Outcome in patients with recurrent restenosis after percutaneous transluminal balloon angioplasty

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SUMMARY The records of 1162 consecutive patients undergoing their first percutaneous transluminal coronary angioplasty at a centre between March 1980 and June 1987 were reviewed. Initial angioplasty was successful in 1011 patients (87%). In 202 (20%) symptomatic restenosis developed. Of these, 196 were treated with redilatation; this was successful in 181 (92%). After a second dilatation, restenosis developed in 47 patients (26%). Of these, 41 (87%) were treated with a third angioplasty, with primary success in 38 (93%). A further restenosis developed in 13 of these 38 patients (34%). Eight patients were treated with a fourth angioplasty with restenosis in four (50%). Two of these four patients underwent a fifth angioplasty (with continuing success at long term follow up in both). Overall, 14 of the 47 (30%) patients who developed restenosis twice were eventually treated with coronary bypass surgery. Most patients (33), however, were treated only with repeated angioplasties. Of these 33 patients, 27 were treated with a third angioplasty, four with a fourth procedure, and two with a fifth. Twenty-nine (88%) were symptom free at a mean follow up of 28 (range 8 to 86) months. The combined success rate for a third, fourth, and fifth angioplasty was 94%.

These data suggest that most patients with recurrent restenosis after angioplasty may be managed successfully and safely with repeated redilatations.

Since the introduction of coronary balloon angioplasty a decade ago¹⁻³ the indications for the procedure have widened considerably, the success rate has increased, and the complication rate has fallen.⁴ Despite these impressive advances, restenosis remains the major drawback of the technique, occurring in approximately 30% of patients who have a successful initial angioplasty.^{5,6} Treatment of restenosis with a repeat angioplasty is highly successful (greater than 95%).⁷ Furthermore, it seems that a second recurrence is no more likely than a first.⁷⁻⁹ Accordingly, most physicians recommend a repeat angioplasty for restenosis.⁸ Less, however, is known about the treatment of patients who have a further restenosis after a second angioplasty. With the high annual growth in coronary angioplasty procedures patients with restenosis after a second angioplasty

will become more common. We report our experience in the management of 47 patients with clinical restenosis after a second angioplasty and the long term outcome in these patients.

Patients and methods

Between March 1980 and June 1987 a total of 1162 patients underwent coronary angioplasty at our centre. Initial angioplasty was successful in 1011 patients. Clinical restenosis developed in 202 (20%). At our centre, after angioplasty, patients are followed closely by functional testing for the development of symptoms or signs of myocardial ischaemia. If evidence of ischaemia develops, cardiac catheterisation is performed to verify the occurrence of restenosis.

We defined restenosis as the recurrence of angina with angiographic documentation of > 50% stenosis at a site with primary success. One hundred and ninety six of the 202 patients with clinical restenosis were treated with a second angioplasty procedure.

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The decision to proceed with a repeat angioplasty was determined entirely by the patient and referring physician. Successful angioplasty (defined as a reduction in diameter stenosis to <50% in the absence of myocardial infarction, death, or bypass surgery during hospital stay) was achieved in 181 (92%). There was a further recurrence in 47 (26%) of these 181 patients. We studied these 47 patients with recurrent restenosis of a lesion initially treated by angioplasty. Tables 1 and 2 show the clinical and angiographic features in these patients.

FOLLOW UP

After angioplasty patients attend our centre as out-patients every six months for a physical examination and symptom limited treadmill exercise test. Because the unit is a referral centre for more than twenty community hospitals, a large proportion (38%) of our patients with recurrent restenosis had been followed up at another hospital after their last angioplasty. We established contact with these patients by a postal questionnaire and/or telephone contact in April 1988.

Results

OBSTRUCTIVE LESIONS

Sixty four lesions in 47 patients were successfully dilated at initial angioplasty (table 2) and 55 of these were redilated. Fifty lesions restenosed both after first and second angioplasty. Of these lesions undergoing recurrent restenosis, 26 (52%) were located in the left anterior descending artery (10 in the proximal segment), 13 (26%) in the right coronary, 10 (20%) in the circumflex, and one in a graft vessel.

MANAGEMENT OF SECOND RESTENOSIS

Of the 47 patients with a second restenosis of their

Table 1 *Baseline clinical data in the study patients with recurrent restenosis*

Variable	Data
Patients (no)	47
Mean (SD) age (yr) (range)	54 (10) (39–78)
Men	41 (87)
Hypertension (> 140/> 95 mm Hg)	23 (49)
Cigarette smoking:	
Current	8 (17)
Former	15 (32)
Family history CAD	23 (49)
Hypercholesterolaemia	16 (34)
Previous myocardial infarction	24 (51)
Angina status (Canadian Heart Association classification)	
Unstable	16 (34)
Stable class III–IV	25 (53)
Stable class I–II	6 (13)

Numbers in parentheses are percentages. CAD, coronary artery disease.

Table 2 *Baseline angiographic data in the study patients*

Finding	No (%)
One vessel disease	26 (55%)
Two vessel disease	15 (32%)
Three vessel disease	6 (13%)
Left ventricular ejection fraction (%) (SD and range)	64 (14) (20–84)
Location of lesions (n = 64) dilated (according to vessel):	
Left anterior descending	30 (proximal = 10)
Circumflex	18
Right coronary	15
Graft	1
Single lesion dilatation	35 (74%)
Multilesion dilatation	12 (26%)

initially angioplastied lesion(s), six chose to be treated with coronary graft bypass surgery and 41 had a third angioplasty. Angioplasty was successful in 38 of these 41 patients (93%). Of the three patients in whom a third angioplasty was unsuccessful, two developed abrupt reocclusion requiring emergency coronary bypass graft surgery and one had a fatal cardiac arrest 24 hours after the procedure (table 3). Restenosis occurred in 13 (34%) of the 38 patients who had a successful third angioplasty.

TREATMENT OF A THIRD RESTENOSIS

Eight of the 13 patients with a third restenosis were treated with a fourth angioplasty, four with bypass surgery, and one with medical management. Initial success was obtained in all patients with a fourth angioplasty, but restenosis developed in four (50%) (table 3).

TREATMENT OF A FOURTH RESTENOSIS

Two patients were treated with a fifth angioplasty (successful in both) and two with a bypass operation.

SUMMARY OF RESULTS

Of the 47 patients who developed restenosis twice, 14 (30%) were eventually treated with coronary graft bypass surgery (12 electively and two as emergencies). Most (33), however were treated only with

Table 3 *Outcome of patients with restenosis*

<i>RS</i>	<i>Rate (%)</i>	<i>No</i>	<i>I° CABG</i>	<i>PTCA</i>	<i>Em CABG</i>	<i>Prim succ</i>	<i>Sus succ</i>
1st	20	202	6	196	6 (3%)	181 (92%)	134
2nd	26	47	6	41*	2 (4%)	38 (93%)	23
3rd	34	13	4	8	0	8 (100%)	4 (1)†
4th	50	4	2	2	0	2 (100%)	2

*One patient died.

†One patient treated medically.

RS, restenosis; I* CABG, initial treatment with coronary bypass surgery; PTCA, initial treatment with percutaneous transluminal coronary angioplasty; Em CABG, emergency coronary bypass surgery; Prim succ, primary success, Sus succ, sustained success after PTCA.

Outcome of recurrent restenosis

repeated angioplasty. Of these 33 patients, 27 had three angioplasty procedures, four had four procedures, and two had five procedures.

FOLLOW UP

Of the 33 patients treated only with repeated angioplasty (table 3), 29 (88%) remain well and angina free at a mean follow up period of 28 (range 8–86) months. In three patients (each treated with three angioplasty procedures) angina has recurred. One of these patients had a myocardial infarction and documentation of a third restenosis of his graft lesion. However, further revascularisation was not attempted in this patient, who has moderate symptoms on medical treatment. The other two patients have mild symptoms which are adequately controlled on medical treatment. In addition, two patients reported occasional atypical chest pain after their last angioplasty. There was no evidence of restenosis, however, in either patient at repeat angiography. Both patients treated with a fifth angioplasty remain well and symptom free with no evidence of inducible ischaemia, as assessed by repeated exercise testing, 15 and 32 months after the last procedure. There have been no late deaths and only the patient mentioned earlier has had a myocardial infarction since the last angioplasty.

Of the 14 patients who were eventually treated with bypass surgery, three (21%) have had a recurrence of their symptoms. One of these three patients had a myocardial infarction 10 months after operation. There were no deaths in this patient group at a mean follow up of 27 (range 8–48) months.

Discussion

Our observations suggest that most patients with recurrent restenosis can be managed safely and effectively with repeated angioplasty. Of the 47 patients with a second restenosis, 33 (70%) were treated only with angioplasty and 29 (88%) were well and symptom free at long term follow up. Furthermore, the primary success rate for a third angioplasty was very acceptable (93%), as was the combined success rate (94%) for third, fourth, and fifth angioplasties.

Jolly *et al* reported a similar recurrent restenosis rate (4.3% in their series¹⁰ and 4% in ours). We elected to perform a third angioplasty in most (87%) of our patients with a second restenosis, whereas Jolly *et al* treated most (58%) of such patients with coronary bypass surgery. Jolly *et al* reported that their choice of treatment for patients with a second restenosis seemed to be influenced more by the opinion of the cardiologist and the wishes of the patient than by clinical or angiographic factors, as

was the case in our study. As repeat angioplasty becomes more accepted, it is likely that an increased proportion of such patients will choose repeat angioplasty rather than bypass surgery.

Our success rate (93%) and restenosis rate (34%) after third angioplasty accord with those of other centres. Terstein *et al* reported on 74 patients undergoing a third angioplasty.¹¹ Primary success was achieved in 69 (93%) patients and there was restenosis in 28 (41%). Jolly *et al* reported primary success in 33 (92%) of 36 patients and recurrence in 11 (33%).¹⁰ Abi-Mansour *et al* documented restenosis in four (24%) of 17 patients after a successful third angioplasty.¹² Accordingly, it seems that the primary success rate, complication rate, and restenosis rate after a third angioplasty are similar to those after first or second angioplasty.

A further angioplasty was deemed to be technically feasible in all 12 patients in our study who eventually had elective coronary bypass surgery. Indeed, in all, the decision to proceed to bypass surgery rather than attempt a further angioplasty seemed to be determined more on the basis of patient and/or physician preference rather than angiographic factors.

We applied a hypothetical management model to our study to see what the outcome of treating these patients with repeated angioplasty would be. This model limited the maximum number of angioplasties performed in any one patient to five and assumed restenosis rates of approximately 20%, 30%, 35%, 50%, 50% for successive angioplasties. The general success rate for a second or subsequent angioplasty was assumed to be approximately 94%. Application of this schema to a hypothetical population of 1000 patients with a successful initial angioplasty (figure) forecasts that at some time primary success at angioplasty will not be obtained in 17 patients and that four patients will need five procedures to achieve long lasting revascularisation. Overall, coronary angioplasty will eventually fail in 21 (2.1%) of the hypothetical cohort of 1000 patients.

Whatever the projected outcome not all patients will be prepared to undergo repeated redilatations, and some will elect for revascularisation with coronary graft bypass surgery. Similarly, the development, within individual patients, of progressively more severe lesions with each subsequent redilatation may make further attempts at redilatation more difficult and they will eventually need bypass operations. In addition, the occurrence of progressively more complex as well as more severe lesions with successive redilatations may increase the restenosis rate because of greater vessel damage. This latter consideration may, in part, account for the increasing restenosis rate seen, with each subsequent redilatation, in our study patients.