

## Guidelines for the early management of patients with myocardial infarction

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**In light of recent publications relating to resuscitation and pre-hospital treatment of patients suffering acute myocardial infarction the British Heart Foundation convened a working group to prepare guidelines outlining the responsibilities of general practitioners, ambulance services, and admitting hospitals. The guidelines emphasise the importance of the rapid provision of basic and advanced life support; adequate analgesia; accurate diagnosis; and, when indicated, thrombolytic treatment. The working group developed a standard whereby patients with acute myocardial infarction should receive thrombolysis, when appropriate, within 90 minutes of alerting the medical or ambulance service—the call to needle time. Depending on local circumstances, achieving this standard may involve direct admissions to coronary care units, “fast track” assessments in emergency departments, or pre-hospital thrombolytic treatment started by properly equipped and trained general practitioners.**

In 1989 a working group of the British Heart Foundation published recommendations for the early management of patients with suspected acute myocardial infarction.<sup>1</sup> These were felt to be necessary because of the high incidence of coronary events in the population,<sup>2</sup> the recognition that most of those dying do so soon after the onset of symptoms (before arriving in cardiac care units),<sup>3</sup> and because many lives could be saved by the prompt provision of resuscitation skills and equipment and, where appropriate, by early thrombolytic treatment.<sup>4</sup>

The 1989 report needed revision for two reasons: because of the subsequent publication of relevant studies and to address continued uncertainty, not so much about the aim of treatment, but about the role of the various components of the health service (general practitioners, ancillary staff, ambulance services, admitting hospitals) in achieving these aims. A rapid and effective response to heart attack has been targeted as a major health gain area by the Department of Health,<sup>5</sup> and health districts have been recommended to draw up policy documents to ensure that patients with suspected infarction gain rapid access to facilities for resuscitation and thrombolysis.

### Method

The proposed guidelines were debated and developed by consensus at a workshop sponsored by the British Heart Foundation and held in Cardiff in April 1993. The participants had been chosen by comparing lists of people suggested independently by three clinicians. Among those attending the workshop were general practitioners, representatives of the ambulance service, a nurse, a health educator, epidemiologists, a public health physician, a manager, and hospital doctors from both teaching and district

hospitals (see appendix). The meeting consisted of several short presentations followed by discussion. The presentations were augmented by abstracts that had been submitted beforehand. The guidelines were further discussed at an open conference the following day and have been refined during the drafting process by communication with workshop participants.

The guidelines are presented in two forms: a list of specific recommendations (see box) and a more detailed text outlining their rationale.

### The challenge

The overall goal is to reduce morbidity and mortality due to heart attack. An essential step is to decrease the interval between the onset of symptoms of a coronary event and the provision of appropriate care, whether this is basic life support, advanced cardiac life support including cardiac monitoring and management of arrhythmia, adequate analgesia, adequate assessment and accurate diagnosis or, where indicated, anti-ischaemic and thrombolytic treatment. Many lives could be saved by minimising delay wherever it occurs in the overall management of patients. The most important components of this aspect of management are prompt resuscitation (defibrillation), analgesia and, where appropriate, thrombolytic treatment. By using data from large, placebo controlled trials it has been estimated that thrombolytic treatment starting in the fourth to sixth hour after onset of symptoms is associated with a saving of 25 lives per 1000 patients treated; in the second or third hour with 27 lives per 1000; and within the first hour with 65 lives per 1000.<sup>6</sup> In addition, a more rapid response by health professionals will increase the number of episodes of cardiac arrest that occur in the presence of a doctor or paramedic. This will also lead to increased survival rates.

Improvements are required in several areas, including the response of the patient or bystander to symptoms, the response of the general practitioner or ambulance to a call for assistance,<sup>7</sup> treatment before arrival at hospital, earlier thrombolytic treatment, and the hospital's response to the admission of a patient with suspected myocardial infarction.

### Recommendations

#### PATIENT EDUCATION

“Patient delay” (from the onset of symptoms to calling for help) occurs at the most critical time in the evolution of an acute myocardial infarction. Mass public education campaigns might shorten this time. Such schemes, however, have been disappointing<sup>8</sup> and do not seem to produce major long term benefits.<sup>9</sup> On the other hand, up to 30% of patients presenting with a myocardial infarction are already known to have coronary heart disease, and such patients at high risk of

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## Principles of management

1 The overall goal is to reduce mortality and morbidity of heart attack. A means to this end is to reduce the time interval from the onset of symptoms to the provision of resuscitation skills, adequate analgesia, adequate assessment and accurate diagnosis, and, where appropriate, early thrombolytic treatment.

2 Patients with obvious acute myocardial infarction should expect to receive thrombolytic treatment (in the absence of contraindications) within 90 minutes of alerting the medical or paramedical service (the call to needle time).

3 The above could be achieved through a variety of options, depending on local circumstances. In general a prompt integrated response by general practitioners, ambulance services, and hospital staff is required. Patients with coronary disease, and their relatives, must be provided with guidelines on when to summon help.

### *Responsibilities of general practitioners*

- General practitioners need to develop practice policies for responding rapidly to patients with chest pain. This will involve educating ancillary practice staff. Patients deemed to be at high risk of acute myocardial infarction and their close associates should be informed of the practice policy.

- Where possible general practitioners should arrange to rendezvous with an emergency ambulance at the patient's home providing the patient does not suffer additional delay.

- General practitioners must be prepared to give oxygen, aspirin, and nitrates.

- Adequate analgesia is essential. The analgesic of choice is intravenous diamorphine with an antiemetic.

- Other drugs that should be available include adrenaline, atropine, lignocaine, frusemide, and naloxone.

- General practitioners starting thrombolytic treatment outside hospital need to be fully aware of the indications, contraindications, and side effects of such treatment and should have a defibrillator available. They should confirm the diagnosis by a 12 lead electrocardiogram.

### *Responsibilities of ambulance services*

- Ambulance services should continue to improve training for control staff (ambulance despatchers) and improve prioritisation of emergency and urgent calls using "criteria based response."

- All patients with chest pain require an emergency response with a vehicle containing a defibrillator and staff trained in its use.

- By 1996 all emergency ambulances must be staffed by at least one paramedic fully capable of advanced cardiac life support.

- Once an ambulance has been despatched the patient's general practitioner should (when feasible) be informed; this is particularly important in areas where general practitioners are responsible for initiating thrombolytic treatment.

- Cardiac monitoring must be instituted as soon as possible.

- Protocols should be developed to allow the appropriate administration of oxygen, nitrates, and aspirin.

- Direct communication between the ambulance and the admitting hospital department should be developed.

### *Responsibilities of hospitals*

- Admitting hospitals should streamline their admissions policies by developing "fast tracking" of patients with obvious myocardial infarction.

- If direct admission to a coronary care unit is not possible thrombolytic treatment should be started in the accident and emergency department.

- Senior hospital staff have a responsibility to educate undergraduates, junior staff, general practitioners, and ambulance staff and to provide audit data of delays in treatment.

### *Responsibilities of health authorities*

- Regional, district, and family health service authorities need to formulate and monitor appropriate local protocols to achieve a 90 minute call to needle time.

coronary events, and their close relatives, would benefit from appropriate advice. This advice, perhaps in the form of written guidelines, should form part of coronary rehabilitation programmes. General practitioners, the general public, and relatives of high risk patients should be encouraged to receive training in cardiopulmonary resuscitation according to the European Resuscitation Council guidelines, which emphasise the importance of bystanders immediately contacting the emergency services (999) in cases of suspected cardiac arrest.<sup>10</sup> Training cardiac patients and their relatives in such techniques is feasible and does not lead to increased anxiety.<sup>11</sup> Patients experiencing chest pain should be encouraged to contact both the ambulance service and their general practitioner; witnesses of an unconscious collapsed patient should telephone for an ambulance rather than attempting to call general practitioners, other relatives, or the police.<sup>12</sup>

### RESPONSE OF GENERAL PRACTITIONER AND AMBULANCE SERVICE

#### *General practitioner*

General practitioners have a valuable role in the management of suspected acute myocardial infarction; their knowledge of the patient may facilitate more accurate diagnosis and more sensitive treatment, and the practitioner's knowledge and experience of drug treatments (including the use of opiate analgesics) is likely to be superior to that of ambulance staff.

The general practitioner may not be available immediately, however, and his or her response may be limited by lack of resuscitation equipment. Few general practitioners carry defibrillators when attend-

ing patients with chest pain,<sup>13</sup> although those who do have reported impressive results in resuscitating patients who develop ventricular fibrillation in their presence.<sup>14</sup> Similarly, the use of a 12 lead electrocardiograph is limited in general practice.<sup>15</sup>

A general practitioner's availability will vary during the day, depending on the clinical workload. Overall, patients admitted to hospital with suspected myocardial infarction have a longer delay before admission if they have been assessed by their general practitioner, rather than an ambulance called for directly.<sup>16,17</sup> In most areas, the majority of patients continue to contact their general practitioner first.<sup>18,19</sup> A rapid response is possible—median response times by general practitioners were as short as 20 minutes in an observational study of thrombolytic agents given in hospital<sup>20</sup> and 10 minutes in a randomised controlled trial of thrombolysis before arrival at hospital.<sup>21</sup>

Practices need to determine how they will respond without delay to patients experiencing chest pain in the community. This will involve the practice's ancillary staff (receptionists, nurses, office staff), who should have written instructions on what to do when a patient with chest pain suggestive of myocardial infarction contacts the surgery. The practice's patient information leaflets might usefully include the practice policy.

#### *Ambulance service*

All frontline emergency ambulances carry either manually operated or semiautomatic advisory defibrillators. The advantage of the semiautomatic advisory machine is the relatively short training period required to master its use. Resuscitation schemes using such

defibrillators have been successful.<sup>22</sup> By 1996 there will be a paramedic (ambulance staff with full extended training) on each frontline vehicle. He or she will be trained in advanced airway management and advanced cardiac life support, including basic recognition and treatment of arrhythmia. However, the increased availability of advanced skills must not lead to a detrimental prolongation of time spent at the scene.<sup>23</sup> One possible exception to this may be the development of 12 lead electrocardiogram recording by ambulance personnel; the extra minutes required to record the electrocardiogram, as part of the prehospital evaluation, has been shown to accelerate the in hospital delivery of thrombolytic treatment.<sup>24</sup> Ambulance staff should also alert the receiving hospital so that reception can be prepared.

Another advantage of ambulance attendance is that there are already defined standards in respect of response time (although these standards are not always achieved in some inner city areas). Ambulance services routinely collect data regarding the timings of a call for assistance, arrival at scene, departure from scene, and arrival at hospital, and these can be continually monitored.

Ambulance services should develop a "criteria based response" to emergency calls, by which ambulance control officers determine the priority of responses on the basis of perceived clinical need, rather than responding on a first come, first served basis. Structured interrogation algorithms have already been used by a number of services, and some have successfully incorporated instruction in cardiopulmonary resuscitation.<sup>25</sup>

#### *Combined response*

Ideally, both the general practitioner and an emergency ambulance should attend the patient—the general practitioner to provide diagnostic and therapeutic skills and the ambulance service to provide advanced resuscitation and prompt transport to hospital. Thus, if the source of the call to the ambulance service is not the general practitioner then the patient's general practitioner should be informed immediately by the ambulance service and asked to attend if possible. If a general practitioner is called first to attend a patient with suspected myocardial infarction, he or she should also summon an ambulance immediately to make a defibrillator available at the earliest opportunity. The general practitioner should stay with the patient until the ambulance arrives and should request an "emergency" (999) rather than an "urgent" response.<sup>20,26</sup> An urgent request requires the general practitioner to stipulate a time by which the patient should arrive at hospital, while an emergency request ensures that the next available emergency ambulance will attend. An emergency always takes priority over urgent cases.

Although the ambulance staff and general practitioner may manage the patient as a team, the overall responsibility of care falls on the general practitioner.

#### PRE-HOSPITAL TREATMENT

After a brief assessment, prompt analgesia is essential.<sup>27,28</sup> Recent studies have shown that less than half of patients presenting with chest pain get adequate analgesia. General practitioners should give opioid analgesics intravenously—either diamorphine (usually up to 5 mg) or morphine sulphate (usually up to 10 mg), which should be titrated against the level of residual pain by using small repeated doses of 1 mg/min. An intravenous antiemetic such as metoclopramide (10 mg) should also be given routinely. Intramuscular drugs achieve less predictable blood levels in shocked patients, complicate the enzymatic assessment of acute myocardial infarction, and may result in

large haematomas when combined with thrombolytic treatment. Drugs should be given intramuscularly only if venous access is unobtainable.

Ambulance staff do not give opiates, and most British ambulance services use nitrous oxide inhalation for analgesia. However, some ambulance paramedics have used the intravenous opioid nalbuphine with good effect and few side effects.<sup>29</sup>

Nitrates should be given by sublingual spray or tablet to patients experiencing cardiac pain (unless the patient has already self administered large doses, or if there is hypotension—systolic blood pressure  $\leq 90$  mm Hg). Oxygen should be considered for reversing any hypoxia,<sup>30,31</sup> particularly in patients with evidence of heart failure.

The use of aspirin in acute myocardial infarction significantly reduces the risk of the patient dying, though the mechanism by which it achieves this is unclear.<sup>32</sup> The timing of aspirin ingestion does not seem to be critical but there is evidence of a synergistic effect between aspirin and streptokinase when both drugs are given early.<sup>33</sup> Therefore patients who have not received aspirin in the preceding 24 hours should chew a 300 mg tablet of aspirin so that they rapidly achieve high blood levels, unless there is a clear contraindication. Aspirin can be given by either the general practitioner or appropriately trained ambulance staff.

Other drugs that may prove useful in the pre-hospital management of acute myocardial infarction include atropine, lignocaine, adrenaline, frusemide, and naloxone. General practitioners should be familiar with the indications for and use of such drugs and have these available when attending patients with chest pain. Intravenous  $\beta$  blockers have been shown to reduce mortality when given soon after the onset of symptoms,<sup>34</sup> but their use is not common practice in British hospitals. In some cases intravenous  $\beta$  blockers are definitely indicated (for example, patients with hypertension and sinus tachycardia during acute myocardial infarction) and in these cases pre-hospital treatment may be given by highly trained staff (such as those on mobile cardiac care units). A list of recommended indications and suggested dosages for drugs mentioned in these guidelines is available from the authors.

#### THROMBOLYTIC TREATMENT IN ACUTE MYOCARDIAL INFARCTION

The major trials showing the efficacy of thrombolytic treatment have suggested that the reduction in mortality and infarct size is related to the interval from the onset of symptoms to treatment,<sup>35,37</sup> very early treatment having distinct advantages in terms of reducing mortality.<sup>46</sup> The ideal would be to start thrombolytic treatment as soon as possible.

To reduce delay to treatment, thrombolytic agents have been given outside hospital by general practitioners, by doctors on board mobile intensive care or coronary care units,<sup>38</sup> by ambulance nurses,<sup>39</sup> and by ambulance paramedics.<sup>40</sup> The feasibility of pre-hospital treatment is well established and two recent studies have shown that pre-hospital thrombolysis results in a substantial time saving compared with thrombolysis started in hospital—just under an hour in the European Myocardial Infarction Group's study and over two hours in the Grampian region early trial.<sup>21,41</sup> The Grampian study—a relatively small study of thrombolysis initiated by general practitioners in locations distant from hospital—showed clear and significant reductions in both mortality and markers of left ventricular damage associated with pre-hospital treatment soon after the onset of symptoms.<sup>21</sup> The larger, multicentred European study has, however, failed to show a statistically significant reduction in all

cause mortality.<sup>41</sup> The American myocardial infarction triage and intervention study by paramedics showed that a reduction in infarct size and mortality was associated with pre-hospital thrombolysis started within 70 minutes of symptom onset.<sup>42</sup> Overall, however, there was no significant effect of pre-hospital treatment, though it was noted that the time saving over hospital treatment was only about 30 minutes.<sup>6</sup> The larger mortality reduction with pre-hospital thrombolysis in the Grampian trial than in the European and American studies may be explained by the greater time saving in the first. The European data also showed a definite, but small, increase in the incidence of ventricular fibrillation soon after fibrinolysis both in hospital and in the community.

As pre-hospital treatment can result in such a time saving over hospital treatment, general practitioners (though not at present ambulance paramedics) may wish to start thrombolytic treatment outside hospital providing that they have facilities for managing arrhythmia and for resuscitation, including defibrillators (which may be provided by an attending ambulance); they can accurately diagnose acute myocardial infarction by using clinical and electrocardiographic criteria; and they believe that pre-hospital treatment in each case will result in an appreciable time saving, particularly if this is the only way of achieving a 90 minute "call to needle" time (see below). Although there is no mechanism to enforce these criteria it is assumed that general practitioners intending to use thrombolytic agents will obtain necessary training, including advice on which thrombolytic agent to use and its storage, reconstitution and administration from their local hospital physician or cardiologist.

Recording an electrocardiogram before giving thrombolysis is an important safeguard, not an impediment to treatment. The larger thrombolytic studies have found that patients with ST segment elevation or left bundle branch block showed the greatest relative reduction in mortality, whereas those with normal electrocardiograms or ST segment depression showed no significant benefit.<sup>43,44</sup> But, perhaps more importantly, withholding thrombolytic treatment from someone with a normal electrocardiogram reduces the likelihood of the harm that may result from giving thrombolysis for a condition mimicking acute myocardial infarction. Checking the electrocardiogram first for confirmatory evidence of infarction considerably improves the appropriateness and safety of thrombolytic treatment. The additional time taken to record an electrocardiogram is small in relation to the time already taken to provide pain relief and general medical care. In the Grampian trial, thrombolytic treatment was started at home by general practitioners 55 minutes after receipt of the patient's call. Patients presenting with a history suspicious of acute cardiac pain and a normal electrocardiogram continue to need careful monitoring with a repeat electrocardiogram until the diagnosis is established.

The onset of symptoms is notoriously difficult to define. A measure of the hospital delay is the door to needle time,<sup>3,45</sup> but a more valid marker of the overall performance of the health service in providing thrombolytic treatment is the call to needle time—that is, the time interval between a patient summoning assistance and subsequently receiving thrombolysis. The call to needle time should ideally be no longer than 60 minutes, but 90 minutes is a reasonable target for those patients with a readily diagnosed acute myocardial infarction. However, given that delays are currently in the order of 40-110 minutes outside hospital and an additional 80 minutes after arriving in hospital,<sup>20</sup> even the 90 minute call to needle time requires improvement in many localities.

Achieving a 90 minute call to needle time will

require the development and implementation of local procedures that will take into account local circumstances, including the performance of individual hospitals and ambulance services and the potential for general practitioners to initiate thrombolytic treatment. Thus in localities where transport times to hospital are prolonged, or where delays in hospital are great, general practitioners should take the initiative for thrombolytic treatment. In areas where hospitals are easily reached and delays in hospital are known to be small the local procedure should emphasise rapid transport and prompt hospital treatment. Regional, district, and family health services authorities should take the responsibility in formulating the appropriate policy for their area and for ensuring adequate data collection for regular, published audit to occur. This should include a requirement for admitting hospitals to provide information on door to needle times.

All four commonly available thrombolytic agents have been used outside hospital.<sup>46</sup> The earlier patency achieved by tissue plasminogen activator<sup>47</sup> may be of clinical benefit for certain patients—for instance, those in cardiogenic shock—and this has been confirmed in subgroups (patients presenting early with anterior infarctions) treated with an accelerated regimen.<sup>48</sup> The choice of agent, however, will depend on convenience, ease of administration, and cost. Patients who have received streptokinase or anistreplase within the preceding year should be given urokinase or tissue plasminogen activator. (A list of suggested dosages for these agents is available from the authors.)

#### IN HOSPITAL TREATMENT

The door to needle time varies widely between hospitals.<sup>20</sup> This results largely from duplication of clinical assessments by different teams of clinicians and restriction of the use of thrombolytic drugs to cardiac care units.

Hospitals should develop "fast track" systems that allow for the rapid assessment of all patients with chest pain and the prompt identification of those with obvious myocardial infarction and no contraindication to thrombolytic treatment.<sup>45,49</sup> These patients enter the fast track and receive prompt thrombolysis. Patients presenting diagnostic difficulties do not enter the fast track and require more detailed assessment. Fast tracking can result in time savings of over an hour in comparison to routine admission policies.

Having been alerted of the imminent arrival of a patient with acute chest pain, hospital staff should be waiting in a prepared receiving area. Subsequent assessment, to include the interpretation of the 12 lead electrocardiogram, should be performed by a competent clinician. Junior medical staff, who are usually responsible for the initial hospital management of these patients, will require instruction and guidance in order to maximise diagnostic accuracy<sup>50</sup> and minimise delays and duplication by other clinicians.

Time could also be saved by admitting of patients with chest pain directly to coronary care units.<sup>51</sup> Where such direct admission is not possible, thrombolytic treatment should begin in the accident and emergency department.<sup>20,52</sup>

#### GUIDELINES

The stages in the application of guidelines in clinical practice include production, dissemination, implementation, and evaluation. These guidelines have been developed by discussion and consensus and are being disseminated in this report.

Obviously, within such a large working group, there were differences in interpretation of published research, leading to differences of opinion in some areas, and contentious issues were exhaustively discussed. These guidelines represent the collective

opinion of the members of the working group, all of whom support this publication. The principles of management (see box) were unanimously agreed.

Implementation will, to a large extent, depend on local responses to the guidelines and collaboration between hospital staff, general practitioners, the ambulance service, and health authorities. If guideline production is not to be purely a paper exercise properly planned evaluation projects are required.

## Appendix

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