Percutaneous transluminal angioplasty of left internal mammary artery grafts: two years' experience with a femoral approach

MALCOLM R BELL, DAVID R HOLMES JR, RONALD E VLIETSTRA,
DENNIS R BRESNAHAN

From the Division of Cardiovascular Diseases and Internal Medicine, Mayo Clinic and Mayo Foundation, Rochester, Minnesota, USA

SUMMARY Percutaneous transluminal angioplasty via the femoral approach was attempted through internal mammary artery grafts in 11 patients who presented with distal anastomotic stenoses or distal native coronary artery stenoses and angina pectoris. The procedure was technically successful in 10 patients and no major complications occurred. During follow up there was one late death, but all 10 surviving patients showed functional improvement.

Percutaneous transluminal angioplasty seems to be a safe and effective treatment for stenoses of internal mammary artery grafts. This is an effective technique for treating the increasing number of patients who are likely to present with stenoses of these grafts.

The success of percutaneous transluminal angioplasty of saphenous vein grafts¹ has prompted its use in stenoses of internal mammary artery grafts, and the results in a small number of selected patients have been very encouraging.²⁻⁴ None the less, concern has been expressed about the technical difficulties and the risks of the femoral artery approach when angioplasty of these grafts is attempted.^{2,5}

We report our experience and follow up results with percutaneous transluminal angioplasty of internal mammary artery grafts from the femoral approach.

Patients and methods

DATA ACQUISITION

We reviewed all cases of percutaneous transluminal angioplasty of internal mammary artery grafts performed at the Mayo Clinic up to and including July 1988. Clinical and follow up data were obtained from the medical history, from our angioplasty

registry, and by interviewing the patient. Cine-angiographic films of all patients were reviewed.

TECHNIQUE AND EQUIPMENT

Our approach to dilating internal mammary artery grafts was through the femoral artery. Arterial access was established with an 8 F sheath. A Judkins size 4 right coronary diagnostic catheter was advanced to the aortic arch and into the left subclavian artery. A 0.035 inch (0.89 mm) flexible J tip "long exchange" wire was then advanced to the axillary artery and the diagnostic catheter was exchanged for an 8 F internal mammary artery guiding catheter (USCI Division, C R Bard, Inc, Billerica, Massachusetts). This catheter was then slowly withdrawn, with the tip directed anteriorly and inferiorly, until it engaged the ostium of the internal mammary artery. Although pressure damping was noted occasionally after engagement of the ostium, this did not result in clinical problems.

We recommend a low profile trackable balloon to negotiate the sometimes tortuous internal mammary artery (table 1). We had no difficulty in stabilising the guiding catheter while attempting to cross any stenosis.

We used a non-ionic contrast medium to help minimise any chest wall, neck, or arm discomfort associated with contrast injection and to reduce the

Requests for reprints to Dr David R Holmes Jr, Mayo Clinic, 200 First Street Southwest, Rochester, Minnesota 55905, USA.

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Table 1 Specifications of balloon dilatation catheters used for angioplasty of internal mammary artery grafts

Balloon catheter	Frequency of use (no of patients)
Hartzler LPS, 20 mm (2 to 3 mm)*	9
Probe Balloon (2.5 mm)†	2
Profile Plus 20-25†	1

*Advanced Cardiovascular Systems, Inc, Temecula, California.

†USCI Division, C R Bard Inc, Billerica, Massachusetts.

risk of neurotoxicity should the vertebral artery be injected.

Results

PATIENTS

We report on 11 patients (six men and five women, mean (SD) age 58 (11) years) (table 2). The median interval between graft implantation and subsequent angioplasty was six months (range five days to six years). All 11 patients had angioplasty involving the left internal mammary artery graft, which was implanted into the left anterior descending artery in 10 patients and into an obtuse marginal artery in one. The stenoses affected a distal anastomotic site (seven cases) and the native coronary artery distal to the anastomosis (four cases) (figs 1 and 2). In the latter four patients the mammary artery was used as a conduit to reach the distal vessel.

OUTCOME AND COMPLICATIONS OF ANGIOPLASTY

Dilatation was regarded as successful (that is, there was at least a 40% reduction in the visually assessed lumen diameter narrowing) in 10 patients (91%). The mean (SD) reduction in luminal diameter of 93 (5)% before dilatation was reduced to 30 (24)% after dilatation. The only failure occurred in a patient (case 4) with a 90% stenosis of the distal left anterior descending artery. The stenosis was successfully

crossed with a balloon but could not be dilated. One patient (case 1) had transient occlusion at the site of angioplasty during dilatation of the distal mammary anastomosis; this was successfully recrossed and dilated with no clinical sequelae. There were no other complications in this series.

FOLLOW UP

We followed all 11 patients (mean (SD) 12 (7) months; range 2-22 months). There was an improvement in functional class in 10 patients, four of whom remained symptom free (fig 3). A 76 year old woman (case 8) who had successful dilatation of an internal mammary artery graft after resuscitation from an out of hospital cardiac arrest died at home (unwitnessed) two months later. There were no myocardial infarctions during follow up in any patient.

Two patients (cases 5 and 7) had repeat coronary angiography (one month after angioplasty), and patency of the internal mammary artery grafts was shown in each case. One patient (case 5) required a repeat coronary operation because of incomplete revascularisation.

Discussion

The superior patency rates and improved survival of patients when the internal mammary artery is used as a coronary bypass conduit compared with the saphenous vein have been established⁶; as a consequence, use of the internal mammary artery is increasing rapidly.⁷ Angiographic and postmortem studies have shown a very low frequency of atherosclerosis in this artery.⁸⁻¹⁰ Although the internal mammary artery is a better conduit, it can become stenosed at the distal anastomotic site.¹¹ Furthermore, disease in the native vessel distal to the graft insertion may progress. As the number of patients with internal mammary artery grafts increases, we

Table 2 Clinical and technical data from 11 patients with stenosis of internal mammary artery grafts

Case	Age (yr)	Interval between grafting to PTA	Site	Stenosis (%)		Complications
				Pre-PTA	Post-PTA	
1	66	3 mnth	DA	80	30	IMA graft and LAD occlusion (redilated)
2	44	13 mnth	NDV	95	30	None
3	61	5 mnth	DA	95	20	None
4	68	2 mnth	NDV	90	90	None
5	46	14 mnth	DA	90	10	None
6	58	50 mnth	NDV	99	30	None
7	65	2 mnth	DA	95	20	None
8	76	11 mnth	DA	90	30	None
9	43	5 day	DA	95	50	None
10	55	74 mnth	DA	100	0	None
11	63	6 mnth	NDV	90	20	None

DA, distal anastomosis; IMA, internal mammary artery; LAD, left anterior descending artery; NDV, native distal vessel; PTA, percutaneous transluminal angioplasty.

Fig 1 Angiograms during angioplasty of internal mammary artery graft at distal anastomotic site. (a) A 90% stenosis (arrowhead) at anastomosis of graft and left anterior descending artery. (b) Angioplasty balloon inflated within lesion. (c) Subsequent angiogram shows minimal residual stenosis (arrowhead).

can expect a growing number of patients with postoperative stenosis of the graft or distal vessel.

We have shown in a small number of patients that angioplasty of left internal mammary artery grafts can be safely and successfully performed from the femoral approach. Early follow up showed significant improvement in anginal symptoms in most patients, and none required repeat dilatation for restenosis.

Some favour the ipsilateral brachial artery approach for angioplasty of internal mammary artery

graft stenoses to overcome the potential problems with cannulating and then maintaining stability of the guiding catheter positioned from the femoral artery.²⁵ In a recent series, however, use of this approach was not without complication: three of eight procedures were complicated by ventricular fibrillation, internal mammary artery spasm, or dissection.²

Pinkerton *et al* recently described their success with angioplasty of internal mammary artery grafts

Fig 2 Angiograms from patient with acute inferior myocardial infarction. (a) Angioplasty performed via internal mammary artery graft to dilate occluded distal left anterior descending artery (arrowhead). (b) Balloon inflated at site of occlusion. (c) Subsequent angiogram showing successful dilatation with filling of distal left anterior descending artery.

Fig 3 Functional class (Canadian Heart Association classification, CHA) of 10 surviving patients before and after angioplasty.

via the femoral approach in 10 patients.⁴ Their technique included the use of a specially constructed guide wire placed deeply into the internal mammary artery over which they advanced a tapered guiding catheter. Our experience with a more straightforward technique was similarly successful. We support their advice to use ultralow profile balloons, which enabled easy passage of catheters through even the most tortuous internal mammary arteries and permitted the crossing of tight stenoses.

Caution should be exercised when positioning the guiding catheter in the ostium of the internal mammary artery to avoid dissection of this fragile vessel.^{2,12,13} If serious difficulty is encountered in maintaining a stable position of the guiding catheter, then the ipsilateral brachial artery approach seems to be a reasonable alternative, particularly when dilatation of right internal mammary artery grafts is attempted, because this may be more difficult from the groin.

Percutaneous transluminal angioplasty of mammary artery grafts seems to be both safe and successful and to result in an excellent improvement in symptoms. The relatively simple technique that we have described with the use of standard equip-

ment and the currently available guiding catheters should provide an effective means for experienced angioplasty centres to treat patients presenting with stenoses of internal mammary artery grafts.

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