

Patients' action during their cardiac event: qualitative study exploring differences and modifiable factors

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Abstract

Objectives: To explore the circumstances and factors that explain variations in response to a cardiac event and to identify potentially modifiable factors.

Design: Qualitative analysis of semistructured, face to face interviews with patients admitted to two district hospitals for a cardiac event and with other people present at the time of the event. Patients were divided into three groups according to the length of delay between onset of symptoms and calling for medical help.

Subjects: 43 patients and 21 other people present at the time of the cardiac event. Patients were divided into three groups according to the length of time between onset of symptoms and seeking medical help: non-delayers (< 4 h; n = 21), delayers (4-12 h; n = 12), and extended delayers (> 12 h; n = 10).

Main outcome measures: Decision making process, strategies for dealing with symptoms, and perception of risk and of heart attacks before the event according to delay in seeking help.

Results: The illness and help seeking behaviour of informants had several components, including warning, interpretation, preliminary action, re-evaluation, and final action stages. The length of each stage was variable and depended on the extent to which informants mobilised and integrated resources into a strategy to bring their symptoms under control. There were obvious differences in informants' knowledge of the symptoms that they associated with a heart attack before the event. Non-delayers described a wider range of symptoms before their heart attack and twice as many (13) considered themselves to be potentially at risk of a heart attack compared with the other two groups. For most informants the heart attack differed considerably from their concept of a heart attack.

Conclusion: The most critical factor influencing the time between onset of symptoms and calling for professional medical help is that patients and others recognise their symptoms as cardiac in origin. This study suggests that various points of intervention in the decision making process could assist symptom recognition and therefore faster access to effective treatment.

Introduction

A critical factor in preventing premature death or disability from a heart attack is ensuring that patients receive effective treatment to reduce damage to the heart muscle. Thrombolysis can reduce the size of the clot and hence the amount of muscle damage, but it must be given early for maximal benefit.^{1 2} Thus patients or their associates need to recognise the symptoms and call for appropriate help immediately. We sought to explain variation in response to a cardiac event and to identify modifiable factors.

Subjects and methods

The study was conducted in two district general hospitals with coronary care units in one health authority. The subjects of the study were all admitted patients who had survived a cardiac event, which for this study was defined as a suspected or confirmed acute myocardial infarction. One patient who was too ill to be interviewed on the fifth day after the event was excluded. An integral part of the research design was interviewing, whenever possible, anyone else present at the time of the cardiac event. Subjects were recruited over five separate weeks in summer and winter months to ensure the required diversity of experience of a cardiac event and access to medical services. The original study design was intended to include associates of patients who died before arrival at hospital, but we could not obtain full ethical clearance for this.

Before the main study a pilot study was undertaken in one of the hospitals. During one week eight patients surviving a cardiac event and their associates (four relatives) were interviewed. They were not included in the main study.

Forty three patients were identified from coronary care units, accident and emergency departments, and medical and surgical wards, to ensure total coverage. Twenty one relatives and bystanders were also recruited.

Interviews

Patients were approached three to four days after admission to hospital and interviewed on the fifth day. The interviews lasted between 45 and 60 minutes. Patients were interviewed alone in the morning, and the other people were interviewed in the afternoon of the same day before they visited the patient. The

emphasis in the interviews was on enabling the informants to give spontaneous accounts of their decision making at the time of the cardiac event. However, after thorough piloting we decided to add some direct questions about informants' beliefs and knowledge of cardiac events. The themes explored in the interviews covered what experiences and actions led up to the cardiac event; when informants thought that the cardiac event had begun, what they thought the problem was and why it had occurred; whom they talked to and the effect of this interaction; when the decision to call for medical help was made and by whom; and who was called. The more direct areas of questioning were informants' conception of risk factors; which groups of people they associated with heart attacks; their knowledge of symptoms before the event; their concept of a heart attack; their knowledge of thrombolytic treatment; their family history; and personal details, including risk factors.

Data analysis

The interviews were tape recorded and transcribed verbatim. Before analysis informants were divided into three groups according to the length of time between the onset of symptoms and seeking medical help. The delays were less than 4 hours (non-delayers), between 4 and 12 hours (delayers), and more than 12 hours (extended delayers). The division was prompted by current evidence, which suggests that the earlier thrombolytic treatment is given the greater the reduction in deaths¹ and that for patients presenting after 12 hours benefit is limited.² Of the patients interviewed, 21 were non-delayers, 12 delayers, and 10 extended delayers. The division of informants into these groups provided a basis for illustrating the differences between those who seek help quickly and those who do not.

The data were analysed using the constant comparative method to cover identified and emerging themes.³ A further analysis was undertaken by a second researcher AR, who listened to the tape recordings and examined the data to ensure that concepts, relations between variables, differences between groups, and the division of informants into the groups were confirmed or modified if necessary. There was agreement over which groups patients belonged to in all but three cases.

Results

Forty patients were diagnosed as having a confirmed acute myocardial infarction, and 9 of them had had a previous infarction (5 were non-delayers (24%), 2 delayers (17%), and 2 extended delayers (20%)) (table 1). Three quarters of the non-delayers were men (16/21) compared with 58% (7/12) of the delayers and 50% (5/10) of the extended delayers. A greater proportion of non-delayers were under 65 years of age compared with the other two groups (67% (14/21) *v* 58% (7/12) and 40% (4/10) respectively). A greater proportion of non-delayers also had manual occupations (62% (13/21) *v* 58% (7/12) and 50% (5/10) respectively).

Decision making process

The illness and help seeking behaviour of informants had several stages, including warning, interpretation,

Table 1 Characteristics of patients according to delay in seeking medical help for cardiac event

Case No	Age (years)	Sex	Acute myocardial infarction		Receiving treatment for CHD	Social group*
			Confirmed	Previous		
Non-delayers (<4 h)						
1	47	M	Yes	No	No	IV
2	65	F	Yes	Yes	Yes	V
3	79	F	Yes	No	No	V
4	55	M	Yes	No	No	IIIN
5	59	M	Yes	No	No	IIIN
6	52	M	Yes	No	No	II
7	64	M	Yes	No	No	IIIM
8	71	M	No	No	Yes	IV
9	50	M	Yes	No	No	IIIN
10	53	M	Yes	No	No	IIIM
11	75	M	Yes	Yes	Yes	IV
12	72	F	Yes	No	No	IV
13	52	F	Yes	No	No	IV
14	60	M	Yes	Yes	No	IV
15	59	M	Yes	Yes	Yes	IIIM
16	53	M	Yes	No	No	II
17	76	M	Yes	No	No	IIIN
18	64	M	Yes	No	No	IIIM
19	65	M	Yes	Yes	Yes	II
20	57	F	Yes	No	No	IV
21	60	M	Yes	No	No	IIIN
Delayers (4-12 h)						
22	53	F	No	No	No	IIIN
23	69	M	Yes	No	No	IV
24	74	F	Yes	No	No	IV
25	60	F	Yes	Yes	Yes	IV
26	71	F	Yes	No	Yes	IV
27	60	M	Yes	No	No	IIIN
28	49	M	Yes	No	No	IIIN
29	82	M	Yes	No	No	IIIM
30	48	M	Yes	No	No	II
31	55	M	Yes	No	No	IV
32	62	F	Yes	No	No	IV
33	80	M	Yes	Yes	Yes	II
Extended delayers (>12 h)						
34	71	F	Yes	No	No	IV
35	80	M	Yes	Yes	Yes	IIIM
36	73	M	No	No	Yes	IIIM
37	65	F	Yes	No	No	IIIN
38	56	M	Yes	No	No	IIIM
39	51	M	Yes	No	No	II
40	57	F	Yes	Yes	Yes	II
41	69	F	Yes	No	No	IV
42	75	F	Yes	No	Yes	II
43	63	M	Yes	No	No	II

CHD=coronary heart disease.

*Registrar general's classification.

preliminary action, re-evaluation, and final action. The length of each stage was variable and depended on the extent to which informants mobilised and integrated resources into a strategy to bring their symptoms under control. The time between onset of symptoms and calling for medical help was directly affected by the number and quality of the resources used in the individual strategy.

Five patients' symptoms were classically severe and unexpected and led them to respond quickly and call for medical help (cases 3, 4, 6, 20, and 21). The remaining patients experienced a warning stage in which symptoms were often intermittent and variable. The symptoms in many cases made the informants realise that they were not experiencing an episode from an

Table 2 Prevalence of symptoms during cardiac event according to delay in seeking medical help. Values are numbers (percentages) of patients

	Chest pain	Pain in neck and arms	Pain in arms	Sweating	Breathlessness	Nausea
Non-delayers (n=21)	20 (95)	6 (29)	6 (29)	10 (48)	6 (29)	2 (10)
Delayers (n=12)	11 (92)	8 (67)	8 (67)	5 (42)	6 (50)	2 (17)
Extended delayers (n=10)	9 (90)	3 (30)	8 (80)	5 (50)	7 (70)	3 (30)

acute illness but an evolving and cumulative event. During this stage patients treated themselves, referred to others, and in some cases sought medical help. For most patients, experience of symptoms before the acute phase had two effects: to increase tolerance of symptoms and to ensure that treatments were available to relieve symptoms during the acute event.

Table 2 shows the range of symptoms reported by informants. The range and severity of symptoms were similar in the three groups, symptoms initially being interpreted as common non-threatening problems by most informants. However, previous knowledge of the symptoms associated with a heart attack was noticeably different in the three groups. Non-delayers knew about a wide range of symptoms, including sweating, nausea, pains in the arms and neck, and breathing problems. Delayers generally knew only about chest and arm pain, while most extended delayers were unsure about symptoms.

Strategies for dealing with symptoms

Although most informants assigned an inappropriate diagnostic label to their symptoms at this stage, the strategy adopted for dealing with the symptoms delineated the three groups.

Non-delayers

The non-delayers generally entered a period of isolation and self evaluation, they did not consult with others, and only a few took any form of drug treatment. Most engaged in some form of diversion—for example, drinking cups of tea or moving about—while they evaluated the situation (box). In doing this, their symptoms were not masked and therefore escalated to a point where re-evaluation revealed the serious nature

Non-delayers: interpretation of symptoms

Taking stock

"I can't really explain how I felt, but I didn't feel well and I thought it was time to sit down and think about things. So, I just sat down and had a drink of water and then thought that I would sit more comfortably."

"I got my dressing gown on, went downstairs, had a drink of water, went out into the conservatory, went out into the garden. Had a little walk around the garden and I thought: 'Oh, this will ease off.'"

Previous experience

"I knew it was a heart attack because I knew that once you get the pains in the chest and pain in the arm, I knew that it was a heart attack... only because of experience though, you know."

Lay medical knowledge

"Well I'm not an expert, I just have what I have read in the newspapers, but I asked my husband if it could be a heart attack because he had a feeling like ... a belt around [his] chest and down the left arm."—Wife of non-delayer

Intuition

"I knew it was the heart ... does that sound conceited? But you know your own body and I was pretty sure that that was what it was."

Strategy of delayers

Attempts to treat

"Yes I said: 'Oh, you know, I've got this indigestion' and of course my missus says: 'Well take some of your Zantac.' So I did like, you know, but it made no difference and they [mother in law and wife] said: 'Try some lemonade.' Then her mum gave me some mints. I tried everything."

Lay consultation

"He said he thought it could be thyroid but I mean he isn't a doctor ... he said that it could even be a hiatus hernia, because he's got a hiatus hernia and he gets a burning feeling sometimes there."

Use of personal and contextual information

"I had been doing a lot of these fruit inspections so I'd honestly thought it was just working ... but on Friday I'd got home earlier and so I said: 'Ah, I'll do the tea, I'll make something ...'. The only thing I can really do is a fry up stuff and that's what I did. I fried up sausages and got some eggs and got some chips in the oven and we had a fry up ... So then I just thought: 'Well I've been out drinking, had this fry up and I've got real indigestion.' That's what I thought it was when I went home."

of the event. Non-delayers used their experience, medical knowledge, and intuition to reinterpret their symptoms (box).

All of the patients in this group reached a point where they thought they were experiencing either a heart attack or something associated with the heart.

Delayers

The delayers used various medical and non-medical resources to try to bring their symptoms under control. They also consulted lay people and used the information in various ways to try to rationalise the experience of illness. This often resulted in delay as the experience of others had to be compared and discounted. Contextual and personal information was used to reinterpret the situation (box, above).

This process of treatment and continual reassurance and readjustment to the symptoms delayed the realisation that the symptoms were serious enough to require urgent medical intervention. None of the patients in this group considered that they were having a heart attack but eventually came to realise that they were experiencing something serious.

Extended delayers

The extended delayers tried treatments and movement as well as seeking both lay and medical consultation in their attempts to deal with their experience. The greater the number of interventions used, whether in the form of drugs or consultation, the greater the delay. Notable in this group was the influence of contact with the medical profession. Elements of diagnosis by health professionals that discounted patients' risk of having a heart attack and attributed symptoms to other causes both before and during the cardiac event considerably influenced decision making and added to the delay (box, next page).

Patients in this group failed to obtain effective help in managing their symptoms and were eventually admitted to hospital because they could no longer cope.

Extended delayers: two case histories

Case 37

A patient initially thought that her symptoms were caused by a viral infection:
 "I thought it's not angina because it's both arms. I mean you think, you tend to kid yourself about these things, and I thought: 'Well my heart doesn't feel as if its palpitating, doing this' [hand gestures]. And you think these things, and I thought well, I thought it could be a viral infection because of these glands coming up. And sweating like a pig as well."

She subsequently contacted her general practitioner's out of hours service and the doctor assured her over the telephone that the symptoms were viral: "'Oh there's a lot of that going around, it's a viral infection, just take some aspirin and if you're not better after 48 hours ring us up again.'" She therefore believed that her problem was viral and treated it accordingly for nearly 24 hours in spite of worsening symptoms.

Case 43

A patient became progressively short of breath and developed a "severe" indigestion-type pain. He visited his doctor, who diagnosed hiatus hernia and prescribed drug treatment. He did not gain relief from his symptoms and began to experience other symptoms. Having read the information sheet accompanying the drug to treat hiatus hernia, however, he attributed his additional symptoms to side effects from the drug.

"Friday morning [I] was out doing some jobs on the tractor because it was wet, and I went to move and it felt as if I had got grease on the bottom of my shoe. It didn't want to go where I wanted it to. So I went indoors and that and sat down for a little while, looked on the tablet packet and it said there are side effects, that it affects your muscles. So, OK, I wasn't worried—carried on working."

Perception of risk and of heart attacks before the event

Patients' previous perceptions of their own risk varied among the three groups, with more than twice as many of the non-delayers considering themselves to be potentially at risk of a cardiac event compared with the other two groups. In describing a typical potential victim of a heart attack, informants described a stereotype unlike themselves (box, above right).

For most informants their experience of a heart attack differed considerably from their concept of what a heart attack would be like. Heart attacks were thought to be dramatic, sudden events, as often portrayed on television. Informants associated heart attacks with collapse and death, whereas they were, in many cases, still able to function to some degree (box, below right).

Discussion

Studies of patient behaviour and decision making at the time of a heart attack have identified socioeconomic class, education, age, sex, marital status, and race as factors implicated in delay.^{4,5} Other variables identified include clinical factors such as having had a heart attack before and the intensity of symptoms.^{6,7} Our study used a qualitative approach to explain delay rather than produce statistically representative factors associated with delay.

Perception of heart attack victim and heart attacks

Typical victim

- "Well, yes, there is a sort of stereotypical person—people propping up the bar, swilling beer down, then eating pizza or fish and chips in between cigarettes—I suppose."—Relative of non-delayer
- "If I see someone smoking, drinking, obese, I think 'God, you're in for a heart attack chummy.'"—Delayer
- "My opinion is that it is the guy that's on the dole, sits in front of the TV all day, drinking pints of beer and lager and eating fish and chips. Of course, that's not me!"—Extended delayer

Typical heart attack

- "People going 'aahh' and dying, basically."—Delayer
- "You know, I would have thought somebody clutching, although he [her husband] was clutching but basically just dropping down, you know. The pains and on the floor and not actually being able to do anything."—Wife of non-delayer
- "Well, having heard of people who've had a heart attack, it didn't seem that serious. It seemed as if a heart attack was more of a serious thing ... you've only got seconds to live sort of thing."—Non-delayer

Portrayal in media

- "Well, I saw Superman, you know, when he clutched his chest, went to his arm, and then he died ... Do you remember that, when Superman's adopted father on earth died of a heart attack?"—Delayer

Socioeconomic group and previous occurrence of a heart attack were similar in the three groups, but the age and sex distributions varied, with a greater proportion of men under 65 being non-delayers.

The most critical factor influencing the time taken between onset of symptoms and seeking medical help is that patients and others recognise the symptoms as cardiac in origin. Our results show that intervention could take place at various points in the process to help symptom recognition and speed access to effective treatment. Non-delayers were more likely to see themselves as potentially at risk, were able to describe a wider range of symptoms of a heart attack, and were much less likely to treat their symptoms.

The main focus of information campaigns to date has been to recommend that people experiencing central chest pain (some list additional symptoms) for more than 15 minutes should call an ambulance.⁸⁻¹⁰ We found, however, that for most people a heart attack evolved, they experienced the symptoms for much longer than 15 minutes before seeking help, and many were able to contain or relieve their symptoms to some extent. Thus, in most cases, the 15 minute rule may be

Informants' experience of a heart attack

- "Mine wasn't excruciating pain like you hear, you know ... Heart attacks are excruciating and you never forget it ... and falling down with crushing pain, nothing like you've ever had before—in reality it's not like that."—Delayer
- "Er, when she had this heart attack it wasn't the heart attack that I know ... where they lose consciousness and you could give them the kiss of life or something like that. I mean I'd know what to do there, but it wasn't like that you see, you can't give a person the kiss of life if they're not unconscious or they are gasping for breath."—Husband of delayer
- "I mean, I've seen one once, years ago, when I was a coalman. I saw a man have a heart attack. He didn't die on the spot, but he died within an hour or so. He was just on the floor, sort of foaming at the mouth and people milling around him ... but with me, I kept walking, stopping, getting things sorted out, getting back in the car, having a cigarette, driving to a safe location, finding help—nothing like this man."—Extended delayer

Key messages

- Research using methods that can explain variations in response to cardiac events has been neglected
- Informants in this study thought of heart attacks as sudden dramatic events in which people collapse and probably die, rather than as the evolving event that they experienced
- Those who sought medical help within 4 hours were more likely to see themselves as potentially at risk, knew a wider range of symptoms of a heart attack, and were much less likely to use drugs to treat their symptoms compared with those who waited longer
- Intervention at various points in the decision making process could help recognition of symptoms and speed access to effective treatment

too simplistic to be effective. Linked with this is the stereotypical heart attack victim and the perception of a heart attack as a dramatic event in which people collapse with crushing chest pains and probably die. Clearly, the myth that a heart attack is a dramatic event needs to be dispelled and public perceptions of a heart attack and its associated symptoms need to be changed.

Commentary: Grounded theory and the constant comparative method

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The potential for qualitative research to sensitise policymakers and practitioners to the perceptions of health service users and professionals¹ and to strengthen aetiological and health services research² is now well recognised, but the reporting of qualitative data continues to generate dissatisfaction for both researchers and readers. For qualitative researchers used to the more discursive formats of social science journals, the need to present succinctly with clear implications for policy or practice can constrain reports of the theoretical richness, complexity, and ambiguity of their research findings. For readers, small sample sizes and illustrative quotes imply impressionistic accounts of doubtful validity and generalisability. The development of guidelines for producing^{3,4} and judging qualitative research⁵⁻⁷ has been helpful for researchers and editors, but a problem remains for many readers about the credibility of published qualitative research in medical journals. Few authors report how validity and reliability were maximised,⁸ and, indeed, such criteria may be inappropriate in theoretical rather than empirical studies, which have traditionally been the most influential in health.⁹

Grounded theory

One strategy used by some researchers to improve the credibility of published papers has been to include routinely the line: "the data were analysed using grounded theory," which suggests an esoteric technique guaranteeing rigour. Unfortunately, what follows may be merely an account of some key themes in the data, with brief textual quotes in illustration, and sceptical

Contributors: AR initiated the research, discussed core ideas, participated in the protocol design, in analysing and interpreting data, and in writing the paper. JC participated in the data collection and in analysing and interpreting data and contributed to the paper. MC participated in the protocol design, discussed core ideas, and contributed to the paper. AR and MC are guarantors for the study.

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readers remain unconvinced that qualitative analysis is anything other than journalistic reportage. Ruston et al have used the constant comparative method in a more analytical way to generate data which contribute to understanding what stops people seeking help quickly after a heart attack and also explore patients' perceptions of what a normal heart attack looks like. These findings are most useful to practitioners and health promoters, and the authors have provided information on how they improved reliability. However, the constant comparative method, which is derived from grounded theory, can offer more than this when it is applied and reported well.

Grounded theory was developed by the sociologists Anselm Strauss and Barney Glaser as a way of formalising the operations needed to develop theory from empirical data.¹⁰⁻¹² It is a methodological approach (entailing a cyclical process of induction, deduction, and verification) and a set of strategies of data analysis to improve the reliability and theoretical depth of analysis. Particular attention is paid to the processes entailed in coding data. Too often in published health research coding has meant simply labelling data extracts as examples of themes the researcher was interested in. Coding should entail comparing indicators (such as actions or fragments of text or talk) to refine their fit to underlying concepts. Initial coding can be based on what Glaser and Strauss call *in vivo* codes as well as on conceptually derived codes. *In vivo* codes are the categories used by respondents themselves to organise their world—for

example, the description of some patients as "normal rubbish" noted by Jeffrey in his work on staff in accident and emergency departments. These were patients attending with minor or self inflicted injuries or those who had social rather than medical problems.¹³ However, such codes are provisional and are essentially descriptive summaries of respondents' own accounts. Analytical coding requires also questioning and comparison. Indicators are coded according to a coding paradigm, which the researcher uses to ask a battery of questions of each indicator to establish its properties, its dimensions, and its relation to other codes. Constant comparison of indicators with each other refines their fit to the emerging conceptual categories. In the example of Jeffrey's study of staff in accident and emergency departments,¹³ the properties of patients termed normal rubbish were inductively generated through analysing accounts of why staff did not like dealing with certain patients. Coding also has to be theoretically informed: Jeffrey used sociological theory about the sick role to analyse the properties both of patients termed normal rubbish and of "good patients."¹³ Normal rubbish were patients whose behaviour did not conform to social norms of the sick role, whereas good patients enabled staff to practise clinical and technical skills.

Validity

The key to developing rigorous and valid theory using the constant comparative method is the search for deviant cases. These can be within the researcher's data, which are searched for exceptions to the emerging relations between codes. Grounded theory also advocates theoretical sampling, in which potentially deviant cases can be purposively sampled as the study progresses. A full report of qualitative analysis

should account for deviant cases and how they have contributed to refining theory. Constant comparison does not stop within the researcher's own data set. Theoretical insight and comparative material comes from other research, perhaps outside the substantive field of interest.

For Glaser and Strauss social phenomena are always complex and require sensitive and dense theory to account for as much variation in the data as possible. The challenge for qualitative researchers is to find ways of reflecting this complexity. To do this they need adequate methods of analysis to offer complex theoretical insights within the constraints of biomedical and health services journals. Without such endeavour, qualitative research will remain descriptive anecdote.

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Fatality outside hospital from acute coronary events in three British health districts, 1994-5

R M Norris on behalf of the United Kingdom Heart Attack Study Collaborative Group

Abstract

Objectives: To provide a contemporary account of the treatment and outcomes of acute coronary attacks in England and Wales and to identify strategies that might improve the outcome.

Design: Two year community and hospital based study in three British health districts.

Setting: Health districts of Brighton (population 282 000), South Glamorgan (408 000), and York (264 000).

Subjects: 3523 men and women under 75 years of age who died outside hospital from acute coronary causes, who were admitted to hospital with acute myocardial infarction, or who developed acute infarction or died unexpectedly from acute coronary causes while they were already in hospital.

Interventions: Attempted resuscitation in people having a cardiac arrest outside hospital.

Main outcome measures: Total case fatality, case fatality outside and inside hospital, and the effect of resuscitation on case fatality outside hospital.

Results: 1589 patients died within 30 days of the acute event. Case fatality was 45% (95% confidence interval 43% to 47%), rising from 27% (160/595) (23% to 31%) at age <55 years to 53% (1019/1916) (51% to 55%) at 65-74 years. Overall, 74% (1172/1589) (72% to 76%) of fatal events happened outside hospital, and there was a negative age gradient ($P < 0.001$) such that 91% (145/160) (87% to 95%) of fatalities occurred outside hospital at age < 55 compared with 70% (710/1019) (67% to 73%) at 65-74 years. Without successful resuscitation of 55 patients outside hospital, total case fatality at 30 days would have risen from 45% to 46.7%.

Conclusion: Opportunities for reducing fatality from acute coronary attacks lie mainly outside hospital. These results and others imply that survival from

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Collaborators and participating centres are listed at the end of the report

cardiac arrest outside hospital might be trebled by improved ambulance and patient response. Proper application of secondary preventive measures for patients with coronary disease could have an even larger impact.

Introduction

Twenty five years ago at least two thirds of deaths from acute coronary heart disease happened outside hospital,¹⁻³ and data from the monitoring trends and determinants in cardiovascular disease (MONICA) study showed that this was still the case in many countries during the 1980s.⁴ Mortality from coronary heart disease has, however, declined by about 30% in England and Wales since 1980.⁵ Moreover, devolution of prehospital care to paramedical staff, public training in cardiopulmonary resuscitation, and efforts to reduce delay in giving thrombolytic treatment should all ensure that the benefits of therapeutic advances are more readily available to victims of acute heart attack.

The aim of the United Kingdom heart attack study is to re-examine the incidence, treatment, and outcome of acute heart attacks by studying events in three health districts in England and Wales during 1994-5. This report describes total case fatality, with particular reference to events occurring outside hospital and the impact of resuscitation attempts outside hospital. The outcome of myocardial infarction in patients admitted to hospital is reported elsewhere.⁶

Subjects and methods

All deaths from acute episodes of ischaemic heart disease and all cases of acute myocardial infarction in hospital in people under 75 years of age were recorded over two years (January 1994 to December 1995) in the three health districts of Brighton, South Glamorgan, and York. Methods were established during a pilot study carried out in Brighton during 1993^{7,8} and, in the light of the experience gained, were agreed on before the main study was started.

Definition of population

To avoid bias from recording deaths outside and inside hospital in different populations, we selected our catchment population to include only the areas served by the study hospitals (one each in Brighton and York and two in South Glamorgan); patients were classed by postcode. Population figures broken down by age and sex were supplied by the Office for National Statistics. Defined in this way, the population of Brighton (Brighton, Hove, and Lewes) was 282 000, that of South Glamorgan (Cardiff and the Vale of Glamorgan) 408 000, and that of York (city and surrounding, mainly rural, area) 264 000. The total study population (all ages) was 954 000. People whose events occurred within the study area who were visitors to the area (275, or 8% of total cases) were recorded as non-resident but were included on the assumption that similar numbers of events occurred in visitors as in residents who had gone outside the area.

Selection and identification of cases

Deaths outside hospital were included if ischaemic heart disease was the principal cause of death at coro-

ners' necropsy (86% (959/1114)) or, when there was no necropsy, if the patient had a history of ischaemic heart disease and had died suddenly or after prolonged chest pain and had no other apparent cause of death (14% (155/1114)). Cases at necropsy were required to have at least 50% stenosis of the diameter of one major epicardial coronary artery, with or without recent coronary thrombus or old or recent myocardial infarction. Deaths from chronic heart failure due to ischaemic heart disease were recorded in one centre (Brighton) but were not included in this analysis. They comprised 11% of all coronary deaths in Brighton in the age range studied, and only 29% occurred outside hospital.

We identified deaths outside hospital from transcripts of death certificates provided regularly to the health authorities by the local registrars of deaths. The date and place of death, the name of the practitioner who signed the certificate, and the name and address of the person who informed the registrar of deaths (usually the next of kin) were recorded. With permission from coroners in the three centres, we regularly reviewed copies of all necropsy reports and checked them against data from the transcripts. We then wrote to the general practitioners asking for details of the medical history and of current cardiac drugs, if any. With permission from the general practitioners, we retrieved case notes if necessary from the family health services authority. Circumstances of death were taken either from summaries made by coroners' officers and recorded on necropsy reports or from forms made out by ambulance paramedical staff who had been summoned to the cardiac arrest. In some cases in which these approaches failed, permission was sought from the general practitioner to contact the next of kin directly. We sought whether death had been witnessed, the nature and approximate duration of any symptoms which the victim might have reported before death, whether resuscitation had been attempted, the cardiac rhythm, and the outcome. Resuscitation was considered to have been successful when the patient was discharged from hospital and survived for at least 30 days without serious neurological deficit. Necropsy details were recorded from pathologists' reports.

Cases of myocardial infarction in hospital showed at least two of the following three features: typical or compatible clinical history, sequential electrocardiographic changes, and a rise in serum enzyme concentrations to at least twice the upper limit of normal values for the hospital laboratory. Sudden deaths from ischaemic heart disease in patients who had been admitted to hospital for another reason were also included as deaths in hospital. Survivors of myocardial infarction were not included when the infarction was diagnosed and treated outside hospital.¹ We confirmed from questionnaires returned by general practitioners that these circumstances were rare.

Data were recorded on standardised forms, stored on computers at all three centres using a Paradox database, and sent regularly on disk to the coordinating centre in Brighton for amalgamation. Quality control was achieved by checking data for internal consistency locally, at the coordinating centre, and by a member of the steering committee (DGJ), who visited the three centres to audit a random selection of cases. Differences were resolved and progress assessed at

investigators' meetings, which were held every three to six months throughout the study.

Case fatality and statistics

Case fatality rates were calculated as the total number of deaths divided by the total number of events as defined and were expressed as percentages. Events occurring more than 30 days after a previous non-fatal episode were considered to be new events. Patients who were brought into hospital after having had a cardiac arrest outside hospital who were pronounced dead or who later died in hospital were included as deaths outside hospital because the event directly leading to death had occurred before arrival at hospital.

Results

Figure 1 shows the numbers of cases, case fatality rates, and the proportion of fatal events occurring outside hospital for the individual centres. Of the 3523 events which we recorded, 3476 occurred in white people and 934 in women; 1589 (45% (95% confidence interval 43% to 47%)) were fatal within 30 days of the event. Case fatality was lower in York than in the other centres for all age groups (42% (466/1117) v 47% (1123/2406); P=0.02) and for ages <55 years (19% (40/206) v 31% (120/389); P=0.01) but not for age groups 55-64 and 65-74 years.

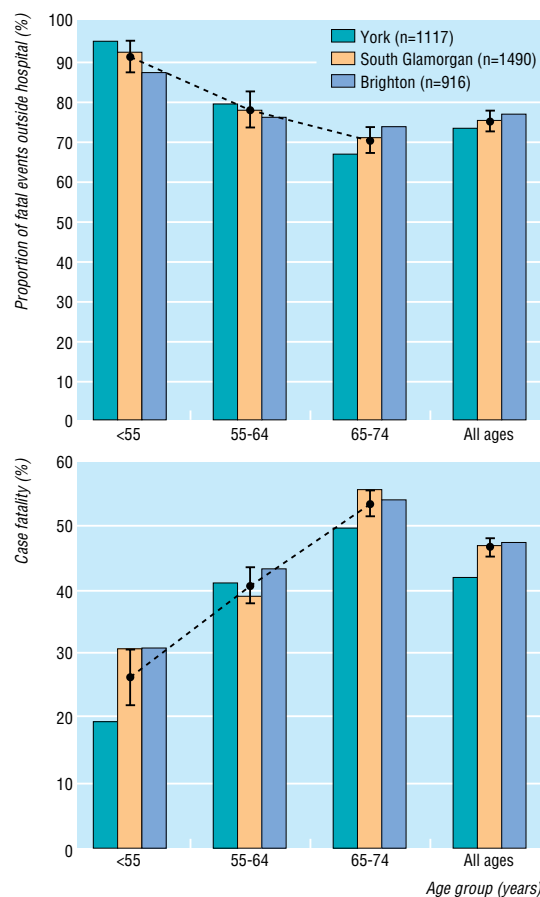


Fig 1 Case fatality and proportion of fatal events occurring outside hospital in the three centres. Circles indicate mean values and bars 95% confidence intervals

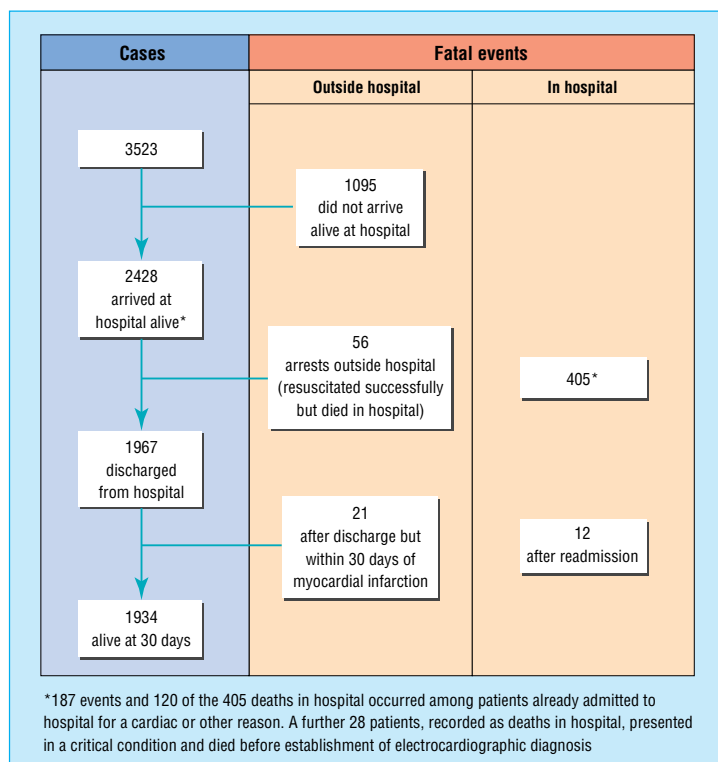


Fig 2 Flow diagram showing numbers of survivors and deaths at each stage

Figure 2 shows the numbers of survivors and deaths at each stage of the illness. Overall, 1172 of the 1589 fatal events (74% (72% to 76%)) occurred outside hospital. Of these, 1095 occurred in people who were not admitted to hospital, 21 occurred after discharge from hospital but within 30 days of the infarction, and 56 occurred in patients who were resuscitated outside hospital but later died in hospital. The remaining 417 (26%) fatal events occurred in hospital. Forty six per cent of the patients who died (737/1589) were known to have ischaemic heart disease, and this proportion rose with age from 31% (50/160) at <55 years to 49% (503/1019) at age 65-74.

Table 1 shows the relation between the place of occurrence of the fatal event, age, and sex, and figure 3 shows the relation with age alone. Total 30 day fatality (upper line in fig 3) rose with age from 27% (23% to 31%) at age <55 to 53% (51% to 55%) at 65-74 years. The lower line in figure 3 represents fatality outside hospital. Thus the portion between the two lines represents fatality in hospital, which was very low (3% of those admitted to hospital) for patients under 55 years of age but rose to 29% for those aged 70-74 years. Corresponding figures for fatality outside hospital were 24% and 37%, so that the increase in fatality outside hospital with age was much less than the increase in fatality in hospital. Consequently, the proportion of fatal events occurring outside hospital was age dependent, falling from 91% (87% to 95%) at age <55 years to 77% (73% to 81%) at 55-64 years and 70% (67% to 73%) at 65-74 years. The (negative) gradient for age as a determinant of whether death occurred outside or inside hospital was highly significant (P<0.001) for men (table 1) and for both sexes combined (fig 3), but it was not significant for women.

Table 1 Case fatality from acute coronary events in men and women outside and inside hospital

Age (years)	Total No of cases		No of fatal events outside hospital		No of deaths in hospital		Total case fatality (%)		Proportion of case fatality outside hospital (%)	
	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women
<45	124	18	25	6	3	0	23	33	89	100
45-49	173	22	44	3	1	1	26	18	98	75
50-54	221	37	55	12	9	1	29	35	86	92
55-59	335	85	97	18	17	11	34	34	85	62
60-64	453	139	163	39	45	20	46	42	78	66
65-69	602	255	234	79	76	38	51	46	75	68
70-74	681	378	258	139	125	70	56	55	67	67
Total	2589	934	876	296	276	141	44	47	76	68

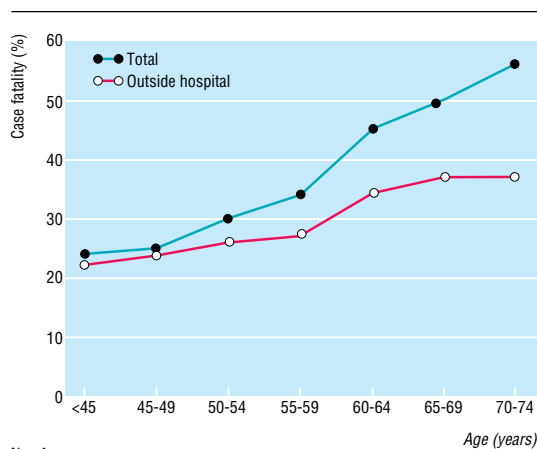


Fig 3 Total case fatality and case fatality outside hospital by age group

Premonitory symptoms, usually chest pain, during the few hours before the cardiac arrest were reported by bereaved relatives in 38% of deaths outside hospital (441/1172), while death seemed to be truly sudden in 13% (150/1172). In 49% of cases (581/1172) it was impossible to establish whether symptoms had been present, usually because the victim was found dead, having last been seen alive several hours (median 7 hours) previously. The commonest symptom was chest pain, but symptoms of “breathlessness,” “indigestion,” or “feeling unwell” were also reported frequently. There was a tendency for premonitory symptoms to be reported more often in younger than in older subjects, but this was not significant.

Effect of resuscitation outside hospital on case fatality

Of the 1227 cardiac arrests outside hospital, 920 occurred at home, 203 in a public place, 79 in doctors’ surgeries, ambulances, or nursing homes, and 25 at work. Fifty five of the 111 people who were successfully resuscitated outside hospital recovered in hospital and survived to 30 days. Of these, 51 had documented ventricular fibrillation, pulseless ventricular tachycardia, or asystole, while 4 responded to basic life support and were thought to have had a cardiac arrest on clinical grounds. Had these 55 patients not been resuscitated, the total case fatality would have been 46.7% not 45%.

Of great importance for successful resuscitation was whether the arrest was witnessed and by whom (table 2). In 39% of cases there was no witness, and no patient survived. Fifty four per cent of arrests were wit-

nessed by a relative or bystander; cardiopulmonary resuscitation was attempted in less than one third of these cases, but when it was attempted the success rate rose from 2% to 8% (P<0.001). The best result occurred when the arrest was witnessed by a paramedic equipped with a defibrillator; this happened in only 5% of cases, but the success rate increased to 40% (28% to 53%) (table 2).

Discussion

The most important findings in this study were the high proportion (74%) of fatal events that occurred outside hospital and the inverse relation with age, 91% of fatalities at age <55 and 70% at age 65-74 happening outside hospital. A similar age trend has been reported from the United States on the basis of data from death certificates⁹ and was also observed in the pilot Brighton heart attack study.⁷ In the Glasgow MONICA study men were more likely than women to die outside hospital¹⁰; whether the likelihood of fatal events occurring outside hospital was related to age was not stated, but patients aged >64 years are not included in MONICA studies.

What is the reason for this disturbing finding? Hospital treatment has improved greatly over the past 20 years, resulting in a fatality rate in hospital for our patients who were under 55 years of age of only 3% (fig 3). If fatality outside hospital has not improved to the same extent, this would increase the proportion of deaths outside hospital for younger patients. Again, we did not record unclassifiable deaths outside hospital—that is, those in which death was attributed to coronary disease without results from necropsy or a history of clinical manifestation.⁴ We found such cases to be confined mainly to those aged 65-74, who were not included in the MONICA study.¹¹ Inclusion of such cases would have increased the proportion of deaths outside hospital and diminished the age gradient.

Table 2 Success of resuscitation outside hospital in relation to witness of arrest

Witness	No (%) of cases*	No (%) given ALS by paramedical staff	No (%; 95% CI) who survived up to 30 days
None	474 (39)	70 (15)	0
Relative or bystander:			
CPR given	177 (15)	169 (95)	14 (8; 4 to 13)
No CPR given	476 (39)	331 (70)	8 (2; 1 to 3)
General practitioner	27 (2)	15 (56)	7 (26; 11 to 46)
Paramedical staff	65 (5)	57 (88)	26 (40; 28 to 53)
Total cases	1219	642 (53)	55 (4.5; 3 to 6)

*1184 fatal + 55 non-fatal arrests. Data not available for 8 cases. ALS=advanced life support. CPR=cardiopulmonary resuscitation.

The high proportion of deaths outside hospital shows the potential limitations of further improvements in hospital treatment, particularly for younger patients. It emphasises that further large reductions in mortality can be accomplished only by primary prevention, secondary prevention, or intervention before admission.

Three potential strategies exist to improve intervention before admission: improved responses by ambulance crews, intensified training of members of the public in cardiopulmonary resuscitation, and public education on the importance of dialling 999 for prolonged chest pain. These strategies might result in more cardiac arrests being witnessed by paramedical staff and more patients having successful defibrillation.

Improved ambulance response

The most successful centres have a dual¹² or triple¹³ response system in which the immediate response to an emergency call is made by a normal ambulance or by the fire service, followed by paramedical staff trained in advanced life support who may have to travel a longer distance. A previous analysis found that dual response provides an optimum success rate,¹⁴ and success is enhanced by providing those who first attend the scene with automatic defibrillators.¹⁵ In the United Kingdom all frontline ambulances carry defibrillators, and one member of the ambulance crew has usually had paramedical training. The NHS is planned to continue with a single paramedic response system but with prioritisation of emergency calls so that response times for life threatening emergencies will be reduced from the present 14 minutes in 95% of urban areas to 8 minutes for 90% of calls in all areas.¹⁶

Comparison of our results with the best of those reported suggests a considerable potential for improvement. Thus, in Seattle (population 500 000) about 10 lives per 100 000 of the population were saved each year¹² compared with 3 per 100 000 in our study. In Helsinki (population 516 000) cardiac arrests witnessed by paramedical staff were not reported on,¹³ and about 7 lives per 100 000 were saved by resuscitation compared with 1.5 per 100 000 in our report when we excluded cardiac arrests witnessed by paramedical staff. Moreover, in Brighton during the 1980s about 8 lives per 100 000 were saved.¹⁷ Had these results been replicated over the two years in our three health districts at least three times as many lives as the 55 which we recorded might have been saved. Fatality might have been reduced from 46.5% to 42% rather than to 45% by the saving of 110 extra lives.

Citizen training in cardiopulmonary resuscitation

Basic life support was given by bystanders in 27% of witnessed arrests in our series, and it reduced fatality modestly but significantly (table 2). Interestingly, the proportions receiving bystander life support were little different at 22% in Helsinki,¹³ 18% in Gothenburg,¹⁸ and 36% in Seattle.¹⁴ In the unlikely event that the proportion receiving basic life support could be doubled in the United Kingdom, and assuming that the proportions in table 2 were replicated, the reduction in fatality would be less than 0.5%. These figures support previous opinions that present benefits from bystander cardiopulmonary resuscitation are real but limited.¹⁹ Protocols need to be rigorously taught,

rethought, and remembered; failure by bystanders to dial the emergency number before doing anything else is another problem.¹⁹ The ideal place to start training may be in school.²⁰ Notwithstanding the above, the contribution of bystander life support to survival would very likely be larger if ambulance response times could be improved.¹⁶

Public education

A much more impressive result (40% (28% to 53%) survival) was seen among those of our patients who experienced cardiac arrest in the presence of paramedical staff equipped with a defibrillator. These people, comprising only 5% of those who had arrests outside hospital, were fortunate enough to have reported premonitory symptoms in time, and the ambulance responded promptly. We have shown in a pilot study that there is a marked deficiency in public knowledge about the causation of myocardial infarction and in particular the differentiation of heart attack from cardiac arrest.²¹ Many, and probably most, people who died outside hospital in our series had premonitory symptoms, usually chest pain, often lasting for several hours. Similar findings have been reported recently from Glasgow.²² Although the success of media campaigns to induce patients with prolonged chest pain to seek help early has been limited,²³ we believe that provision of information to the general public so that they can make informed decisions about the action to take for suspected heart attack can only be beneficial. Fresh initiatives in public education are necessary. A useful message is to dial an emergency number (999) for chest pain lasting 15 minutes or more.

Prevention of death outside hospital

Primary prevention of coronary heart disease is the ideal, and reduction in coronary risk factors has been a major contributory factor to the declining mortality from coronary heart disease.²⁴ A recent analysis suggests, however, that more has been achieved and is still achievable by secondary than by primary prevention.²⁵ An important finding from our study was that 46% of the patients who died were already known to have ischaemic heart disease. Recent advances in secondary prevention, particularly in lowering cholesterol concentration with drugs that inhibit 3-hydroxy-3-methylglutaryl coenzyme A reductase,^{26 27} have shown a 20-30% reduction in total deaths in patients with a history of angina or previous myocardial infarction. A reduction in mortality by 25% among those in our study who were known to have coronary heart disease and who died from events occurring outside hospital would have saved about 183 further lives. Additional benefits might also have been obtained from more strenuous advice to stop smoking and wider use of antiplatelet drugs and β blockers, none of which seemed to have been used to their full potential in subjects known to have coronary disease (data not shown).

A recent survey of secondary prevention, sponsored by the British Cardiac Society and carried out in specialist cardiac centres and district general hospitals, has shown remarkable deficiencies in recording and efforts to modify other known risk factors.²⁸ Perhaps the greatest potential for reduction in the burden of

Key messages

- In three health districts during 1994-5 total case fatality for people under 75 years of age was 45% and 74% of fatal events happened outside hospital
- The likelihood of a fatal event occurring outside hospital was greater for people under 55 years of age (91%) than for those aged 65-74 years (70%)
- Total fatality was reduced appreciably (by 1.7%) by resuscitation outside hospital, but this proportion might possibly be trebled by further upgrading of ambulance services
- Because 46% of people who died were already known to have coronary heart disease, improved secondary prevention may have a major part in further reducing mortality

fatality outside hospital lies in better application of secondary preventive measures.

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One hundred years ago
The Nobel prizes

It appears that the total value of the personal estate of the late Mr Alfred Nobel, the inventor of dynamite, is over £434,000. After the paying of certain specific legacies, none of them of very large amount, the whole of the remainder is to be capitalised, and the interest is to be divided annually into five equal parts, to be given as prizes to those who during the preceding year have done most for the benefit of humanity. One of these prizes is to be given to him who has made the most important discovery in the department of physiology or medicine. This prize will be

awarded by the Carolinian Institution in Stockholm, but Mr Nobel distinctly directs that in the distribution of the prizes "no regard is to be paid to any kind of nationality, so that the most worthy competitor may receive the prize whether he be a Scandinavian or not." The other prizes are to be given for discoveries in natural philosophy, in chemistry, for the most excellent idealistic literary work and for the best work promoting peace between nations. (*BMJ* 1898;i:40)