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Journal Title: Circulation: Cardiovascular Imaging
Volume: Volume 10, Number 8
Publisher: American Heart Association | 2017-08-01, Pages e006246-e006246
Type of Work: Article | Post-print: After Peer Review
Publisher DOI: 10.1161/CIRCIMAGING.117.006246
Permanent URL: https://pid.emory.edu/ark:/25593/t6h8w

Final published version: http://dx.doi.org/10.1161/CIRCIMAGING.117.006246

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Accessed May 22, 2019 3:04 AM EDT
Prognostic Significance of Nonobstructive Left Main Coronary Artery Disease in Women versus Men: Long-Term Outcomes from the CONFIRM Registry

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Abstract

**Background**—Patients with obstructive (≥50% stenosis) left main (LM) coronary artery disease (CAD) are at high risk for adverse events; prior studies have also documented worse outcomes among women than men with severe multivessel/LM CAD. However, the prognostic significance of nonobstructive (1-49% stenosis) LM CAD, including sex-specific differences, have not been previously examined.

**Methods and Results**—In the long-term CONFIRM registry, patients underwent elective coronary computed tomographic angiography (CCTA) for suspected CAD and were followed for 5 years. Analysis of these data revealed significant differences in outcomes between men and women with nonobstructive LM CAD, with women experiencing higher rates of cardiovascular events and mortality.

**Conclusion**—The findings of this study highlight the importance of considering sex-specific differences in the management of nonobstructive LM CAD, as women may be at higher risk for adverse outcomes compared to men.
years. After excluding those with obstructive LM CAD, 5,166 patients were categorized as having normal LM or nonobstructive LM (18% of cohort). Cumulative 5-year incidence of death, myocardial infarction, or revascularization was higher among patients with nonobstructive LM than normal LM in both women and men: women (34.3% versus 15.4%, \( p<0.0001 \)); men (24.6% versus 18.2%, \( p<0.0001 \)). A significant interaction existed between sex and LM status for the composite outcome (\( p=0.001 \)). In multivariable Cox regression, the presence of nonobstructive LM plaque increased the risk for the composite outcome in women (HR\(_{adj}\) 1.48, \( p=0.005 \)), but not in men (HR\(_{adj}\) 0.98, \( p=0.806 \)). In subgroup analysis, women with nonobstructive LM CAD had a nearly 80% higher risk for events than men with nonobstructive LM CAD (HR\(_{adj}\) 1.78, \( p=0.017 \)); sex-specific interactions were not observed across other patterns (e.g. location or extent) of nonobstructive plaque.

**Conclusion**—Nonobstructive LM CAD was frequently detected on CCTA and strongly associated with adverse events among women. Recognizing the sex-specific prognostic significance of nonobstructive LM plaque may augment risk stratification efforts.

**Keywords**
Left main; Nonobstructive coronary artery disease; Coronary computed tomographic angiography; Sex disparities in coronary heart disease

Obstructive left main (LM) coronary artery disease (CAD), defined as ≥50% luminal stenosis, is associated with significant morbidity and mortality.\(^1\) Although the prevalence and burden of obstructive CAD is higher among men, prior studies have described worse outcomes among women than men with severe multivessel or LM CAD, including after revascularization.\(^2\)-\(^5\) Despite abundant prognostic evidence regarding patients with obstructive LM CAD, clinical outcomes of patients with nonobstructive (1-49% luminal stenosis) LM CAD, including sex-specific differences, have not been previously evaluated.

Importantly, nonobstructive CAD is frequently identified on coronary angiography among patients with stable ischemic heart disease (SIHD) and is more prevalent in symptomatic women (\( \sim 60\% \)) than men (\( \sim 30\% \)).\(^4\),\(^6\),\(^7\) Furthermore, recent investigations have described a strong association between nonobstructive CAD and adverse cardiovascular events in both invasive and noninvasive angiographic cohorts, however, comparative prognostic data of women versus men with nonobstructive CAD are limited.\(^8\)-\(^14\) These findings have prompted increased efforts to examine the importance of nonobstructive CAD, including characterizing sex-related differences in outcomes, as a means to improve prognostic models and more precisely identify at-risk patients to target preventive care.\(^7\) Notably, nonobstructive plaque within the LM has not been an emphasis within any of these studies to date.

Accordingly, we sought to determine the prognostic significance of nonobstructive LM CAD in a large, ‘real-world’ cohort of patients who underwent elective coronary computed tomographic angiography (CCTA) for the evaluation of suspected CAD. Our objectives were to (1) assess the association between nonobstructive LM CAD and clinical outcomes including all-cause mortality, nonfatal myocardial infarction (MI), and coronary revascularization; and (2) determine whether sex-specific differences in outcomes exist.
among patients with nonobstructive LM CAD and compared to other subgroups of nonobstructive CAD.

Methods

Study Cohort

In the long-term phase of the CONFIRM (COronary CT Angiography EvaluatioN For Clinical Outcomes: An InteRnational Multicenter) registry, a total of 12,086 stable outpatients underwent elective CCTA for evaluation of clinically suspected CAD and had prospective follow-up extended to 5 years. A total of 17 participating sites from 9 countries enrolled patients between 2002 and 2009. All sites received institutional review board approval and oversight, and all patients provided informed consent. Patient and site identifiers were not entered into the CONFIRM database. Additional details regarding the CONFIRM registry’s design, rationale, site eligibility, and patient recruitment have been previously described. The inclusion criteria for our analysis reflected the enrollment indications of the CONFIRM registry, including: (1) adults ≥18 years of age, (2) referral for CCTA to evaluate for suspected CAD given presenting symptoms or for risk stratification using a ≥64-detector row scanner, (3) prospective data collection of CAD risk factors and CCTA data, and (4) standardized reporting of segmental coronary stenosis, as per Society of Cardiovascular Computer Tomography (SCCT) guidelines. Excluded from our study were patients with obstructive LM CAD or missing LM stenosis severity (n=1,147), history of known CAD, previous percutaneous coronary intervention, or previous coronary artery bypass surgery (n=1,416), and incomplete adjudication of clinical events (n=4,357) for a final cohort size of 5,166 patients. All CONFIRM investigators have reviewed and approved our study.

Clinical Descriptive Data

All patients enrolled in CONFIRM underwent evaluation by a physician or nurse prior to CCTA. Each participating site uniformly collected self-reported baseline clinical data including age, gender, history of hypertension (HTN), diabetes mellitus (DM), hyperlipidemia (HLD), smoking status, early family history of early CAD (father <55 or mother <65 years of age), left ventricular ejection fraction (LVEF), and presenting symptom characteristics categorized as no chest pain, non-anginal chest pain, atypical angina, or typical angina.

CCTA Protocol and Anatomic Definitions

Each CONFIRM site was directed by a level III-trained expert in CCTA and followed standardized protocols for performing CCTA as defined by guidelines of the SCCT. The percent luminal stenosis in the LM was coded as normal (0% stenosis) or nonobstructive (1-49% stenosis) by visual assessment. Luminal stenosis in non-LM vessels, including the left anterior descending (LAD) artery, left circumflex (LCx) artery, and right coronary artery (RCA) were also gathered and coded as normal, nonobstructive, or obstructive (≥50% stenosis), which were consistent with previous CCTA-derived definitions.
for obstructive and nonobstructive CAD. At all laboratories, intra- and inter-reader reliability were routinely assessed and have been previously described in detail.

Outcome Data Collection and Follow-up Methods

Our primary outcome was a composite of incident all-cause mortality, nonfatal MI, or late coronary revascularization occurring >90 days from the index CCTA. Each individual endpoint was also evaluated as a secondary outcome. The National Death Index was queried for all-cause death within the United States, or determined through direct interview with the patient's family or physician, telephone call, or review of medical records for events outside of the United States. MI events were confirmed through review of the patient's medical records for hospital documentation of biomarker elevation and electrocardiographic alterations consistent with the Universal Definition of MI. Coronary revascularization events were also confirmed through review of medical records, however, target vessel revascularization was not reported. Only late (>90 days from the index CCTA) revascularization events were used as an endpoint; earlier revascularization events represent continued evaluation of the index, but stable CAD course for a patient, while use of late revascularization is a common means to separate elective versus non-elective conditions and consistent with prior literature. Additional information on ascertainment and adjudication methods have been previously described.

Statistical Analysis

Using chi-squared tests for categorical variables and t-tests for normally distributed or Wilcoxon tests for non-normally distributed continuous variables, baseline characteristics were compared between patients with normal LM and nonobstructive LM. We estimated time-to-event using the Kaplan-Meier method and compared differences in cumulative incidence of events between LM groups with log-rank tests.

Next, we tested for an interaction between sex and LM status for the study endpoints and examined sex-specific differences in outcomes according to LM status. After meeting the proportional hazards assumption by graphical assessment, four multivariable Cox proportional hazards models were created using covariables defined a priori based on clinical judgment. Model 1 included age, HTN, DM, HLD, smoking history, and the presence of typical angina to control for baseline demographics, CAD risk factors, and pretest probability for obstructive CAD. Model 2 included the covariables from Model 1 plus the number of non-LM coronary vessels with obstructive plaque in order to adjust for differences in obstructive plaque burden between LM strata. As an alternative method to adjust for co-occurring obstructive plaque, Model 3 included the covariables from Model 1 plus the total number of non-LM coronary artery segments with obstructive plaque. Finally, Model 4 expanded upon the previous models with inclusion of the segment involvement score (SIS, scored 0 to 15 excluding LM), which accounts for overall CAD burden by measuring both nonobstructive and obstructive plaque extent.

We performed several subgroup and sensitivity analyses to test the robustness of our findings. (1) We assessed time-to-event by LM status in a subset of 3,325 patients without any obstructive CAD to further account for baseline differences in plaque burden. (2) In the
same subset, we examined whether sex-specific differences in risk varied based on the location (LM, LAD, LCX, or RCA) or extent (per-segment and per-vessel) of nonobstructive plaque. (3) In order to assess for potential selection bias, the baseline characteristics of patients who were excluded (n=6,920) were compared to those included in the final cohort. We repeated survival analysis on the entire pooled cohort for the endpoint of all-cause mortality, which was the only outcome completely adjudicated in CONFIRM. (4) Since target vessel revascularization was not known and may have been subject to biases by gender or the extent of obstructive CAD, we removed revascularization from the composite endpoint and repeated the survival analysis using death or nonfatal MI as the primary outcome. A two-tailed p-value <0.05 was considered statistically significant for each analysis. All statistical analyses were performed using SAS version 9.4 (Cary, NC).

Results

Clinical and CCTA Characteristics of the Study Cohort

Of 5,166 patients, 82% had normal LM and 18% had nonobstructive LM CAD (Table 1). Patients with nonobstructive LM were older and had higher baseline rates of CAD risk factors including HTN, DM, and HLD (p<0.001). Furthermore, patients with nonobstructive LM CAD had more extensive co-occurring obstructive plaque and higher SIS score (p<0.001). Neither baseline LVEF (p=0.232) nor presenting symptoms (p=0.424) were significantly different by LM status.

Estimating the Risk of Death, Myocardial Infarction, or Revascularization

Through a mean 5.3±1.8 years (median 5.5, interquartile range 5.1-6.2 years) of follow-up, there were 349 deaths, 471 nonfatal MIs, and 364 revascularization events. Cumulative 5-year incidence of the composite outcome was 27.3% for patients with nonobstructive LM CAD compared to 17.2% for patients with normal LM (p<0.0001, Figure 1). Differences in the incidence for the individual endpoints of all-cause mortality, nonfatal MI, and late coronary revascularization by LM status are also displayed.

Sex-specific Differences in Outcomes

Next, we examined sex-specific differences in outcomes according to LM status. Women had a lower burden of obstructive CAD and SIS scores than men (p<0.001, Supplemental Table 1). In both women and men, those with nonobstructive LM had a higher incidence of composite events than those with normal LM: women (34.3% versus 15.4%, p<0.0001); men (24.6% versus 18.2%, p<0.0001) (Figure 2). Importantly, a significant interaction existed between sex and LM status for the primary outcome (p=0.001). After multivariable adjustment, the association between nonobstructive LM and the composite endpoint remained significant in women (HRadj 1.48 [1.21-1.75], p=0.005), but was not significant in men (HRadj 0.98 [0.81-1.18], p=0.806) (Tables 2 and 3). Similarly, the association between nonobstructive LM and the individual endpoints of death, nonfatal MI, and revascularization also differed by sex and are presented in Tables 2 and 3. The sex-specific HRs for the composite outcome by other measures of CAD extent are displayed in Supplemental Table 2.
Subgroup and Sensitivity Analyses

In a subgroup of 3,325 patients without any obstructive CAD, the cumulative 5-year incidence of the composite outcome remained significantly higher among those with nonobstructive LM than those with normal LM (18.6% versus 10.7%, p<0.0001, Figure 3), and was also consistent in sex-stratified Kaplan-Meier analysis: women (28.3% versus 10.5%, p<0.0001); men (14.0% versus 10.8%, p=0.036).

Next, we examined whether sex-related differences in outcomes varied by nonobstructive plaque pattern. As shown in Figure 4, in subgroups of patients with nonobstructive LM CAD, women had a significantly higher risk for adverse events than men (HR\textsubscript{adj} 1.78 [1.31-2.25], p=0.017). In contrast, outcomes were not significantly different between women and men in other subgroups of nonobstructive plaque.

In addition, we examined the baseline characteristics of patients excluded (n=6,920) from our analysis (Supplemental Table 3). In a pooled Kaplan-Meier analysis, those with nonobstructive LM CAD had a consistent and elevated incidence of death compared to those with normal LM (13.9% versus 7.9%, p<0.0001). Similar sex-specific differences were also observed: women (18.7% versus 8.1%, p<0.0001), men (11.8% versus 7.7%, p<0.0001, Supplemental Figure 1).

Finally, we removed revascularization events from the composite endpoint. Consistently, patients with nonobstructive LM had higher cumulative incidence of death or MI than patients with normal LM (19.8% versus 13.2%, p<0.0001, Supplemental Figure 2) and when separated by sex: women (26.1% versus 13.1%, p<0.0001), men (17.4%, 13.3%, p=0.001).

Discussion

Although prognosis is well established in the setting of obstructive LM CAD, our findings were the first to reveal sex-specific differences in long-term outcomes for nonobstructive LM CAD. Notably, nonobstructive LM plaque was associated with a nearly 50% higher risk for adverse events among women independent of CAD burden in other vessels, whereas the association between nonobstructive LM CAD and future events was not significant among men after risk adjustment. Furthermore, women with nonobstructive LM plaque had a ~1.8-fold higher risk for future events than men with nonobstructive LM plaque; sex-specific differences in outcomes were not observed across other patterns of nonobstructive CAD. These findings provide evidence that nonobstructive LM plaque may represent an important risk marker in women that should be considered during risk stratification efforts.

Surprisingly, there has been a paucity of data regarding the prognostic implication of nonobstructive LM plaque within the published literature. One reason may be that previous studies have frequently represented nonobstructive CAD as having a uniform level of risk. For instance, in the Women’s Ischemia Syndrome Evaluation (WISE) study\textsuperscript{9}, 5-year event rates for MI were estimated to be 3.9% for patients with any nonobstructive CAD. However, the extent and lesion-specific distribution of nonobstructive CAD were not further delineated.
More recently, both invasive angiographic and CCTA series have characterized gradations of risk based on the extent of nonobstructive CAD. Maddox et al described 1-year MI event rates of 0.24%, 0.56% and 0.59%, respectively, among patients with 1-vessel, 2-vessel, and 3-vessel nonobstructive CAD (defined as 20%-49% stenosis on invasive angiography).\textsuperscript{12} Similar proportional increases in mortality rates were reported with increasing nonobstructive vessel involvement in CCTA cohorts.\textsuperscript{20} In contrast to our study, these prior investigations had shorter follow-up times, and nonobstructive LM plaque was classified as ‘1-vessel’ nonobstructive CAD, as a lesion within the LAD territory, or incorporated within the segment involvement score.\textsuperscript{2, 3, 8, 10, 20} One exception was a small, single-center CCTA study of 76 patients with nonobstructive LM CAD, of whom, none experienced an event after 20 months of follow-up.\textsuperscript{21} Thus, our investigation expands upon previous findings with longer, 5-year follow-up, and to our knowledge, is the first study sufficiently powered to assess the prognostic significance of nonobstructive LM CAD.

Specifically, our study revealed that nonobstructive LM plaque was strongly associated with adverse events in women but not in men, independent of CAD burden in other vessels. These sex-specific differences in prognosis were not observed for other subgroups of patients with multi-segment or multi-vessel nonobstructive CAD. Our results are in concordance with prior studies by Leipsic and others, who did not find that outcomes in women versus men differed based on the extent of nonobstructive CAD; however, disparities in prognosis based upon the location of nonobstructive plaque (e.g. LM versus other vessel) were not previously explored.\textsuperscript{11, 14} Shaw et al described both higher in-hospital and 4-year mortality among women with significant atherosclerotic burden or high-risk lesions such as obstructive multivessel or LM CAD as compared to men;\textsuperscript{2-4} we now extend these observations of sex-based differences in outcomes of LM disease to patients with nonobstructive plaque.

Although elucidating possible mechanisms for the association between nonobstructive LM plaque and adverse outcomes in women requires additional investigation, several potential explanations exist. Independent of body surface area, women are known to have significantly smaller coronary arterial sizes than men, including the luminal area of the LM, which has been associated with worse outcomes in women than men following coronary revascularization and may also increase susceptibility to thrombotic occlusion.\textsuperscript{22} Numerous pathology examinations and intravascular ultrasound (IVUS) studies have also characterized differences in coronary atherosclerotic composition and progression between women and men.\textsuperscript{23, 24} Although women have been noted to have less severe and extensive CAD than men, positive coronary artery remodeling was detected in the majority (73%) of women without obstructive CAD in an IVUS sub-study of WISE.\textsuperscript{24} These nonobstructive, but positively remodeled plaques, have been proposed to serve as precursor lesions vulnerable to future erosion or rupture.\textsuperscript{25} Given that the LM subtends a large proportion of the myocardium, any sex-related differences in plaque vulnerability in the LM could conceivably place women at a significant and higher risk for downstream coronary events; additional characterization of LM plaque morphology is needed to improve discrimination of at-risk lesions. Moreover, previous studies from the National Cardiovascular Data Registry have shown that patients with nonobstructive CAD are less than half as likely to receive aspirin, statins, or beta-blockers as compared to patients with obstructive CAD.\textsuperscript{26-28} The preponderance of ‘hidden’ or positively remodeled plaque in women may also lead to...
an underestimation of true atherosclerotic burden and further therapeutic delay, potentially contributing to disparities in outcomes between women and men with nonobstructive CAD.

Our findings add to the growing body of evidence that depict a heterogeneous distribution of risk among patients with nonobstructive CAD; both the extent and location of nonobstructive plaque appear to confer varying prognostic value. Importantly, estimated rates of obstructive CAD on elective cardiac catheterization have been as low as \(~40\%\) with a disproportionately lower yield for obstructive CAD among women compared to men.\(^6\),\(^29\) Guideline recommendations on the management of this large cohort of patients with nonobstructive CAD have remained poorly defined, however, simple reassurance and complacency in clinical management are not likely appropriate given the prognostic implications of nonobstructive plaque. In this context, elucidating and recognizing high-risk patterns of nonobstructive CAD, such as the sex-specific significance of nonobstructive LM plaque, may not only help provide a more granular estimation of cardiovascular risk, but may also identify promising targets to focus preventive care as higher risk patients may derive a greater benefit from risk-modifying therapies. Future prospective randomized trials are still needed to determine optimal strategies for therapeutic risk reduction among patients with nonobstructive CAD.

**Study Limitations**

Inherently, we were unable to account for all confounders given our retrospective study design, however, we utilized several multivariable regression models that incorporated all available and pertinent clinical characteristics. Selection bias may have also impacted our analysis as we excluded many higher risk patients with obstructive LM or a history of CAD, however, after pooling all patients, those with nonobstructive LM remained at higher risk of death than those with normal LM and similar sex-specific differences in outcomes were observed. Nonetheless, both external and prospective validation of our results remain to be performed, but we chose the CONFIRM registry for our initial analysis as it represents the largest CCTA cohort and with the longest duration of patient follow-up. Moreover, we did not have further details on plaque vulnerability, which may have yielded additional sex-specific predictive information and should be included in future prognostic models derived from invasive (e.g., IVUS or optical coherence tomography) or noninvasive imaging cohorts. Similarly, both LVEF and myocardial ischemia carry important prognostic value and may have influenced downstream clinical outcomes; however, neither were core variables defined by CONFIRM, and were thus not consistently documented by all enrolling sites. Finally, the CONFIRM registry did not collect information regarding medication use or post-CCTA changes in clinical management, which may have differed by sex and impacted patient outcomes.

**Conclusion**

Although abundant prognostic data have documented poor clinical outcomes among patients with obstructive LM CAD, our findings were the first to reveal an elevated 5-year risk for death, MI, or revascularization associated with nonobstructive LM CAD. Specifically, nonobstructive LM plaque may represent an important risk marker in women, potentially
contributing to disparities in outcomes between women and men with nonobstructive CAD. Recognizing the sex-specific prognostic significance of nonobstructive LM plaque may improve future risk stratification efforts in patients undergoing evaluation for CAD.

**Supplementary Material**

Refer to Web version on PubMed Central for supplementary material.

**Acknowledgments**

**Funding:** This work was supported by the National Institutes of Health-National Heart, Lung, and Blood Institute (5T32HL007745-20).

Dr. Berman: consultant with Molecular Dynamics, employed and receives royalties from Cedars-Sinai Medical Center, grant with Bayer Pharmaceutical; Dr. Chow: holds the Saul and Edna Goldfarb Chair in Cardiac Imaging Research, receives research support from GE Healthcare and educational support from TeraRecon Inc; Dr. Andreini: personal fees from GE Healthcare. Dr. Pontone: grants and fees from GE Healthcare, fees from Medtronic, fees from Bracco; grants from Heartflow; Dr. Leipsic: personal fees from Circl CVI, personal fees from GE Healthcare, personal fees from Samsung; Dr. Budoff: grants from NIH, grants from general Electric; Dr. Al-Mallah: fees from Speaker Bureau: GE Healthcare and Phillips; Dr. Min: fees from MDDX, fees from Heartflow, Inc, fees from Arineta.

**References**


Clinical Perspective

Although it is well established that obstructive left main (LM) coronary artery disease (CAD) has major prognostic implications, our study reveals that nonobstructive LM plaque is also associated with adverse cardiovascular events. Importantly, the presence of nonobstructive LM CAD was associated with a nearly 50% increase in risk for future events in women, independent of CAD burden or extent in other vessels; however, the association between nonobstructive LM plaque and clinical outcomes was not significant in men. These findings show the heterogeneous profile of risk that exists for nonobstructive CAD as both plaque extent and location carry different prognostic value in women and men. Future risk stratification efforts should recognize nonobstructive LM plaque in women as an important marker of risk.
Figure 1. Cumulative 5-Year Incidence of Events by Left Main Status
Cumulative incidence of the primary composite outcome of all-cause mortality, nonfatal myocardial infarction or coronary revascularization is displayed using a 90-day landmark time. Cumulative events rates for the secondary endpoints of death, nonfatal myocardial infarction, and revascularization are also shown. Patients are stratified as having normal LM or nonobstructive LM.
LM: Left main; Nonobs: Nonobstructive
Figure 2. Cumulative 5-Year Incidence of Events by Left Main Status in Women and Men
Cumulative incidence of the composite outcome of all-cause mortality, nonfatal myocardial infarction or coronary revascularization are displayed by LM status in women and men.
LM: Left main; Nonobs: Nonobstructive
Figure 3. Cumulative 5-Year Incidence of Events among Patients without any Obstructive CAD
Cumulative incident event rates for the composite outcome of all-cause mortality, nonfatal myocardial infarction or coronary revascularization are displayed among patients without any obstructive CAD. Patients are stratified as having normal LM or nonobstructive LM. Cumulative incidence curves are also displayed in women and men, separately.
CAD: Coronary artery disease; LM: Left main; Nonobs: Nonobstructive
Figure 4. Sex-specific Differences in Risk by Nonobstructive Plaque Location and Extent

Risk-adjusted hazard ratios comparing women to men for the composite outcome of all-cause mortality, nonfatal myocardial infarction, or revascularization are shown in different subgroups of nonobstructive CAD. All models adjusted for age, hypertension, hyperlipidemia, diabetes, smoking, and angina.

CAD: Coronary artery disease; LM: Left main; LAD: left anterior descending artery; LCX: left circumflex artery; RCA: right coronary artery

<table>
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<tr>
<th>Plaque Location</th>
<th>Hazard Ratio (95%CI)</th>
<th>P-Value</th>
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<td>Nonobstructive LM</td>
<td>1.78 (1.31-2.25)</td>
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<td>1.08 (0.81-1.35)</td>
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<td>Nonobstructive LCX</td>
<td>1.36 (0.98-1.75)</td>
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<td>Nonobstructive RCA</td>
<td>1.19 (0.84-1.55)</td>
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<td>1.10 (0.75-1.45)</td>
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<td>1.45 (0.96-1.95)</td>
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Circ Cardiovasc Imaging. Author manuscript; available in PMC 2018 August 01.
Table 1
Baseline Characteristics of Study Cohort by Left Main Status

<table>
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<tr>
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<th>All Patients (N=5,166)</th>
<th>Normal LM (N=4,241)</th>
<th>Nonobstructive LM (N=925)</th>
<th>P. Value*</th>
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</thead>
<tbody>
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<td>60±12</td>
<td>65±10</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Male</td>
<td>3,255 (63)</td>
<td>2,592 (61)</td>
<td>663 (71)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Hypertension</td>
<td>2,769 (54)</td>
<td>2,230 (53)</td>
<td>539 (59)</td>
<td>0.001</td>
</tr>
<tr>
<td>Diabetes</td>
<td>865 (17)</td>
<td>676 (16)</td>
<td>189 (21)</td>
<td>0.001</td>
</tr>
<tr>
<td>Hyperlipidemia</td>
<td>2,717 (53)</td>
<td>2,128 (50)</td>
<td>589 (64)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Smoking History</td>
<td>1,030 (20)</td>
<td>827 (20)</td>
<td>203 (22)</td>
<td>0.099</td>
</tr>
<tr>
<td>Family History of Early CAD</td>
<td>1,490 (29)</td>
<td>1,204 (29)</td>
<td>286 (31)</td>
<td>0.118</td>
</tr>
<tr>
<td>LVEF, %</td>
<td>60±13</td>
<td>60±13</td>
<td>61±15</td>
<td>0.232</td>
</tr>
<tr>
<td>Typical angina</td>
<td>696 (15)</td>
<td>582 (16)</td>
<td>114 (14)</td>
<td></td>
</tr>
<tr>
<td>Atypical angina</td>
<td>1,587 (35)</td>
<td>1,295 (35)</td>
<td>292 (35)</td>
<td></td>
</tr>
<tr>
<td>Non-cardiac</td>
<td>409 (9)</td>
<td>341 (9)</td>
<td>68 (8)</td>
<td></td>
</tr>
<tr>
<td>No chest pain</td>
<td>1,867 (41)</td>
<td>1,515 (41)</td>
<td>352 (43)</td>
<td></td>
</tr>
<tr>
<td>Extent of Obstructive CAD (per vessel)</td>
<td>&lt;0.001</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-vessel</td>
<td>986 (19)</td>
<td>723 (17)</td>
<td>263 (30)</td>
<td></td>
</tr>
<tr>
<td>2-vessel</td>
<td>496 (10)</td>
<td>340 (8)</td>
<td>156 (18)</td>
<td></td>
</tr>
<tr>
<td>3-vessel</td>
<td>207 (6)</td>
<td>205 (5)</td>
<td>102 (11)</td>
<td></td>
</tr>
<tr>
<td>Extent of Obstructive CAD (per segment)</td>
<td>0.8±1.5; 0.7±1.4</td>
<td>1.5±1.9; 1.0 ±2</td>
<td></td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Overall CAD Burden (Segment Involvement Score)</td>
<td>2.6±2.9; 2.1±2.4</td>
<td>1.9±2.4; 2.0 ±4</td>
<td>5.6±2.9; 6.4 ±9</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Values reported as mean ± standard deviation (median [interquartile range] also reported if non-normally distributed), or N (%)

* Comparison of patients with normal LM and nonobstructive LM using chi-squared test for categorical variables and t-test or Wilcoxon tests for continuous variables

** LVEF only available in 858 (17%) of patients

CAD: Coronary artery disease; LM: Left main; LVEF: Left ventricular ejection fraction;
### Table 2
Risk of Death, Myocardial Infarction, and Revascularization by Left Main Status in Women

<table>
<thead>
<tr>
<th></th>
<th>Unadjusted</th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
<th>Model 4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HR (95% CI)</td>
<td>P-Value</td>
<td>HR (95% CI)</td>
<td>P-Value</td>
<td>HR (95% CI)</td>
</tr>
<tr>
<td><strong>Composite Endpoint</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal LM</td>
<td>1.00</td>
<td>Reference</td>
<td>1.00</td>
<td>Reference</td>
<td>1.00</td>
</tr>
<tr>
<td>Nonobstructive LM</td>
<td>2.37 (1.87-3.01)</td>
<td>&lt;0.001</td>
<td>2.02 (1.57-2.58)</td>
<td>&lt;0.001</td>
<td>1.63 (1.26-2.10)</td>
</tr>
<tr>
<td><strong>All-Cause Mortality</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal LM</td>
<td>1.00</td>
<td>Reference</td>
<td>1.00</td>
<td>Reference</td>
<td>1.00</td>
</tr>
<tr>
<td>Nonobstructive LM</td>
<td>2.52 (2.31-2.90)</td>
<td>&lt;0.001</td>
<td>1.96 (1.55-2.36)</td>
<td>0.003</td>
<td>1.87 (1.45-2.29)</td>
</tr>
<tr>
<td><strong>Nonfatal MI</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal LM</td>
<td>1.00</td>
<td>Reference</td>
<td>1.00</td>
<td>Reference</td>
<td>1.00</td>
</tr>
<tr>
<td>Nonobstructive LM</td>
<td>1.75 (1.21-2.52)</td>
<td>0.003</td>
<td>1.60 (1.10-2.33)</td>
<td>0.015</td>
<td>1.25 (0.85-1.83)</td>
</tr>
<tr>
<td><strong>Revascularization</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal LM</td>
<td>1.00</td>
<td>Reference</td>
<td>1.00</td>
<td>Reference</td>
<td>1.00</td>
</tr>
<tr>
<td>Nonobstructive LM</td>
<td>2.62 (2.18-3.06)</td>
<td>&lt;0.001</td>
<td>2.33 (1.87-2.80)</td>
<td>&lt;0.001</td>
<td>1.86 (1.38-2.34)</td>
</tr>
</tbody>
</table>

*a* Model 1: covariables include age, hypertension, diabetes, hyperlipidemia, smoking, and angina

*b* Model 2: covariables include those in Model 1 plus the number of non-LM vessels with obstructive CAD

*c* Model 3: covariables include those in Model 1 plus the total number of non-LM segments with obstructive CAD

*d* Model 4: covariables include those in Model 1 plus the segment involvement score

CI: Confidence Interval; HR: Hazard ratio; LM: Left main; MI: Myocardial infarction
Table 3
Risk of Death, Myocardial Infarction, and Revascularization by Left Main Status in Men

<table>
<thead>
<tr>
<th></th>
<th>Unadjusted</th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
<th>Model 4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HR (95% CI)</td>
<td>P-Value</td>
<td>HR (95% CI)</td>
<td>P-Value</td>
<td>HR (95% CI)</td>
</tr>
<tr>
<td>Composite Endpoint</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal LM</td>
<td>1.00</td>
<td>Reference</td>
<td>1.00</td>
<td>Reference</td>
<td>1.00</td>
</tr>
<tr>
<td>Nonobstructive LM</td>
<td>1.44 (1.21-1.71)</td>
<td>&lt;0.001</td>
<td>1.18 (0.99-1.42)</td>
<td>0.065</td>
<td>0.99 (0.82-1.19)</td>
</tr>
<tr>
<td>All-Cause Mortality</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal LM</td>
<td>1.00</td>
<td>Reference</td>
<td>1.00</td>
<td>Reference</td>
<td>1.00</td>
</tr>
<tr>
<td>Nonobstructive LM</td>
<td>1.57 (1.16-2.12)</td>
<td>0.004</td>
<td>1.14 (0.84-1.55)</td>
<td>0.412</td>
<td>1.04 (0.75-1.44)</td>
</tr>
<tr>
<td>Nonfatal MI</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal LM</td>
<td>1.00</td>
<td>Reference</td>
<td>1.00</td>
<td>Reference</td>
<td>1.00</td>
</tr>
<tr>
<td>Nonobstructive LM</td>
<td>1.32 (1.01-1.72)</td>
<td>0.041</td>
<td>1.20 (0.91-1.58)</td>
<td>0.203</td>
<td>0.98 (0.74-1.30)</td>
</tr>
<tr>
<td>Revascularization</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal LM</td>
<td>1.00</td>
<td>Reference</td>
<td>1.00</td>
<td>Reference</td>
<td>1.00</td>
</tr>
<tr>
<td>Nonobstructive LM</td>
<td>1.46 (1.11-1.91)</td>
<td>0.007</td>
<td>1.18 (0.89-1.57)</td>
<td>0.232</td>
<td>0.98 (0.73-1.31)</td>
</tr>
</tbody>
</table>

a Model 1: covariables include age, hypertension, diabetes, hyperlipidemia, smoking, and angina
b Model 2: covariables include those in Model 1 plus the number of non-LM vessels with obstructive CAD
c Model 3: covariables include those in Model 1 plus the total number of non-LM segments with obstructive CAD
d Model 4: covariables include those in Model 1 plus the segment involvement score

CI: Confidence Interval; HR: Hazard ratio; LM: Left main; MI: Myocardial infarction