Characteristics and outcome among patients having out of hospital cardiac arrest at home compared with elsewhere

J Herlitz, M Eek, M Holmberg, J Engdahl, S Holmberg

Objective: To describe the characteristics and outcome of patients who have a cardiac arrest at home compared with elsewhere out of hospital.

Patients: Subjects were patients included in the Swedish cardiac arrest registry between 1990 and 1999. The registry covers about 60% of all ambulance organisations in Sweden.

Methods: The study sample comprised patients reached by the ambulance crew and in whom resuscitation was attempted out of hospital. There was no age limit. Crew witnessed cases were excluded. The patients were divided into two groups: cardiac arrest at home and cardiac arrest elsewhere.

Results: Among a study population of 24 630 patients the event took place at home in 16 150 (65.5%). Those in whom the arrest took place at home differed from the remainder in that they were older, more often women, less often had a witnessed cardiac arrest, were less often exposed to bystander cardiopulmonary resuscitation (CPR), were less often found in ventricular fibrillation, and had a longer interval between collapse and call for ambulance, arrival of ambulance, start of CPR, and first defibrillation. Of patients in whom the arrest took place at home, 11.3% were admitted to hospital alive, versus 19.4% in the elsewhere group (p < 0.0001); corresponding figures for survival after one month were 1.7% vs 6.2% (p < 0.0001). The adjusted odds ratio for survival after one month (at home vs not at home; considering age, sex, initial arrhythmia, bystander CPR, aetiology, and whether the arrest was witnessed) was 0.40 (95% confidence interval 0.33 to 0.49; p < 0.0001).

Conclusions: Sixty five per cent of out of hospital cardiac arrests in Sweden occur at home. The patients differed greatly from those with out of hospital cardiac arrests elsewhere, and fewer than 2% were alive after one month. Having an arrest at home was a strong independent predictor of adverse outcome. Further research is needed to identify the reasons for this.

METHODS

Patients

All patients with cardiac arrest to whom the ambulance was called were included in the registry, with one exception—that is, individuals who had obviously been dead for a long time and whose bodies were not brought to hospital by the ambulance crew. For all other cases, a standardised form was completed by the ambulance crew. In this survey, crew witnessed cases were excluded, as were people who suffered a cardiac arrest within the two hospitals in the community. However, sometimes ambulances were called to patients in apartments (for the elderly or disabled) or other institutions and these were included in the survey.

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procedure, including intervention times and interventions such as bystander CPR (a bystander was defined as someone starting CPR before the arrival of the first ambulance, regardless of profession), defibrillation, intubation, drug treatment, and status at the first contact.

In ambulances with manual defibrillators, the rhythm was defined as ventricular fibrillation (VF), pulseless electrical activity (PEA), or asystole. For automated external defibrillators, the rhythm was defined as shockable rhythm (VF) or non-shockable rhythm. In this study, VF includes patients with pulseless ventricular tachycardia (VT).

To establish the time of cardiac arrest in witnessed cases, the ambulance crew was instructed to interview the bystanders about the delay from arrest to call. It was stressed in written instructions that a maximum effort had to be made to obtain these times. The ambulance crew recorded the time of arrival at the patient’s side, the time of starting CPR, the time of the first defibrillation, the time of a palpable pulse, the time of starting transport to hospital, and time of arrival at hospital. The number of direct current (DC) shocks was recorded. The ambulance crew also classified the aetiology of the arrest into nine different diagnostic categories (heart disease, lung disease, trauma, drug overdose, suicide, drowning, suffocation, sudden infant death syndrome, and other), based on clinical assessment and bystander information. Their diagnosis was accepted for this study and no further control was made among initial survivors during their hospital stay.

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The form was filled in during and immediately after the acute event. Each form was reviewed by the medical director and a copy was sent to the central registry. Another copy was subsequently sent with additional information about whether the patient was dead or alive after one month. If there was uncertainty about whether or not the patient had died, this was established from the national registry of deaths.

No absolute validation of adherence to the protocol was undertaken, as it would have been extremely complicated and expensive to do this in 57 different ambulance districts. Instead, a questionnaire was sent to all the medical directors of the ambulance organisations participating in the registry. They were asked to estimate the accuracy of the representation of the study population. They estimated the percentage of the study population that was wrongly omitted from the study in their own district; the proportions varied from 0–30% (mean 5%).

**Statistical methods**

The distributions of the variables are given as means and medians. For comparison between groups with ordered and continuous variables, Fisher’s non-parametric permutation test was used. For comparison of dichotomous variables between groups Fisher’s exact test was used. Stepwise logistic regression was used to select independent predictors for multivariate analyses.

**RESULTS**

In all, 24,917 patients were included in the survey. Information on the place of cardiac arrest was available in 24,630 (98.8%). Among these, the cardiac arrest took place in the home in 16,150 cases (65.0%). The following comparisons are between those individuals in whom the arrest took place at home and those in whom the arrest took place outside the home.

**Age, sex, and factors at resuscitation**

These data are shown in table 1. Patients in whom the cardiac arrest took place at home differed from the remainder in the
Cardiac arrest at home

Table 2  Type of bystander and type of CPR

<table>
<thead>
<tr>
<th>Variable</th>
<th>Missing*</th>
<th>Cardiac arrest at home</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of bystander</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lay person†</td>
<td>182, 111</td>
<td>n=4114</td>
<td>n=3831</td>
</tr>
<tr>
<td>Medical personnel</td>
<td></td>
<td>2728 (66.3%)</td>
<td>1701 (44.4%)</td>
</tr>
<tr>
<td>Ambulance personnel</td>
<td></td>
<td>718 (17.4%)</td>
<td>1539 (40.7%)</td>
</tr>
<tr>
<td>Police</td>
<td></td>
<td>79 (1.9%)</td>
<td>150 (3.9%)</td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td>38 (0.9%)</td>
<td>137 (3.6%)</td>
</tr>
<tr>
<td>Type of bystander CPR</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chest compression and ventilation</td>
<td>493, 372</td>
<td>n=3803</td>
<td>n=3570</td>
</tr>
<tr>
<td>Chest compression only</td>
<td></td>
<td>2466 (64.8%)</td>
<td>2835 (79.4%)</td>
</tr>
<tr>
<td>Ventilation only</td>
<td></td>
<td>327 (8.6%)</td>
<td>336 (9.4%)</td>
</tr>
<tr>
<td>Ventilation only</td>
<td></td>
<td>1010 (26.6%)</td>
<td>399 (11.2%)</td>
</tr>
</tbody>
</table>

Values are n (%).  
*Number of patients with missing information in the two categories.  
†On a few occasions more than one category was involved.

CPR, cardiopulmonary resuscitation.

Table 3  Survival at one month in various age groups

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Missing*</th>
<th>Cardiac arrest at home</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0–18</td>
<td>13</td>
<td>9/285 (3.2%)</td>
<td>12/158 (7.6%)</td>
</tr>
<tr>
<td>19–35</td>
<td>10</td>
<td>10/388 (2.6%)</td>
<td>34/348 (9.8%)</td>
</tr>
<tr>
<td>36–70</td>
<td>163</td>
<td>151/6479 (2.3%)</td>
<td>242/3418 (7.1%)</td>
</tr>
<tr>
<td>&gt;70</td>
<td>180</td>
<td>104/9446 (1.2%)</td>
<td>254/3728 (6.3%)</td>
</tr>
</tbody>
</table>

Values are n surviving / n evaluated (survival rate [%]).  
*Number of patients with missing information.

following ways: they were older, they were more often women, the arrest was less often witnessed, they were less likely to have received bystander CPR, they were less often found in ventricular fibrillation, and there was a longer interval between collapse and call for ambulance, arrival of ambulance, start of CPR, and first defibrillation when found in ventricular fibrillation. There was also a longer interval between call for an ambulance and the arrival of the ambulance.

Type of bystander and type of CPR

In those who were exposed to bystander CPR, the procedure was more often undertaken by lay persons when the arrest took place in the patient’s home (table 2). Furthermore, combined chest compression and ventilation was done less frequently when the arrest took place in the patient’s home.

Aetiology

The underlying aetiology was more often judged to be heart disease in patients with a cardiac arrest at home than in those with an arrest elsewhere (73.8% vs 69.8%).

Admitted to hospital alive

Patients in whom the cardiac arrest took place at home had a much lower initial survival rate than those with an arrest elsewhere (11.3% vs 19.4%; p < 0.0001). The corresponding values for patients found in a shockable rhythm were 21.5% vs 30.1% (p < 0.0001), and for those found in a non-shockable rhythm, 7.8% vs 11.4% (p < 0.0001).

Alive after one month

Survival to one month after the event was much lower among patients with a cardiac arrest at home than in patients with an arrest elsewhere (1.7% vs 6.3%; p < 0.0001). The corresponding values for patients found in a shockable rhythm were 4.7% vs 12.2% (p < 0.0001), and for patients found in a non-shockable rhythm, 0.6% vs 2.1% (p < 0.0001). Table 3 shows survival among patients suffering from cardiac arrest at home and outside home in various age groups.

Multivariate analysis

In a multivariate analysis, age, sex, initial arrhythmia, bystander CPR, whether the arrest was witnessed, aetiology, and place where the arrest took place (that is, home vs not at home) were included in the model (n = 16 362, comprising 66% of the total series). Cardiac arrest at home was a very strong independent predictor of a low chance of survival one month after the event (odds ratio 0.40, 95% confidence interval (CI) 0.33 to 0.48; p < 0.0001). The corresponding values in the univariate analysis were odds ratio 0.26, 95% CI 0.22 to 0.36; p < 0.0001.

DISCUSSION

In this survey we found that two thirds of people who suffered an out of hospital cardiac arrest had it in their home. This is in good agreement with previous experience, though the proportions have varied between 59–84%.

We found that patients who had a cardiac arrest at home differed notably from those having an out of hospital cardiac arrest elsewhere. In many ways individuals who had an arrest at home had characteristics that forecasted a poor outcome. These included an older age, a lower occurrence of a witnessed cardiac arrest, and a longer interval between collapse and the arrival of an ambulance.

Our findings are in agreement with previous surveys. Thus, Litwin and colleagues also found that patients who had a cardiac arrest at home were older, less often had a witnessed arrest, less often received bystander CPR, and were less commonly found in ventricular fibrillation, while Jackson and Swor found that patients who had a cardiac arrest outside their homes were about four times more likely to receive bystander CPR.

Although these differences suggest a worse outcome among patients having a cardiac arrest at home, we found that in a
multivariate analysis, even when these differences were taken into account, the place of arrest—that is, having the arrest at home—was still a strong independent predictor of an adverse outcome. This is in agreement with previous observations and suggests that there are other factors which we did not incorporate in the multivariate model that explain at least part of the adverse outcome among these patients. Such factors include comorbidity, and in our study there was a complete lack of information on this. One might expect that as the individuals who had cardiac arrests at home were older, they would also have a higher prevalence of cardiovascular diseases such as congestive heart failure and diabetes. Furthermore, they would be expected to suffer more often from disorders such as cancer and other chronic diseases, all likely to make them more vulnerable to an adverse outcome.

Psychosocial factors might also influence the outcome. One might expect that patients who suffer from cardiac arrest at home would be more prone to loneliness and depression, factors that are known to affect the outcome of patients suffering from various manifestations of coronary artery disease.

Our observation that the chance of survival is much lower if the patient has a cardiac arrest at home is in agreement with previous reports. Studied cases, and in unwitnessed arrest it is not known.

**Study limitations**

It was estimated that about 5% of the patients fulfilling the inclusion criteria were wrongly omitted. Furthermore, 23% of the study population came from the three large cities in which 25% of the Swedish inhabitants live. We do not suspect that either of these two limitations would seriously bias the results.

The time of the arrest is often inaccurate in bystander witnessed cases, and in unwitnessed arrest it is not known.

**Implications**

In patients who have a cardiac arrest at home in Sweden, the chance of survival is extremely low (less than 2%). Only a little over one in four patients receives CPR before the arrival of the ambulance, and only one in four is found to be in ventricular fibrillation. To increase survival in this subset of patients, they would need to have better access to bystander CPR. This might be accomplished either by a more effective telephone CPR or by a better system for educating spouses of patients with heart disease in the use of CPR. However, it is probable that education and support measures will improve survival only in witnessed instances of cardiac arrest.

**ACKNOWLEDGEMENT**

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**APPENDIX**


**REFERENCES**