Presence of Carotid and Peripheral Arterial Disease in Patients With Left Main Disease

Aaron L. Doonan, MD[a], Juhana Karha, MD[b], Thomas P. Carrigan, MD[a], Anthony A. Bavry, MD, MPH[b], Susan M. Begelman, MD[c], Stephen G. Ellis, MD[b], Jay Yadav, MD[d], and Deepak L. Bhatt, MD[b,*]

Left main (LM) coronary disease, carotid artery disease, and peripheral arterial disease each reflects advanced atherosclerosis. The frequency of their coexistence in the same patient has not been fully elucidated. All coronary angiograms obtained at the Cleveland Clinic from November 2003 to October 2005 were analyzed for presence of LM stenosis ≥50%. Patients with previous coronary artery bypass graft surgery were excluded. Patients with available carotid ultrasound and ankle-brachial indexes formed the analysis cohorts. A total of 10,298 coronary angiograms were obtained in 9,715 patients. There were 186 patients with LM disease and 1,913 patients without LM disease with carotid artery ultrasound data. There were 29 patients with LM disease and 604 patients without LM disease with available ankle-brachial indexes. Patients with significant LM disease more frequently had associated carotid stenosis ≥60% compared with patients without LM disease (31.2% vs 15.2%, p <0.0001). Patients with LM disease had lower mean ankle-brachial indexes compared with patients without LM disease (0.78 vs 0.87, p = 0.042). In conclusion, compared with patients without LM disease, patients with LM disease have a higher burden of advanced atherosclerosis as evidenced by a higher prevalence of significant carotid stenosis and lower ankle-brachial indexes. **(Am J Cardiol 2007;100:1087–1089)**

The frequency of carotid stenosis and peripheral arterial disease (PAD) in relation to the overall level of coronary artery disease (CAD) has not been fully elucidated. Together they confer a higher risk of morbidity and mortality and identification might affect treatment.[1,2] This study examined how often carotid arterial disease and PAD disease were present in patients with significant left main (LM) CAD.

Methods and Results

From November 18, 2003 to October 4, 2005, a total of 10,298 consecutive coronary angiograms were obtained in 9,715 patients at the Cleveland Clinic (Cleveland, Ohio), excluding patients with previous coronary artery bypass grafting. Angiographic appearance of coronary arteries and baseline clinical information were assessed by physicians and entered into a diagnostic catheterization database. Significant coronary disease was defined as any stenosis ≥50%. Study patients with available carotid arterial assessment up to 1 year before cardiac catheterization were added to these data (n = 2,099). Percent carotid stenosis was analyzed by B-mode duplex ultrasonography. Left and right carotid percent stenoses, peak systolic velocity, and end-diastolic velocity were each combined and reported as mean values. Study patients with available ankle-brachial indexes up to 1 year before cardiac catheterization were also added to these data (n = 633). Lowest ankle-brachial index was used in analysis for patients with discrepant right and left sides.

Patients were grouped and analyzed by the presence or absence of LM disease. Continuous variables are expressed as means ± SDs and categorical variables as frequencies (percentages). Continuous variables were evaluated using Student's *t* test for parametric data and by Mann-Whitney U test for nonparametric data. Categorical variables were evaluated using Fisher's exact test. Statistical significance was defined as a p value <0.05. All data analysis was performed using SPSS 11.5.0 (SPSS, Inc., Chicago, Illinois).

A total of 10,298 coronary angiograms were obtained in 9,715 study patients for various indications. A total of 348 patients were found to have significant LM disease. Of these, only 2 patients had isolated LM disease.

Mean ankle-brachial index (Figure 1) in all patients presenting for coronary angiography without LM disease was 0.87 ± 0.20 but was lower in patients with LM disease (0.78 ± 0.24, p = 0.042). In all patients with CAD, ankle-brachial indexes were significantly lower in patients with LM disease only compared with patients with 1-vessel disease (p = 0.028). All patients with CAD had mean ankle-brachial indexes significantly lower than in patients without CAD (0.82 ± 0.22 vs 0.94 ± 0.14, p <0.0001).

Mean carotid peak systolic velocity (Figure 2) was significantly different between all patients presenting for cardiac catheterization without LM disease and patients with LM disease (105 ± 64 vs 124 ± 73 cm/second, p = 0.001). This also includes progressive levels of CAD versus LM

Departments of [a]Internal Medicine and [b]Cardiovascular Medicine, Cleveland Clinic, Cleveland, Ohio; [c]Nuvelo, Inc., San Carlos, California; and [d]CardioMEMS, Atlanta, Georgia. Manuscript received February 13, 2007; revised manuscript received and accepted May 8, 2007.

*Corresponding author: Tel: 216-445-4042; fax: 216-445-8531.

E-mail address: bhattd@ccf.org (D.L. Bhatt).

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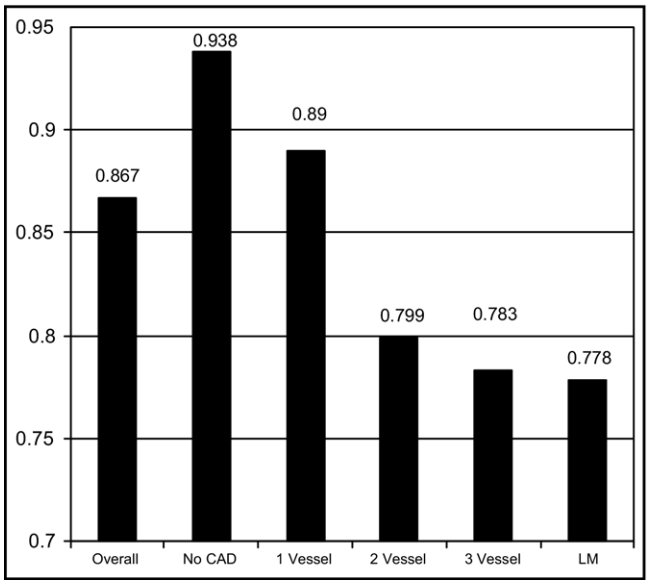

Figure 1. Mean ankle-brachial indexes (ABIs) of all patients presenting for coronary angiography, including those without angiographic CAD, were outside the normal range as defined by current American College of Cardiology/American Heart Association guidelines. In all patients with multivessel CAD, mean ankle-brachial index was <0.8, a level that may be associated with symptoms of intermittent claudication. Patients with LM disease had the lowest mean ankle-brachial index.

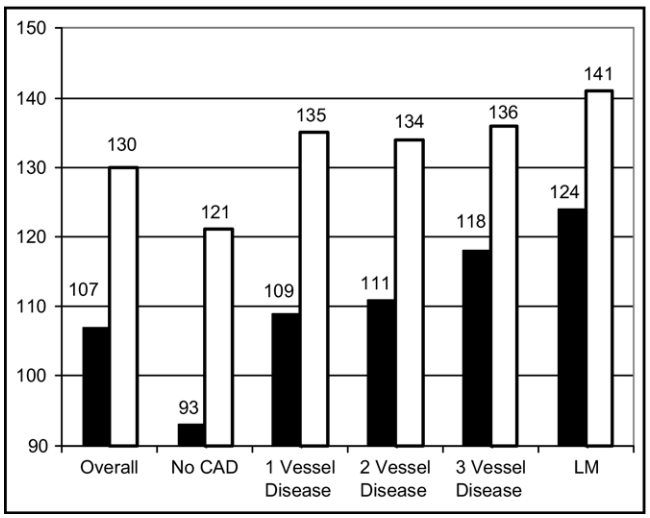

Figure 2. Carotid peak systolic velocity (PSV; centimeters per second) *(black bars)*, 1 measurement used to quantify high-grade stenoses on duplex ultrasonography, was significantly increased with progressive levels of CAD, peaking in patients with LM disease. Subclavian peak systolic velocities *(white bars)* were also significantly increased in patients with LM disease.

disease ($p < 0.0001$ for 1-vessel disease, $p = 0.003$ for 2-vessel disease, and $p = 0.004$ for 3-vessel disease; Figure 2). Carotid end-diastolic velocity was not significantly different between all patients and those with LM disease, but it did differ in patients with 1-vessel CAD and LM disease ($p = 0.042$). Of patients with available carotid analysis, 31.2% with LM disease had carotid stenosis ≥60% compared with 15.2% without LM disease ($p < 0.0001$; Figure 3). Of

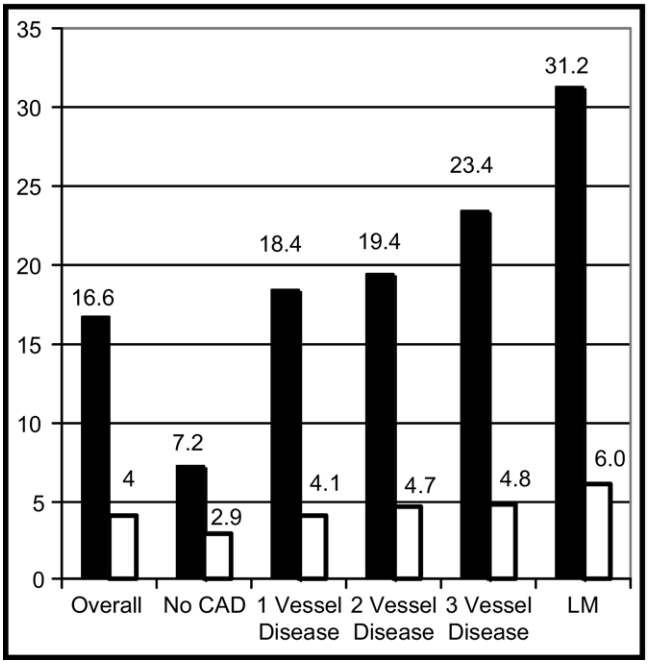

Figure 3. Significant carotid disease (stenosis ≥60%) *(black bars)* was more prevalent in patients with progressive CAD, peaking in patients with LM disease. Subclavian stenosis (>50%) *(white bars)* was not statistically significant between groups but did show a trend similar to carotid stenosis.

patients with any CAD, carotid stenosis ≥60% was still significantly more prevalent in patients with LM disease (31.2% vs 20.6%, $p = 0.002$).

In all patients presenting with coronary angiograms without LM disease, subclavian peak systolic velocity was higher with LM disease (129 ± 48 vs 141 ± 53 cm/second, $p = 0.006$). Patients with subclavian stenosis ≥50% did not significantly differ between groups (6.0% in patients with LM disease vs 3.9% in those without LM disease, $p = 0.32$; Figure 3).

Discussion

We found that overall atherosclerotic burden in patients presenting for cardiac catheterization as measured by carotid artery stenosis and ankle-brachial index was significantly higher in patients with angiographically proved LM CAD than in patients without it. Patients presenting for coronary angiography with available ankle-brachial indexes did have PAD, but PAD was present to a greater degree in patients with LM disease. Patients with CAD had significantly lower ankle-brachial indexes compared with patients without CAD. However, patients with 2-vessel, 3-vessel, and LM disease had significantly lower ankle-brachial indexes than patients with 1-vessel CAD. This supports the observation that PAD is associated with advanced CAD.

Similarly, detection of significant carotid stenosis noninvasively could help identify patients at risk for CAD previously believed to be at low risk.[3] This should prompt more intensive treatment of traditional modifiable cardiovascular risk factors such as hyperlipidemia and hypertension, typically reserved for proved CAD. Our findings showing an association of carotid stenosis, PAD, and CAD also support systematic noninvasive screening[4] for atherosclerosis in patients with CAD, especially for those with LM disease.[1,5,6]

This retrospective study is limited by possible selection bias because all study patients presented in some manner for coronary angiography, so the results may not be applicable to the general population. However, it is relevant for patients presenting for coronary angiography at tertiary care centers. Patients were included from a single center, possibly resulting in sampling bias. We could not assess the possible relation of a high ankle-brachial index (>1.50) on CAD or mortality because standards in our vascular laboratory were only recently changed to measure and report this finding. However, this association has been explored in other publications[7] and could be an avenue for further study as standards are revised. Although a large number of patients were initially included in the study, relatively small numbers of patients had available carotid and peripheral screening studies within the specified time frame. The indication for screening of carotid and peripheral diseases was not evaluated in this study. This potentially increases the perception of higher disease burden in the LM group because these patients undergo more carotid and peripheral screenings before bypass surgery. Significant differences between groups might be discerned if more patients were included or studied prospectively.

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