascular disease (p value < 0.001), and age (p value = 0.001) were significant in the development of carotid stenosis (Table 2).

Table 2. Characteristics of patients with and without carotid stenosis

Variables	Group 1* (n = 1583)	Group 2** (n = 21)	p value
Age (mean±SD) (y)	60.97±8.79	67.24±7.75	0.001
Female	25.8%	47.6%	0.023
Smoking	37.6%	28.6%	0.396
Diabetes	37%	28.6%	0.426
Hyperlipidemia	76.1%	76.2%	0.994
Hypertension	65.8%	85.7%	0.055
PVD	3.3%	61.9%	< 0.001
Left main disease	11.9%	23.8%	0.165
In-hospital mortality	1.6%	0	1.000
LVEF (mean±SD)	48.44%±10.89	50.48%±13.13	0.396
CVA	1.4%	0	1.000

*Without significant carotid stenosis
**With significant carotid stenosis
PVD, Peripheral vascular disease; LVEF; Left ventricular ejection fraction; CVA, Cerebrovascular accident

Discussion

An association between carotid and coronary artery disease is well recognized. Routine pre-operative duplex carotid screening of all coronary surgery patients, albeit common, may delay surgery and increase cost. In our study of patients with significant carotid artery stenosis, CVA did not occur in any of the patients; an adequate focused history and physical examination could, therefore, identify patients at risk for the presence of significant carotid disease and obviate the need for a costly routine scanning of all CABG patients. On the other hand, female gender, age, hypertension, and peripheral vascular disease were significant risk factors for developing carotid stenosis (p value ≤ 0.05) in our univariate analysis. Interestingly, the factors that other studies deem significant, namely cigarette smoking and left main disease,[7, 15, 16] had no influence on the developing of carotid stenosis in our patients.

Nicolaides et al.[13] demonstrated that the advantages of Duplex US, including absence of complications, relatively low costs, and widespread availability, were weakened by the lack of standards for quantifying degrees of stenosis. Screening of carotid arteries for stenosis combined with endarterectomy reduces peri-operative as well as post-operative stroke. Screening also helps to discover and follow significant carotid artery stenosis cases without neurological symptoms. The presence of significant carotid artery stenosis can change the bypass schedule to a bypass with endarterectomy or endarterectomy and then bypass surgery.17 In light of our results, it seems that the presence of factors such as hypertension, peripheral vascular disease, female gender, and advanced age renders pre-operative duplex carotid screening necessary.

Conclusion

It is deserving of note that in our patients, CVA occurred only in cases that had no significant carotid artery stenosis. This may be partially due to more precaution exercised by the cardiac surgeon in patients with significant stenosis during surgery such as high perfusion pressure, prevention of aggressive manipulation of the aorta, or use of side-biting clamp (Satinsky) of the ascending aorta. Overall, it seems that peri-operative CVA is multifactorial and has no direct (linear) relationship with stenosis of the carotid artery. We would, therefore, recommend that carotid Doppler study be carried out in selected patients to save time and reduce cost.

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