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Clinical paper

Termination of resuscitation in the prehospital setting: A comparison of decisions in clinical practice vs. recommendations of a termination rule☆

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ABSTRACT

Background: Of the proposed algorithms that provide guidance for in-field termination of resuscitation (TOR) decisions, the guidelines for cardiopulmonary resuscitation (CPR) refer to the basic and advanced life support (ALS)-TOR rules. To assess the potential consequences of implementation of the ALS-TOR rule, we performed a case-by-case evaluation of our in-field termination decisions and assessed the corresponding recommendations of the ALS-TOR rule.
Methods: Cohort of non-traumatic out-of-hospital cardiac arrest (OHCA)-patients who were resuscitated by the ALS-practising emergency medical service (EMS) in the Nijmegen area (2008–2011). The ALS-TOR rule recommends termination in case all following criteria are met: unwitnessed arrest, no bystander CPR, no shock delivery, no return of spontaneous circulation (ROSC).
Results: Of the 598 cases reviewed, resuscitative efforts were terminated in the field in 46% and 15% survived to discharge. The ALS-TOR rule would have recommended in-field termination in only 6% of patients, due to high percentages of witnessed arrests (73%) and bystander CPR (54%). In current practice, absence of ROSC was the most important determinant of termination [aOR 35.6 (95% CI 18.3–69.3)]. Weaker associations were found for: unwitnessed and non-public arrests, non-shockable initial rhythms and longer EMS-response times.
Conclusion: While designed to optimise hospital transportations, application of the ALS-TOR rule would almost double our hospital transportation rate to over 90% of OHCA-cases due to the favourable arrest circumstances in our region. Prior to implementation of the ALS-TOR rule, local evaluation of the potential consequences for the efficiency of triage is to be recommended and initiatives to improve field-triage for ALS-based EMS-systems are eagerly awaited.

Introduction

Out-of-hospital cardiac arrests (OHCAs) occur frequently and carry a rather poor prognosis, with survival to hospital discharge ranging between 5% and 20%.[1] In patients in whom the chance of survival is deemed negligible, it may be considered to terminate resuscitation efforts in the field.

Based on data from observational studies, ongoing asystole for more than 20 min despite advanced life support (ALS) has long been a generally accepted ground for abandoning a resuscitation attempt.[2,3] More recently, easily applicable termination of resuscitation (TOR) rules have been created which recommend in-field termination or hospital transportation based on established prognosticators.[4–6] The currently available algorithms seem to perform well; in multiple validation studies the chance of survival to discharge was lower than 1% in case of a termination recommendation. Moreover, these studies indicate that triage based on TOR rules leads to a more efficient transportation rate of 40–70% of all OHCA-cases.[7–16]

Despite the available guidance, which is also referenced in the guidelines for cardiopulmonary resuscitation (CPR), there is large variability in termination strategies in daily practice, with in-field

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termination rates varying from 0 to about 50%.[9,17–22] A possible explanation may be that TOR decisions are not only driven by the current evidence, but also by local legislation, infrastructure and practices.[23] Moreover, the efficiency of a TOR rule to reduce hospital transportations may vary depending on pre-existing transportation rates as well as on regional differences in arrest circumstances of OHCA-cases.

To gain insight into the potential consequences of the implementation of a TOR rule in our region, we studied in-field termination decisions in daily practice and assessed how this figure relates to the recommendations of the advanced life support (ALS)-TOR rule.

Methods

Patient population

We performed a retrospective study of all consecutive patients with an OHCA who were resuscitated by the emergency medical services (EMS) in the Nijmegen area (Gelderland-Zuid, The Netherlands) between April 2008 and January 2011. Exclusion criteria were age <18 years, traumatic arrests (including hanging and drowning) and prematurely discontinued resuscitations (due to 'do not resuscitate' order or terminal illness). All consecutive OHCA-cases were included regardless of participation in other registries or trials, as these did not alter the local in-field termination policy.[24,25] Given the observational design, for the present study written informed consent was not necessary to obtain according to the Dutch Act on Medical Research involving Human Subjects.

Emergency medical services

Gelderland-Zuid has a population of about 530,000 residents and covers 1040 square kilometres, including urban, suburban and rural areas. The EMS-system is activated by calling 112. Paramedics will give instructions to the caller to initiate basic life support (BLS), and at least one, but usually two ambulances are dispatched to the location of the emergency. In some cases, police or firemen may be dispatched to initiate BLS, including automatic external defibrillator (AED) use, before ambulance arrival. Ambulances are staffed by a driver and a paramedic, who are professionally trained to perform ALS. Resuscitation was started in all OHCA-cases, unless there were valid advanced directives to the contrary (e.g. valid 'do not resuscitate' order) or signs of irreversible death.[3] During the study period, a mechanical chest compression device (Autopulse®) was part of the standard EMS-equipment, but not routinely used. Since 2011, a more liberal approach was agreed upon with early transportation of patients with persistent shockable rhythms with ongoing mechanical CPR to enable invasive interventions.[26] CPR delivery was performed according to the guidelines of the European Resuscitation Council of 2005.[27]

Termination of resuscitation

The actual termination strategy was based on recommendations of the CPR guidelines 2005, which state that a resuscitation attempt may be abandoned in case of ongoing asystole for more than 20 min in the absence of a reversible cause and with all ALS measures in place.[3] In practice, the EMS often consults the general practitioner before a decision to terminate is made.

Of the available TOR algorithms, we decided to use and study the recommendations of the ALS-TOR rule, as in our EMS-system ALS is performed in the prehospital setting.[5,6] According to this rule, in-field TOR may be considered incase *all* following criteria are met: unwitnessed arrest, no bystander CPR, no shock delivery and no return of spontaneous circulation (ROSC) before transportation.[5]

Data collection

Baseline characteristics were collected using EMS and hospital records. Demographics, arrest circumstances (i.e. location of the arrest, the presence of a witness and bystander CPR) and other baseline characteristics were manually retrieved. Variables were defined according to the Utstein style definitions, with the exception of sustained ROSC, which was defined as ROSC followed by hospital transport.[28] Survival to discharge was collected using hospital records and information from family physicians.

Outcome measure and aim of the study

The primary outcome measure was in-field termination of resuscitation. The termination rate in daily practice was determined as well as the expected termination rate based on recommendations of the ALS-TOR rule. In addition, we determined which baseline characteristics were independently associated with in-field termination in daily practice.

Statistical analysis

Statistical analyses were performed using IBM SPSS Statistics software (version 20.0, IBM Corp., Armonk, NY, USA). Categorical variables were expressed as numbers (percentages) and analysed using the Pearson Chi-square test or Fisher's exact test, whichever appropriate. In case of missing data, we used the numbers of patients with available data as denominators to calculate percentages as depicted in the Tables. Continuous data are expressed as means ± standard deviations or medians with interquartile ranges (IQR) and compared with the Student's *t*-test or Mann–Whitney *U* test, whichever appropriate. A *p*-value of <0.05 was considered statistically significant.

The sensitivity, specificity, positive and negative predictive values of the ALS-TOR rule for identifying patients who likely will not survive to hospital discharge were calculated. The agreement between the recommendations of the ALS-TOR rule and the actual EMS decisions was assessed by calculating the kappa coefficient, with the 95% confidence interval. Multivariate binary logistic regression analysis was performed to study independent associations between baseline variables and a decision to terminate. All baseline variables (excluding medication) that differed significantly ($p < 0.1$) between the groups were studied in the multivariate model. Nagelkerke's *R*-squares were calculated to examine the fit of the model at each step. Analyses were performed for the entire cohort as well as for the subset without field ROSC.

Results

Patient population

A total of 598 patients were studied (Fig. 1). The mean age was 66 years ± 13 and 69% was male. In total, 73% of the arrests were witnessed, either by bystanders or the EMS. Bystander CPR was delivered in 54% of the patients in whom the arrests were not EMS-witnessed. The median ambulance response time was 8 min (IQR 6–12). The first observed cardiac rhythm was shockable in 47% of patients. A total of 61% of patients received at least one shock (AED and/or EMS shocks). Any form of (advanced) airway management was reported in 84% of patients. Sustained ROSC was achieved in 37% of patients. Follow-up until discharge was available for 96%,