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A 20-year perspective of in hospital cardiac arrest Experiences from a university hospital with focus on wards with and without monitoring facilities

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ABSTRACT

Background: Knowledge about change in the characteristics and outcome of in hospital cardiac arrests (IHCAs) is insufficient.
Aim: To describe a 20 year perspective of in hospital cardiac arrest (IHCA) in wards with and without monitoring capabilities.
Settings: Sahlgrenska University Hospital (800 beds). The number of beds varied during the time of survey from 850–746
Time: 1994–2013.
Methods: Retrospective registry study. Patients were assessed in four five year intervals.
Inclusion criteria: Witnessed and nonwitnessed IHCAs when cardiopulmonary resuscitation (CPR) was attempted.
Exclusion criteria: Age below 18 years.
Results: In all, there were 2340 patients with IHCA during the time of the survey. 30-Day survival increased significantly in wards with monitoring facilities from 43.5% to 55.6% ($p = 0.002$) for trend but not in wards without such facilities ($p = 0.003$ for interaction between wards with/without monitoring facilities and time period). The CPC-score among survivors did not change significantly in any of the two types of wards. In wards with monitoring facilities there was a significant reduction of the delay time from collapse to start of CPR and an increase in the proportion of patients who were defibrillated before the arrival of the rescue team. In wards without such facilities there was a significant reduction of the delay from collapse to defibrillation. However, the latter observation corresponds to a marked decrease in the proportion of patients found in ventricular fibrillation.
Conclusion: In a 20 year perspective the treatment of in hospital cardiac arrest was characterised by a more rapid start of treatment. This was reflected in a significant increase in 30-day survival in wards with monitoring facilities. In wards without such facilities there was a decrease in patients found in ventricular fibrillation.
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1. Introduction

Sudden cardiac arrest is the predominant cause of death in cardiovascular diseases [1]. Most commonly this situation is initiated by a stenosis or occlusion of one of the main cardiac vessels, causing myocardial ischemia, which may trigger a potentially life-threatening cardiac arrhythmia, i.e. ventricular fibrillation.

In the event of a cardiac arrest, regardless of the location being in- or out-of-hospital, the time until onset of treatment is of utmost importance for survival.

The treatment is divided into two steps; 1) CPR — for maintaining circulation to the heart and brain, and 2) defibrillation — for restoring cardiac rhythm.

Over the last decades lots of efforts have been invested in shortening the time from cardiac arrest to defibrillation, traditionally more so for the out-of-hospital arrests [2]. The treatment procedures of in-hospital arrests have in comparison been somewhat belated and many die within reach of emergency medicine. In recent years, however, the development work in this area has been increasingly progressive [3–5].

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If correct actions are immediately taken in the event of a cardiac arrest, the survival rate is most probably far more than 50% [6–7]. With immediate action we mean start of CPR within 1 min and defibrillation within 3 min after collapse. For every minute medical help is delayed, the rate of survival steadily decreases. At body temperature, vulnerable organs suffer incurable damage due to lack of oxygen already after 5 min. By 15 min death is almost inevitable, regardless of medical efforts.

The in-hospital cardiac arrest survival to hospital discharge rate before the last decade in general has been reported to be approximately 15% [8]. More recent results have shown great improvement and indicate survival to discharge rates that are at least twice as high [9–10]. The location for an in-hospital cardiac arrest is of great importance, probably because time is such a crucial factor for survival and cerebral function [11]. In monitored patient units, for instance the intensive care unit (ICU), cardiac care unit (CCU) and cath. lab, where continuous ECG monitoring is used, cardiac arrhythmias are detected more promptly and therapy can therefore be started sooner [12]. Consequently, these units have shown a much higher survival rate (>50%) compared to non-monitored patient units [13]. In units where patients are not monitored i.e. regular patient wards, the detection of cardiac arrests more commonly is delayed, resulting in an increased time to initiation of resuscitation [13].

The aim of this study was to describe changes in the characteristics and outcome in a 20 year perspective after in hospital cardiac arrest in a University hospital. The evaluation included time periods before and after organisation changes had taken place within the hospital, which included a more widespread use of automated external defibrillators outside wards with monitoring facilities. Other changes included new guidelines which were implemented with five year intervals. Finally, a marked increase in the use of coronary angiography raised the possibility that more cardiac arrests should occur in the coronary angiography laboratory in the latter part of the survey.

The hypothesis was that there was an increase in survival and that the cerebral function among survivors has improved during these 20 years of prospective and retrospective evaluation.

2. Patients and methods

This study is based on a registry and performed both prospectively and retrospectively. All patients admitted to the Sahlgrenska University Hospital between the years 1994 and 2013, who attended wards with and without monitoring facilities and suffered from an in-hospital cardiac arrest where resuscitation was initiated, were included. The only exclusion criteria was age below 18 years.

2.1. Settings

The Sahlgrenska University Hospital serves as a primary, secondary and tertiary hospital. Sahlgrenska, with approximately 800 beds, is serving both a local population of about 600,000 inhabitants and a regional population of about 1,600,000 inhabitants.

2.2. Resuscitation team

During the study period there was a designated resuscitation team available around the clock. It is composed of three physicians: a specialist in internal medicine or, in specific wards, a thoracic surgeon, an anesthesiologist and a cardiologist. Furthermore, during recent years, the resuscitation team often includes a nurse specialized in anesthesia. Cardiopulmonary resuscitation (CPR) including basic life support (BLS) and advanced life support (ALS) is performed according to the European Resuscitation Council guidelines [14].

2.3. Resuscitation equipment

The availability of resuscitation equipment has varied over the time of this study. In 1996, portable automated external defibrillators (AEDs) were distributed to nearly all non-monitored units in the Sahlgrenska University Hospital, in order to decrease the time from cardiac arrest to defibrillation. Around this time all units were also furnished with their own standardized emergency equipment including drugs, intubation kit, etc.

In addition, to improve resuscitation conditions, extensive CPR-training of the medical personnel has repeatedly been conducted.

2.4. Data collection

Patients were prospectively reported at the time of cardiac arrest mostly by a nurse who attended the event. Information on time of event, initial rhythm, delay times to various actions and various treatments that were given were recorded. In a second step more than 30 days after the event information with regard to the patients' previous history, the etiology behind the event and outcome (30-day survival and CPC-score among 30-day survivors at hospital discharge) were retrospectively recorded.

2.5. Outcome and CPC score

Survival was defined as 30-day survival.

The survivors' functional status according to the cerebral performance category (CPC score) was evaluated retrospectively from the patients' medical records, both on admission to, and on discharge from, a hospital. A CPC score of 1 represents no neurological impairment and a CPC score of 2 represents mild impairment with a capacity for the activities of daily living (ADL). CPC scores 3 and 4 represent poor neurological outcome, dependent on others for ADL or living in a sheltered environment. CPC score 5 represents brain death.

3. Definition of wards with and without monitoring facilities

Wards with monitoring facilities included the following: intensive care units, coronary care units, coronary angiography laboratory, emergency department and operation theatre.

The remaining wards were defined as wards without monitoring facilities.

4. Validation

The recording of IHCAs in Sahlgrenska Hospital during 2009 was validated by an external monitor. In all there were 110 reported IHCAs of which 107 (97%) were confirmed. The first recorded arrhythmia was correctly reported in 76%, incorrectly reported in 5% and information was missing in 19%. The place of IHCA was correctly reported in 99% and information was missing in 1%. Witnessed status was correctly reported in 92%, incorrectly reported in 3% and information was missing in 5%. Information on 30-day survival was correctly reported in 100% of the cases.

5. Ethical approval

This study obtained ethics approval by a Swedish research committee. The number of the approval is 460-06.

6. Statistical methods

To test for trends over time periods within monitored and non-monitored groups Mann Whitney *U* test and Spearman rank correlation test were used for dichotomous and continuous/ordered variables respectively. For analysis of interaction between time period and whether

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