

*Editorial***Infarct angioplasty**

Although secondary prevention and rehabilitation are essential for optimising care for patients presenting with acute myocardial infarction, the best outcomes are achieved with treatments that rapidly restore normal coronary artery flow and then maintain patency. To minimise time to treatment, patients can either be thrombolysed en route to hospital or be assessed and sometimes treated directly by paramedics in appropriately equipped ambulances (bypassing the family doctor).<sup>1–3</sup>

Once the patient is in the coronary care unit (CCU), further assessment is required. If no prehospital treatment has been provided, the patient should receive either thrombolytic treatment or primary angioplasty. If thrombolytic therapy has already been given, alternative strategies should be considered if it appears to have failed.

There is still considerable debate about the relative merits of thrombolytic treatment and angioplasty. The PAMI (primary angioplasty in myocardial infarction) study group and Zwolle *et al* have established that primary angioplasty can be highly effective. They and others have shown that the rapid transfer of patients from general hospitals to acute revascularisation units is safe.<sup>4–8</sup> In reality, few centres worldwide are equipped or staffed for the routine application of primary angioplasty. Some believe that the available evidence does not warrant a wholesale switch to primary angioplasty and that more evidence is required. However, no trial to date shows angioplasty to be an inferior treatment, and once the strengths and weaknesses of the various studies are evaluated, we have little doubt that primary angioplasty, provided by dedicated and fast teams, provides the best means of survival for acute myocardial infarction patients.<sup>9</sup> Compared to current thrombolytic treatment, primary angioplasty achieves a much higher rate of coronary patency, a much higher rate of normal flow (TIMI 3; thrombolysis in myocardial infarction), a lower re-infarction rate, a lower mortality rate, improved ventricular function, and a lower stroke rate.<sup>4–5, 9</sup> Further improvements are coming in the shape of intracoronary stents and the selective use of intra-aortic balloon pumps and glycoprotein IIb/IIIa receptor blockers.

Some argue that primary angioplasty will not be cost effective. This has been disproved by the PAMI and Zwolle groups.<sup>10–11</sup> Although the results of the GUSTO IIb trial (global utilisation of streptokinase and tissue plasminogen activator for occluded coronary arteries) have tempered the enthusiasm of some cardiologists, it still showed primary angioplasty to be superior to thrombolysis.<sup>12</sup> This trial can be criticised for a number of reasons. There was a degree of non-random case selection in some of the centres which contributed the larger number of patients, and many centres contributed only a few patients. This trial design does not show primary angioplasty in its best light. One conclusion that can be drawn from the early angioplasty trials is that if it is to be used, primary angioplasty should be performed by highly skilled dedicated teams of operators with a large experience in this sort of work. Units

providing this treatment should be working towards minimising the “door to balloon” time. In our unit we aim to open the vessel within an hour of the decision to treat.

**Patients who should be treated with primary angioplasty**

At present, most units cannot provide an around the clock primary angioplasty service. There are many reasons for this including lack of funding, insufficient cardiologists trained in coronary intervention, and a lack of facilities in revascularisation centres. If infarct angioplasty is to develop, purchasers of health care will have to be persuaded of the efficacy of the treatment and departments will have to change. Funding for angioplasty will have to be increased, more interventional cardiologists will have to be employed, and more catheter laboratory facilities will be required.

Even if primary angioplasty cannot be offered to all patients who are presently treated with thrombolytics, some groups should now be treated with this technique:

- patients with a contraindication to thrombolysis
- patients presenting with cardiogenic shock
- patients who reinfarct following initially successful thrombolysis
- patients in whom thrombolytic treatment fails (“salvage” or “rescue” angioplasty).

Although there can be no doubt about the first group, further clarification of the role of angioplasty for the other three groups is required. Our experience with cardiogenic shock patients (who do not receive significant benefit from conventional thrombolysis) encourages us to continue to use angioplasty. We believe that patients who reinfarct do so because of an adverse anatomical substrate and that coronary intervention provides better results than repeat thrombolysis. There is a growing interest in the use of salvage angioplasty.

Although further trials in this area are needed, it is our view (supported by locally derived evidence) that if salvage angioplasty is to be considered it should be offered early when there is still a significant amount of viable myocardium to preserve. Although patients who reperfuse early after thrombolytic treatment have a good prognosis, one recent study showed that those with ECG evidence of failure to reperfuse within an hour had an 18% in-hospital mortality.<sup>13</sup> With thrombolytic treatment, the number of patients achieving TIMI 3 flow after the first 90 minutes is relatively small. Our local protocol is to provide salvage angioplasty for failed thrombolysis on the basis of the ECG two hours after the start of thrombolytic treatment. Angioplasty is provided immediately (whatever the time of day) as long as it can be provided within 12 hours of the onset of chest pain.

The drawbacks of salvage compared with primary angioplasty are obvious. These include a longer time before the angioplasty is applied, thereby making the substrate more difficult. Salvage angioplasty success rates are about 85% compared with rates of more than 95% for primary

angioplasty. The patient still has the downside of thrombolytic therapy (such as the risk of stroke), and it is possible that in some patients the combination of salvage angioplasty and thrombolysis is harmful. The in-hospital mortality of patients with failed salvage angioplasty in this setting is high (> 25% in most studies).<sup>14</sup> In spite of these relative drawbacks, salvage angioplasty provides a useful steppingstone to setting up a primary angioplasty service.

Doctors who send patients for salvage angioplasty should share a protocol with the centre that provides the service. This allows the rapid assessment and transfer of appropriate patients, minimising delays and inappropriate referrals. Haphazard referrals from centres with no set protocol and dependent more on the enthusiasm of a junior physician who just happens to be passing by the CCU are not ideal. Patients referred after the CCU ward round the next day, 10 hours or more into the infarct (having been in hospital for more than 6 to 8 hours), pain free but with persistent ST elevation are a somewhat depressing subset.

### Implications for angioplasty services

It is self evident that the provision of a fast, efficient primary angioplasty service, available around the clock, is not possible without sufficient staff or facilities. Most interventionists would not want to commit themselves to anything less than a 1 in 5 rota but some services are provided by a team of three. Timetables need to be reorganised to avoid a clash between on-call and other clinical commitments, and interventionists working at night should not be expected to have a fixed clinical commitment the next morning. With an increasing workload in elective and semi-urgent angioplasty, interventionists may have less time for other facets of cardiology; subspecialisation within departments and an expansion of the consultant base become inevitable. Similarly, appropriate numbers of radiographers, cardiac technicians, and nursing staff as well as on-call facilities are needed. Depending on local arrangements, additional catheter laboratory suites, more beds, and a larger CCU facility may be necessary. CCU staff should be trained to look after patients treated with an intra-aortic balloon pump, be expert at sheath removal and control of anticoagulation, and have a good understanding of the new pharmacological agents (especially glycoprotein IIb/IIIa receptor blockers). For centres referring patients, an expansion of appropriately trained CCU staff may be required to ensure that patients are treated and escorted with a high level of care.

Other services will be influenced by this activity. More ambulances will be required to allow a rapid response to patients with chest pain, and rapid interhospital transfer.

Because some patients treated with angioplasty are extremely agitated, they need careful sedation and monitoring in the catheter laboratory, and some may even need ventilation and nursing thereafter in the cardiac intensive care unit. Some patients will require immediate or delayed coronary artery bypass grafting.

Treatment for such patients is more effective if the programme is supported by experienced anaesthetists and a cooperative surgical team.

### Organisation of regional services

Most people live near enough to a large hospital where the facilities required for primary angioplasty could be developed. Current cardiothoracic surgical and angioplasty units have a number of surrounding hospitals that refer patients for revascularisation. With this background, local decisions will have to be made about whether such a service is provided in a regional centre or in every district hospital.

### INFARCT ANGIOPLASTY ONLY IN CURRENT REVASULARISATION CENTRES

Sufficient ambulance services will be needed to transfer patients rapidly to these units (possibly even bypassing the local district hospital). Central units must have adequate capacity and staff to support the programme. In some centres cardiologists from adjacent district hospitals could participate in on-call angioplasty rotas. Local arrangements will be needed for the successful handover of potentially very sick patients to other physicians (who must be happy to accept their care even though not actually responsible for the revascularisation procedure). Continuity of care as well as provision of information to patients and their relatives is essential. Such an arrangement will also need support from the unit employing the "visiting" cardiologist, who cannot be expected to provide this sort of treatment while contributing equally to a general medical on-call rota. In most units, however, it will be much more appropriate to have sufficient staff working as a team, in an environment they are familiar with, within the central unit. Infarct angioplasty is not easy and interventionists performing this work must have a sufficient volume of elective work to maintain basic angioplasty expertise and be recognised by their national professional societies.<sup>15</sup> Data collection, audit activity, and monitoring of clinical standards will be easier for a team than for those working in isolation.

### INFARCT ANGIOPLASTY IN EVERY DISTRICT HOSPITAL

A second option is for every district general hospital to provide a primary angioplasty service. Each would have to build a dedicated catheter laboratory and employ support staff as well as three to five committed interventional cardiologists. Such a plan is unlikely to be implemented given the prohibitively high capital and revenue costs of such a development.

### MIXED ARRANGEMENTS

A third option is a hybrid of the other two. A central revascularisation unit provides infarct angioplasty for most of the surrounding district hospitals, but some smaller units may ultimately merge to provide services for populations approaching 500 000, in which case it may well be cost effective to develop a catheter facility and employ sufficient staff. These units will still require arrangements for the urgent transfer of patients to cardiothoracic surgical units.

For district hospitals that refer patients to the revascularisation unit, a clear shared philosophy with the central unit is required. Guidelines should be established and protocols set to optimise the management of these patients and to prevent avoidable transfer delays. Rapid transmission of information from the referral source to the revascularisation unit should be reciprocated when the patient is either discharged or transferred back.

### Conclusions

Although more research is required into the many facets of infarct angioplasty, the inevitable conclusion is that this treatment is here to stay. Planning for infarct angioplasty needs to be coordinated and clinical protocols agreed with purchasers of health care. Whether angioplasty is provided for certain patients who cannot be treated with, or do not benefit from, thrombolytic treatment, or whether it is provided for all infarct patients with ST segment elevation, angioplasty centres will have to reorganise themselves either to establish or develop the service. Even if primary angioplasty is not immediately available as a routine, units should establish guidelines for patients with contraindications to thrombolysis, those in whom thrombolytic

treatment fails, and those who reinfarct once the primary event settles with thrombolysis. In our centre, the support staff and referring cardiologists and physicians have responded enthusiastically to these developments as they have seen the undoubted benefits for patients.

M A DE BELDER  
J A HALL

Cardiothoracic Division, South Cleveland Hospital,  
Marton Road, Middlesbrough TS4 3BW, UK

- 1 Rawles J, on behalf of the GREAT Group. Halving of mortality at 1 year by domiciliary thrombolysis in the Grampian region early anistreplase trial (GREAT). *J Am Coll Cardiol* 1994;**23**:1-5.
- 2 Millar-Craig MW, Joy AV, Adamowicz M, et al. Reduction in treatment delay by paramedic ECG diagnosis of myocardial infarction with direct CCU admission. *Heart* 1997;**78**:456-61.
- 3 Prasad N, Wright A, Hogg KJ, et al. Direct admission to the coronary care unit by the ambulance service for patients with suspected myocardial infarction. *Heart* 1997;**78**:462-4.
- 4 Grines CL, Browne KF, Marco J, et al, for the Primary Angioplasty in Myocardial Infarction Study Group. A comparison of immediate angioplasty with thrombolytic therapy for acute myocardial infarction. *N Engl J Med* 1993;**328**:673-9.
- 5 Zijlstra F, de Boer MJ, Hoorntje JCA, et al. A comparison of immediate coronary angioplasty with intravenous streptokinase in acute myocardial infarction. *N Engl J Med* 1993;**328**:680-4.
- 6 Bellinger RL, Califf RM, Mark DB, et al. Helicopter transport of patients during acute myocardial infarction. *Am J Cardiol* 1988;**61**:718-22.
- 7 Gore JM, Corrao JM, Goldberg RJ, et al. Feasibility and safety of emergency interhospital transport during early hours of acute myocardial infarction. *Arch Intern Med* 1989;**149**:353-5.
- 8 Zijlstra F, van't Hof AWJ, Liem AL, et al. Transferring patients for primary angioplasty: a retrospective analysis of 104 selected high risk patients with acute myocardial infarction. *Heart* 1997;**78**:333-6.
- 9 Weaver WD, Simes RJ, Betriu A, et al. Comparison of primary coronary angioplasty and intravenous thrombolytic therapy for acute myocardial infarction: a quantitative review. *JAMA* 1997;**278**:2093-8.
- 10 de Boer MJ, van Hout BA, Liem AL, et al. A cost-effective analysis of primary coronary angioplasty versus thrombolysis for acute myocardial infarction. *Am J Cardiol* 1995;**76**:830-3.
- 11 Stone GW, Grines CL, Rothbaum D, et al, for the PAMI Trial Investigators. Analysis of the relative costs and effectiveness of primary angioplasty versus tissue-type plasminogen activator: the primary angioplasty in myocardial infarction (PAMI) trial. *J Am Coll Cardiol* 1997;**29**:901-7.
- 12 The GUSTO IIb Angioplasty Substudy Investigators. A clinical trial comparing primary coronary angioplasty with tissue plasminogen activator for acute myocardial infarction. *N Engl J Med* 1997;**336**:1621-8.
- 13 Purcell IF, Newall N, Farrer M. Change in ST segment elevation 60 minutes after thrombolytic initiation predicts clinical outcome as accurately as later electrocardiographic changes. *Heart* 1997;**78**:465-71.
- 14 Ross AM, Lundergan CF, Rohrbeck SC, et al. Rescue angioplasty after failed thrombolysis: technical and clinical outcomes in a large thrombolysis trial. GUSTO-1 Angiographic Investigators. Global utilization of streptokinase and tissue plasminogen Activator for occluded coronary arteries. *J Am Coll Cardiol* 1998;**31**:1511-17.
- 15 British Cardiac Society (BCS) and British Cardiovascular Intervention Society (BCIS) Working Group on Interventional Cardiology. Planning for coronary angioplasty: guidelines for training and continuing competence. *Heart* 1996;**75**:419-25.