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Clinical Paper

Out-of-hospital cardiac arrest in the elderly: A large-scale population-based study☆

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ABSTRACT

Background: There is little information on elderly people who suffer from out-of-hospital cardiac arrest (OHCA).
Aim: To determine 30-day mortality and neurological outcome in elderly patients with OHCA.
Methods: OHCA patients ≥70 years of age who were registered in the Swedish Cardiopulmonary Resuscitation Register between 1990 and 2013 were included and divided into three age categories (70–79, 80–89, and ≥90 years). Multiple logistic regression analyses were performed to identify independent predictors of 30-day survival.
Results: Altogether, 36,605 cases were included in the study. Thirty-day survival was 6.7% in patients aged 70–79 years, 4.4% in patients aged 80–89 years, and 2.4% in those over 90 years. For patients with witnessed OHCA of cardiac aetiology found in a shockable rhythm, survival was higher: 20%, 15%, and 11%, respectively. In 30-day survivors, the distribution according to the cerebral performance categories (CPC) score at discharge from hospital was similar in the three age groups. In multivariate analysis, in patients over 70 years of age, the following factors were associated with increased chance of 30-day survival: younger age, OHCA outside the home, witnessed OHCA, CPR before arrival of EMS, shockable first-recorded rhythm, and short emergency response time.
Conclusions: Advanced age is an independent predictor of mortality in OHCA patients over 70 years of age. However, even in patients above 90 years of age, defined subsets with a survival rate of more than 10% exist. In survivors, the neurological outcome remains similar regardless of age.
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1. Introduction

The elderly are currently the fastest growing segment of clinical practice and data are needed to adequately counsel patients so that their expectations are aligned with their likely outcomes.

Ethical dilemmas are common in the geriatric population. To withhold life-supporting treatment from patient groups with no hope of a meaningful life is usually non-questionable. On the other hand, selection of individual patients who will gain from treatment without unnecessary suffering, or harm, is challenging. In the case of cardiac arrest, there is usually no time to think, necessitating action in the form of immediate cardiopulmonary resuscitation (CPR) in order to save the person's life. Different individuals have different ethical values regarding CPR in the oldest old.

A strong evidence base is needed in order to come closer to answering the difficult questions such as "Is there an upper age limit where it can be regarded as unethical to start CPR?"

In resuscitated cardiac arrest patients, neurological recovery is the most critical issue. In case of cardiac arrest, qualitative reports[1,2] have shown that elderly people are mainly concerned about loss of autonomy, about the outcome of serious illness rather than the medical interventions that might be used, and about whether they would be able to return to their valued life activities. This is why in

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studies of elderly patients one should concentrate not only on survival rates but also on inclusion of other outcome measures—such as neurological outcome, which is one factor that really matters for patients and their families.

The aim of this large observational study was to evaluate an elderly population of OHCA victims, to analyze temporal trends, and to determine whether there were age-related differences in outcome (30-day survival and cerebral performance category (CPC) score).

2. Methods

2.1. Register

The Swedish CPR Register has been described in previous reports.[3–6] Briefly, the registry started to include patients in year 1990 and the coverage and completeness of data collection has improved over time. Today, all the ambulance organizations in Sweden participate in this registry, and the CPR Register covers more than 90% of all OHCA patients in whom cardiopulmonary resuscitation has been attempted.[5] The technology for inclusion has changed over time, in the past being handwritten CPR reports according to the standardized Utstein style[7] but now data are entered in the web-based registry, describing the characteristics of the cardiac arrest and the initial outcome. The ambulance crew submits variables both prospectively and retrospectively, and specially educated monitors also report some retrospective cases.

The population of Sweden is approximately 9.5 million inhabitants in an area of 449,964 km^2. Approximately 5000 new cases of OHCA are reported to the register annually.

2.2. Study population

Those included in the study were all patients with OHCA, at least 70 years of age, and registered in the Swedish CPR Register during the period 1 January 1990 to 31 December 2013. In the tables and figures, when comparing the different time periods, we have excluded the years 1990 and 1991 due to the small number of patients included during these first two years.

Regarding the ethical aspects of the study, according to Swedish law, the use of certain registry data does not require individuals included in a study to give their informed consent. The study was approved by the Ethical Review Board of Gothenburg (entry number 810-14).

2.3. Outcome measures

Information about outcome, whether the patient was dead or alive at 30 days, was reported either by the EMS crew or by monitors in hospital who followed up the patient. In cases of uncertainty or missing data, confirmation of death or survival was obtained from the national state administrative authority.

For 30-day survivors, information on CPC score[8] at discharge from hospital was obtained through the hospital monitors from hospital records. CPC scores of 1 (conscious, alert, able to work, with mild neurological or psychological deficit) and 2 (conscious, sufficient neurological function for independent activities of daily living) are often grouped together and are considered good outcomes. A score of 3 indicates inability to perform independent activities of daily living, a score of 4 indicates a comatose or vegetative state, and a score of 5 indicates brain death. Clearly, scores of 3–5 indicate poor neurological outcomes.

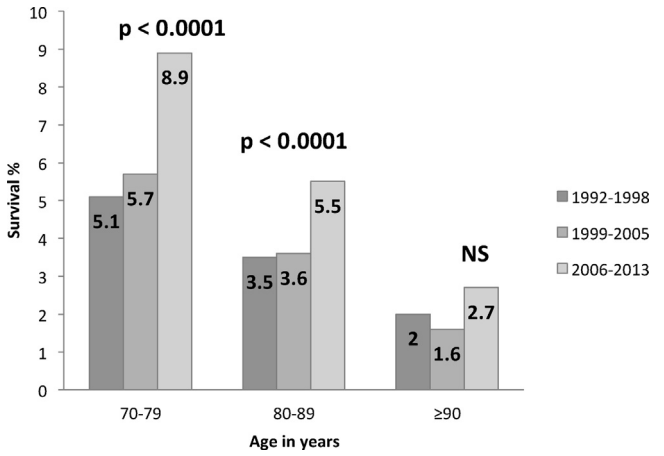

Fig. 1. Changes in survival in relation to age from 1992 to 2013. Due to few patients included in the registry years 1990–1991, we have excluded those years.

2.4. Statistical analysis

Actual age, as a continuous variable, was used in all *p*-value calculations. For proportions Mann–Whitney *U* test was used and for continuous/ordered variables Spearman's rank correlation was used. Logistic regression was used for calculation of odds ratios with corresponding confidence intervals, both in univariate and multivariate analysis. All tests are two-sided and *p*-values below 0.05 were considered statistically significant. SAS v9.3 was used for the analyses.

3. Results

Altogether, 36,605 patients aged ≥70 years who were reported to the registry were included in the study. Among them, 53% were in the age range 70–79 years, 40% were in the age range 80–89 years, and 7% were aged ≥90 years.

3.1. Factors associated with 30-day survival

The following were found to be associated with an increased chance of 30-day survival in univariate analysis: younger age, male gender, place of OHCA outside home, witnessed OHCA, CPR prior to arrival of EMS, first-recorded rhythm was ventricular fibrillation, and a shorter delay from call for until arrival of EMS (Table 2).

In the multivariate analysis, the same variables—with the exception of gender—were found to be independent predictors of an increased chance of survival.

3.2. Outcome

Data on outcome are given in Table 2. The 30-day survival decreased with increasing age, from 6.7% (70–79 years) to 2.4% (≥90 years). The 30-day survival increased significantly over time in the age groups 70–79 years and 80–89 years (Fig. 1). In patients aged ≥90 years who had a witnessed OHCA of cardiac aetiology and were found in VF, 11.4% survived to 30 days.

Of the 30-day survivors, the distribution of patients in the three age groups according to CPC score at discharge from hospital was similar (Fig. 2).

3.3. Characteristics

The characteristics of the patients included are given in detail in Table 1. The proportion of women increased with increasing age. With increasing age, the proportion of crew-witnessed cases

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