JACC: CARDIOVASCULAR INTERVENTIONS VOL. 4, NO. 11, 2011

ISSN 1936-8798/$36.00
PUBLISHED BY ELSEVIER INC. DOI: 10.1016/j.jcin.2011.09.007

EXPEDITED PUBLICATION: CLINICAL RESEARCH

# Long-Term Follow-Up After Fractional Flow Reserve–Guided Treatment Strategy in Patients With an Isolated Proximal Left Anterior Descending Coronary Artery Stenosis

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**Objectives** This study sought to evaluate the long-term clinical outcome of patients with an angiographically intermediate left anterior descending coronary artery (LAD) stenosis in whom the revascularization strategy was based on fractional flow reserve (FFR).

**Background** When revascularization is based mainly on angiographic guidance, a number of hemodynamically nonsignificant stenoses will be revascularized.

**Methods** In 730 patients with a 30% to 70% isolated stenosis in the proximal LAD and no significant valvular disease, FFR measurements were obtained to guide treatment strategy. When FFR was ≥0.80, the patients (n = 564) were treated medically (medical group); when FFR was <0.80, the patients (n = 166) underwent a revascularization procedure (revascularization group; 13% coronary artery bypass graft surgery and 87% percutaneous coronary intervention). A 100% long-term clinical follow-up (median follow-up: 40 months) was obtained. The 5-year survival of the medical group was compared with that of a reference population. For each patient, 4 controls were selected from an age- and sex-matched control population.

**Results** The 5-year survival estimate was 92.9% in the medical group versus 89.6% in the controls (p = 0.74). The mean diameter stenosis was significantly smaller in the medical than in the revascularization group (39 ± 14% vs. 54 ± 13%, p < 0.0001), but there was a large overlap between both groups. The 5-year event-free survival estimates (death, myocardial infarction, and target vessel revascularization) were 89.7% and 68.5%, respectively (p < 0.0001).

**Conclusions** Medical treatment of patients with a hemodynamically nonsignificant stenosis (FFR ≥0.80) in the proximal LAD is associated with an excellent long-term clinical outcome with survival at 5 years similar to an age- and sex-matched control population. (J Am Coll Cardiol Intv 2011;4: 1175–82) © 2011 by the American College of Cardiology Foundation

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Manuscript received July 28, 2011; revised manuscript received September 7, 2011, accepted September 9, 2011.

JACC: CARDIOVASCULAR INTERVENTIONS, VOL. 4, NO. 11, 2011
NOVEMBER 2011:1175–82

The presence of a significant narrowing in the proximal left anterior descending coronary artery (LAD) is a generally accepted indication for treatment by either coronary artery bypass graft surgery (CABG) or percutaneous coronary intervention (PCI) (1–3). Several small trials have compared these modalities of revascularization in patients with isolated stenoses in the proximal LAD (4–6). The very definition of a significant stenosis is, however, rarely questioned. In most trials, the presence of a 50% diameter stenosis by visual estimate in the proximal LAD has been a sufficient criterion for the patient to be randomized. It is now widely recognized that the angiogram is a poor tool to gauge the functional significance of a coronary stenosis. When revascularization is based mainly on angiographic guidance, it is unavoidable that a number of hemodynamically nonsignificant stenoses will be revascularized, whereas a number of stenoses deemed nonsignificant will be deferred inappropriately (7–9). Fractional flow reserve (FFR) is a well-validated method to quantify the impact of a coronary stenosis on myocardial perfusion (10,11). It is based on coronary pressure measurements obtained during maximal hyperemia. FFR has a high spatial resolution (at the level of a few millimeters) and can be obtained in a few minutes in the catheterization laboratory, allowing an "on the spot" decision about the appropriateness of revascularization (8,12,13).

**Abbreviations and Acronyms**

**CABG** = coronary artery bypass graft surgery
**CI** = confidence interval
**FFR** = fractional flow reserve
**HR** = hazard ratio
**LAD** = left anterior descending coronary artery
**MACE** = major adverse cardiac event(s)
**PCI** = percutaneous coronary intervention
**QCA** = quantitative coronary angiography

The aim of the present study was to assess the long-term clinical outcome of patients with an angiographically equivocal LAD stenosis and in whom the revascularization strategy was based on the FFR.

## Methods

**Patient population.** From 1999 to 2008, 6,107 patients with stable angina underwent coronary angiography and an FFR measurement in at least 1 coronary artery at the Cardiovascular Center, Aalst, Belgium. Among them, 852 patients presented with a stenosis between 30% and 70% by visual estimate in the proximal segment of the LAD (14,15) and no other stenosis of more than 30% elsewhere in the coronary tree. Patients presenting with a concomitant noncardiac life-threatening disease (n = 35), those requiring valvular surgery (n = 42), and those in whom the referring cardiologist decided not to take the FFR value into account to guide the treatment (n = 45) were not included in the analysis. In the remaining 730 patients, when FFR was ≥0.80, patients were treated medically ("medical group," n = 564); When FFR was <0.80, patients were treated by revascularization ("revascularization group," n = 166) (Fig. 1). All demographics and baseline clinical follow-up data were retrieved from the local database.

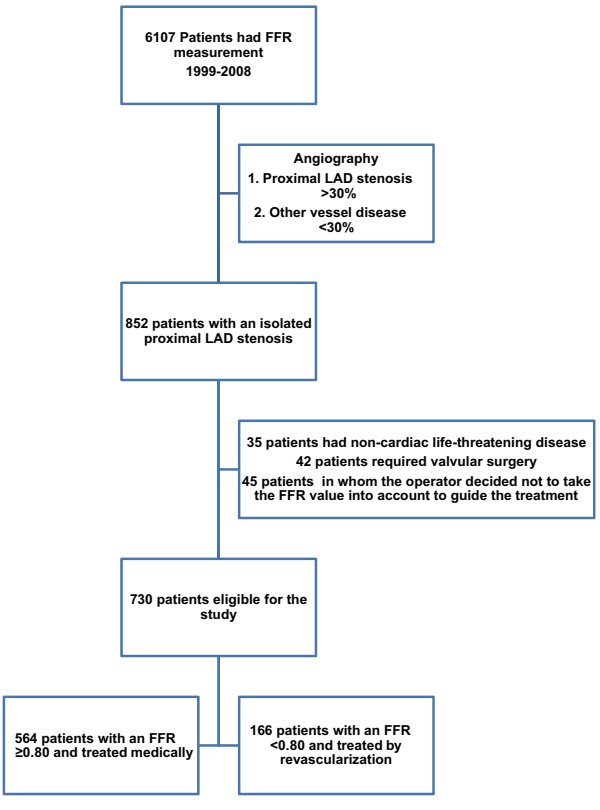


**Figure 1. Flow Chart of the Study**

FFR = fractional flow reserve; LAD = left anterior descending coronary artery.

**Coronary angiography.** Diagnostic left heart catheterization and coronary angiography were performed by a standard percutaneous femoral approach. After the diagnostic angiogram, a 6-F guiding catheter was introduced, and after administration of 200 μg of intracoronary isosorbide dinitrate, the angiogram was repeated in the projection allowing the best possible visualization of the proximal LAD stenosis.

In all patients, a visual estimate of the diameter stenosis of the proximal LAD stenosis was made by the operator. This value was used in the clinical report produced after the diagnostic angiogram. This value was also used for patient selection in the present study. In addition to this subjective analysis, quantitative analysis was obtained offline in a subset of 200 patients. Therefore, a computer-based analysis system, Siemens QuantCor QCA (ACOM.PC 5.01, Siemens Medical Systems Inc., Malvern, Pennsylvania) based