

Results and long-term predictors of adverse clinical events after elective percutaneous interventions on unprotected left main coronary artery.

Takagi T, Stankovic G, Finci L, Toutouzas K, Chieffo A, Spanos V, Liistro F, Briguori C, Corvaja N, Albero R, Sivieri G, Paloschi R, Di Mario C, Colombo A.

BACKGROUND: The safety and efficacy of percutaneous coronary intervention of de novo lesions in unprotected left main coronary arteries remains an unresolved issue. **METHODS AND RESULTS:** We analyzed 67 consecutive patients treated with the following devices: 39 with stents, 12 with rotational atherectomy plus stents, 13 with directional coronary atherectomy plus stents (a total of 64 patients were treated with stents), and 3 patients with directional coronary atherectomy only. The reference vessel size was 3.780.73 mm and lesion length was 6.63.0 mm. In-hospital complications were 2 coronary artery bypass grafts (CABGs) (3.0%), 2 Q-wave myocardial infarctions (MIs) (3.0%), and 3 non-Q-wave MIs (4.5%); there were no deaths. The estimated cardiac survival at 3 years was 91%. The cardiac mortality rate was higher in patients with Parsonnet score >15 versus < or =15 (21.4% versus 4.2%, $P=0.02$) at 3 years. The independent covariate of cardiac death was preserved left ventricular ejection fraction; for combined cardiac events (cardiac death, MI, repeat revascularization) it was large reference vessel size. Follow-up angiography at 52 months in 85% of eligible patients revealed 31.4% restenosis. Extending the follow-up to 3123 months (19 patients with follow-up beyond 3 years) the cumulative event rates were 11 deaths (16.4%), 8 of them cardiac (11.9%), 2 (3.0%) MI, and 16 (23.9%) repeat revascularizations (CABG in 5 patients). **CONCLUSIONS:** Elective percutaneous coronary intervention of de novo lesions in left main coronary arteries is feasible, with low procedural risk. The long-term follow-up revealed a high rate of angiographic restenosis and repeat revascularization, with a relatively high incidence of cardiac death. Reference vessel size and left ventricular function are the most important predictors of favorable follow-up.

Stenting of an unprotected left main coronary artery stenosis in cardiogenic shock and ventricular fibrillation: three-year follow-up.

Lee DW, Garnic JD.

We describe a case of stenting an unprotected left main coronary artery stenosis in an octogenarian patient with cardiogenic shock complicating acute myocardial infarction. Our patient had no in-stent restenosis of the left main for three years and remains asymptomatic. Since, in the octogenarian patient, the surgical risk for emergent coronary artery bypass graft is extremely high, coronary artery stenting of the unprotected left main for myocardial infarction complicated by cardiogenic shock is an alternative treatment in selected patients.

Long-term follow-up of patients with proximal left anterior descending coronary artery stenosis treated with stent

Valencia J, Bordes P, Berenguer A, Mainar V, Ruiz Nodar JM, Arrarte V.

INTRODUCTION AND OBJECTIVE: Patients with lesions of the proximal left anterior descending coronary artery are a special high-risk group. In the present study we analyzed the efficacy and safety of coronary stenting in such lesions and the factors related to a less favorable prognosis in long-term follow-up. **METHODS:** Ninety-eight consecutive patients with severe left anterior descending artery stenosis were enrolled, all with coronary angioplasty and elective stenting. Clinical follow-up was carried out annually in all patients by personal interview or telephone contact. The incidence of death, new infarction, anginal status, and new revascularization procedures was registered. Clinical, angiographic, and procedural variables were analyzed to identify predictors of long term prognosis. **RESULTS:** Mean follow-up was 38 11 months. There was only one major periprocedural complication, which required urgent surgery. Five deaths were registered, 3 of non-cardiac and 2 of cardiac origin. Twenty-five patients developed angina and 11 underwent a new revascularization of the proximal left anterior descending coronary artery (6 surgical and 5 angioplasty). Two patients had new anterior myocardial infarction. At 60 months the major cardiac event-free rate was 83.7% and the cardiac death-free rate was 98%. The use of two stents and the association of diabetes-hypertension-hypercholesterolemia were associated with a less favorable prognosis in our population. **CONCLUSIONS:** Stenting of left anterior descending coronary stenosis was safe and effective in a long-term analysis. The survival rate was high and the incidence of new revascularization was low.

Isolated left main coronary artery stenosis: long term follow up in 106 patients after surgery.

d'Allonnes FR, Corbineau H, Le Breton H, Leclercq C, Leguerrier A, Daubert C.

OBJECTIVE: To analyse the long term prognosis in patients with isolated stenoses of the left main coronary artery (LMCA) following surgical revascularisation. PATIENTS: 106 patients (71 men and 35 women, mean age 61 years) were operated on between 1982 and 1998. Before surgery, 103 patients presented with angina pectoris and only 10 had a history of myocardial infarction. Their mean left ventricular ejection fraction was 62%. Stenoses were localised on the LMCA ostium in 19 patients, a subgroup characterised by a high proportion of women (68%). Three patients presented with chronic LMCA occlusion. Forty six patients were operated on as an emergency. The mean (SD) number of grafts per patient was 2.0 (0.5), and only one patient had no left anterior descending (LAD) coronary artery bypass. Bypass of the LAD using the internal thoracic artery was performed in 88 cases. RESULTS: Early postoperative mortality was 4.7% and the five year survival was 86.8%. Late mortality occurred in nine cases, and in three of these it was linked to a coronary condition. Of the 92 long term survivors, 81.5% were totally symptom-free and 77% of those of working age were able to resume work. The postoperative outcome of patients with isolated ostial LMCA stenosis did not differ significantly from that of the other patients. CONCLUSIONS: The postoperative prognosis of isolated LMCA stenosis appears good in terms of mortality and symptoms.

Emergency coronary stenting for complete thrombotic occlusion of an unprotected left main coronary artery in acute myocardial infarction complicated by cardiogenic shock in an octogenarian patient - - a case report.

Tariq M, Carroll R, Zabih I, Stenberg RG, Hussain KM.

This report concerns an 82-year-old white man, who was admitted with cardiogenic shock secondary to an acute anterior myocardial infarction with right bundle branch block requiring an intra-aortic balloon pump for hemodynamic support and mechanical ventilatory support for respiratory distress. An immediate cardiac catheterization with coronary angiography revealed a complete thrombotic occlusion of the left main coronary artery. Prompt stent-supported percutaneous transluminal coronary angioplasty to the occluded left main coronary artery, a critical stenosis of the ostial left anterior descending artery, and the left circumflex coronary artery, allowed for recovery from this life-threatening condition and subsequent discharge from the hospital of this octogenarian patient. It is suggested that in a critical clinical condition with particularly challenging coronary anatomical findings, stent-supported coronary angioplasty can be lifesaving treatment in selected patients with octogenarian status with acute myocardial infarction.

Ital Heart J 2002 Jan;3(1):72-4

Emergency stenting of the unprotected left main coronary artery.

Ramondo A, Favero L, Chioin R.

We report a case of successful stenting of the unprotected left main coronary artery as a salvage procedure in a patient with tight ostial left main coronary artery stenosis who had cardiac arrest following diagnostic coronary angiography.

Primary stenting versus MIDCAB: preliminary report-comparison of two methods of revascularization in single left anterior descending coronary artery stenosis.

Cisowski M, Drzewiecki J, Drzewiecka-Gerber A, Jaklik A, Kruczak W, Szczeklik M, Bochenek A.

BACKGROUND: Percutaneous revascularization is a well-accepted method of treatment for a single left anterior descending coronary artery (LAD) stenosis. With the introduction of primary stenting, it has become the treatment of choice for a LAD lesion. In the last few years however, the introduction of minimally invasive cardiac surgery, video-assisted left internal thoracic artery (LITA) harvesting, and robotic surgery have raised the question as to whether minimally invasive surgical revascularization would be competitive with percutaneous coronary interventions in cases of single-vessel stenoses. METHODS: A group of 100 patients with Canadian Cardiovascular Society class II to IV, and angiographically confirmed single critical stenosis of the LAD (type A or B), were treated with direct primary stenting (group 1, n = 50), or with endoscopic atraumatic coronary artery bypass grafting (group 2, n =50). RESULTS: All patients in a group 1, obtained a very good angiographic and clinical effect. No acute postoperative complications were noted at 1 month of follow-up. However, at 1 month of follow-up, 3 patients (6%) developed restenosis of the LAD, and at 6 months follow-up, 6 patients (12%), developed restenosis of the LAD. In these cases, repeated percutaneous coronary interventions of the target vessel were successfully performed. In group 2, very good operative results were observed. In 1 and 6 months of follow-up, all patients remained asymptomatic. Critical stenosis of the left internal thoracic artery-LAD anastomosis was angiographically documented in 1 case (2%). This patient was successfully treated with balloon angioplasty. CONCLUSIONS: The study results document the superiority of endoscopic atraumatic coronary artery bypass grafting over direct primary stenting in LAD revascularization, along with the slightly higher costs of the surgical procedure.

Direct coronary stenting versus stenting with balloon pre-dilation: immediate and follow-up results of a multicentre, prospective, randomized study. The DISCO trial. Direct Stenting of COronary Arteries.

Martinez-Elbal L, Ruiz-Nodar JM, Zueco J, Lopez-Minguez JR, Moreu J, Calvo I, Ramirez JA, Alonso M, Vazquez N, Lezaun R, Rodriguez C.

AIMS: To assess the safety of direct coronary stenting, its influence on costs, duration of the procedure, radiation exposure, clinical outcome and angiographic restenosis. **METHODS AND RESULTS:** We randomized 416 patients (446 lesions) to direct stent implant or stent implant following balloon pre-dilation. Patients >75 years old, heavily calcified lesions, bifurcations, total occlusions, left main lesions and very tortuous vessels were excluded. Direct stenting was successful in 217/224 lesions (96.8%). No single loss or embolization of the stent occurred. All stents in the group with pre-dilation were effectively deployed. The immediate post-procedure angiographic results were similar with both techniques. Fluoroscopy and procedural time were significantly lower in direct stenting (6.40.3 and 210.9 min) than in pre-dilated stenting (9.10.4 and 27.51.1 min) ($P>0.001$). Major adverse cardiac events during hospitalization were one in direct and four in pre-dilated stenting ($P=0.05$) but there were no significant differences at follow-ups at 1, 6 and 12 months between the two groups. Angiographic reevaluation at 6 months was performed in 94% of the cases. Restenosis rate was 16.5% in direct stenting and 14.3% in pre-dilated stenting ($P=ns$). **CONCLUSIONS:** Direct stenting is as safe as pre-dilated stenting in selected coronary lesions. Acute angiographic results are similar but procedural costs, duration of the procedure and radiation exposure are lower in direct stenting. Overall success rate, mid-term clinical outcome and restenosis are similar with both techniques.

Attempted retrograde reopening of an occluded left main stent.

Niccoli G, Martin J, Banning AP.

Percutaneous revascularization is generally considered to be the treatment of choice for patients with recurrence of symptoms following coronary artery bypass surgery. Protected left main disease is usually approached in an antegrade way. However, if the left main coronary artery is occluded, such an approach is often very challenging, and alternative strategies are adopted. We present a case of attempted retrograde reopening of an occluded left main stent through the right coronary artery, a sequential radial graft from the right coronary artery to the marginal branch and eventually in a retrograde way to the left main coronary artery. Although this case was unsuccessful it demonstrates how technological developments are allowing interventionists to tackle a vast range of challenging cases, which only few years ago would have been considered impossible.

Left main trunk ostial stenosis and aortic incompetence in Takayasu's arteritis.

Bottio T, Cardaioli P, Ossi E, Casarotto D, Thiene G, Basso C.

A 41-year-old woman with recent onset of heart failure and angina due to aortic valve incompetence and critical left coronary ostium stenosis in the setting of Takayasu's arteritis is reported. The patient was successfully surgically treated by aortic valve replacement and coronary artery bypass with saphenous vein graft, showing a cardiac event-free 17 months follow-up. Takayasu's arteritis must be included among the possible causes of coronary artery disease and aortic valve incompetence in young female patients. Although chronic inflammation of the aortic wall may result in late graft occlusion, surgical therapy is effective for short and mid-term clinical improvement.

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Circulation 2002 Aug 6;106(6):698-702

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J Invasive Cardiol 2002 Dec;14(12):764-6

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Heart 2002 Jun;87(6):544-8

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Angiology 2002 Jan-Feb;53(1):95-8

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Eur Heart J 2002 Apr;23(8):633-40

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Ital Heart J 2002 Aug;3(8):483-5

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Cardiovasc Pathol 2002 Sep-Oct;11(5):291-5

Am J Cardiol 2001 Jul 1;88(1):1-4

Intravascular ultrasound assessment of the stenoses location and morphology in the left main coronary artery in relation to anatomic left main length.

Maehara A, Mintz GS, Castagna MT, Pichard AD, Satler LF, Waksman R, Laird JR Jr, Suddath WO, Kent KM, Weissman NJ.

Eighty-seven left main stenoses were evaluated by angiography and intravascular ultrasound. Intravascular ultrasound analysis included left main length (bifurcation to ostium), stenosis location, stenosis length, stenosis external elastic membrane, lumen, plaque & media cross-sectional area (CSA), plaque burden (plaque & media/external elastic membrane CSA), calcium arc, calcium length, eccentricity, and remodeling index (stenosis/reference external elastic membrane CSA). Long anatomic left main arteries (length ≥ 10 mm, n = 43) were compared with short anatomic left main arteries (length < 10 mm, n = 44) regarding stenosis location. Ostial (proximal third of left main artery) (n = 32) and nonostial (midthird and distal third) stenoses (n = 55) were compared regarding stenosis morphology. Short anatomic left main arteries developed stenoses more frequently near the ostium (ostium 55%, bifurcation 38%). Conversely, long anatomic left main arteries developed stenoses more frequently near the bifurcation (ostium 18%, bifurcation 77%, p = 0.001). Ostial left main stenoses were more common in women (44% vs 20%, p = 0.02), had larger lumen area (6.2 \pm 2.2 vs 4.6 \pm 2.3 mm², p = 0.002), less plaque burden (62 \pm 15% vs 80 \pm 9%, p < 0.0001), less calcification (arc = 78 \pm 65 degrees vs 195 \pm 101 degrees, p < 0.0001), and more negative remodeling (remodeling index = 0.87 \pm 0.19 vs 1.01 \pm 0.21, p = 0.005) than nonostial left main stenoses. Most ostial left main stenoses were categorized as eccentric (97% vs 76%, p = 0.01). Short and long left main arteries develop stenoses at different locations. Stenosis morphology was significantly different in these 2 locations.

Chest 2001 Oct;120(4):1212-7

Effect of primary angioplasty on total or subtotal left main occlusion: analysis of incidence, clinical features, outcomes, and prognostic determinants.

Yip HK, Wu CJ, Chen MC, Chang HW, Hsieh KY, Hang CL, Fu M.

BACKGROUND: Although acute left main coronary artery (LMCA) occlusion is a rare clinical entity, it carries a very high mortality rate. The purposes of this study were to evaluate the effect of primary angioplasty for a severely obstructed or totally occluded LMCA, and to determine the incidence, clinical features, outcome, and prognostic determinants in this clinical setting. **MATERIALS AND METHODS:** Between May 1993 and July 2000, a total of 740 patients with acute myocardial infarction underwent primary angioplasty in our hospital. Eighteen of 740 patients (2.4%) with a severely obstructed or totally occluded LMCA constituted the population of this study. **RESULTS:** Seventeen of 18 patients (94.4%) experienced pulmonary edema (including 14 patients in cardiogenic shock). Six patients (33.3%) sustained sudden death due to malignant ventricular tachyarrhythmias. Coronary angiography showed that there were variable grade flow of intercoronary collaterals in 12 patients (66.7%), a totally occluded LMCA in 8 patients (44.4%), an incompletely occluded LMCA in 10 patients (55.6%), and a dominant right coronary artery (RCA) in 16 patients (88.9%). Primary angioplasty of the LMCA was performed with a 72.2% procedural success rate. Four patients (22.2%) received coronary artery bypass surgery after angioplasty. Six patients (33.3%) died in the hospital. Two patients died after discharge. Ten of 18 patients (55.6%) survived in long-term follow-up (mean +/- SD, 44 +/- 14 months). Those patients who survived to be discharged had significantly higher combined coexisting incidence of intercoronary collaterals, dominant RCA, and incompletely occluded LMCA (100% vs 0.0%, $p = 0.0006$) than those patients who died in the hospital. **CONCLUSIONS:** Acute obstructive LMCA disease generally presented as pulmonary edema, cardiogenic shock, or sudden death. Only those who had combined coexistence of intercoronary collaterals, a dominant RCA, and an incompletely occluded LMCA could survive to be discharged. Our experience suggests that primary LMCA angioplasty is a feasible and effective procedure, and it may save lives in this clinical setting.

Int J Cardiol 2001 Sep-Oct;80(2-3):173-7

Immediate and long-term outcomes of stent implantation for unprotected left main coronary artery disease.

Lee RJ, Lee SH, Shyu KG, Lin SC, Hung HF, Liou JY, Cheng JJ, Kuan P, Lin HS, Wang CF.

Left main coronary artery (LMCA) disease is now uniformly treated with coronary artery bypass grafting (CABG). However, some patients with LMCA disease do not receive CABG because of high operative risks. The advent of stent implantation has permitted a non-operative improvement in myocardial blood flow in many patients with single-and multi-vessel coronary artery disease. However, the outcomes of stent implantation for unprotected LMCA disease are still unclear. Stent implantation was performed for unprotected LMCA disease in 13 patients; eight patients had high operative risk and five patients had refused CABG. The primary success rate was 100% (13/13 patients). One patient (8%) developed a non-Q-wave myocardial infarction after LMCA stenting. Repeat angiography was obtained in five patients (38%) with recurrent angina, and three patients (23%) received repeated percutaneous transluminal coronary angioplasty (PTCA) for LMCA restenosis. In the follow-up period of 18+/-3 months, 12 patients (92%) remained in satisfactory condition with no further need for surgical intervention. One patient (8%) ultimately required CABG, and she died after CABG at 3 months after LMCA stenting. In conclusion, although CABG remains the standard treatment for LMCA disease, the present study demonstrates that stent implantation is a safe and clinically beneficial revascularization procedure for unprotected LMCA disease in patients who have high operative risk as well as those who refuse CABG.

J Am Coll Cardiol 2001 Oct;38(4):1054-60

Elective stenting of unprotected left main coronary artery stenosis: effect of debulking before stenting and intravascular ultrasound guidance.

Park SJ, Hong MK, Lee CW, Kim JJ, Song JK, Kang DH, Park SW, Mintz GS.

OBJECTIVES: We sought to evaluate: 1) the long-term outcomes of 127 selected patients receiving unprotected left main coronary artery (LMCA) stenting; and 2) the impact of the debulking procedure before stenting and intravascular ultrasound (IVUS) guidance on their clinical outcomes. **BACKGROUND:** The long-term safety of stenting of unprotected LMCA stenoses has not been established yet. **METHODS:** A total of 127 consecutive patients with unprotected LMCA stenosis and normal left ventricular function were treated by elective stenting. The long-term outcomes were evaluated between two groups: IVUS guidance (n = 77) vs. angiographic

guidance (n = 50); and debulking plus stenting (debulking/stenting; n = 40) vs. stenting only (n = 87). RESULTS: Angiographic restenosis was documented in 19 (19%) of 100 patients. The lumen diameter after stenting was significantly larger in IVUS-guided group (p = 0.003). The angiographic restenosis rate was significantly lower in the debulking/stenting group (8.3% vs. 25%, p = 0.034). The reference artery size was the only independent predictor of angiographic restenosis. During follow-up (25.5 +/- 16.7 months), there were four deaths, but no nonfatal myocardial infarctions occurred. The survival rate was 97.0 +/- 1.7% at two years. CONCLUSIONS: These data suggest that stenting of unprotected LMCA stenosis might be associated with a favorable long-term outcome in selected patients. Guidance with IVUS may optimize the immediate results, and debulking before stenting seems to be effective in reducing the restenosis rate. However, we need a large-scale, randomized study.

Circulation 2001 Oct 2;104(14):1609-14

Long-term clinical outcomes after unprotected left main trunk percutaneous revascularization in 279 patients.

Tan WA, Tamai H, Park SJ, Plokker HW, Nobuyoshi M, Suzuki T, Colombo A, Macaya C, Holmes DR Jr, Cohen DJ, Whitlow PL, Ellis SG; ULTIMA Investigators.

BACKGROUND: Percutaneous coronary revascularization (PCI) has been increasingly applied to unprotected left main trunk (LMT) lesions, with varied long-term success. This study attempts to define the predictors of outcome in this population. METHODS AND RESULTS: Two hundred seventy-nine consecutive patients who had LMT PCI at 1 of 25 sites between 1993 and 1998 were studied. Forty-six percent of these patients were deemed inoperable or at high surgical risk. Thirty-eight patients (13.7%) died in hospital, and the rest were followed up for a mean of 19 months. The 1-year incidence was 24.2% for all-cause mortality, 20.2% for cardiac mortality, 9.8% for myocardial infarction, and 9.4% for CABG. Independent correlates of all-cause mortality were left ventricular ejection fraction $\leq 30\%$, mitral regurgitation grade 3 or 4, presentation with myocardial infarction and shock, creatinine ≥ 2.0 mg/dL, and severe lesion calcification. For the 32% of patients < 65 years old with left ventricular ejection fraction $> 30\%$ and without shock, the prevalence of these adverse risk factors was low. No periprocedural deaths were observed in this low-risk subset, and the 1-year mortality was only 3.4%. CONCLUSIONS: Patients undergoing unprotected LMT PCI have frequent serious comorbidities and consequently have high event rates. PCI may be an alternative to CABG for a select proportion of elective patients and may also be appropriate for highly symptomatic inoperable patients. Meticulous follow-up of

hospital survivors is required because of the rather high mortality during the first few months after treatment.

J Am Coll Cardiol 2001 Nov 1;38(5):1348-54

Prediction of acute left main coronary artery obstruction by 12-lead electrocardiography. ST segment elevation in lead aVR with less ST segment elevation in lead V(1).

Yamaji H, Iwasaki K, Kusachi S, Murakami T, Hiramami R, Hamamoto H, Hina K, Kita T, Sakakibara N, Tsuji T

OBJECTIVES: We sought to determine the electrocardiographic (ECG) features associated with acute left main coronary artery (LMCA) obstruction. **BACKGROUND:** Prediction of LMCA obstruction is important with regard to selecting the appropriate treatment strategy, because acute LMCA obstruction usually causes severe hemodynamic deterioration, resulting in a less favorable prognosis. **METHODS:** We studied the admission 12-lead ECGs in 16 consecutive patients with acute LMCA obstruction (LMCA group), 46 patients with acute left anterior descending coronary artery (LAD) obstruction (LAD group) and 24 patients with acute right coronary artery (RCA) obstruction (RCA group). **RESULTS:** Lead aVR ST segment elevation (>0.05 mV) occurred with a significantly higher incidence in the LMCA group (88% [14/16]) than in the LAD (43% [20/46]) or RCA (8% [2/24]) groups. Lead aVR ST segment elevation was significantly higher in the LMCA group (0.16 ± 0.13 mV) than in the LAD group (0.04 ± 0.10 mV). Lead V(1) ST segment elevation was lower in the LMCA group (0.00 ± 0.21 mV) than in the LAD group (0.14 ± 0.11 mV). The finding of lead aVR ST segment elevation greater than or equal to lead V(1) ST segment elevation distinguished the LMCA group from the LAD group, with 81% sensitivity, 80% specificity and 81% accuracy. A ST segment shift in lead aVR and the inferior leads distinguished the LMCA group from the RCA group. In acute LMCA obstruction, death occurred more frequently in patients with higher ST segment elevation in lead aVR than in those with less severe elevation. **CONCLUSIONS:** Lead aVR ST segment elevation with less ST segment elevation in lead V(1) is an important predictor of acute LMCA obstruction. In acute LMCA obstruction, lead aVR ST segment elevation also contributes to predicting a patient's clinical outcome.

Circulation 2001 Nov 27;104(22):2660-5

Effect of an aggressive lipid-lowering strategy on progression of atherosclerosis in the left main coronary artery from patients in the post coronary artery bypass graft trial.

White CW, Gobel FL, Campeau L, Knatterud GL, Forman SA, Forrester JS, Geller NL, Herd JA, Hickey A, Hoogwerf BJ, Hunninghake DB, Rosenberg Y, Terrin ML

BACKGROUND: The Post Coronary Artery Bypass Graft Trial, designed to compare the effects of two lipid-lowering regimens and low-dose anticoagulation versus placebo on progression of atherosclerosis in saphenous vein grafts of patients who had had CABG surgery, demonstrated that aggressive lowering of LDL cholesterol levels to a mean yearly cholesterol level from 93 to 97 mg/dL compared with a moderate reduction to a level of 132 to 136 mg/dL decreased the progression of atherosclerosis in saphenous vein grafts. Low-dose anticoagulation did not affect progression. This secondary analysis tested the hypothesis that a similar decrease in progression of atherosclerosis would also be present in native coronary arteries as measured in the left main coronary artery (LMCA). **METHODS AND RESULTS:** A sample of 402 patients was randomly selected from 1102 patients who had baseline and follow-up views of the LMCA suitable for analysis. Patients treated with the aggressive lipid-lowering strategy had less progression of atherosclerosis in the LMCA as measured by changes in minimum ($P=0.0003$) lumen diameter or the maximum percent stenosis ($P=0.001$), or the presence of substantial progression ($P=0.008$), or vascular occlusion ($P=0.005$) when compared with the moderate strategy. **CONCLUSIONS:** A strategy of aggressive lipid lowering results in significantly less atherosclerosis progression than a moderate approach in LMCAs.

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Contemporary Percutaneous Treatment of Unprotected Left Main Coronary Stenoses : Initial Results From a Multicenter Registry Analysis 1994-1996

Stephen G. Ellis, Hideo Tamai, Masakiyo Nobuyoshi, Kunihiko Kosuga, Antonio Colombo, David R. Holmes, Carlos Macaya, Cindy L. Grines, Patrick L. Whitlow, Harvey J. White, Jeffrey Moses, Paul S. Teirstein, Patrick W. Serruys, John A. Bittl, Michael R. Mooney, Thomas M. Shimshak, Peter C. Block, and Raimund Erbel

Background. Coronary artery bypass surgery (CABG) has been considered the therapy of choice for patients with unprotected left main (ULMT) coronary stenoses. Selected single-center reports suggest that the results of

percutaneous intervention may now approach those of CABG.

Methods and Results. To assess the results of percutaneous ULMT treatment from a wide variety of experienced interventional centers, we requested data on consecutive patients treated after January 1, 1994, from 25 centers. One hundred seven patients were identified who were treated either electively (n=91) or for acute myocardial infarction (n=16). Of patients treated electively, 25% were considered inoperable, and 27% were considered high risk for bypass surgery. Primary treatment included stents (50%), directional atherectomy (24%), and balloon angioplasty (20%). Follow-up was 98.8% complete at 15±8 months. Results varied considerably, depending on presentation and treatment. For patients with acute myocardial infarction, technical success was achieved in 75%, and survival to hospital discharge was 31%. For elective patients, technical success was achieved in 98.9%, and in-hospital survival was strongly correlated with left ventricular ejection fraction (P=.003). Longer-term event (death, infarction, or bypass surgery) -free survival was correlated with ejection fraction (P<.001) and was inversely related to presentation with progressive or rest angina (P<.001). Surgical candidates with ejection fractions ≥40% had an in-hospital survival of 98% and a 9-month event-free survival of 86±5%, whereas patients with ejection fractions <40% had 67% and 22±12% in-hospital and 9-month event-free survivals, respectively. Nine hospital survivors (10.6%) experienced cardiac death within 6 months of hospital discharge.

Conclusions. While results for selected patients appear promising, until early post-hospital discharge cardiac death can be better understood and minimized, percutaneous revascularization of ULMT stenosis should not be considered an alternative to bypass surgery for most patients. When percutaneous revascularization of ULMT is required, directional atherectomy and stenting appear to be the preferred techniques, and follow-up angiography 6 to 8 weeks after treatment is probably advisable.

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Stenting of Unprotected Left Main Coronary Artery Stenoses: Immediate and Late Outcomes

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Objectives. We examined the immediate and long-term outcomes after stenting of unprotected left main coronary artery (LMCA) stenoses in patients with normal left ventricular (LV) function.

Background. Left main coronary artery disease is regarded as an absolute contraindication for coronary angioplasty. Recently, several reports on protected or unprotected LMCA stenting, or both, suggested the possibility of percutaneous intervention for this prohibited area.

Methods. Forty-two consecutive patients with unprotected LMCA stenoses and normal LV function were treated with stents. The post-stent antithrombotic regimens were aspirin and ticlopidine; 14 patients also received warfarin. Patients were followed very closely with monthly telephone interviews and follow-up angiography at 6 months.

Results. The procedural success rate was 100%, with no episodes of subacute thrombosis regardless of anticoagulation regimen. Six-month follow-up angiography was performed in 32 of 34 eligible patients. Angiographic restenosis occurred in seven patients (22%, 95% confidence interval 7% to 37%); five patients subsequently underwent elective coronary artery bypass graft surgery (CABG), and two patients were treated with rotational atherectomy plus adjunct balloon angioplasty. The only death occurred 2 days after elective CABG for treatment of in-stent restenosis. The other patients (without angiographic follow-up) remain asymptomatic.

Conclusions. Stenting of unprotected LMCA stenoses may be a safe and effective alternative to CABG in carefully selected patients with normal LV function. Further studies in larger patient populations are needed to assess late outcome.

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Comparison of Quantitative Coronary Angiographic Results After Directional Coronary Atherectomy and Balloon Angioplasty of Protected Left Main Coronary Stenosis

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We compared the angiographic and clinical outcomes after directional coronary atherectomy (DCA, 13 patients) with those after conventional balloon angioplasty (BA, 21 patients) in patients with protected left main coronary artery stenosis. The initial success rate was 100% in the DCA group and 81% (17 of 21) in the BA group. Restenosis was present in 2 of 11 patients in the DCA group and 9 of 16 patients in the BA group (18% vs. 56%, $P < 0.05$). DCA and BA improved a minimal lumen diameter. The initial gain after DCA was greater than that after BA. At follow-up, the minimal lumen diameter was larger and the percentage diameter stenosis

was smaller in the DCA group. The late loss and loss index were equivalent in both groups. Compared with conventional BA, DCA in protected left main coronary artery stenosis is associated with a higher angiographic success rate and provides a wider lumen diameter with reduced incidence of restenosis.

Summary

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Impact of Stents on Clinical Outcomes in Percutaneous Left Main Coronary Artery Revascularization

Ran Kornowski, MD, Marc Klutstein, MD, Lowell F. Salter, MD, Augusto D. Pichard, MD, Kenneth M. Kent, MD, Alexandre Abizaid, MD, Gary S. Mintz, MD, Mun K. Hong, MD, Jeffrey J. Popma, MD, Roxana Mehran, MD, and Martin B. Leon, MD

Despite effective treatment of left main coronary artery (LMCA) disease by coronary bypass, there is still need for treatment of the LMCA due to progression of disease or bypass graft failure. We compared the in-hospital and follow-up (1-year) outcomes of patients with LMCA stenosis treated with stents (n=88), with a matched group of patients undergoing LMCA non-stent procedures (n=36). Nine-seven percent of patients in each group underwent previous coronary bypass. Procedural success (angiographic success without major in-hospital complications) tended to be higher in stent patients than in their non-stent counterparts (98% vs. 92%, p=0.12), and overall procedural complications were higher for the non-stent group (5.4% vs. 0%, p=0.03). The incidence of non-Q wave myocardial infarction was higher in patients with the LMCA treated with stents than in non-stent patients (13% vs 2.7%, p=0.09). There was no difference in death or Q-wave myocardial infarction between the 2 groups during follow-up. Overall target lesion revascularization at 1 year was 15% after LMCA stenting, and 18% in non-stent patients (p=0.71). Also, any cardiac event-free survival (including death, Q-wave myocardial infarction, coronary bypass, or angioplasty) was similar for both group (78% for stents vs. 76% for non-stents, p=0.85). We conclude that in patients undergoing LMCA interventions, stents reduce major hospital complications, but may not significantly reduce repeat revascularization or major cardiac events at 1 year compared with non-stent LMCA procedures.

Summary

The American Journal of Cardiology, 83:11:1513-1517

Catheter-based reperfusion of unprotected left main stenosis during an acute myocardial infarction (the ULTIMA experience)

Steven P. Marso, Gabriel Steg, Thijs Plokker, David Holmes, Seung-Jung Park, Kunihiko Kosuga, Hideo Tamai, Carlos Macaya, Jeffery Moses, Harvey White, S.F.C. Verstraete, Stephen G. Ellis

The ULTIMA registry was a prospective, multicenter, international registry of 277 patients who underwent percutaneous coronary interventions of unprotected left main trunk stenosis. The 40 patients who underwent an emergency percutaneous left main intervention for acute myocardial infarction are the focus of this study. We compared the results of primary angioplasty with primary stenting, characterizing both the short-term (in-hospital) and long-term (12-month) outcomes. Of the 40 patients, 23 underwent primary angioplasty, whereas 17 underwent primary stenting. The angiographic success rate was an 88% for the cohort. The in-hospital death or coronary artery bypass grafting rate was 65% for the entire group, 74% for the percutaneous transluminal coronary angioplasty group (PTCA), and 53% for the stent group ($p = 0.2$). The in-hospital death rate was 55% for the entire cohort, 70% for the PTCA group, and 35% for the stent group ($p = 0.1$). The 12-month rate of death or bypass surgery was 83% and 58% for the PTCA and stent groups, respectively ($p = 0.047$). The 12-month survival rate was 35% and 53% for the PTCA and stent groups, respectively ($p = 0.18$). Bypass surgery was required in 6 patients in the PTCA group and 2 patients in the stent group ($p = 0.07$). Patients undergoing percutaneous interventions for unprotected left main myocardial stenosis during an acute myocardial infarction are critically ill; an initial percutaneous revascularization approach appears feasible and may be the preferred revascularization strategy. Primary stenting was associated with improved clinical outcomes.

The American Journal of Cardiology, 1999;83:10:1427-1432

Serial volumetric intravascular ultrasound assessment of arterial remodeling in left main coronary artery disease

Avinoam Shiran, Gary S. Mintz, Borjanca Leiboff, Kenneth M. Kent, Augusto D. Pichard, Lowell F. Satler, Takeshi Kimura, Masakiyo Nobuyoshi, Martin B. Leon

Serial volumetric intravascular ultrasound (IVUS) was used to study de novo, nontreated left main coronary arteries (LMCAs) in 31 patients. Using an automated contour detection algorithm, analysis of 7.2 ± 2.5 mm long segments included arterial, lumen, and plaque volumes and plaque burden (plaque/arterial volumes). During follow-up (7.7 ± 2.4 months), the percent change in lumen volume correlated with the percent change in arterial volume ($r = 0.897$, $p < 0.0001$), but not with the percent change in plaque volume ($r = 0.066$, $p = 0.7263$). Percent changes in arterial volume correlated with percent changes in plaque + media volume ($r = 0.448$, $p = 0.0115$), indicating arterial remodeling. However, there was a spectrum of responses ranging from inadequate remodeling (decrease in lumen volume despite no increase or a decrease in plaque volume: i.e., arterial shrinkage) to overcompensation (an increase in lumen volume despite an increase in plaque volume). Serial volumetric IVUS (1) confirms the existence of both positive and negative remodeling in LMCA, and (2) shows that in moderate LMCA disease, luminal changes resulted primarily from positive versus negative remodeling, not plaque progression and/or regression.

The American Journal of Cardiology, 83:1:32-37

Initial and long-term results of angioplasty in unprotected left main coronary artery

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Angioplasty of the unprotected left main coronary artery (LMCA) has been controversial. Although recent single-center studies suggest that new devices may change the situation, many questions and problems remain. Therefore, the results of unprotected left main coronary angioplasty of 175 procedures in 107 patients were analyzed to evaluate its feasibility and effectiveness. The treatment of the initial 107 cases included balloon angioplasty (39 cases, 36%), directional coronary atherectomy (53 cases, 50%), and stents (15 cases, 14%). They were divided into 3 major subgroups: (1) acute group ($n = 14$), in which LMCA angioplasty was performed in patients with acute myocardial infarction; (2) emergency group ($n = 10$); and (3) elective group ($n = 83$). In-hospital mortality was higher in the acute (35.7%) and emergency (40.0%) groups than in the elective group (3.6%; $p < 0.0001$). Angiographic follow-up was routinely performed and the restenosis rate including in-

hospital restenosis was 70% in the acute group, 37.5% in the emergency group, and 40% in the elective group ($p = \text{NS}$). The mean clinical follow-up period was 2.9 years, and the estimated 5-year survival rates of the acute and emergency groups were 50% and 48.2%, respectively. However the 5-year survival rate of the elective group was higher than that seen in the acute or emergency group (77.5%; $p < 0.05$). Repeat LMCA angioplasty was performed in 37 of 68 patients with 8.8% mortality (38.5% of acute and emergency cases and 1.8% of elective cases). The results indicated that elective unprotected LMCA angioplasty is relatively feasible and effective under scheduled angiographic follow-up.

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Intravascular ultrasound predictors of target lesion revascularization after stenting of protected left main coronary artery stenoses.

Hong MK, Mintz GS, Hong MK, Pichard AD, Satler LF, Kent KM, Popma JJ, Leon MB

We evaluated the predictors of late clinical outcomes after stenting of protected left main coronary artery (LMCA) stenoses. Intravascular ultrasound (IVUS) guided stenting of protected LMCA stenoses was performed in 87 consecutive patients between January 1994 and December 1996. Results were evaluated using conventional (clinical, angiographic, and IVUS) methodology. Late (12 month) clinical follow-up information was obtained in all patients. Initial procedural success was achieved in 86 patients (99%). There was 1 in-hospital death (in the 1 patient with a procedural failure). There were no other in-hospital complications, including Q-wave myocardial infarction, emergency bypass surgery, or repeat coronary angioplasty. The overall target lesion revascularization (TLR) rate was 13%. Using multivariate logistic regression analysis, the only independent predictor of TLR was the postintervention lumen area by IVUS. A final lumen area ≥ 7.0 mm² was obtained in 74 patients (86%); the TLR rate for these patients was 7%. This was compared with patients with a final lumen area < 7.0 mm² in whom the TLR rate was 50% ($p = 0.0011$). Stenting of protected LMCA stenoses is safe and effective with acceptable long-term clinical outcomes. The most important factor determining long-term success was the postintervention lumen area by IVUS.

Summary

Figure. TLR rate according to postintervention lumen CSA. * $p = 0.02$, ** $p = 0.002$.

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