PREHOSPITAL CARE

Identifying barriers to prehospital thrombolysis in the treatment of acute myocardial infarction

T C Hanson, D Williamson

See end of article for authors' affiliations

Emerg Med J 2006;23:650–653. doi: 10.1136/emj.2005.033993

Correspondence to:
Dr D Williamson,
Consultant Emergency
Medicine, Emergency
Department, Royal United
Hospital, Combe Park,
Bath BA1 3NG, UK;
dominic.williamson@
ruh-bath.swest.nhs.uk

Accepted for publication
18 April 2006

Background and objectives: After an acute myocardial infarction (AMI) prehospital thrombolysis (PHT) reduces mortality compared with in-hospital thrombolysis. In practice, a relatively small proportion of the total population with AMI receives PHT. This study was designed to identify the current barriers to PHT. **Methods:** A retrospective practice review of 57 consecutive patients treated in or before arrival at a district general hospital emergency department. All patients received thrombolysis for an AMI. **Results:** The main barriers to delivery of PHT appear to be the inclusion and exclusion criteria laid out in the ambulance service central guidelines. Despite recent widening of the inclusion criteria, 54% of patients eligible for immediate treatment on arrival in hospital either received or were eligible for PHT. **Conclusion:** To increase the number of patients who are eligible for PHT these guidelines need to be revised further in line with in-hospital criteria for thrombolysis.

Since the 1970s, a number of landmark treatments have led to a fall in mortality from acute myocardial infarction (AMI). With the introduction of specialised coronary care units (CCU), pharmacological reperfusion therapies, and the use of catheter based interventions, clinical outcomes have markedly improved. However, the key prognostic factor for improved mortality and morbidity is the speed of intervention. It has been consistently proved that early restoration of coronary blood flow in the infarct related artery is needed to preserve functional myocardium.¹

In 1996 Boersma *et al* demonstrated that the duration of coronary occlusion and the extent of collateral circulation are the main determinants of myocardial infarct size.² Treatment within one hour of symptom onset resulted in a 6.5% absolute reduction in mortality. Figure 1 shows that the benefit of treatment (absolute reduction in mortality) falls with time in a non-linear fashion, clearly demonstrating that very early reperfusion of the occluded coronary artery (within 30 minutes) may lead to full recovery of ischaemic tissue and thus prevent necrosis. Therefore the primary objective in managing patients with AMI is reperfusion as early as possible.³

Both pharmacological and mechanical treatment strategies can be used to achieve reperfusion. The most widely used and established method is pharmacological fibrinolysis. Fibrinolysis, irrespective of the agent used, is usually referred to as thrombolysis. Until 15 years ago, thrombolysis was carried out almost exclusively in a coronary care unit (CCU). However, treatment is most effective when the delay to the delivery of thrombolysis, or call to help to needle time (CTN), is minimised. To improve morbidity and lower mortality, the CTN had to be reduced. In response to this observation, thrombolysis was moved from CCUs to emergency departments (EDs), usually the first point of medical contact for the patient. This was successful in significantly reducing the time from arrival at hospital to the time the thrombolytic drug was administered (the door to needle time or DTN).⁴ As a function of this, CTN times were also reduced. The development and introduction of bolus thrombolytic agents during the past few years has now

facilitated thrombolysis delivery in the prehospital arena, potentially reducing CTN times even further.

In 1998, a working party of the European Society of Cardiology and the European Resuscitation Council recommended that thrombolytic drugs should be administered by ambulance paramedics in the prehospital phase if journey time and hospital delays were likely to exceed 60 minutes.⁵ In the UK, prehospital treatment was endorsed by the National Institute for Clinical Excellence (NICE).⁶ The Joint Royal College Ambulance Liaison Committee (JRCALC) has since developed prehospital thrombolysis (PHT) consensus guidelines,⁷ which were updated in November 2005. As of January 2006 it is reported that 28 of the 31 ambulance services across England were trained and equipped to provide PHT.⁸

Figure 1 The Boersma curve.² Reprinted from Boersma E, Maas ACP, Deckers JW, *et al*. Early thrombolytic treatment in acute myocardial infarction: reappraisal of the golden hour. *Lancet* 1996;348:771–5, with permission from Elsevier.

Abbreviations: AMI, acute myocardial infarction; CCU, coronary care unit; CTN, call to needle time; DTN, door to needle time; ECG, electrocardiogram; ED, emergency department; JRCALC, Joint Royal Colleges Ambulance Liaison Committee; NICE, National Institute for Health and Clinical Excellence; PHT, prehospital thrombolysis

Current Department of Health policy (England) sets a standard of providing thrombolysis within 60 minutes of patients calling for help. In 2003 the Priorities and Planning Framework (2003–06) set a target of 38% of AMI patients achieving CTN times of less than 60 minutes, with a 10% improvement on this figure each subsequent year.⁹ PHT will have to play an increasing role in meeting this progressive target.

OBJECTIVES

Considerable resources have been made available to ensure that PHT can be provided by the ambulance service, although in most areas the PHT service is still in its infancy. Approximately 20% of AMI patients receiving thrombolysis are treated in the prehospital setting (estimated regional figures). This figure is predicted to grow. This study set out to determine what factors influence the provision of prehospital or in-hospital thrombolysis and how many patients should be eligible for PHT under current guidelines.

METHODS

We included all patients with AMI who received thrombolysis on presenting to the ED in the Royal United Hospital, Bath, over a five month period. This ED receives patients from Avon, Wiltshire, and West Country Ambulance Services. All these services have a PHT policy following the JRCALC guidelines, and all use a physician assisted thrombolysis administration model (the electrocardiogram (ECG) is transmitted to hospital and assessed for eligibility for thrombolysis, which is then communicated back to the ambulance crew).

We retrospectively collected the data from the ED records and ambulance patient record forms and reviewed these against the JRCALC criteria for PHT (see appendix online at <http://www.emjonline.com/supplemental/>). Patient data were collected before the JRCALC criteria were updated in November 2005. The results were scrutinised against the criteria in use at the time of data collection and reviewed when the criteria for PHT were updated. Data were anonymised and had no influence on patient outcome. Ethical approval for this study was not required.

We used SPSS version 12 software for statistical analyses. Mann–Whitney test was used to compare median prehospital

thrombolysis CTN times versus median hospital thrombolysis CTN times.

RESULTS

A total of 57 patients underwent thrombolysis during the study period. Of these, 15 patients were not eligible for immediate thrombolysis on arrival due to recognised treatment barriers (hypertension, ineligible ECG, not obtaining consent, cardiac arrest or suspected contraindication to thrombolysis)—so called “justified delays”. These patients were unlikely to be eligible for PHT if they were not eligible for immediate treatment on arrival to hospital. One patient self-presented to the emergency department, therefore bypassing the ambulance service.

Of the 41 remaining patients, 8 (20%) received PHT and the other 33 (80%) received treatment in hospital (fig 2). Of these 33 patients found to be eligible for immediate thrombolysis on arrival at the ED, table 1 details the reasons why they had not been treated prehospital by application of the JRCALC criteria for PHT. In some patients more than one contraindication will coexist.

The median CTN time for all patients without justified delays was 69 minutes (inter-quartile range (IQR) 57–86). Median prehospital thrombolysis CTN time and hospital thrombolysis CTN time was 51 minutes (95% CI 40.5 to 69.0) and 75 minutes (95% CI 67.8 to 82.9), respectively ($p < 0.01$).

In the group receiving PHT or being eligible for immediate treatment on arrival (41 patients), in seven cases (17%) PHT was not delivered, but without any contraindication identified. Therefore, a total of 15 patients (37% of all patients with no contraindication to immediate hospital treatment) either received PHT (eight patients) or were not found to have any contraindications (seven patients) and fulfilled criteria for PHT.

When this dataset was reviewed applying the November 2005 updates to the JRCALC criteria (box 1), it was found that a further seven patients would have been eligible for PHT. Therefore, in applying the updated criteria, a total of 22 patients (54%) would have either received or been eligible for PHT (table 2).

DISCUSSION

CTN time reduction

PHT has had a positive impact on reducing CTN times. Even in this small study the median CTN time for prehospital compared with in-hospital thrombolysis was reduced (51 minutes compared with 75 minutes) achieving both statistical and clinical significance. However, it is important to recall that the National Service Framework target for CTN

Figure 2 Summary of patient outcomes.

Table 1 Identified contraindications to prehospital thrombolysis (PHT)

Contraindication to PHT*	No. of patients
Age (>75 years old)	10
ECG not eligible	8
Only technician crew on board	8
Hypertensive (>160 mm Hg)	8
History not consistent with acute myocardial infarction	6
Bradycardia (<50 beats/min)	6
Symptoms >6 hours	5
Anticoagulation therapy	3
Tachycardia (>140 beats/min)	2
Did not consent to prehospital treatment	1
No contraindication identified	7

*See JRCALC guidelines (appendix online at <http://www.emjonline.com/supplemental/>).

Box 1: Summary of JRCALC guideline changes: November 2005

- Age: Increase of age limit to 80 years
- Heart rate: Lower limit decreased to 40/min, but upper limit remains at 140/min
- Maximum blood pressure: Systolic limit increased to 180 mm Hg

times is progressive—10% more patients must have a CTN time of less than 60 minutes each year. More patients must receive PHT if these targets are to be achieved in this locality.

Role of paramedics

Paramedics are experts in the delivery of prehospital care and the key to success in PHT. A recent qualitative study has shown that there is a will to provide PHT and paramedics have an appreciation of its benefits to patients as well as the associated risks. However, the same study suggested that aspects of pay and working conditions, and certain organisational factors undermined the willingness of some paramedics to administer PHT.¹⁰ Service providers and commissioners need to take this into account and ensure that these issues are addressed.

In our sample, up to 8 additional patients (20%) may have been eligible for PHT if trained paramedics rather than technician crews had been in attendance. If all AMI patients were attended by a prehospital provider qualified to administer thrombolysis, a possible maximum of 30 (73%) patients may have been eligible for PHT under the new guidelines, assuming all the patients attended by technician crews would have been eligible. The healthcare community needs to ensure that all prehospital responders are trained to provide the appropriate treatment to individual patients within agreed guidelines.

Door to needle time

During this review, the median time taken to receive thrombolysis after arrival in the ED (the door to needle or DTN time) for patients without justified delays, was 19 minutes (IQR 14–25). If PHT was administered to these patients this time would be eliminated. If all these patients had received PHT, the overall median CTN time could potentially have been reduced to 52 minutes.

DTN times need to be considered a target of the past. EDs should be providing seamless care with the prehospital care teams to ensure that patients receive treatment at the earliest opportunity by the first responder competent to deliver it.

CONCLUSION

This study confirms the expected benefit that PHT reduces CTN times. Even in this small group of patients it provided a clinically and statistically significant decrease in time to receive treatment. However, only 15 out of 41 (37%) patients were eligible for PHT. Under the new guidelines this would rise to 22 patients (54%). This is not an adequate number to achieve the government's projected targets for CTN times in this locality (68% CTN < 60 minutes for 2006/7).

To increase the number of patients who are eligible for PHT and to meet the progressive target that the Department of Health has set, the JRCALC guidelines will need to be revised further to be more inclusive. Any reluctance on the part of paramedics will need to be addressed through support, further training, and recognition of the increasing

Table 2. Identified contraindications to prehospital thrombolysis (PHT) by JRCALC criteria updated in November 2005

Contraindication to PHT including update*	No. of patients
Age (>80 years old)	4
ECG not eligible	8
Only technician crew on board	8
Hypertensive (>180 mm Hg)	3
History not consistent with acute myocardial infarction	6
Bradycardia (<40 beats/min)	0
Symptoms >6 hours	5
Anticoagulation therapy	3
Tachycardia (>140 beats/min)	2
Did not consent to prehospital treatment	1
No contraindication identified	14

*See JRCALC guidelines (appendix online at <http://www.emjonline.com/supplemental/>).

responsibility they bear. Also the initial responder to all AMI patients needs to be qualified to provide PHT.

JRCALC and the Joint Thrombolytic Committee were understandably cautious when setting their guidelines, giving high priority to safety, while PHT was gaining acceptance by paramedics and the medical community. This initial phase is passing and, as has always been intended, it is now time to standardise the indications for PHT with the evidence based guidelines used in hospitals which, over the years, have proved to be safe enough.⁵ Only when this standardisation occurs will we see the maximum benefit of delivering this potentially life saving treatment in the prehospital arena.

ACKNOWLEDGEMENT

The authors wish to thank Dr G Taylor for his help in the statistical analysis of this paper.

An appendix to this paper has been posted online at <http://www.emjonline.com/supplemental/>

Authors' affiliations

T C Hanson, Bristol University Medical School, Bristol, UK

D Williamson, Emergency Department, Royal United Hospital, Bath, UK

Competing interests: none declared

Ethical approval was not required for this study.

REFERENCES

- 1 Van de Werf F, Ardissino D, Betriu A et al. Management of acute myocardial infarction in patients presenting with ST-segment elevation. The Task Force on the Management of Acute Myocardial Infarction of the European Society of Cardiology. *Eur Heart J* 2003;24:28–66.
- 2 Boersma E, Maas ACP, Deckers JW, et al. Early thrombolytic treatment in acute myocardial infarction: reappraisal of the golden hour. *Lancet* 1996;348:771–5.
- 3 [No authors listed]. Reperfusion in acute myocardial infarction. *Drug Ther Bull* 2005;43:49–53.
- 4 Kendall JM, McCabe SE. The use of audit to set up a thrombolysis programme in the accident and emergency department. *J Accid Emerg Med* 1996;13:49–53.
- 5 [No authors listed]. The pre-hospital management of acute heart attacks. Recommendations of a Task Force of the European Society of Cardiology and the European Resuscitation Council. *Eur Heart J* 1998;19:1140–64.
- 6 National Institute for Clinical Excellence. *Guidance on the Use of Drugs for Early Thrombolysis in the Treatment of Acute Myocardial Infarction*, Technology Appraisal Guidance no.52. London: NICE, 2002.
- 7 Joint Royal Colleges Ambulance Service Liaison Committee. Clinical Practice Guidelines version 3. Emergency Care Specialist Library: 2004, Chapter 26, 1–4. Available at: www.asancep.org.uk/JRCALC/guidelines/ (accessed July 2005).

- 8 **Ambulance Service Association/Joint Royal Colleges Ambulance Service Liaison Committee.** Thrombolysis update, January 2006. Available at: www.asancep.org.uk/thromb%20web%20update%20Jan%2006.pdf (accessed March 2006).
- 9 **Department of Health.** *Improvement, Expansion and Reform: the Next 3 Years' Priorities and Planning Framework, 2003–2006*, Appendix B. London: Department of Health, 2002.
- 10 **Joint Royal Colleges Ambulance Service Liaison Committee.** Prehospital Thrombolytic Therapy JRCALC Position Statement: July 2004. Available at: www.asancep.org.uk/JRCALC/guidelines/JRCALCThromb2004.pdf (accessed July 2005).
- 11 **Price L, Keeling P, Brown G, et al.** A qualitative study of paramedics' attitudes to providing prehospital thrombolysis. *Emerg Med J* 2005;**22**:738–41.

Clinical Evidence—Call for contributors

Clinical Evidence is a regularly updated evidence-based journal available worldwide both as a paper version and on the internet. *Clinical Evidence* needs to recruit a number of new contributors. Contributors are healthcare professionals or epidemiologists with experience in evidence-based medicine and the ability to write in a concise and structured way.

Areas for which we are currently seeking contributors:

- Pregnancy and childbirth
- Endocrine disorders
- Palliative care
- Tropical diseases

We are also looking for contributors for existing topics. For full details on what these topics are please visit www.clinicalevidence.com/ceweb/contribute/index.jsp

However, we are always looking for others, so do not let this list discourage you.

Being a contributor involves:

- Selecting from a validated, screened search (performed by in-house Information Specialists) epidemiologically sound studies for inclusion.
- Documenting your decisions about which studies to include on an inclusion and exclusion form, which we keep on file.
- Writing the text to a highly structured template (about 1500–3000 words), using evidence from the final studies chosen, within 8–10 weeks of receiving the literature search.
- Working with *Clinical Evidence* editors to ensure that the final text meets epidemiological and style standards.
- Updating the text every 12 months using any new, sound evidence that becomes available. The *Clinical Evidence* in-house team will conduct the searches for contributors; your task is simply to filter out high quality studies and incorporate them in the existing text.

If you would like to become a contributor for *Clinical Evidence* or require more information about what this involves please send your contact details and a copy of your CV, clearly stating the clinical area you are interested in, to CECommissioning@bmjgroup.com.

Call for peer reviewers

Clinical Evidence also needs to recruit a number of new peer reviewers specifically with an interest in the clinical areas stated above, and also others related to general practice. Peer reviewers are healthcare professionals or epidemiologists with experience in evidence-based medicine. As a peer reviewer you would be asked for your views on the clinical relevance, validity, and accessibility of specific topics within the journal, and their usefulness to the intended audience (international generalists and healthcare professionals, possibly with limited statistical knowledge). Topics are usually 1500–3000 words in length and we would ask you to review between 2–5 topics per year. The peer review process takes place throughout the year, and out turnaround time for each review is ideally 10–14 days.

If you are interested in becoming a peer reviewer for *Clinical Evidence*, please complete the peer review questionnaire at www.clinicalevidence.com/ceweb/contribute/peerreviewer.jsp