# Prevalence of Narrowing ≥50% of the Left Main Coronary Artery Among 17,300 Patients Having Coronary Angiography

George D. Giannoglou, MD, PhD*, Antonios P. Antoniadis, MD, MSc, Yiannis S. Chatzizisis, MD, MSc, Efthalia Damvopoulou, MD, MSc, George E. Parcharidis, MD, PhD, and George E. Louridas, MD, PhD

**We sought to investigate the prevalence of left main coronary artery significant stenosis (LMSS) (≥50% of the luminal diameter) in an angiographic series of patients, to describe the associated coronary stenoses, and to assess the influence of age and gender on these findings. The angiograms of 17,323 consecutive patients from January 1, 1984 to December 31, 2003 were retrospectively analyzed. LMSS was found in 823 patients (4.8%) and was more predominant in men ($p < 0.001$). Men with LMSS (median age 63 years, interquartile range 57 to 69) were younger than the women (median age 67 years, interquartile range 61 to 72, $p < 0.001$). Logistic regression analyses revealed male gender (odds ratio [OR] 1.79, 95% confidence interval [CI] 1.46 to 2.18, $p < 0.001$) and age (OR 1.05, 95% CI 1.04 to 1.06, $p < 0.001$) as independent predictors of LMSS. In the total series, luminal narrowing ≥50% in the right coronary artery, the left circumflex artery, the left anterior descending artery, the intermediate artery, first and second obtuse marginal branch, posterior descending artery, and posterolateral branch was significantly more frequent in association with LMSS. Approximately half of the patients with LMSS also had triple-vessel disease. Co-existent disease in 3 major vessels with minor branches was more evident in men (men/women OR 1.77, 95% CI 1.08 to 2.88, $p = 0.02$). In contrast, the remaining 4.7% of patients with LMSS, and this was more frequent in women (men/women OR 0.31, 95% CI 0.15 to 0.61, $p = 0.001$). In conclusion, men presented more frequently with LMSS and at a younger age than women. Also, LMSS with co-existent triple-vessel disease was more common in men.**  **(Am J Cardiol 2006;98:1202–1205)**

The aim of our present study was to determine the prevalence of ≥50% left main coronary artery (LMCA) narrowing in patients referred for coronary angiography to our institution and examine its association with ≥50% stenoses in the rest of the coronary tree. We also sought to describe the age and gender effects on the prevalence of luminal narrowing ≥50% in the LMCA.

## Methods and Results

The data of 17,323 consecutive patients who underwent coronary angiography for any reason at our institution in Northern Greece from January 1, 1984 to December 31, 2003 were assessed through our database and retrospectively analyzed. The demographic parameters, in particular age and gender, of the investigated patients were recorded and summarized. All the angiograms were evaluated by an independent, expert interventional cardiologist blinded to the patients' clinical and laboratory data. The angiographic outcome regarding LMCA was classified into 3 categories: (1) left main significant stenoses (LMSS), defined as the occurrence of ≥1 lesion causing a reduction of the lumen ≥50% in diameter; (2) left main nonsignificant stenoses corresponding to obstructions <50%; and (3) normal LMCA with no obstruction revealed on the angiogram. Patients with LMCA obstruction <50% or with an angiographically normal LMCA were classified together as 1 group and compared with the group of patients with LMCA stenosis ≥50%. The same classification scheme was also applied to lesions in the other coronary arteries. Moreover, these vessels were divided into 2 groups: (1) major vessels, including the left anterior descending, left circumflex, right coronary, and intermediate arteries; and (2) minor branches corresponding to the remaining of the coronary arteries. With regard to the extent of coronary stenoses, the lesions were classified into 7 categories according to the presence of significant obstruction of ≥50% in (1) 1 major vessel, (2) 1 major vessel with minor branches, (3) 2 major vessels, (4) 2 major vessels with minor branches, (5) 3 major vessels, (6) 3 major vessels with minor branches, and (7) minor branches only. The institutional medical ethics committee approved the study.

The statistical analyses were performed with the Statistical Package for Social Sciences, version 12.0 (SPSS, Chicago, Illinois). A p value of <0.05 was considered statistically significant. Because age did not fulfill the assumption of normality in certain subgroups of our series, it was summarized as the median and interquartile range (IQR), the latter representing the values between the 25th and 75th percentile of its distribution. The remaining variables stud-

First Cardiology Department, AHEPA University Hospital, Aristotle University Medical School, Thessaloniki, Greece. Manuscript received February 17, 2006; revised manuscript received May 19, 2006 and accepted May 23, 2006.

This study was supported by a grant from the Greek State Scholarships Foundation, Athens, Greece.

*Corresponding author: Tel: 30-2310-994-837; fax: 30-2310-994-837.
*E-mail address:* yan@med.auth.gr (G. D. Giannoglou).

0002-9149/06/$ – see front matter 
doi:10.1016/j.amjcard.2006.05.052

Table 1
Demographic and angiographic characteristics of subjects with ≥50% left main coronary artery (LMCA) disease

| Characteristic | Total (n = 823) | Men (n = 694) | Women (n = 129) |
|---|---|---|---|
| Age (yrs) | | | |
| Median | 64 | 63 | 67 |
| IQR | 58–70 | 57–69 | 61–72 |
| Extent of co-existent ≥50% luminal stenoses (%) | | | |
| 1 major vessel | 72 (8.7%) | 59 (8.5%) | 13 (10.1%) |
| 1 major vessel and branches | 34 (4.1%) | 30 (4.3%) | 4 (3.1%) |
| 2 major vessels | 145 (17.6%) | 119 (17.1%) | 26 (20.2%) |
| 2 major vessels and branches | 100 (12.2%) | 84 (12.1%) | 16 (12.4%) |
| 3 major vessels | 222 (27.0%) | 190 (27.4%) | 32 (24.8%) |
| 3 major vessels and branches | 207 (25.2%) | 185 (26.7%) | 22 (17.1%) |
| Branches | 4 (0.5%) | 2 (0.3%) | 2 (1.6%) |
| Solitary LMSS | 39 (4.7%) | 25 (3.6%) | 14 (10.9%) |
| Prevalence of co-existent ≥50% luminal stenoses (%) | | | |
| Left anterior descending artery | 654 (79.5%) | 560 (80.7%) | 94 (72.9%) |
| Left circumflex artery | 543 (66.0%) | 469 (67.6%) | 74 (57.4%) |
| Right | 642 (78.0%) | 552 (79.5%) | 90 (69.8%) |
| Intermediate artery | 85 (10.3%) | 75 (10.8%) | 10 (7.8%) |
| First diagonal branch | 140 (17.0%) | 119 (17.1%) | 21 (16.3%) |
| Second diagonal branch | 20 (2.4%) | 15 (2.2%) | 5 (3.9%) |
| First septal branch | 10 (1.2%) | 10 (1.4%) | 0 (0.0%) |
| Second septal branch | 2 (0.2%) | 2 (0.3%) | 0 (0.0%) |
| First obtuse marginal branch | 178 (21.6%) | 162 (23.3%) | 16 (12.4%) |
| Second obtuse marginal branch | 32 (3.9%) | 29 (4.2%) | 3 (2.3%) |
| Third obtuse marginal branch | 2 (0.2%) | 2 (0.3%) | 0 (0.0%) |
| Right ventricular branch | 7 (0.9%) | 6 (0.9%) | 1 (0.8%) |
| Acute marginal branch | 1 (0.1%) | 1 (0.1%) | 0 (0.0%) |
| Posterior descending artery | 52 (6.3%) | 41 (5.9%) | 11 (8.5%) |
| Posterolateral branch | 27 (3.3%) | 26 (3.7%) | 1 (0.8%) |
| Other coronary branches | 4 (0.5%) | 3 (0.4%) | 1 (0.8%) |

ied were categorical and included gender, degree of luminal narrowing in the LMCA (≥50%, <50%, or no obstruction), and the presence or absence of ≥50% luminal stenosis in the other coronary arteries; hence, they were summarized as absolute values and percentages. Comparisons between groups were done using the chi-square test and Fisher's exact test for categorical variables. The Student's *t* test or the nonparametric Mann-Whitney U test was used for continuous variables. The influence of age and gender on the presence of LMSS was investigated by logistic regression analysis.

Angiography was performed in our subjects as a part of the investigation of suspected ischemic heart disease in 83.4%, valvular heart disease in 4.7%, congenital heart disease in 0.5%, other forms of heart disease in 0.6%, and for a combination of these in 10.8% of our subjects. The demographic and angiographic characteristics of the subjects with LMSS are listed in Table 1. LMSS was found in 823 subjects, comprising 4.8% of the total angiographic cases. Of these, 694 were men (5.1% of the total number of men) and 129 were women (3.4% of the total number of women). LMCA stenosis <50% was present in 567 subjects (3.3%; 476 men and 91 women). The remaining 15,933 patients (12,324 men and 3,609 women) had normal LMCAs. Regarding the odds ratios (ORs) between genders in the total population, men were more likely to present with LMSS (men/women OR 1.56, 95% confidence interval [CI] 1.28 to 1.88, p <0.001) or <50% LMCA obstruction (men/women OR 1.5, 95% CI 1.12 to 1.86, p <0.001). However, in these patients with ≥50% stenosis in the coronary tree (regardless of the affected vessel) (n = 13,310), we found no significant gender differences in the prevalence of LMSS (men/women OR 1.04, 95% CI 0.86 to 1.26, p = 0.70).

Patients with LMSS were older compared with those with significant (≥50%) stenoses elsewhere in the coronary tree (median age 64 years, IQR 58 to 70, vs median age 60 years, IQR 53 to 66, p <0.001). Binary logistic regression analysis revealed that the presence of LMSS was associated with the progression of age (OR 1.05, 95% CI 1.04 to 1.06, p <0.001). Thus, for each extra year of age, the likelihood of presenting with LMSS increased by a factor of 1.05. Men with LMSS were significantly younger than the women (median age 63 years, IQR 57 to 69, vs median age 67 years, IQR 61 to 72, p <0.001). By applying binary logistic regression analysis in men and women separately, the following was revealed regarding the effect of age in the likelihood for LMSS: men OR 1.05, 95% CI 1.04 to 1.06, p <0.001 and women OR 1.06, 95% CI 1.03 to 1.08, p <0.001. Thus, the likelihood of LMSS was increased by age in each gender separately. The effect of gender and age on the presence of LMSS was also predicted by a logistic regression model, which revealed for male gender an OR of 1.79 (95% CI 1.46 to 2.18, p <0.001) and for each extra year of age an OR of 1.05 (95% CI 1.04 to 1.06, p <0.001, suggesting that age and male gender are independent predictors for LMSS.

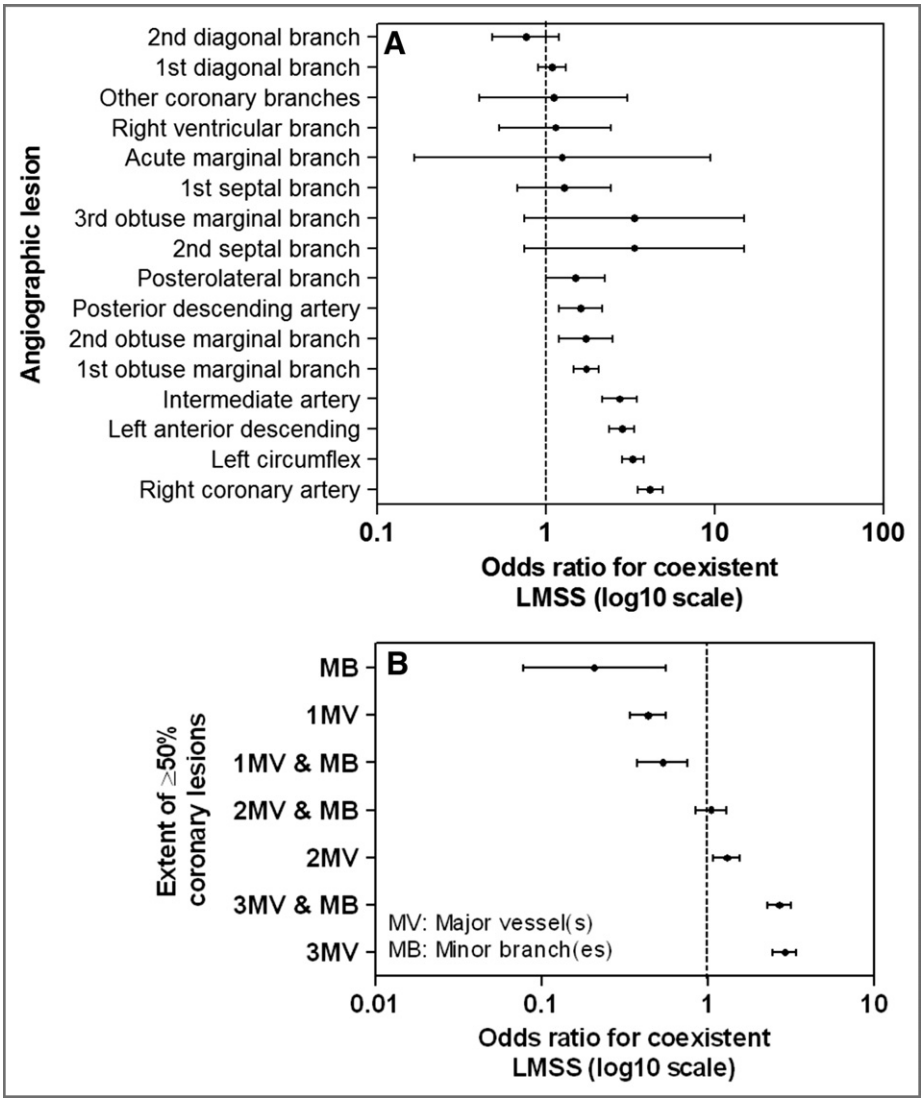


Figure 1. *(A)* OR plot for co-existence of ≥50% LMSS with ≥50% stenosis in each of other coronary arteries in total study population. Obstruction of ≥50% in right coronary artery, left circumflex artery, left anterior descending artery, intermediate artery, first and second obtuse marginal branch, posterior descending artery, and posterolateral branch was associated with co-existent LMSS ($p < 0.05$). *(B)* OR plot for association of LMSS with each category of extent of coronary artery disease in total study population. Obstruction ≥50% in 3 major vessels, 3 major vessels with minor branches, and 2 major vessels was associated with presence of LMSS ($p < 0.01$). Disease of ≥50% in 1 major vessel, 1 major vessel with minor branches, and in minor branches only was associated with absence of LMSS ($p < 0.001$).

The frequency of co-existent ≥50% obstruction in the rest of the coronary tree in patients with LMSS is listed in Table 1. In our total study population, luminal narrowing of ≥50% in right coronary artery, left circumflex artery, left anterior descending artery, intermediate artery, first and second obtuse marginal branch, posterior descending artery, and posterolateral branch was recorded significantly more frequently in association with LMSS (Figure 1).

Table 1 also lists the distribution of the several categories of the extent of coronary artery disease in patients with LMSS. In 429 patients (52.1%), LMSS was accompanied with triple-vessel disease. In our total study population, obstruction in 2 major vessels, 3 major vessels, and 3 major vessels with minor branches was associated with the presence of coexistent LMSS (OR 1.3, 95% CI 1.09 to 1.58, $p < 0.01$; OR 2.91, 95% CI 2.48 to 3.43, $p < 0.001$, and OR 2.7, 95% CI 2.29 to 3.18, $p < 0.001$, respectively). In contrast, obstruction in 1 major vessel, 1 major vessel with minor branches, and only minor branches was associated with the absence of LMSS (OR 0.44, 95% CI 0.34 to 0.56, $p < 0.001$; OR 0.54, 95% CI 0.38 to 0.76, $p < 0.001$; and OR 0.21, 95% CI 0.08 to 0.56, $p < 0.001$, respectively; Figure 1).

LMSS with co-existent disease in 3 major vessels with minor branches was most frequent in men (men/women OR 1.77, 95% CI 1.08 to 2.88, $p = 0.02$). LMSS without lesions in any of the other coronary arteries was found in 39 patients (4.7%) and most commonly occurred in women (men/women OR 0.31, 95% CI 0.15 to 0.61, $p = 0.001$). In the remaining subclasses of coronary involvement in patients with LMSS, no significant gender differences were recorded.

## Discussion

The large number of patients included in our study (n = 17,323) enabled us to come to a secure and solid estimation regarding the prevalence of LMSS in the studied population. The prevalence of LMSS in our series (n = 823, 4.8%) was within the range of prevalence rates reported in previous studies.[1–5] Several studies in the past[6,7] reported the absence of a substantial gender difference in the prevalence of LMSS in patients with angiographically significant coronary disease, although different angiographic thresholds for coronary artery disease were used in each study. Consistent with those findings, in our group of patients with ≥50% coronary stenosis, regardless of the affected vessel, we found no significant gender differences in the prevalence of LMSS. Nonetheless, in our total study population (which also included patients with <50% coronary stenosis and normal coronary arteries), LMSS was significantly predominant in men compared with women (5.1% vs 3.4%).

The median age of those with LMSS in our series was 64 years (IQR 58 to 70). The mean age of patients with LMSS was 62 years in a previous study,[8] and another study[9] in India reported a mean age of 61.6 ± 9.1 years. Regression analyses revealed age and male gender to be independent predictors of LMSS. Also, men with LMSS were markedly younger than the women, a finding that could be attributed to the established higher risk of men to develop early atherosclerosis.[10] Overall, patients with coronary artery disease without left main involvement were significantly younger than those with LMSS, a finding that, although previously reported,[11] remains unexplained.

Obstruction of ≥50% in the right coronary artery, left circumflex artery, left anterior descending artery, intermediate artery, first and second obtuse marginal branch, posterior descending artery, and posterolateral branch was associated with LMSS. Moreover, LMSS occurred together with ≥1 occurrences of ≥50% stenosis in the rest of the coronary arteries in 95.3% of patients compared with 52.1% of patients with co-existent triple-vessel disease. This is generally consistent with previous reports of either autopsy[12] or angiographic[13,14] series. In contrast, a study in Singapore[15] reported a prevalence rate of 37.6% for triple-vessel disease among patients with LMCA disease, a rate considerably less than ours. Thus, it seems that lesions throughout the rest of the coronary arterial tree accompany LMSS. This could indicate either an extension of a left main lesion to the proximal portions of the left anterior descending artery and left circumflex artery or severe diffuse coronary atherosclerosis. It seems that the former is more likely, taking into account the natural history of atherosclerosis, which involves focal lesions at initial stages that progress downstream over the long term.[16]

Our study was limited in that it was confined to patients referred for coronary angiography; thus, the real prevalence of LMSS in the general population remains unknown. Also, the burden of coronary artery disease in human coronary arteries was determined from angiographic data, although other imaging modalities such as intravascular ultrasound are more accurate in coronary imaging. Finally, the gender groups studied were unequal. This fact, which was also encountered in previous studies on this subject,[6,7] may have influenced the results, because the relatively small number of women limited the power of the comparisons performed.

In conclusion, in this study, we found an overall prevalence of 4.8% for LMSS in an angiographic series. Men presented more frequently with LMSS and at a younger age than women.


1. Cohen MV, Cohn PF, Herman MV, Gorlin R. Diagnosis and prognosis of main left coronary artery obstruction. *Circulation* 1972;45:I57–I65.
2. Takaro T, Hultgren HN, Lipton MJ, Detre KM. The VA Cooperative randomized study of surgery for coronary arterial occlusive disease. II. Subgroup with significant left main lesions. *Circulation* 1976;54: III107–III117.
3. Taylor HA, Deumite NJ, Chaitman BR, Davis KB, Killip T, Rogers WJ. Asymptomatic left main coronary artery disease in the Coronary Artery Surgery Study (CASS) registry. *Circulation* 1989;79:1171–1179.
4. Hind CR, Oldershaw PJ, Miller GA. Left main coronary artery stenosis: experience of 93 patients. *J Cardiovasc Surg* 1982;23:394–400.
5. Cohen MV, Gorlin R. Main left coronary artery disease. Clinical experience from 1964–1974. *Circulation* 1975;52:275–285.
6. Leaf DA, Sanmarco ME, Bahl RA. Gender differences in coronary angiographic findings from 1972 through 1981 in Los Angeles, California. *Angiology* 1990;41:609–615.
7. Roeters van Lennep JE, Zwinderman AH, Roeters van Lennep HWO, Westerveld HE, Plokker HWM, Voors AA, Bruschke AVG, van der Wall EE. Gender differences in diagnosis and treatment of coronary artery disease from 1981 to 1997. *Eur Heart J* 2000;21:911–918.
8. Atie J, Brugada P, Brugada J, Smeets JL, Cruz FE, Roukens MP, Gorgels A, Bar FW, Wellens HJ. Clinical presentation and prognosis of left main coronary artery disease in the 1980s. *Eur Heart J* 1991; 12:495–502.
9. Bansal M, Gupta H, Bhargava K, Choudhary C, Kasliwal RR. Clinical and angiographic profile in patients with left main coronary artery disease. *Indian Heart J* 2002;54:Article No.B288.
10. Lerner DJ, Kannel WB. Patterns of coronary heart disease morbidity and mortality in the sexes: a 26-year follow-up of the Framingham population. *Am Heart J* 1986;111:383–390.
11. Kosuge M, Kimura K, Ishikawa T, Ebina T, Shimizu T, Hibi K, Toda N, Tahara Y, Tsukahara K, Kanna M, et al. Predictors of left main or three-vessel disease in patients who have acute coronary syndromes with non–ST-segment elevation. *Am J Cardiol* 2005;95:1366–1369.
12. Bulkley BH, Roberts WC. Atherosclerotic narrowing of the left main coronary artery. A necropsy analysis of 152 patients with fatal coronary heart disease and varying degrees of left main narrowing. *Circulation* 1976;53:823–828.
13. Conti CR, Selby JH, Christie LG, Pepine CJ, Curry RC Jr., Nichols WW, Conetta DG, Feldman RL, Mehta J, Alexander JA. Left main coronary artery stenosis: clinical spectrum, pathophysiology and management. *Prog Cardiovasc Dis* 1979;22:73–106.
14. Nygaard TW, Gibson RS, Ryan JM, Gascho JA, Watson DD, Beller GA. Prevalence of high-risk thallium-201 scintigraphic findings in left main coronary artery stenosis: comparison with patients with multiple- and single-vessel coronary artery disease. *Am J Cardiol* 1984;53:462–469.
15. Wong JW, Tong MC, Tan NC, Lim YC, Ong KK. Left main coronary artery obstruction: surgical experience with 93 patients. *Ann Acad Med Singapore* 1990;19:37–40.
16. Stone PH, Coskun AU, Yeghiazarians Y, Kinlay S, Popma JJ, Kuntz RE, Feldman CL. Prediction of sites of coronary atherosclerosis progression: in vivo profiling of endothelial shear stress, lumen, and outer vessel wall characteristics to predict vascular behavior. *Curr Opin Cardiol* 2003;18:458–470.