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Comparison of Helsinki and European Resuscitation Council "do not attempt to resuscitate" guidelines, and a termination of resuscitation clinical prediction rule for out-of-hospital cardiac arrest patients found in asystole or pulseless electrical activity☆

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ABSTRACT

Background: The outcome of out-of-hospital cardiac arrest (OHCA) with a non-shockable rhythm is poor.

For patients found in asystole or pulseless electrical activity (PEA), recent guidelines or rules that may be used include "do not attempt to resuscitate" (DNAR) guidelines from Helsinki, discontinuing resuscitation in the guidelines of the European Resuscitation Council and a clinical prediction rule from Canada. We compared these guidelines and the rule using a large Scandinavian dataset.

Materials and methods: The Swedish Cardiac Arrest Registry includes prospectively collected data on 44 121 OHCA patients. We identified patients with asystole or PEA as the initial rhythm and excluded cases caused by trauma or drowning. The specificities and positive predictive values (PPVs) were calculated for the guidelines, and the clinical prediction rule for comparison.

Results: A total of 20 484 patients with non-shockable rhythms were identified; 85% had asystole and 15% PEA. The overall survival to hospital admission was 9% ($n = 1.861$) and 1% ($n = 231$) were alive at 1 month from the arrest. The specificity of the Helsinki guidelines in identifying non-survivors was 71% (95% confidence interval (CI): 65–77%) and the PPV was 99.4% (95% CI: 99.3–99.5), while the corresponding values for the European Resuscitation Council (ERC) was 95% (95% CI: 91.3–97.5) and 99.9% (95% CI: 99.9–99.9) and, for the prediction rule, 99.1% (95% CI: 96.7–99.9) and 99.9% (95% CI: 99.9–100.00), respectively.

Conclusion: In this comparison study, the Helsinki DNAR guidelines did not perform well enough in a general OHCA material to be widely adopted. The main reason for this was the unpredicted survival of patients with unwitnessed asystole. The clinical prediction rule and the recommendations of the ERC Guidelines worked well.

Outcome after out-of-hospital cardiac arrest (OHCA) with a non-shockable initial rhythm such as asystole or pulseless electrical activity (PEA) is poor and the hospital mortality of those patients who achieved return of spontaneous circulation was high.[1,2] A clinical prediction rule and "do not attempt to resuscitate" (DNAR) guidelines have been developed in order to identify patients with a low chance of survival where resuscitation should not be commenced or when it can be stopped.[3–6] Most of these guidelines focus on emergency medical service (EMS) systems capable of basic life support (BLS).[3,4] Recently, a clinical prediction rule focussing on EMS systems capable of advance life support (ALS) was developed and validated.[5] Termination of resuscitation (TOR) or DNAR guidelines may also be an aid to clinicians in identifying patients who, despite achieving return of spontaneous circulation (ROSC), will have a very low chance of survival to hospital discharge with good neurological recovery.

The current guidelines of the European Resuscitation Council (ERC) suggest that, for OHCA with ongoing asystole, resuscitation

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attempts can be stopped following 20 min of ALS.[7] The guidelines did not specify limits for continuing resuscitation in PEA. Helsinki DNAR guidelines for identifying patients with no chance of survival to hospital discharge or survival with considerable neurological injury following OHCA and patients with asystole or pulseless electrical activity have been published.[8,9] They were created based on prospectively collected cardiac arrest data from a physician-staffed EMS system over a 10-year period.

The focus of the TOR clinical prediction rule by Morrison et al. is to identify patients with a low chance of survival in order to avoid transportation of patients to hospital with ongoing cardiopulmonary resuscitation (CPR).[3] Transporting patients with ongoing CPR is associated with a low chance of survival, poor neurological outcomes and hazards to the EMS crew and public.[10] Physician-led EMS systems in Scandinavia, in general, terminate unsuccessful resuscitation in the field and refrain from transporting patients with ongoing CPR with the exception of patients who have hypothermia, drowning or penetrating trauma.[11] However, physician-staffed systems are not available in all areas.[11]

In order to examine whether these guidelines from Helsinki, the clinical prediction rule of Morrison et al. and the ERC guideline are suitable for wider implementation including arrests of a non-cardiac origin, we sought to validate these in a large cardiac arrest database.

1. Materials and methods

1.1. The Helsinki "do not attempt to resuscitate" guidelines

The Helsinki DNAR guidelines were developed from prospectively collected OHCA data from Helsinki, Finland. In two previous papers with data from the Helsinki OHCA registry over a 10-year period, patients were identified with good outcomes following OHCA with asystole or PEA.[8,9] Good outcome was defined as surviving to hospital discharge with either a cerebral performance category (CPC) scale of 1 or 2. Based on this, we developed DNAR guidelines, that is, we defined patients with no chance of good neurological outcome based on whether the arrest was witnessed, time delay to arrival of ambulance and time delay to ROSC. The DNAR guidelines also includes situations when resuscitation can be stopped after being initiated so the guidelines are combined DNAR and termination of resuscitation guidelines but, for the sake of clarity, they are referred to as DNAR guidelines. The DNAR guidelines suggest that there is no chance of survival to hospital discharge with CPC of 1 or 2 in the following situations:

(1) In asystole if the arrest is unwitnessed or if the delay to arrival of the ambulance exceeds 10 min from call or if ROSC cannot be achieved despite 20 min of ALS.
(2) In witnessed PEA if the delay to arrival of the ambulance exceeds 15 min from call or if ROSC cannot be achieved within 20 min of ALS and in un-witnessed PEA arrests if ROSC cannot be achieved within 10 min of ALS.

Bystander-initiated life support did not impact on outcome according to the data generating the DNAR guidelines and was, therefore, not included. The guidelines also exclude cases in which the patient is found with hypothermia, if the reason for the cardiac arrest is drowning or penetrating trauma.

The clinical prediction rule developed by Morrison et al. is based on five criteria, all of which have to be met before resuscitation can be terminated. The criteria are:

1. The arrest was not witnessed by the EMS.
2. No shock was delivered.
3. No return of spontaneous circulation at any point during the resuscitation.
4. No bystander-initiated CPR.
5. Not witnessed by bystander.

If any of the criteria are not met then the patient is to be transported with ongoing CPR to the hospital. The Morrison rule was validated for patients with an assumed cardiac cause of the arrest. In the present study, we separately examined the applicability of the rule in all patients and in those with an assumed cardiac cause of the arrest.

The current resuscitation guidelines by the ERC recommend that, in cases of non-shockable rhythm, resuscitation can be ceased in cases of ongoing asystole despite 20 min of ALS.[7]

1.2. Study population

The Swedish Cardiac Arrest registry was founded in 1990 and is a joint venture between the Federation of Leaders in Swedish Ambulance and Emergency Medical Services and the Swedish Council on Cardiopulmonary Resuscitation. The registry includes prospectively collected data on OHCAs covering ~70% of the OHCAs occurring in Sweden. Each year, ~3000 OHCAs are reported to the registry. Ethics approval for keeping, maintaining and using the registry for scientific purposes has been obtained. In case of an OHCA, the ambulance crew completes a form with information regarding the arrest. The collected data include age, location of the arrest, probable cause and data on management including time delays. Time delays are calculated from call to the dispatch centre. Bystander CPR is defined as CPR performed prior to arrival of the ambulance. The initial rhythm is defined as ventricular fibrillation (VF), ventricular tachycardia (VT), PEA or asystole. Several previous studies from Swedish Cardiac Arrest Registry have been published.

Most ambulance systems are staffed with nurses or paramedics and Emergency Medical Technicians without the presence of an onsite prehospital physician. In general, resuscitation attempts can be abandoned only in cases of ongoing asystole despite 30 min of CPR and, in other instances, the patient is transported with ongoing resuscitation.

1.3. Study cohort

For comparison, we developed a cohort excluding patients with an EMS-witnessed arrest, patients with VF or VT as the initial rhythm, patients in whom the initial rhythm was defined as non-shockable but not specified as either asystole or PEA and patients with drowning or trauma as the cause of the arrest.

1.4. Outcome measure

The studied outcome was any survival at 1 month from the arrest because the registry does not include data on neurological recovery. For the present study, it was decided that in patients who survived despite being defined as not having a chance of survival according to the DNAR guidelines, long-term outcome, neurological recovery and circumstance surrounding the arrest were to be identified from hospital notes. It was decided prior to the study that if any of the survivors were found to have had accidental hypothermia they were to be excluded from the analysis. The cerebral performance category scale was used to retrospectively assess, from hospital charts, the neurological outcome in patients who survived even though the guidelines recommended stopping.[12] The CPC scale is defined as follows: 1 = good cerebral performance (conscious, alert, able to work and to lead a normal life), 2 = moderate cerebral disability (conscious and able to function independently – dress, travel