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Clinical Paper

Predictors of long-term survival after out-of-hospital cardiac arrest: The impact of Activities of Daily Living and Cerebral Performance Category scores☆

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ABSTRACT

Background: Current focus on immediate survival from out-of-hospital cardiac arrest (OHCA) has diverted attention away from the variables potentially affecting long-term survival.
Aim: To determine the relationship between neurological and functional status at hospital discharge and long-term survival after OHCA.
Methods: Prospective data collection for all OHCA patients aged >18 years in the Jerusalem district ($n = 1043$, 2008–2009). Primary outcome measure: Length of survival after OHCA. Potential predictors: Activities of Daily Living (ADL) and Cerebral Performance Category (CPC) scores at hospital discharge, age and sex.
Results: There were 52/279 (18.6%) survivors to hospital discharge. Fourteen were discharged on mechanical ventilation (27%). Interviews with survivors and/or their legal guardians were sought 2.8 ± 0.6 years post-arrest. Eighteen died before long-term follow-up (median survival 126 days, IQR 94–740). Six improved their ADL and CPC scores between discharge and follow-up. Long-term survival was positively related with lower CPC scores ($p = 0.002$) and less deterioration in ADL from before the arrest to hospital discharge ($p = 0.001$). For each point increment in ADL at hospital discharge, the hazard ratio of death was 1.31 (95%CI 1.12, 1.53, $p = 0.001$); this remained unchanged after adjustment for age and sex (HR 1.26, 95%CI 0.07, 1.48, $p = 0.005$).
Conclusions: One-third of the patients discharged from hospital after OHCA died within 30 months of the event. Long-term survival was associated both with better neurological and functional level at hospital discharge and a smaller decrease in functional limitation from before to after the arrest, yet some patients with a poor neurological outcome survived prolonged periods after hospital discharge.

1. Introduction

Despite regular guideline updates and major investment in pre-hospital resuscitation efforts, the survival of patients after OHCA has remained almost unchanged in the last 30 years.[1] Although much improvement has been made in the pre-hospital care of the patient undergoing resuscitation, until recently, substantially less effort has been directed towards "neurological resuscitation" and in-hospital management, yet these factors seem to contribute significantly to overall survival outcome.[2–7] Physical disability has been reported to create an "age offset" of up to 10 years (i.e. patients with decreased functional status are physically 10 years older).[8] As a result of the existing focus on the immediate outcome of resuscitation, we often remain unaware of the long-term consequences of resuscitation in terms of functional patient outcome measures and their eventual effect on long-term survival.

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Reports of long-term outcome after resuscitation seem discordant: some suggest that survivors suffer motor, cognitive or emotional damage, either alone or in combination,[9–12] whereas others report more favourable outcomes.[13–17] The definition of long-term outcome in the existing literature is broad, ranging from months[10,12,13] to more than 10 years[17] after hospital discharge, and few reports have addressed the relationship between quality of life, functional outcome and long-term survival after OHCA.[9,16,18,19]

The current work aimed to study long-term survival after out-of-hospital cardiac arrest (OHCA) and determine the relationship between age and sex adjusted neurological and functional condition and long-term survival. We hypothesized that a better discharge condition is associated with longer survival. We also studied whether changes occur in neurological and functional status over time in order to assess the likelihood of true improvement vs. further deterioration.

2. Methods

This prospective study included all patients aged >18 years who had undergone OHCA and resuscitation in the Jerusalem district during 2008–2009, achieved return of spontaneous circulation (ROSC) and survived to hospital discharge at the Hebrew University affiliated hospitals of Shaare Zedek and Hadassah Ein Kerem. These hospitals are the two largest of the four acute-care hospitals in the city; however, following OHCA and ROSC, the admission criteria were similar in all the Jerusalem hospitals. Both hospital Institutional Review Boards authorized the study. Signed informed consent was obtained for post-discharge patient interviews.

2.1. Clinical setting

The Jerusalem district covers a population of ~900,000. Pre-hospital emergency services are provided throughout Israel by the national Emergency Medical Service (EMS).[20] The national EMS has a centralized organization and command, enabling country-wide standardization of guidelines, equipment and treatment. Paramedics are trained in both ACLS and PHTLS. The response is three tiered. 3rd tier ambulances, which have a paramedic on board, attend all OHCAs irrespective of whether 1st/2nd tier responders are already at the scene. The EMS guidelines are that all OHCA patients should undergo resuscitation attempts unless a valid Do Not Attempt Resuscitation order exists or irrevocable signs of death (e.g. rigour mortis, decapitation, dependent lividity) are determined by the paramedic on location. Once initiated, resuscitative efforts can either be transferred to a 3rd tier team or terminated by physician order. Cardio-pulmonary resuscitation is performed in accordance with American Heart Association guidelines and all patients who achieve ROSC on location are transported to an acute-care hospital. At the time of study inception, in-hospital protocols in one of the two hospitals included routine cooling of patients with witnessed Ventricular Tachycardia/Ventricular Fibrillation (VT/VF) arrest who remained comatose and were not severely hemodynamically compromised at the time of ICU admission.

2.2. Study endpoints

The primary study end point was length of survival after OHCA, with patient Activities of Daily Living (ADL) and Cerebral Performance Category (CPC) scores at the time of hospital discharge as potential predictors of this measure. The secondary end point was the change in ADL and CPC from before OHCA to hospital discharge, one year after hospital discharge and long-term follow-up (i.e. at approximately 2.5 years after hospital discharge).

2.3. Case screening and selection

Data regarding each cardiac arrest were collected from dispatcher records and standardized ambulance forms filled in by the EMS team on location. Cases coded by paramedics as “cardiac arrest – no resuscitation”, “dead on arrival” and “cardiac arrest” were flagged by the study team and screened for inclusion. Patients were defined as having undergone cardiac arrest when there was EMS-documented (paramedic or physician) pulselessness accompanied by a non-perfusing rhythm [i.e. asystole, pulseless electrical activity (PEA), VF or VT]. Layperson chest compression and defibrillation with an automated external defibrillator (AED) prior to EMS arrival were verified and documented by the paramedic on location. Patients who had undergone defibrillation were included. In-patient files served as the data source for admission details and were collected in real time. All survivors underwent neurological assessment by the same trained nurse (NK) prior to hospital discharge.

2.4. Long-term follow-up

Survival status after hospital discharge was verified through the National Population Registry prior to initiation of post-discharge follow-up. We directly approached survivors who were cognitively intact at the time of hospital discharge, but contacted the formal legal guardian of those who had died in the interim and/or those who had impaired decision-making capacity at the time of hospital discharge for informed consent. An introductory letter signed by both PIs (SE and JDK) and sent to the survivors and/or their representatives explained the study purpose, the intended interview, the process of informed consent and introduced the investigator who would later conduct the interviews (GP). Three to six months after sending two rounds of letters, the interviewer contacted the survivors and/or their representatives in order to obtain the signed informed consent and coordinate a face-to-face interview. The interview was conducted by telephone if specifically requested by the patient or his/her representative.

2.5. Data collection

The data collected for all survivors to hospital admission included demographic details (e.g. age, sex), the details of the index event (e.g. witnessed status, arrival time, presenting rhythm) and the details of the index admission (e.g. length of stay, length of stay in intensive care, treatment with therapeutic hypothermia). For patients who survived to hospital discharge, we also collected data regarding their previous medical history.

2.6. Interviews and measurement instruments

We aimed to conduct interviews at 2.5 years after hospital discharge. Interviews were conducted by a single investigator (GP) in either Hebrew or English. A family member was used as a translator in a single instance when required for Amhari. Although we had planned similar translation for Russian and Arabic speakers, this proved unnecessary. Patients were assessed for their Activities of Daily Living (ADL) and Cerebral Performance Category (CPC) scores. The ADL score reflects the functional level of independence during performance of tasks related to personal care (i.e. mobility, toileting, eating and dressing). The score ranges from 0 (fully independent) to 12 (fully dependent).[21] The CPC score is a measure of neurological impairment ranging from 1 (good cerebral performance) to 5 (brain death).[22] Both scores were assessed at four points in time as following: pre-admission through medical records and patient recall, at hospital discharge through real time clinical assessment, at one year post-hospital discharge through