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CLINICAL PAPER

An evaluation of post-resuscitation care as a possible explanation of a difference in survival after out-of-hospital cardiac arrest☆

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Summary
Background: A recently published study has shown that survival after out-of-hospital cardiac arrest (OHCA) in Göteborg is almost three times higher than in Stockholm. The aim of this study was to investigate whether in-hospital factors were associated with outcome in terms of survival.
Methods: All patients suffering from OHCA in Stockholm and Göteborg between January 1, 2000 and June 30, 2002 were included. The two groups were compared with reference to patient characteristics, medical history, pre-hospital and hospital course (including in-hospital investigations and interventions) and mortality. All medical charts from patients admitted alive to the different hospitals were studied. Data from the Swedish National Register of Deaths regarding long-term survival were analysed. Pre-hospital data were collected from the Swedish Ambulance Cardiac Arrest Register.
Results: In all, 1542 OHCA in Stockholm and 546 in Göteborg were registered during the 30-month study period. In Göteborg, 28% (153 patients) were admitted alive to the two major hospitals whereas in Stockholm 16% (253 patients) were admitted alive to the seven major hospitals ($p < 0.0001$). On admission to the emergency rooms, a larger proportion of patients in Stockholm was unconscious ($p = 0.006$), received assisted breathing ($p = 0.008$) and ongoing CPR ($p = 0.0002$). Patient demography, medical history, in-hospital investigations and interventions and in-hospital mortality (78% in Göteborg, 80% in Stockholm) did not differ between the two groups.

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Various pre-hospital time intervals were significantly longer in Stockholm than in Göteborg. Total survival to discharge after OHCA was 3.3% in Stockholm and 6.1% in Göteborg ($p = 0.01$).
Conclusion: An almost 2-fold difference in survival after OHCA between Stockholm and Göteborg appears to be associated with pre-hospital factors only (predominately in form of prolonged intervals in Stockholm), rather than with in-hospital factors or patient characteristics.

1. Introduction

Death from cardiac disease is the single most common cause of mortality in the western world and the majority of these deaths occurs out-of-hospital.[1] The vast majority of studies made so far on out-of-hospital cardiac arrests (OHCA) have focused primarily on features related to Emergency Medical Services (EMS), including the four links of the ''chain-of-survival'' concept, i.e., early access, early CPR, early defibrillation and early advanced life support.[2] Some of these factors, predominately early CPR and early defibrillation, have been associated with increased survival rates.[3–5] However, during the last few years questions about the in-hospital phase have also been raised. Following the publication of two randomised, controlled studies that demonstrated improved neurological outcome in comatose survivors after ventricular fibrillation,[6,7] therapeutic mild hypothermia is becoming implemented in clinical practice. This has led to the proposition of an additional fifth link to the ''chain-of-survival'' concept called post-resuscitation care. However, the effects of post-resuscitation care on survival after OHCA are still poorly recognised and are sparse.

A recent study in Sweden[8] has shown that survival after OHCA in Göteborg is almost three times higher than in Stockholm and the proportion of patients with shockable rhythms is much lower in Stockholm compared with Göteborg. This is probably due to the longer intervals in Stockholm from the time of the cardiac arrest to critical resuscitation. The aim of this study was to explore whether there were differences also in in-hospital investigations and interventions between the two largest cities in Sweden, Stockholm and Göteborg, and to study possible mechanisms behind such differences. We therefore wanted to investigate whether in-hospital factors were associated with outcome in terms of survival or whether the difference in survival is due to pre-hospital factors only.

2. Methods and patients

2.1. Organisation and equipment

The ambulance organisations in Stockholm and Göteborg work according to a two-tier system, i.e. for each call judged as a cardiac arrest, a mobile coronary care unit (if available), and an ambulance, are dispatched. Ambulances usually did not carry nurses but were equipped with specialised ambulance personnel trained in basic CPR and the use of defibrillators. The educational programme for the ambulance personnel is the same in both cities. The mobile coronary care units in both cities are equipped with a registered nurse trained in anaesthesiology with additional courses in advanced cardiac life support. Both mobile coronary care units and ambulances are equipped with defibrillators. The ambulances are stationed throughout the two cities and are not predominantly situated at the hospitals. The pre-hospital (ambulance) pharmacological treatment does not differ between Göteborg and Stockholm nor from that given in other parts of Sweden. Further details on organisation, equipment and crew training levels are described elsewhere.[8] All ambulance organisations have physicians as medical directors.

There are seven major hospitals in the County of Stockholm and two major hospitals in Göteborg. They are situated predominately within the city centers and in larger suburbs, and are geographically spread in densely populated areas.

At the time of this study, hypothermia as treatment after OHCA had not been introduced in Göteborg or Stockholm.

2.2. Study design

In order to achieve the aim of this study, two groups of patients suffering OHCA were studied. One group consisted of patients resuscitated after OHCA in the city of Göteborg and the other group comprised patients resuscitated after OHCA in the county of Stockholm. As described above, the EMS systems