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Preoperative semi-selective left internal mammary artery angiography: easy, safe, necessary and worthy

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Aim. **The left internal mammary artery is the graft of choice for coronary artery bypass surgery. The necessity for preoperative internal mammary artery angiography is still controversial. We designed a prospective left internal mammary angiography for evaluating the risk of stenosis in the left internal mammary and subclavian artery, and the risk and the necessity for preoperative internal mammary artery angiography.**

Methods. **Eighty-six patients were included in a prospective study for semi-selective left internal mammary artery angiography during cardiac catheterization via the left radial or femoral approach. Stenosis of the left internal mammary and proximal left subclavian arteries was calculated with DCA; χ^2 analysis was used for analyzing the correlation between the risk factors and arterial stenosis.**

Results. **One patient (1.2%) showed left internal mammary artery stenosis and 5 (5.8%) showed proximal left subclavian artery stenosis. No complications were found in all cases. The only significant factor affecting left subclavian or internal mammary artery stenosis was the female sex. All patients tolerated the procedure well.**

Conclusion. **Semi-selective left internal mammary artery angiography is a safe and easy procedure that should be performed routinely for patients with CAD prior to coronary artery bypass surgery.**

KEY WORDS: Mammary arteries - Coronary artery bypass - Angiography.

The left internal mammary artery is generally used for coronary artery bypass grafting. In fact, it is the graft of choice for coronary artery bypass surgery.[1] Many studies have documented that the patency rate for internal mammary artery grafts is better than that for saphenous vein grafts.[2, 3] Left internal mammary artery grafts have greater longevity in comparison with saphenous vein grafts.[4] Those who received only vein grafts had a greater risk of death over the next 10 years in comparison with those who received an internal mammary graft.[5] Gibson and Loop also stated that the patency rate for internal mammary artery grafts was 97% at 15 months after operation.[6] Even so, some percentage of internal mammary artery grafts did fail after coronary artery bypass grafting. Early postoperative graft failure may be due to the mammary artery being too narrow to be used as a graft, internal mammary artery occlusion, or subclavian artery stenosis. As we know, a second operation for coronary artery bypass grafting is relatively difficult, highly risky and more complicated than the first operation. Yet, the incidence of atherosclerotic narrowing of the left internal mammary and subclavian artery is variably noted in previous studies and the necessity for routine internal mammary artery angiography before coronary artery bypass surgery is controversial. Should internal mammary arteriography be routinely performed before coronary surgery? We performed this study to attempt to answer this question.

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Materials and methods

Patients

From May 2001 to February 2002, with the exclusion of patients with acute ST-elevation myocaridial

Figure 1.—Semi-selective left internal mammary artery angiography showed normal left internal mammary artery (arrow) and a segmental 50% stenosis at proximal left subclavian artery (arrow head).

infarction, cardiogenic shock (systolic blood pressure below 90 mmHg) and the necessity of right radial approach, 86 consecutive patients (53 men and 33 women) receiving coronary angiographic examination were included for performing a semi-selective left internal mammary artery angiography. Both the left internal mammary artery and proximal left subclavian artery were studied. These patient's ages ranged from 32 to 86 years, with an average of 63. All patients gave informed consent. All cases were performed via the femoral or left radial artery approach.

Methods

Cardiac catheterization was performed via the left radial artery or femoral artery approach. The 6-French right Judkins (JR4) diagnostic catheters were used in all patients. The catheter was guided by a wire and advanced from the femoral or left radial artery. The tip was placed near the take-off of the left internal mammary artery while withdrawing the wire. Five ml of non-ionic contrast (Ultravist) was used and diluted with the same amount of normal saline to reduce patient discomfort during the contrast injection. A GE LC/LP+ biplane system was used for image acquisition. Biplane views (posterior-anterior and lateral) were recorded on a CD-ROM. The stenosis was calculated with DCA. The results were classified as normal or abnormal (those with significant stenosis, more than 50% in the cross-section area, at left internal mammary artery or left subclavian artery proximal to the orifice of left internal mammary artery). When analyzing the correlation between 2 discrete variables, χ^2 analysis was used when appropriate.

Results

In the 86 patients, 6 patients (7%) were found to have an abnormal left internal mammary or subclavian artery. Only 1 case (1.2%) showed a 30% stenosis in diameter at the left internal mammary artery. Five cases (5.8%) showed proximal left subclavian artery stenosis (Figure 1) and the stenosis was more significant than that in the first case that showed left internal mammary artery stenosis. Table I shows the parameters, such as diabetes, hypertension, hypercholesterolemia (serum total cholesterol more than 200 mg/dl), hypertriglyceridemia (serum triglyceride more than 200 mg/dl), smoking history, patient's age and sex, via left radial or femoral approach, the catheterization diagnosis and the treatment choice in both the normal and abnormal groups. No significant difference was found in both groups except sex, which showed female sex is of high risk for left internal mammary or subclavian artery stenosis. No complications such as cerebral vascular accident or LIMA dissection were noted in all 86 cases. No patients felt discomfort during the contrast injection.

Discussion

Routine preoperative angiography of the internal mammary artery has rarely been done in Taiwan. The cardiovascular surgeon usually evaluated the patency of the internal mammary artery during operation according to the strength of the blood flow jet of the cut internal mammary artery. However, this is not a reliable method. The reported incidence of internal mammary artery narrowing was low, ranging from 2% to 15%.[7-10] In our study, the incidence of stenosis in the left internal mammary artery was only 1.2%

TABLE I.—*Characteristics in normal and abnormal groups.*

	Normal groups (N=80) (%)	Abnormal groups (N=6) (%)	p value
Mean age (years)	64	58	NS
Age >65 years	38 (47.5)	5 (83.3)	NS
Women*	30 (37.5)	5 (83.3)	0.039
Diabetes	19 (23.8)	2 (33.3)	NS
Hypertension	45 (56.3)	3 (50)	NS
Hyprecholesterolemia (cholesterol >200 mg/dL)	34 (42.5)	3 (50)	NS
Hypertriglycemia (Triglyceride >200 mg/dL)	22 (27.5)	2 (33.3)	NS
Smoking	28 (35)	1 (16.7)	NS
Normal coronary angiography	28 (35)	1 (16.7)	NS
Single vessel disease	22 (27.5)	1 (16.7)	NS
Two vessel disease	8 (10)	2 (33.3)	NS
Triple vessel disease	15 (18.8)	0 (0)	NS
Left main disease	7 (8.8)	2 (33.3)	NS

*) Means p value less than 0.05. NS: no significance, means p value more than 0.05.

and was lower than that in previous reports. The incidence of left subclavian artery stenosis proximal to the take-off of the left internal mammary artery was higher than that for the internal mammary artery (5.8% *vs* 1.2%). This result was similar to the result reported by Krijne *et al.* that the incidence of left internal mammary artery stenosis was 2% and subclavian artery stenosis was 4%.[7] Actually, the incidence of atherosclerosis in the internal mammary artery was low and this is due to their good resistance to the sclerotic process.[9] Some authors hypothesized that the abundant collateral blood supply to its runoff bed provides protection for the intima.[10] This theory may not apply to the subclavian artery. We do not know the basic mechanism but can only postulate that the incidence of subclavian stenosis was higher than that for the left internal mammary artery.

Left internal mammary artery angiography can be obtained by selective cine angiography. It is technically difficult in some cases and usually cannot be achieved by the JR4 catheter, which was usually used in right coronary artery angiography. Nonselective digital subtraction angiography can be applied with contrast injection at the ascending aorta.[11] This is easy and the image quality is good. Yet, not every catheterization laboratory can provide this option and the quality was affected by moving the table. In addition, at least 20 ml of contrast is needed. Actually, complications in the internal mammary artery angiography have rarely been reported. We worried about cerebral embolism or artery dissection, which rarely occurred.[12] Indeed, no complications were noted in our study. Bhatt *et al.* recommended a nonselective technique for visualizing the mammary artery that was significantly faster than and as reliable as the standard selective technique.[13] In our practice, the image quality for semi-selective LIMA angiography was good enough for evaluation of significant stenosis. We could evaluate the proximal subclavian artery concomitantly. Only 5 ml of contrast medium was used in each study. All patients tolerated the diluted contrast well.

Except for the female sex, no risk factors for internal mammary or subclavian artery stenosis were documented in this study. This is possibly due to the low case number in this study. No studies before could identify the high risk groups. Ochi *et al.* suggested that a cervical or supraclavicular bruit, an upper extremity blood pressure difference greater than 20 mmHg, an extensive aortoiliac occlusion, certain disorders such as Takayasu's arteritis or Kawasaki disease, and a history of open heart surgery were high risk groups.[8] Those that received mastectomy and local radiotherapy were also risky.[14] In our study, no one had any of the above risk factors.

The necessity for preoperative angiography in the left internal mammary artery is controversial. This procedure is not routinely performed in Taiwan. Ochi, Krijne and Sisto stated that this procedure is indeed unnecessary.[7-9] Yet, some authors had opposing opinions.[15-17] Although the risk for internal mammary or subclavian artery stenosis is low as mentioned above, it did occur in some patients and can not be predicted prior to surgery. Semi-selective internal mammary

artery angiography is easy to do and the risk for this procedure is pretty low. Only 5 ml of contrast was used and all patients could tolerate the procedure well with the diluted contrast. In our experience, this procedure was fast and consumed about 3 minutes in addition to original cardiac catheterization procedure. Preoperative internal mammary angiography is an easy, fast and safe procedure. Even though the risk for internal mammary artery stenosis is low, that for subclavian artery stenosis is relatively higher and can not be predicted. Both these conditions affected the outcome of coronary artery bypass surgery when the left internal mammary artery was used as a graft to the left anterior descending artery. Preoperative semi-selective left internal mammary artery angiography can provide reliable information about the selection of LIMA as a graft. It would reduce the possibility of early graft failure. This is cost-effective and we recommend routine preoperative semi-selective LIMA angiography.

Conclusions

There are 7% cases with stenosis of either the left internal mammary or subclavian artery and left subclavian artery stenosis is far more common than left internal mammary artery. Semi-selective left internal mammary artery angiography is safe and easy with a right Judkins coronary catheter. Routine preoperative semi-selective left internal mammary artery angiography is necessary and worthwhile.

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