Percutaneous transluminal angioplasty of stenosed aortocoronary bypass grafts

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SUMMARY During the period between October 1980 and December 1982, percutaneous transluminal angioplasty of stenosed aortocoronary bypass grafts was attempted 44 times in 31 patients who had developed disabling angina pectoris four months to seven years after coronary bypass surgery. The primary success rate was 93%. Two (4.5%) patients developed myocardial infarction related to the procedure. No emergency aortocoronary bypass surgery was required and there was no mortality. Although the primary success rate was high, the incidence of recurrence after one or more angioplasties was 50%. Despite this recurrence rate the condition of 10 of the first 16 (62%) patients was clinically improved after a mean follow up of 26 months.

Recurrence of angina in patients after aortocoronary bypass graft surgery is related to graft occlusion or stenosis or to progression of coronary artery disease. The management of such patients has been either conservative or by repeat cardiac surgery. Percutaneous transluminal angioplasty has been used as an alternative to repeat cardiac surgery for stenoses in the native coronary arteries as well as in the bypass grafts. This report deals exclusively with our experience of percutaneous transluminal angioplasty of stenosed bypass grafts.

Patients and methods

Between October 1980 and December 1982 we attempted percutaneous transluminal angioplasty of stenosed aortocoronary bypass grafts 44 times in 31 patients. These patients had developed disabling angina pectoris four months to seven years after coronary bypass surgery. The procedure was attempted in 26 left anterior descending grafts, 13 right coronary artery grafts, and five circumflex artery grafts. Angioplasty was performed using the technique described by Gruntzig *et al.*¹ A preformed guiding catheter (8 or 9F, Schneider Medintag or USCI) was used to insert the grafts. The following types (Fig. 1) were used: (a) the femoral right (Judkins right coronary) type as first choice in 12 attempts, (b) the El Gamal type as first

choice in 30 attempts, (c) a multipurpose type in one attempt, and (d) the femoral right superior type in one attempt.

A standard dilatation catheter was used in 41 attempts (Schneider Medintag). A 2.0, 3.0, 3.7, or 4.2 mm maximal balloon diameter was chosen, depending on the severity of the stenosis and the estimated diameter of the graft. In severe stenoses a 2.0 mm dilatation catheter was used initially but was subsequently exchanged for a larger one. A double balloon

Fig. 1 Guiding catheters used for angioplasty of stenosed aortocoronary bypass grafts. 1, El Gamal type, 2, multipurpose type, 3, femoral right superior type, 4, femoral right (right Judkins) type.

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was used in two attempts; the distal balloon diameter is 2.0 mm and the proximal 3.0 mm. This avoids the risks of exchange. A steerable dilatation catheter was used only once in December 1982, when it was available in our laboratory. Mean pressure gradients across the stenoses were measured before and after the procedure in 30 patients. The number of dilatations varied between 3 and 20 times (mean 9). The duration of dilatation was from 10 to 70 s (mean 40 s). The balloon inflation pressure was from 4 to 9 atmospheres.

Results

The balloon dilatation catheter crossed the lesion in 41 out of 44 (93%) attempts. The mean pressure gradients ranged from 25 to 68 mm Hg (mean 42 mm Hg) before the procedure and from 0 to 24 mm Hg (mean 15 mm Hg) after.

All stenoses were successfully dilated as shown angiographically by improvement in the lumen diameter of more than 20%. The mean stenosis before the procedure was 75%, after 28%. We were unable to cross the lesion in three attempts (three patients). Two underwent elective coronary artery bypass grafting and one was treated conservatively. Two patients developed myocardial infarction (raised cardiac enzyme activities but no pathological Q waves on the electrocardiogram) despite a successful angioplasty procedure.

No emergency surgery was required and there were no deaths related to the procedure. The success rate of the procedure was analysed in relation to the guiding catheter that was used.

FR (Judkins right coronary) type was used as first choice in 12 attempts: nine left anterior descending grafts, two right coronary artery grafts, and one circumflex graft. Five out of the 12 attempts were successful. The *El Gamal* type guiding was subsequently tried in six of the failures. Five were successfully dilated, but one failed.

The *El Gamal* type was used as first choice in 30 attempts: 16 left anterior descending grafts, 10 right coronary artery grafts, and four circumflex artery grafts. All were successfully dilated.

The *multipurpose* type was used in one left anterior descending graft which was successfully dilated.

The *FRS* type was used in one right coronary artery graft, which failed.

FOLLOW UP

To study the outcome of successful angioplasty of stenosed bypass grafts a longer follow up is required. We therefore reviewed our data for the patients who had grafts dilated in the period between October 1980 and April 1982 that were followed up to December 1983 (Fig. 2).

There were 28 attempts in 18 patients. Two attempts in two patients failed. There were 26 successful procedures in 16 patients: 20 at the first, four at the second, one at the third, and one at the fourth. After a successful first procedure angina and graft restenosis or occlusion occurred 1–12 months later in nine of the 16 patients (11 of the 20 grafts).

Angiography showed restenosis in eight and total occlusion in three grafts. Three patients underwent elective coronary artery bypass grafting, two were treated conservatively and four patients (four grafts) underwent a successful second angioplasty. Two patients (two grafts) remained clinically improved 28 and 29 months later. There were no angiographic signs of restenosis in the graft in the latter patient when re-examined 23 months after angioplasty. The two remaining patients (two grafts) developed recurrence of graft stenosis. One underwent a coronary artery bypass graft after 14 months and the other a third successful angioplasty after two months. The latter patient developed recurrence after five months. He underwent a fourth successful angioplasty, because satisfactory surgical revascularisation was not possible. He remained clinically improved 18 months later. Seven out of 16 patients remained asymptomatic 22–37 months after a first successful angioplasty (nine of 20 grafts). Five patients (six grafts) consented to have repeat angiography that was performed 6–26 months after the angioplasty. There was no recurrence of the stenosis in five grafts (three to the left

Fig. 2 Follow up of percutaneous transluminal angioplasty of stenosed coronary artery bypass grafts. Figures are numbers of attempts with numbers of patients in parentheses.* Seven out of 10 patients had a repeat angiogram with no signs of restenosis; three patients refused. PTA, percutaneous transluminal angioplasty; CABG, coronary artery bypass graft.

Fig. 3 Angiograms showing the El Gamal guiding catheter positioned in line with (a) a stenosed bypass graft anastomosed to the posterior aortic wall in the right anterior oblique position and (b) the same graft after dilatation.

anterior descending and two to the circumflex artery). A single graft to the right coronary artery showed a 40% stenosis (70% before angioplasty). Thus in our series the total recurrence of graft stenosis after one or more procedures was 50%.

Discussion

The experience of transluminal angioplasty of stenosed aortocoronary bypass grafts to date is still limited. The reported success rate has varied widely

Table Relation between recurrence and the initial site of the stenosed segment in the aortocoronary bypass graft. Figures are numbers of grafts

Site of stenosis	n	Recurrence
Ostium	2	1
Distal anastomosis	3	2
Body of vein:		
Localised	12	5
Multiple	3	3

between 57% and more than 90% regardless of whether the brachial or femoral approach was used.²⁻⁴

We realised early in our experience that failure to cross a tight stenosis was frequently due to inadequate support provided by the guiding catheter. The use of an alternative guiding catheter (El Gamal type) contributed to the high success rate of the procedure in our series, since the smoothly curved flexible tip allowed it to be positioned in line with most grafts as they left the aorta (Fig. 3).

We studied the relation between the recurrence of stenosis and the initial site of the stenosed segment in the graft (Table). Vein grafts with multiple stenoses had the highest incidence of recurrence, whereas localised stenoses in the body of the vein had the lowest incidence. As far as other sites were concerned, we were unable to draw any conclusions because the numbers were too small. Recurrence of graft stenosis at a site that was not previously narrowed occurred twice.

The mean stenosis by angiography was 75% before and 31% after the procedure in grafts that became restenosed, whereas it was 76% before and 20% after in grafts that did not. The difference is statistically significant ($p < 0.05$).

In conclusion, percutaneous transluminal angioplasty is useful in the management of patients with stenoses of aortocoronary bypass grafts and recurrent angina. The procedure is safe and easily performed. The advent of steerable balloons and guide wires has increased the success rate and safety of the procedure. We recommend using them in all cases. We now routinely dilate severely narrowed bypass grafts found at angiography because of the high and unpredictable rate of occlusion that occurs shortly after. Although the primary success rate was high (93%), the incidence of recurrence after one or more procedures was 50%. Douglas *et al* reported a similar high recurrence rate (47%) after graft angioplasty in a series of 37 patients.⁵ Despite this recurrence rate, 10 of 16 (62%) patients were clinically improved after a mean follow up of 26 months.

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