False cardiac arrests: the right time to turn away?

Gary Kenward, Alan Robinson, Sandra Bradburn, Richard Steeds

Postgrad Med J 2007;**83**:344–347. doi: 10.1136/pgmj.2006.054981

See end of article for authors' affiliations

Correspondence to:
Dr Richard Steeds, University
Hospital (Queen Elizabeth),
Metchley Park Road,
Edgbaston, Birmingham,
B15 2TH, UK; rick.steeds@
uhb.nhs.uk

Received 2 November 2006
Accepted 15 January 2007

Aim: Cardiac arrest teams may be activated only to find that the patient does not require cardiac or respiratory resuscitation. Members of the cardiac arrest team are drawn from medical personnel with other responsibilities who may disperse quickly, leaving ongoing care of the patient to existing ward staff. The outcome for such false cardiac arrests, however, is rarely reported. The objective of this study was to determine the causes of false cardiac arrest team alerts (FCAs) and to assess the outcome of these patients relative to the general hospital population.

Setting: Tertiary care hospital.

Participants: Patients subject to a cardiac arrest call who were found not to require basic or advanced cardiac life support on arrival.

Results: In 512 events over a 1-year period, patients suffering FCAs were more likely to survive compared to patients suffering cardiac arrest (15% vs 73%, odds ratio (OR) 14.95; χ^2 $p \leq 0.0001$), but significantly less likely to survive than the general hospitalised population (73% vs 97%, OR 14.15; χ^2 $p \leq 0.0001$). The cause of the FCA was often minimised as collapse or vasovagal syncope; in 58% (87/150) of cases no further action was taken by the attending medical team. Patients suffering FCAs tended to be long-stay patients with a worse outcome at weekends.

Conclusion: In areas lacking a medical alert, outreach or patient at risk system, particular attention should be paid to optimising care of those suffering FCAs.

In-hospital cardiac arrest is a relatively common event with between 4–7 arrests per 1000 hospital admissions.¹ However, in a proportion of cardiac arrest team activations no intervention is deemed necessary as the patient is not in cardiac or respiratory arrest and the team is dismissed on, or soon after, arrival at the patient's bedside. False cardiac arrest team alerts (FCAs) are rarely reported as such within the published literature and are often referred to as "inappropriate" cardiac arrest calls or "false alarms". Importantly, the reporting of FCAs is generally scant and there is little published evidence regarding outcomes following FCAs. The incidence of FCAs is therefore difficult to quantify as this may encompass erroneous calls made to the hospital switchboard or calls for patients who collapsed but were not in respiratory or cardiac arrest. Concern about this group of patients at the study site followed anecdotal reports that outcome for FCAs was worse when compared with similar patient groups not experiencing an FCA.

Our study aimed to ascertain the causes of FCAs and to determine whether these patients are at higher risk for adverse outcomes than the general ward-based hospital population.

METHODS

Setting

The study took place in a university teaching hospital located in the West Midlands, UK, split over two sites serving the adult population of South Birmingham. In addition to the provision of standard secondary care hospital services in general medicine and surgery, the hospitals also provide specialist tertiary services to a wider population drawn from the West Midlands for cancer, burns, bone marrow transplant, cardiothoracic surgery and transplantation, liver medicine and transplantation, renal medicine and transplantation, neurosciences, plastics and trauma. There are separate local hospitals for children and for women which were not included in this study.

Participants

Information was collected for each cardiac arrest call involving any adult patient (>15 years) at all in-hospital locations

(including outpatients but not including arrest arrivals at accident and emergency) during the period 1 February 2004 to 31 January 2005. All cardiac arrest calls during office hours were routinely attended by a resuscitation officer who ensured completion of documentation by the senior medical practitioner attending the arrest. For out-of-hours cardiac arrests accurate data collection was confirmed by a resuscitation officer within 24 h of the event and details were confirmed with the senior medical practitioner attending. Records of cardiac arrest events were cross-referenced with the switchboard log of cardiac arrest calls—the standard mechanism for activating the team. No information was available regarding arrest events not requiring a call to the hospital switchboard. This study was performed as a prospective audit and ethical approval was not required.

Definitions

"False cardiac arrest" alerts (FCAs) were defined as arrest calls made through switchboard to inpatients not in respiratory or cardiac arrest on arrival of the cardiac arrest team—that is, neither basic life support nor advanced life support was required. "Survival at the time of the event" was defined as to completion of the arrest call. "Survival" was defined as to discharge from hospital or 6 weeks.²

Data collection

Outcome data from arrest calls were collected prospectively for non-survivors or from the hospital's patient administration system for event survivors. Follow-up was 100% complete for all patients included. For those with more than one arrest call during an admission, the patient was categorised according to the primary event. For example, if a patient suffered a false cardiac arrest but then went on to have an asystolic arrest at a later date during the admission, the data on outcome was

Abbreviations: DNAR, do not attempt to resuscitate; FCAs, false cardiac arrest team alerts; VF, ventricular fibrillation

Figure 1 Cardiac arrest team activations. CCU, cardiac care unit; DNAR, do not attempt to resuscitate; HDU, high dependency unit; ICU, intensive care unit; PEA, pulseless electrical activity; VF, ventricular fibrillation; VT, ventricular tachycardia.

categorised according to the false cardiac arrest. If a patient suffered a ventricular fibrillation (VF) arrest but then went on to have a false cardiac arrest, any outcome information was recorded under the VF arrest and was not included in data for false cardiac arrests.

Statistical methods

Data were expressed as mean (SD). Differences of normally distributed parameters between two groups were compared by the independent samples t test and differences between three groups were compared using analysis of variance (ANOVA). Categorical data were compared using Pearson's χ^2 analysis. All probability values were calculated two sided and a probability level of $p > 0.05$ was considered significant. All calculations were done with SPSS for Windows version 11.5.1 (SPSS Inc, Chicago, Illinois, USA).

RESULTS

There were 77 683 adult (>15 years) admissions during the study period with 2012 deaths, giving a crude mortality of 25.9/1000 admissions. The cardiac arrest team attended 512 separate events in 494 inpatients and a breakdown of events is shown in fig 1. The cardiac arrest rate was 3.4/1000 admissions. Table 1 shows the population demographics for cardiac arrest, respiratory arrest and FCA patients. There was no significant difference in age or sex distribution between the separate arrest categories but, as might be expected, survival at the time of the event was lower in those suffering a true cardiac arrest ($p < 0.05$).

The "do not attempt to resuscitate" (DNAR) rate was 89% (total deaths minus deaths following cardiac arrest team attendance/total deaths). A separate audit over the study

period confirmed that all deaths in hospital that were not attended by a cardiac arrest team occurred in patients with completed DNAR certification.

Survival to 6 weeks or discharge

Patients suffering FCA were more likely to survive than patients suffering cardiac arrest (15% vs 73%, odd ratio (OR) 14.95; $\chi^2 p \leq 0.0001$), but less likely to survive than the general hospitalised population (73% vs 97%, OR 14.15; $\chi^2 p \leq 0.0001$). However, the FCA population was significantly older than the general hospital population (mean age 66 years (range 17–94) vs 56 years (range 16–109), $p < 0.001$), and increasing age is acknowledged as a risk factor for mortality.

The primary reasons for alerting the cardiac arrest team in false alert cases was documented as "collapse", vasovagal syncope, epileptic seizure and hypoxia, with other causes given in table 2. In 58% (87/150) of cases no further action was taken by the attending medical team. A further 11% (16/150) of patients were designated DNAR. The rate of transfer to higher medical care was low, with patient removal shown in fig 1.

More patients suffering an FCA (16/150; 11%) went on to suffer a cardiac arrest than the general hospital patient population over the same period (0.34%, OR 34.99; $\chi^2 p \leq 0.0001$).

Predictors of outcome

Younger patients suffering FCAs were more likely to survive to discharge or 6 weeks than older patients (survivors 61 (19) years vs deceased 76 (11) years, $p < 0.0001$). Patients suffering FCAs tended to be long-stay patients (mean length of stay 25.3 (31.2) days), with an overall mean duration from admission to FCA of 10.3 (15.8) days. It was not possible, however, to predict a particular period of risk in relation to the timing of the FCA, since there was no difference in the duration from admission to FCA (survivors 10 (17) days vs deceased 13 (13) days, NS) or from FCA to time of discharge or death (survivors 17 (22) vs 9 (21) days, NS). Of interest, those suffering an FCA on a weekday appeared to have better survival than those suffering an FCA on a weekend day (92/122, 75.4% vs 16/28, 57.1%; OR 2.30, 95% confidence interval 0.98 to 5.41; $\chi^2 p = 0.05$).

Table 1 Population demographics

Event	Patients	Male (%)	Mean age (SD)	Range
Cardiac arrest	265	145 (55)	70 (15)	20–99
Respiratory arrest	79	36 (46)	68 (16)	20–91
False alert	150	85 (57)	66 (18)	17–94

Table 2 Survival to hospital discharge or 6 weeks

Cause of event	Events	% of total	Survived (%)	Died (%)
Collapse	30	20.0	21 (70.0)	9 (30.0)
Vasovagal syncope	26	17.3	22 (84.6)	4 (15.4)
Epileptic seizure	20	13.3	16 (80.0)	4 (20.0)
Hypoxic	18	12.0	10 (55.6)	8 (44.4)
Deteriorated no arrest	17	11.3	12 (70.6)	5 (29.4)
Hypotensive	13	8.7	11 (84.6)	2 (15.4)
Sudden reduced LOC	8	5.3	3 (37.5)	5 (62.5)
GI bleed	6	4.0	3 (50.0)	3 (50.0)
TIA	2	1.3	1 (50.0)	1 (50.0)
Hypoglycaemic	1	0.7	1 (100)	0
Asleep	1	0.7	1 (100)	0
Fall	1	0.7	1 (100)	0
Tracheostomy blocked	1	0.7	1 (100)	0
Rigor	1	0.7	1 (100)	0
Anaphylaxis	1	0.7	1 (100)	0
Chest pain	1	0.7	1 (100)	0
Infarcting	1	0.7	1 (100)	0
DNAR	1	0.7	1 (100)	0
Call rescinded	1	0.7	1 (100)	0
Total	150	100	109	41

DNAR, do not attempt to resuscitate; GI, gastrointestinal; LOC, level of consciousness; TIA, transient ischaemic event.

DISCUSSION

Patients suffering FCAs are at higher risk for adverse outcomes than the general ward-based hospital population. Although survival is better than in those who have suffered a confirmed cardiac arrest, mortality is much higher than that of the general hospital population; however, the greater age of FCA patients may account for some of this increased risk.

False alerts of the cardiac arrest team are a common event, accounting for around one third of all cardiac arrest calls, but causation may be trivialised and FCAs are frequently followed by inaction. Those attending patients following FCAs identify those at high risk of dying, whose status is then changed to DNAR, but miss a substantial proportion who are not transferred for more intensive care yet who go on to arrest again.

Within UK district general hospitals, the reported incidence of FCAs varies from 8–26%.^{3–5} Rates outside the UK appear higher and have been reported as between 17% (Swedish⁶) and 28% (Canadian⁷). The incidence of FCAs found in our study (30%) is slightly higher than reported; however, these studies only included such figures in their rate of exclusion from further investigation and do not give further information regarding outcome. Only two studies are available which have explored the outcome of FCAs in detail. In a retrospective study of 59 false alert calls over a 22-month period, Cashman found that 30 calls were immediately rescinded and 29 were deemed erroneous.⁸ Rescinded calls were those which were cancelled “within minutes” by the ward and erroneous calls were those which were attended by the cardiac arrest team who then found no arrest to have taken place. Only 60% of the group as a whole survived to discharge, an outcome even worse than that in our study. In a more recent prospective study in Sweden, patients were categorised according to cardiac arrest (70%), respiratory arrest (9%) and “other reasons for calling” the arrest team (21%).⁹ Although the survival rate of those with cardiac arrest was better than in many previous studies (36%), survival to discharge or 6 weeks was similar in the FCA group to that in our study at 77%. Thus, although the rate of FCA is slightly higher in our study, the adverse outcome is consistent with the existing data.

Why is the outcome apparently worse for patients following FCA than for the remaining hospital population? The patients

in our study had long periods of in-hospital care and were older. Poor initial health status may be one potential factor, but information was not available in our study on previous medical history or admission diagnosis. It is not known whether the worse outcome from FCAs was due to more extensive medical comorbidity than the general hospital population. The common reasons for false alerts included collapse, syncope and seizure, findings consistent with the limited published literature.⁹ These factors are known to be common antecedents to cardiac arrest¹⁰ but aggressive management, either in terms of transfer for more intensive care or re-registering patient status for DNAR, was uncommon.

A number of studies have shown that warning symptoms are common a few hours before cardiac arrest.^{11–12} It has been suggested that the early identification of risk factors in conjunction with strict criteria for “calling the rescue team” and thereby early intervention might protect patients from critical events.^{10–13} This has led to a trend towards reorganising rescue teams from cardiac arrest teams to “medical emergency teams” with the aim of protecting patients from the development of a cardiac arrest and increasing survival from cardiac arrest by early intervention. Our study preceded the introduction of medical alert and outreach teams in our institution, but it is not known whether such teams would lead to an improvement in outcome following arrest.

One alternative to the introduction of such teams would simply be to require that the leader of the cardiac arrest team alerts the senior physician responsible for the care of the patient to the occurrence of the FCA. It is possible that those who suffer an FCA may have suffered from a true cardiac arrest, but recovered spontaneously before the arrest team arrive. Such an occurrence cannot be excluded but would re-enforce the need to concentrate resources on such patients to either manage more intensively or re-categorise as DNAR to prevent unnecessary arrest team activations.

In conclusion, FCAs are common events occurring in patients who have been in hospital for some time. Although survival from the event itself is high, many go on to arrest again with a poorer survival than the general hospital population. Our suggestion is that, in areas lacking a medical alert, outreach or patient at risk system, senior staff or a support team should be automatically involved following an FCA to direct more intensive care for the individual concerned.

ACKNOWLEDGEMENTS

Yen Chua and Andrew Howman are thanked for their advice and assistance with statistical analysis.

Authors' affiliations

Gary Kenward, Royal Centre for Defence Medicine, Selly Oak Hospital, Birmingham, UK

Alan Robinson, Sandra Bradburn, Richard Steeds, University Hospital (Queen Elizabeth), Edgbaston, Birmingham, UK

No external sources of funding were employed for this work.

Competing interest statements: No competing interests to declare

REFERENCES

- 1 **Weerasinghe DP**, MacIntyre CR, Rubin GL. The epidemiology of cardiac arrests in a Sydney hospital. *Resuscitation* 2002;**53**:53–62.
- 2 **Cummins RO**, Chamberlain D, Hazinski MF, et al. Recommended guidelines for reviewing, reporting, and conducting research on in-hospital resuscitation: the in-hospital Utstein style: A statement for healthcare professionals from the American Heart Association, the European Resuscitation Council, the Heart and Stroke Foundation of Canada, the Australian Resuscitation Council, and the Resuscitation Councils of Southern Africa. *Resuscitation* 1997;**34**:151–83.
- 3 **Gwinnutt CL**, Columb M, Harris R. Outcome after cardiac arrest in adults in UK hospitals: effect of the 1997 guidelines. *Resuscitation* 2000;**47**:125–35.

- 4 **Cooper S**, Janghorbani M, Cooper G. A decade of in-hospital resuscitation: outcomes and prediction of survival? *Resuscitation* 2006;**68**:231–7.
- 5 **Soar J**, McKay U. A revised role for the hospital cardiac arrest team? *Resuscitation* 1998;**38**:145–9.
- 6 **Andreasson AC**, Herlitz J, Bang A, *et al*. Characteristics and outcome among patients with a suspected in-hospital cardiac arrest. *Resuscitation* 1998;**39**:23–31.
- 7 **Doig CJ**, Boiteau PJ, Sandham JD. A 2-year prospective cohort study of cardiac resuscitation in a major Canadian hospital. *Clin Invest Med* 2000;**23**:132–43.
- 8 **Cashman JN**. In-hospital cardiac arrest: what happens to the false arrests? *Resuscitation* 2002;**53**:271–6.
- 9 **Hein A**, Thoren A-B, Herlitz J. Characteristics and outcome of false cardiac arrests in hospital. *Resuscitation* 2006;**69**:191–7.
- 10 **Hodgetts TJ**, Kenward G, Vlachonikolis IG, *et al*. The identification of risk factors for cardiac arrest and formulation of activation criteria to alert a medical emergency team. *Resuscitation* 2002;**54**:125–31.
- 11 **Schein RM**, Hazday N, Pena M, *et al*. Clinical antecedents to in-hospital cardiopulmonary arrest. *Chest* 1990;**98**:1388–92.
- 12 **Smith AF**, Wood J. Can some in-hospital cardio-respiratory arrests be prevented? A prospective survey. *Resuscitation* 1998;**37**:133–7.
- 13 **Franklin C**, Mathew J. Developing strategies to prevent in-hospital cardiac arrest: analyzing responses of physicians and nurses in the hours before the event. *Crit Care Med* 1994;**22**:244–7.