

Simultaneous Preoperative Brachiocephalic Angiography and Coronary Angiography to Prevent Coronary-Subclavian Steal Syndrome in Coronary Surgery Candidates

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ABSTRACT

Background: Whether or not preoperative brachiocephalic angiography with left internal mammary artery (LIMA) visualization should be performed at the time of coronary angiography in patients in whom bypass grafting using LIMA is envisaged is still debated. We sought to assess the role of the routine brachiocephalic angiography artery in preventing the coronary-subclavian steal syndrome in patients who are candidates for bypass grafting using LIMA.

Methods: Medical records of 110 patients (mean age 69.3 ± 8.4 years) who underwent concomitant coronary angiography and brachiocephalic arteriography between May 1998 and December 2002 were reviewed. Stenosis >50%, vessel occlusion, and aneurysm were noted as significant findings.

Results: Significant findings were observed in 23/110 patients (20.9%). Five patients with subclavian artery stenosis and upper limb ischemia underwent subclavian artery angioplasty and stenting and bypass surgery using LIMA. During a mean follow-up of 24.7 ± 10.7 months, only one patient developed a new subclavian artery disease after bypass grafting using LIMA, and underwent subclavian artery angioplasty. Logistic regression analysis revealed 3-vessel CAD (odds ratio (OR) 9.917 ; 95% confidence interval (CI) 2.2 to 43.8; $P = .002$), hypercholesterolemia (OR 2.74; CI 95% 1.05 to 7.7; $P = .044$), and age >65 (OR 3.55; CI 95% 2.2 to 9.2, $P = .038$) to be predictors of brachiocephalic disease.

Conclusion: This study suggests that routine angiography of the brachiocephalic arteries at the time of coronary angiography is effective in preventing coronary-subclavian steal syndrome in select patients who are candidates for bypass grafting using LIMA.

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INTRODUCTION

As the use of the left (or right) internal mammary artery (LIMA) for myocardial revascularization has increased, there is a risk of recurring angina pectoris in patients who have or who develop high-grade stenosis or occlusion of the subclavian artery, because of the coronary-subclavian steal syndrome [Marshall 1988, Rigatelli 2004, Van Son 1989]. The subclavian artery angiography and nonselective visualization of LIMA in patients in whom the internal mammary artery is to be used as a graft, can assess both the presence of subclavian artery disease and the suitability of LIMA for surgical purposes (avoiding iatrogenic vessel injuries by direct selective LIMA angiography). Whether or not angiography of the subclavian artery with LIMA visualization should be performed at the time of coronary angiography in order to prevent coronary-subclavian steal syndrome and assess the suitability of LIMA as an arterial conduit in patients in whom bypass grafting using LIMA is envisaged is still debated. We sought to assess the efficacy and clinical impact of routine subclavian artery and nonselective LIMA angiography at the same time as that of coronary angiography in patients who were candidates for bypass grafting using LIMA.

METHODS

Medical records of 110 patients (mean age 69.3 ± 8.4 years, mean serum creatinine 1.1 ± 0.8 mg/dL, Table 1) who underwent concomitant coronary angiography and brachiocephalic arteriography with semiselective LIMA visualization between May 1998 and December 2002 were reviewed. Subclavian artery angiography with visualization of LIMA was performed when bypass grafting using LIMA was envisaged in patients with multiple cardiovascular risk factors including hypertension, hypercholesterolemia, diabetes, smoking or a differential arm blood pressure of at least 15 mmHg. A diagnostic modified or standard 5F Judkins right diagnostic catheter, through the femoral or brachial artery, was used in all cases. Subclavian artery stenosis >50%, vessel occlusion, and aneurysm were noted as significant angiographic findings. Data are expressed as mean \pm SD and as percentages. Univariate and multivariate logistic regression analyses were employed to determine independent predic-

Table 1. Demographic and Clinical Data*

	No. (%)
Male/female	68/42
Mean number of risk factors	1.6 ± 1.1
Hypertension	93(85.1)
Hypercholesterolemia	82(74.1)
Diabetes	27(24.7)
Smoking	73(65.9)
Non-ST ACS	60(54.1)
AMI	26(23.5)
Heart valve disease	18 (16.4)
CAD	
3 vessels	49(44.7)
2 vessels	32 (29.4)
1 vessel	28(25.8)
Mean EF%	58 ± 24.1

*ACS indicates acute coronary syndrome; AMI, acute myocardial infarction; CAD, coronary artery disease; EF, ejection fraction evaluated by angiography.

tors of extra-cardiac atherosclerotic involvement (SPSS 10.0, SPSS Inc., Chicago, Illinois). A significant level was defined when $P < .05$.

RESULTS

Significant findings was observed in 23/110 patients (20.9%, Table 2). Five patients with subclavian artery stenosis and upper limb ischemia underwent subclavian artery angioplasty and stenting and bypass surgery using LIMA. Two patients underwent vertebral angioplasty. A logistic regression analysis revealed 3-vessel CAD (odds ratio (OR) 9.917; 95% confidence interval (CI) 2.2 to 43.8; $P = .002$), hypercholesterolemia (OR 2.74; CI 95% 1.05 to 7.7; $P = .044$) and age > 65 (OR 3.55; CI 95% 2.2 to 9.2, $P = .038$) to be predictors of brachiocephalic disease. Differential arm pressure of at least 15 mm Hg was a poor independent predictor of subclavian artery stenosis (OR 1.54; CI 95% 3.05 to 9.8; $P = .060$). Previous breast irradiation/thoracic surgery (OR 9.55; CI 95% 3.1 to 21.2, $P < .001$) were found to be predictors of the unsuitability of LIMA as an arterial conduit. During a mean follow-up of 24.7 ± 10.7 months, only one patient developed a new subclavian artery disease after bypass grafting using LIMA, and underwent subclavian artery angioplasty.

DISCUSSION

Proximal subclavian artery occlusive disease, in the presence of a patent's internal mammary artery used as a conduit for a coronary artery bypass graft procedure, may cause the reversal of the internal mammary artery flow (coronary-subclavian steal) and lead to myocardial ischemia [Rigatelli 2001]. Visualization of the subclavian artery by duplex ultrasound is possible in nearly all cases, at least for the distal part of the vessel. Unfortunately, stenosis and occlusions occur mostly at the origin of the vessel. The proximal part of the right subclavian artery, as well as the distal part of the innom-

Table 2. Angiographic Data*

Findings	No. of patients
Subclavian artery stenosis	6
Subclavian artery occlusion	3
Vertebral artery stenosis	12
LIMA stenosis	2
Additional contrast volume (mL)	8 ± 2.6

*LIMA indicates left internal mammary artery.

inate artery are visible in most cases, but the origin of the left subclavian artery, where lesions occur three times more often, is practically never directly visible by duplex ultrasound.

Thus, all patients undergoing cardiac catheterization prior to coronary artery bypass grafting using the internal mammary artery should be evaluated for the presence of upper extremity and cerebrovascular ischemia, the presence of cervical or supraclavicular bruits, and an upper extremity blood pressure differential of 20 mmHg or greater [Bicknell 2004, Feit 1992]. Patients with these findings or with evidence of diffuse atherosclerotic vascular disease should have brachiocephalic arteriography at the time of coronary arteriography to identify significant subclavian artery occlusive disease and assess LIMA for surgical purposes. Some authors [Alcala 1997, Cha 2002, Chen 2004] have produced significant findings in 5.8-15% of the cases of concomitant angiography of the internal mammary artery and coronary angiography, such as too narrow a caliber to be used as a graft, and occlusions related and unrelated to previous surgery. Our data demonstrate a quite higher incidence of significant findings: it should be considered that the number of vertebral lesions, easily appreciable by subclavian angiography but rarely recorded in previous studies, the entry criteria for angiography and the retrospective nature may affect the global incidence of significant angiography findings in our study.

Unfortunately, opinions about when and in which patients routine subclavian/LIMA angiography can be performed significantly differ among different centres and operators, especially when emergent or urgent coronary angiography and revascularization do not permit a careful pre-angiographic screening. Our brief experience, although limited by the small sample and the bias due to the inclusion criteria for brachial angiography, might be considered as a step forward clarifying, this issue. This study suggests that angiography of brachiocephalic arteries at the time of coronary angiography is effective not only in preventing any coronary-subclavian steal syndrome but also in assessing the suitability of LIMA as a conduit; however, it makes sense only in patients over 65 years with multivessel CAD and hypercholesterolemia, regardless of the presence of a differential arm pressure.

In patients <65 years with no clear risk factors and monovessel CAD, preoperative brachiocephalic angiography is not effective due to the rare frequency of significant angiographic findings: it should be considered as an adjunctive hazard and should be avoided.

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