

Oxygen use in acute myocardial infarction: an online survey of health professionals' practice and beliefs

Amanda Burls,¹ José I Empanaza,² Tom Quinn,³ Juan B Cabello⁴

¹Centre for Evidence-Based Medicine, Department of Primary Health Care, University of Oxford, Old Road Campus, Oxford, UK

²Unidad de Epidemiología Clínica e Investigación, CASPe, CIBER-ESP, Hospital Donostia, San Sebastián, Spain

³Division of Health and Social Care, Faculty of Health and Medical Sciences, University of Surrey, Guildford, UK

⁴Centro coordinador CASPe & Cardiology Department, Hospital General Universitario de Alicante, Alicante, Spain

Correspondence to

Professor Tom Quinn, Division of Health and Social Care, Faculty of Health and Medical Sciences, University of Surrey, Guildford GU2 7XH, UK; t.quinn@surrey.ac.uk

Accepted 14 June 2009

ABSTRACT

Introduction There is growing interest in the safety of oxygen therapy in emergency patients. A Cochrane review of oxygen versus air for patients with acute myocardial infarction (AMI) showed a potentially important, but statistically non-significant, increase in mortality (RR 3.03 (95% CI 0.93 to 9.83)) and concluded a definitive randomised controlled trial (RCT) was needed.

Objective To explore the feasibility of conducting an RCT of oxygen versus air in AMI, by exploring the beliefs of UK professionals who treat patients with AMI about oxygen's benefits, and to establish a baseline of reported practice by asking about their use of oxygen.

Method A cross-sectional online survey of UK emergency department, cardiology and ambulance staff.

Result 524 responses were received. All specialities had over 100 respondents. 98.3% said they always or usually use oxygen. 80% reported having local guidelines that recommended the routine use of oxygen. 55% believed oxygen definitely or probably significantly reduces the risk of death, while only 1.3% reported that they thought 'it may even increase the risk of death.' There were only minor differences across specialities and grades.

Conclusion Widespread belief in the benefit of oxygen in AMI may make it difficult to persuade funders of the importance of this issue and health professionals to participate in enrolling patients into a trial in which oxygen would be withheld from half their patients.

INTRODUCTION

In 2007, articles suggesting that oxygen may harm people who have had a heart attack appeared in the UK popular press following the publication of a narrative review of oxygen use in acute myocardial infarction (AMI).¹

National and international guidelines have until recently recommended the use of oxygen in AMI patients in both the prehospital and hospital setting.^{2–5} We undertook a Cochrane systematic review of randomised control trials (RCTs) on this topic.⁶ The review concluded that there was considerable uncertainty with an RR of death for oxygen compared with air of 3.03 (95% CI 0.93 to 9.83) and that, since it was possible that oxygen increases mortality, a definitive RCT was required.⁶

The objectives were:

- ▶ to assess the feasibility of an RCT by examining potential professional resistance;
- ▶ to see how frequently oxygen therapy is reported as being used in patients with AMI;
- ▶ to explore health professionals' beliefs about the benefits or harms of oxygen in terms of death and pain relief, and their relationship to practice;

- ▶ to establish a baseline to later explore variations in reported practice and beliefs between countries and whether publication of the Cochrane review altered perceptions.

METHODS

Design

A cross-sectional online survey of UK professionals who treat patients with AMI was carried out.

Population surveyed

We used theoretical sampling. The most important professional groups in the UK treating AMI were identified as ambulance, emergency department (ED) and cardiology staff. Professional groups were accessed by:

- ▶ Asking the British Cardiovascular Society (BCS) to place a link to the survey on their website. This appeared on the home page as the first item on the central 'what's new' section. Members were alerted to the survey and encouraged to take part via the BCS newsletter.
- ▶ The Joint Royal Colleges Ambulance Liaison Committee (JRCALC), the British Paramedic Association, the British Association for Nursing in Cardiovascular Care and the Royal College of Nursing's Cardiovascular Network disseminated the survey to their members using email.
- ▶ A notice and link were placed on the National Library for Health Cardiovascular Specialist Library webpage encouraging people to participate in the survey.
- ▶ Regional mailing lists of cardiology contacts were used.
- ▶ Some health professionals were alerted to the survey by colleagues.

The survey was launched at the beginning of April 2007 and the above actions taken during the following month. The survey closed on 10 May 2007.

Survey characteristics

To maximise completion rates, we restricted the survey to seven questions. Questions 1, 5, 6 and 7 had a free text option in addition to specified categories. No question required a mandatory response.

People were prevented from completing the survey more than once using cookies. People who left the survey half-way through were able to return to the question at which they stopped and complete the survey.

We used Surveyselect.net software hosted on a university server.

Ethical approval

To ensure that the survey met best practice,^{7–10} a draft was sent to colleagues for comment prior to

Original article

launch. It was confirmed that ethical committee approval was not required for this study in the UK. Participants were invited to leave their email addresses to receive the results of the survey.

Analysis

Data were analysed using Systat according to a prespecified strategy. Email addresses were stripped prior to analysis to maintain confidentiality.

Answers were described in absolute numbers and percentages. The χ^2 test was used to compare frequencies between groups. Where numbers were insufficient, meaningful categories were aggregated and/or the Fischer exact test was used. For hypothesis generating analyses, we aggregated the behavioural and belief data into binary variables: those who said that they 'always,' 'always unless contraindicated' or 'usually' routinely gave oxygen to patients with AMI were designated as 'use oxygen;' those who 'usually' or 'almost always' thought that giving oxygen reduces pain were designated 'improves pain;' those who thought it 'definitely' or 'probably significantly reduces the risk of death' were designated as 'reduces death.' p Values are reported when less than 0.20; otherwise the result is reported as 'not significant.'

RESULTS

The survey was online for 40 days. There were approximately 48 h of downtime during this period while the server was being physically relocated. At close, there were 526 records in the database. Two contained nonsense, not logically possible from the survey structure. We attributed these to technical problems (possibly caused by the relocation of the server) and deleted them. There were therefore 524 valid responses. Given the recruitment methods, it was not possible to report the response rate of those aware of and eligible to complete the survey. The question response rate dropped as the survey progressed, with 75.5% answering the last question. Questions left blank were reclassified to 'don't know' for questions 3–5. There was a good response from all three professional groups: 104 responses from ED; 153 from cardiology; 151 from the ambulance service. One hundred and ninety-eight people left their email address.

All questions and responses are given in table 1.

Overall result

Of those who see patients with AMI, 98.3% said they usually or always use oxygen. Fifty-five per cent of all respondents believed that oxygen definitely or probably significantly reduces the risk of death, contrasted with 1.3% (seven people) who believed it may increase death. Of the latter, three usually or always administered oxygen, and 29.4% believed it always or usually reduces pain. No one thought it increases pain.

Only 1.7% said there were no local guidelines, and 96% of local guidelines were said to recommend the use of oxygen.

Profession and speciality

Non-doctors were more likely to believe oxygen reduces death (69%) than doctors (50%) ($p=0.02$). Moreover, 8.3% of doctors thought that oxygen might actually increase mortality compared with just 0.98% of non-doctors ($p<0.01$). There was no statistically significant difference, however, between professions in their behaviour or their beliefs about the effect of oxygen on pain (table 2).

ED and ambulance staff reported similar behaviours and beliefs. Cardiology staff were, however, marginally less likely to use oxygen than others (96% vs 100% $p<0.003$) and considerably

Table 1 Survey answers

| Question | Possible answers | N | Percentage |
|--|--|-----|------------|
| 1. In your clinical practice, do you routinely give oxygen to patients with acute myocardial infarction? | Never | 1 | 0.2 |
| | Only if there is an additional indication | 4 | 0.8 |
| | Occasionally | 4 | 0.8 |
| | Usually | 30 | 5.7 |
| | Always unless contraindicated | 159 | 30.3 |
| | Always | 319 | 60.9 |
| 2. How many patients do you see each year with acute myocardial infarction? | Not applicable | 7 | 1.3 |
| | 0 | 15 | 2.9 |
| | 1–10 | 98 | 18.7 |
| | 11–25 | 94 | 17.9 |
| | 26–50 | 92 | 17.6 |
| | >50 | 177 | 33.8 |
| 3. Do you believe that giving oxygen to patients with acute myocardial infarction reduces pain? | Left blank | 48 | 9.2 |
| | Yes, almost always | 41 | 7.8 |
| | Usually | 113 | 21.6 |
| | Sometimes | 219 | 41.8 |
| | Rarely | 52 | 9.9 |
| | Never | 13 | 2.5 |
| 4. Do you think giving oxygen reduces the risk of death? | No, it is more likely to make the pain worse | 0 | 0 |
| | Don't know (or left blank) | 86 | 16.4 |
| | Yes, it definitely significantly reduces the risk of death | 68 | 13.0 |
| | Yes, it probably significantly reduces the risk of death | 170 | 32.4 |
| | Yes, but the reduction in risk of death is minimal | 83 | 15.9 |
| | No, it has no effect on reducing mortality | 30 | 5.7 |
| 5. Do your local guidelines recommend the routine use of oxygen therapy in acute myocardial infarction? | No, indeed it may even increase the risk of death | 7 | 1.3 |
| | Don't know (or left blank) | 166 | 31.7 |
| | Yes | 419 | 80.0 |
| | No | 4 | 0.8 |
| | There are no local guidelines | 9 | 1.7 |
| | Yes, but only in specific circumstances | 4 | 0.8 |
| 6. Please give us information about your stage of clinical training | Don't know (or left blank) | 88 | 16.7 |
| | Foundation year doctor | 1 | 0.2 |
| | SHO/specialist registrar | 26 | 4.9 |
| | Consultant | 46 | 8.8 |
| | GP | 6 | 1.2 |
| | Nurse or other profession allied to medicine | 215 | 41.0 |
| 7. What is your speciality? | Paramedic or ambulance technician | 154 | 29.4 |
| | Other (or left blank) | 76 | 14.5 |
| | Emergency department | 104 | 19.8 |
| | Cardiology | 153 | 29.2 |
| | General practice | 9 | 1.7 |
| | Internal medicine | 3 | 0.6 |
| | Ambulance | 151 | 28.8 |
| | Other | 28 | 5.3 |
| | Left blank | 76 | 14.5 |

more sceptical about whether it reduces mortality (48% vs 74% $p<0.01$) (table 2).

All four who reported that they did not routinely use oxygen or believe it reduced pain or death were from cardiology: two consultants, one nurse and one senior house officer.

Table 2 Comparisons of differences in behaviour and beliefs between specialities and profession

| Behaviour/beliefs | Speciality | | | p Value (cardiology versus others) | Doctors versus non-doctors | | |
|-------------------|-----------------------------|---------------|----------------|--|----------------------------|-----------------|---------|
| | Emergency department (%) | Ambulance (%) | Cardiology (%) | | Doctors (%) | Non-doctors (%) | p Value |
| Use oxygen | 100 | 100 | 96.0 | p<0.003 | 95.8 | 99.2 | 0.06 |
| Improves pain | 37.9 | 34.7 | 35.9 | ns | 25.4 | 37.0 | 0.11 |
| Reduces death | 74.4 | 74.1 | 48.0 | p<0.01 | 50.0 | 69.0 | 0.02 |

Experience, seniority and volume

Our prior hypothesis was that senior staff, and those who treated large numbers of patients, would be more sceptical about the benefits and use of oxygen, as they would tend to be more familiar with the lack of evidence to support the practice. Those seeing more than 50 patients a year reported a small, but statistically significantly, lower use of oxygen. This group was also less likely to believe that it improved pain and reduced death, although the differences were not significant (table 3).

Doctors who had finished specialist training were less likely to believe that oxygen improved pain, but there was no significant difference in behaviour or beliefs about the effect on mortality (table 3).

Ambulance staff, whether paramedics or technicians, reported 100% use of oxygen. Paramedics were more sceptical about oxygen's benefits than technicians, although the difference was not statistically significant (table 4).

DISCUSSION

Our survey demonstrated that the majority of respondents believe oxygen to be beneficial, and nearly all report using it routinely, even those who do not believe in its benefits. This is consistent with the recommendations for the management of AMI in most current guidelines at the time we undertook the survey. The overwhelming majority of respondents said there were local guidelines, of which only four were reported not to recommend the use of oxygen. Although the results were highly statistically significant ($p<0.003$), there was negligible difference between specialities with 100% of ED and ambulance staff usually or almost always using oxygen compared with 96% of cardiology staff.

The use of the internet for health research is growing and unstoppable. The speed, ease of conduct and cost-effectiveness of online surveys make them attractive. A strength of this survey is that there was good response from across all key professional groups. However, there are known methodological challenges with online open-access surveys,⁷ and this study suffers in particular from two limitations: we could not ensure that those responding actually came from the professional groups they claim to come from; the sampling is not random. To limit the former problem, we used targeted methods to raise awareness of the study. The consistency and coherence of results

suggest to us that it is unlikely that there is a significant proportion of false respondents. (Also, 198 people left email addresses, many of which were NHS.) The second problem, that random sampling, as commonly used in traditional surveys, is not possible when using the internet signposting, webpage advertising or email snowballing techniques, for recruiting participants, means that there is not a numerically identifiable, probabilistically selected, denominator population. This limits the statistical inferences that can be appropriately drawn. We used theoretical sampling to select key professional groups to be surveyed, choosing those most likely to see patients with AMI, in order to capture not only the use of oxygen but, more importantly, subjective beliefs and rationales behind such use. While it could be speculated that professionals with strong opinions would be more likely to respond to this survey, we do not think there is a compelling a priori reason to suggest that online survey methods will be more likely to systematically select a professional group more likely to report the observed results (a belief in the benefits, and reported use, of oxygen) than traditional survey methods.

There were too few people who were sufficiently sceptical about the value of oxygen to permit deep exploration.

In this study, 98% of respondents reported usually or always using oxygen compared with the 1997 UK survey, which reported that oxygen was not routinely prescribed in 53% of UK coronary care units.¹¹ The difference may be due to today's greater emphasis on following guidelines compared with a decade ago, but it could also be a reporting bias because people wish to appear compliant with recommended practice.

The results of this study implied that there could be significant resistance from professionals to an RCT looking at the benefit of oxygen because they may have insufficient equipoise to be prepared to withhold oxygen from the control group. Most major guidelines current when we undertook the survey would reinforce this. The American College of Cardiology identified oxygen as a 'routine measure,' with a Class I recommendation that it should be administered to patients with arterial oxygen desaturation (SaO_2 less than 90%) based on (level of evidence B), and a IIa recommendation that it is 'reasonable' to administer to all uncomplicated STEMI patients during the first 6 h based on (level of evidence C).²⁻³ The European Society of Cardiology recommended use at 2–4 l/min 'especially to those who are breathless or who have any features of heart failure and shock' and comment on the value of monitoring saturation to help in deciding on the need for oxygen administration.⁴ The International Liaison Committee on Resuscitation (ILCOR) presented a 'consensus on science,' in which they reflect on one

Table 3 Comparisons of differences in beliefs and behaviour by experience

| Behaviour/ beliefs | Patients per annum | | | Stage of training | | |
|-----------------------|--------------------|---------|---------|-------------------|----------------------------|---------|
| | ≥50 (%) | <50 (%) | p Value | Consultant (%) | Doctors in training (%) | p Value |
| Use oxygen | 97.0 | 99.6 | 0.04 | 95.4 | 96.0 | 1 |
| Improves pain | 39.7 | 33.5 | ns | 10.8 | 47.8 | <0.01 |
| Reduces death | 60.0 | 69.5 | 0.09 | 37.0 | 61.1 | 0.14 |

Table 4 Comparison of behaviour and beliefs of ambulance staff

| Behaviour/beliefs | Paramedic (%) | Technician (%) | p Value |
|-------------------|---------------|----------------|---------|
| Use oxygen | 100 | 100 | ns |
| Improves pain | 31.6 | 41.9 | ns |
| Reduces death | 72.4 | 86.7 | 0.19 |

animal study suggesting reduced infarct size, and one human study reporting improvements in the ECG, and a single randomised trial which failed to show any long-term benefit; the subsequent recommendation is that oxygen be given to desaturated patients but goes on to comment 'Given the safety profile of oxygen in the (MI) population and potential benefit in patients with unrecognised hypoxia, it is reasonable to give to all uncomplicated STEMI patients during the first 6 h of emergency management.'⁵ The European Resuscitation Council suggested 4–8 l/min for all desaturated patients and those with pulmonary congestion and, while explicitly acknowledging the 'lack of proof' for long-term benefit in uncomplicated patients, recommend that it be given to all on the basis that it will benefit those with unrecognised hypoxia.¹² JRCALC, which publishes UK national guidelines for treatments delivered by paramedics, recommended routine use of high-concentration oxygen, whatever the oxygen saturation, if an acute coronary syndrome (ACS) is suspected.¹³

That an overwhelming majority of participants in our survey reported routine use of oxygen can be viewed positively in that compliance with guidelines is high. However, the above international recommendations appear to reflect consensus rather than high-quality evidence. Our findings suggest that some professionals follow guidelines despite their personal beliefs about the intervention's value. There is a need, therefore, to critically assess the guidelines on which such treatment is based in an area where concerns about safety and efficacy have been resurrected some decades since the best RCT-reported absence of benefit.

This is beginning to happen. With the growing emphasis on evidence-based practice, new guidelines are beginning to diverge from the consensus. Recent guidelines from the Scottish Intercollegiate Guidelines Network (SIGN) unequivocally state that there is no evidence to support routine use of oxygen across the broad spectrum of ACS, restricting recommendations for use in hypoxic patients and those with pulmonary oedema or continuing myocardial ischaemia, and making clear that this recommendation is based on expert opinion alone.¹⁴ Similarly, the recent European guideline does not recommend routine oxygen use in uncomplicated ACS.¹⁵ The British Thoracic Society have recently published guidelines on emergency oxygen use in adult patients, endorsed by several organisations including JRCALC, recommending that MI or ACS patients should only receive oxygen if hypoxaemic, although this again is based on expert consensus rather than hard evidence.¹⁶

The diversity of approaches to oxygen use, in relation to indications, dosage and duration of treatment, in the major guidelines imply that not all can be recommending what is best for patients. Moreover, there is the potential for confusion among those providing emergency cardiac care. There is a need to adopt a more consistent approach, but this is difficult in the absence of clear evidence of which patients benefit, the appropriate dose and duration of treatment. RCTs are urgently required to clarify the role of this key component of emergency care.

CONCLUSION

The conflict between the current, albeit weak, evidence suggestive of possible harm from oxygen use in AMI, and most current guidelines and practice promoting its use, means that a definitive RCT is urgently required. The widespread belief in

the benefit of oxygen, as demonstrated by this survey, suggests that currently it may be difficult to persuade funders of the importance of this issue or health professionals to participate in enrolling patients into such a trial. However, the fact that new guidelines are beginning to change their recommendations, despite no new evidence having emerged, suggests that attitudes may be changing. An active educational and publicity campaign to make professionals aware of the current evidence may help spread an appreciation of the uncertainties in this area and make it feasible to conduct the long-needed definitive RCT on this question.

Competing interests None.

Contributors TQ is involved in developing JRCALC guidelines and helped to write the CHD NSF.

Provenance and peer review Not commissioned; not externally peer reviewed.

REFERENCES

1. **Beasley R**, Aldington S, Weatherall M, *et al*. Oxygen therapy in myocardial infarction: an historical perspective. *J R Soc Med* 2007;**100**:130–33.
2. **Antman EM**, Anbe DT, Armstrong PW, *et al*. ACC/AHA guidelines for the management of patients with ST-elevation myocardial infarction—executive summary: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Writing Committee to Revise the 1999 Guidelines for the Management of Patients With Acute Myocardial Infarction). *Circulation* 2004;**110**:588–636.
3. **Anderson JL**, Adams CD, Antman EM, *et al*. ACC/AHA 2007 guidelines for the management of patients with unstable angina/non-ST-Elevation myocardial infarction: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Writing Committee to Revise the 2002 Guidelines for the Management of Patients With Unstable Angina/Non-ST-Elevation Myocardial Infarction) developed in collaboration with the American College of Emergency Physicians, the Society for Cardiovascular Angiography and Interventions, and the Society of Thoracic Surgeons endorsed by the American Association of Cardiovascular and Pulmonary Rehabilitation and the Society for Academic Emergency Medicine. *J Am Coll Cardiol* 2007;**50**:e1–e157.
4. **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.
5. **International Liaison Committee on Resuscitation**. 2005 International consensus on cardiopulmonary resuscitation and emergency cardiovascular care science with treatment recommendations. Part 5: acute coronary syndromes. *Resuscitation* 2005;**67**:249–69.
6. **Burks A**, Bayliss S, Emparanza JI, *et al*. Oxygen therapy for acute myocardial infarction (Protocol). *Cochrane Database Syst Rev* 2008;(2):CD007160. doi:10.1002/14651858.CD007160.
7. **Eysenbach G**. Improving the quality of Web surveys: the Checklist for Reporting Results of Internet E-Surveys (CHERRIES). *J Med Internet Res* 2004;**6**:e34.
8. **Schonlau M**. Will web surveys ever become part of mainstream research? *J Med Internet Res* 2004;**6**:e31.
9. **Schleyer TK**, Forrest JL. Methods for the design and administration of web-based surveys 2. *J Am Med Inform Assoc* 2000;**7**:416–25.
10. **Ekman A**, Klint A, Dickman PW, *et al*. Optimizing the design of web-based questionnaires—experience from a population-based study among 50,000 women 2. *Eur J Epidemiol* 2007;**22**:293–300.
11. **Wilson AT**, Channer KS. Hypoxaemia and supplemental oxygen therapy in the first 24 hours after myocardial infarction: the role of pulse oximetry. *J R Coll Physicians Lond* 1997;**31**:657–61.
12. **Arntz HR**, Bossaert L, Filippatos GS. European Resuscitation Council Guidelines for Resuscitation 2005 Section 5. Initial management of acute coronary syndromes. *Resuscitation* 2005;**67**:S87–96.
13. **Scottish Intercollegiate Guidelines Network (SIGN)**. *Acute coronary syndromes. A national clinical guideline*. Edinburgh, Scotland: SIGN, 2007. <http://www.sign.ac.uk/pdf/sign93.pdf>.
14. **Joint Royal Colleges Ambulance Liaison Committee**. UK ambulance service clinical practice guidelines. 2006. http://www2.warwick.ac.uk/fac/med/research/hsr/emergencycare/prehospitalcare/jrcalcstakeholderwebsite/guidelines/acute_coronary_syndrome_2006.pdf (accessed 21 Jan 2009).
15. **Bassand JP**, Hamm CW, Ardissino D, *et al*. Guidelines for the diagnosis and treatment of non-ST-segment elevation acute coronary syndromes. *Eur Heart J* 2007;**28**:1598–660.
16. **O'Driscoll BR**, Howard LS, Davison AG on behalf of the British Thoracic Society. BTS guideline for emergency oxygen use in adult patients. *Thorax* 2008;**63**:Vi1–Vi68.



Oxygen use in acute myocardial infarction: an online survey of health professionals' practice and beliefs

Amanda Burls, José I Empananza, Tom Quinn and Juan B Cabello

Emerg Med J 2010 27: 283-286
doi: 10.1136/emj.2009.077370

Updated information and services can be found at:
<http://emj.bmj.com/content/27/4/283>

| | |
|-------------------------------|---|
| | <i>These include:</i> |
| References | This article cites 13 articles, 5 of which you can access for free at: http://emj.bmj.com/content/27/4/283#BIBL |
| Email alerting service | Receive free email alerts when new articles cite this article. Sign up in the box at the top right corner of the online article. |
| Topic Collections | Articles on similar topics can be found in the following collections Acute coronary syndromes (185) |

Notes

To request permissions go to:
<http://group.bmj.com/group/rights-licensing/permissions>

To order reprints go to:
<http://journals.bmj.com/cgi/reprintform>

To subscribe to BMJ go to:
<http://group.bmj.com/subscribe/>