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Clinical paper

A comparison of the universal TOR Guideline to the absence of prehospital ROSC and duration of resuscitation in predicting futility from out-of-hospital cardiac arrest☆

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ABSTRACT

Introduction: The Universal Termination of Resuscitation (TOR) Guideline accurately identifies potential out-of-hospital cardiac arrest (OHCA) survivors. However, implementation is inconsistent with some Emergency Medical Service (EMS) agencies using absence of return of spontaneous circulation (ROSC) as sole criterion for termination.
Objective: To compare the performance of the Universal TOR Guideline with the single criterion of no prehospital ROSC. Second, to determine factors associated with survival for patients transported without a ROSC. Lastly, to compare the impact of time to ROSC as a marker of futility to the Universal TOR Guideline.
Design: Retrospective, observational cohort study.
Participants: Non-traumatic, adult (≥18 years) OHCA patients of presumed cardiac etiology treated by EMS providers.
Setting: ROC-PRIMED and ROC-Epistry post ROC-PRIMED databases between 2007 and 2011.
Outcomes: Primary outcome was survival to hospital discharge and the secondary outcome was functional survival. We used multivariable regression to evaluate factors associated with survival in patients transported without a ROSC.
Results: 36,543 treated OHCAs occurred of which 9467 (26%) were transported to hospital without a ROSC. Patients transported without a ROSC who met the Universal TOR Guideline for transport had a survival of 3.0% (95% CI 2.5–3.4%) compared to 0.7% (95% CI 0.4–0.9%) in patients who met the Universal TOR Guideline for termination. The Universal TOR Guideline identified 99% of survivors requiring continued

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resuscitation and transportation to hospital including early identification of survivors who sustained a ROSC after extended durations of CPR.
Conclusion: Using absence of ROSC as a sole predictor of futility misses potential survivors. The Universal TOR Guideline remains a strong predictor of survival.

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Introduction

Over 400,000 out-of-hospital cardiac arrests (OHCA) occur annually in Canada and the United States[1,2] yet less than 10% of patients survive to hospital discharge.[1] Consequently, Emergency Medical Services (EMS) inherently transport a significant proportion of patients to hospital that ultimately do not survive.

The Termination of Resuscitation (TOR) Guideline was originally derived in 2002 to guide basic life support (BLS) prehospital providers in determination of patients in whom continued resuscitation and transport to hospital would be futile.[3] Since then, the BLS TOR Guideline has been prospectively and externally validated in a number of studies using both basic and advanced life support providers and is now referred to as the Universal TOR Guideline.[4–6] The Universal TOR Guideline states that resuscitation can be discontinued in the field by prehospital providers if the following three criteria are met: (1) the cardiac arrest was not witnessed by EMS providers; (2) the patient did not obtain a return of spontaneous circulation (ROSC) despite attempted resuscitation; and (3) no shocks were delivered (i.e. not a shockable rhythm) at any time prior to transport.[7] Prospective validation of the Universal TOR Guideline displayed a specificity of 100% (95% CI; 99.8–100%) and positive predictive value of 100% (95% CI; 99.8–100%) for predicting futility, while reducing the transport rate to 46% of attempted resuscitations by EMS.[4]

The 2010 and 2015 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care and the National Association of EMS Physicians both support the use of validated TOR Guidelines,[7–9] however, implementation into EMS practice has been slow and inconsistent.[10,11] Many EMS systems continue to employ non-validated measures such as the absence of a prehospital ROSC alone or a predefined duration of CPR to stop resuscitation in the field. Reliance on these un-tested measures to predict futility risks premature termination of resuscitation in patients who could potentially survive.

We hypothesized that the Universal TOR Guideline is more accurate than use of ROSC or duration of resuscitation to predict futility from OHCA.

The objectives of this study were: (1) Compare survival rate of patients who were transported to hospital despite meeting the Universal Termination of Resuscitation Guideline recommended prehospital termination of resuscitation with the single criterion of no prehospital ROSC; (2) Determine patient characteristics, prehospital and in-hospital factors associated with survival for patients who were transported without a prehospital ROSC; (3) Determine the association between the duration of cardiac arrest, ROSC, the Universal TOR Guideline recommendation to transport and patient survival.

Methods

Study design and setting

This was a retrospective observational cohort study of the Resuscitation Outcomes Consortium (ROC) Prehospital Resuscitation using an IMpedence valve and Early vs. Delayed analysis (ROC PRIMED) and the ROC Epistry-Cardiac Arrest databases, whose methods have been described in detail in previous studies.[12–14] Briefly, the two databases consist of data collected from 10 participating regions, including 7 sites in the U.S. (Birmingham, AL; Dallas/Fort Worth TX; Milwaukee, WI; Pittsburgh, PA; Portland, OR; San Diego, CA; and Seattle/King County, WA) and 3 sites in Canada (Toronto, ON; Ottawa, ON; British Columbia). The EMS agencies involved in each ROC site vary and have been described previously.[15,16] Institutional Review Boards (Research Ethics Boards in Canada) at all 10 ROC sites granted ethics approval for retrospective analyses from the ROC database and waived the requirement for informed consent.

Study population

We focused our analysis on consecutive adult (≥18 years) OHCA patients in whom the cause of cardiac arrest was not of obvious non-cardiac cause, and therefore presumed to be of cardiac etiology that were treated and/or transported by EMS. Arrests of known non-cardiac etiology (i.e. trauma, submersion, drug overdose, asphyxia etc) were excluded. Cases were identified from the ROC PRIMED database between June 1, 2007 and November 6, 2009 and the ROC Epistry database from November 7, 2009 to December 31, 2011

We also defined a subset of subjects with OHCA during the ROC PRIMED trial that had functional outcome data at hospital discharge.

Outcome measures and study definitions

The primary outcome was survival to hospital discharge. The secondary outcome was functional survival at hospital discharge as determined by Modified Rankin Scale (mRS) or Cerebral Performance Category (CPC) score.[17] We defined good functional survival as mRS ≤3 or CPC score of 1 or 2.[17,18]

We defined ROSC in this study as the presence of a pulse as detected by EMS. The Universal TOR Guideline was defined in concordance with previous published literature.[4,7] Patients who met the following three criteria: (1) cardiac arrest was not witnessed by EMS; and (2) no ROSC at any time despite attempted resuscitation; and (3) no shocks were delivered (no shockable rhythm) at any time, met the Universal TOR Guideline for prehospital termination of resuscitation. Otherwise, if patients did not meet all three criteria they met the Universal TOR Guideline for transport to hospital.

Analysis

We calculated descriptive statistics on the study population, stratified by whether the patient met the Universal TOR Guideline criteria for termination of resuscitation in the field and whether they were transported to the ED. Continuous variables were summarized using means and standard deviations, while categorical measures were measured using counts and percentages. Differences between transported/not transported groups were noted as possible selection bias from participating agencies and were adjusted for in our logistic regression analysis.

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