

RESOURCE DOCUMENTS TO THE NAEMSP POSITION STATEMENTS

TERMINATION OF RESUSCITATION OF NONTRAUMATIC CARDIOPULMONARY ARREST: RESOURCE DOCUMENT FOR THE NATIONAL ASSOCIATION OF EMS PHYSICIANS POSITION STATEMENT

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ABSTRACT

In the development of an emergency medical services (EMS) system, medical directors should consider the implementation of protocols for the termination of resuscitation (TOR) of nontraumatic cardiopulmonary arrest. Such protocols have the potential to decrease unnecessary use of warning lights and sirens and save valuable public health resources. Termination-of-resuscitation protocols for nontraumatic cardiopulmonary arrest should be based on the determination that an EMS provider did not witness the arrest, there is no shockable rhythm identified, and there is no return of spontaneous circulation (ROSC) prior to EMS transport. Further research is needed to determine the need for direct medical oversight in TOR protocols and the duration of resuscitation prior to EMS providers' determining that ROSC will not be achieved. This paper is the resource document to the National Association of EMS Physicians position statement on the termination of resuscitation for nontraumatic cardiopul-

monary arrest. **Key words:** termination; resuscitation; cardiopulmonary arrest; EMS.

PREHOSPITAL EMERGENCY CARE 2011;15:547-554

INTRODUCTION

In the development of an emergency medical services (EMS) system, administrators and medical directors should consider the utility of a protocol for termination of resuscitation (TOR) of nontraumatic cardiopulmonary arrest. Approximately 325,000 sudden cardiopulmonary arrests occur every year in the United States, with EMS treating approximately 77,000 to 174,000 of these patients.^{1,2} Since the median reported survival to discharge from any recorded rhythm from cardiopulmonary arrest is 6.4%,¹ it is reasonable to assume that there is a percentage of cardiopulmonary arrests that occur in the out-of-hospital environment that will not be successfully resuscitated, although the exact percentage is not known. Regardless, as there are patients who will not be successfully resuscitated, an evidence-based methodology to determine those patients with out-of-hospital nontraumatic cardiopulmonary arrest that will not result in a favorable outcome would contribute to the public health by conserving valuable health care resources and decreasing the number of emergency vehicles in transit with warning lights and sirens.

In 2000, the National Association of EMS Physicians (NAEMSP) published a position paper on the TOR of patients in nontraumatic cardiopulmonary arrest.³ The NAEMSP position has become the basis for many protocols for EMS system development and further research on the topic of TOR. While this paper has provided guidance to the scientific community, there has been an evolution of TOR science since the original

Received April 15, 2011, from the Department of Emergency Medicine (MGM, SRK), Johns Hopkins University School of Medicine, Baltimore, Maryland; and the Post-Baccalaureate Pre-Med Program (AM), Johns Hopkins University, Baltimore, Maryland. From the Standards and Clinical Practice Committee of the National Association of EMS Physicians, Olathe, Kansas. Revision received July 19, 2011; accepted for publication July 25, 2011

The position statement based on this resource document appears in this issue on page 542.

The authors report no conflicts of interest.

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doi: 10.3109/10903127.2011.608872

publication of the position paper. In addition, it is also clear that for a number of reasons, EMS systems have not been fully supportive of the implementation of TOR protocols. This resource document supports the new NAEMSP position statement on TOR in nontraumatic cardiopulmonary arrest,⁴ considering new literature and population-based data. Further, the simplicity of this position, compared with the previous position, should help to facilitate implementation of TOR protocols.

AMBULANCE TRANSPORT IN RESUSCITATION CASES

In the development of TOR protocols, it is important to consider the implications of emergency response with lights and sirens for a patient who is in cardiopulmonary arrest. In an analysis of the National Highway Traffic Safety Administration's Fatality Analysis Reporting System (FARS), Kahn et al. showed that the majority of ambulance crashes occurred during emergency use (59.6%), and most crashes result in at least one fatality outside of the ambulance (78%).⁵ Similarly, in a study of ambulance crashes in San Francisco, Saunders and Heye showed a rate of ambulance crashes with lights and sirens (LS) vs. crashes without lights and sirens (non-LS) to be 45.9 crashes per 100,000 LS patient travels vs. 27.0 crashes per 100,000 non-LS patient travels, and the rate of injury to be 22.2 injuries per 100,000 LS patient travels vs. 1.5 injuries per 100,000 non-LS patient travels.⁶ Other authors have shown increasing rates of serious or incapacitating injuries during emergency use and that crashes are more likely at intersections and traffic signals.⁷⁻¹⁰

Collectively, these studies demonstrate that there is a risk to the public health and emergency personnel when transporting a patient in an ambulance with lights and sirens. Furthermore, it has been demonstrated that warning lights and sirens do not have a clinically significant effect on the time it takes to get a critical patient to definitive care at a hospital.¹¹⁻¹⁴ A compelling argument for the need for TOR protocols is to minimize the use of emergency response for a patient who has extremely limited to no chance of survival.

In addition to the risk of a crash during transport with lights and sirens, there is preliminary evidence suggesting that cardiac compressions are less effective during ambulance transport than they are on scene.^{15,16} The 2010 American Heart Association (AHA) guidelines emphasize the importance of high-quality, minimally interrupted compressions.¹⁷ Thus, TOR protocols that emphasize on-scene resuscitation may not only mitigate the risk of an ambulance crash, but also improve the probability of successful resuscitation by avoiding interruptions in compressions.

COST

Another consideration in the development of TOR protocols is the cost of resuscitation for a patient in cardiopulmonary arrest. In a rudimentary analysis of the costs of running an in-hospital cardiopulmonary resuscitation program in a 576-bed community hospital, Vrtis notes a total cost for running the program over a 21-month period of \$2.4 million for 432 resuscitation attempts and an initial survival rate of 46.1%.¹⁸ Valenzuela et al. report the cost of managing an out-of-hospital cardiopulmonary arrest in Tucson, Arizona, to be \$118,939 per life saved and \$8,886 per year of life saved, when taking into account the following variables in calculating the cost of resuscitation: personnel, training, response time, and equipment.¹⁹ However, as reported by Lee et al., because of the variability in the literature with regard to calculating costs of resuscitation, it is difficult to report total aggregate costs of cardiopulmonary resuscitation,²⁰ and as such it is difficult to generalize these costs across EMS systems. Nevertheless, there is a cost to an unsuccessful resuscitation such that in consideration of scarce health care resources, these costs should be taken into account when determining the value of a TOR protocol.

EMS SYSTEMS FOLLOWING TERMINATION-OF-RESUSCITATION GUIDELINES

Despite the NAEMSP guideline, some EMS systems have been hesitant to implement TOR protocols. In a study of cardiopulmonary arrest patients brought to hospitals of the Yale Health System in Connecticut, O'Brien et al. showed that 54% of patients transported to the emergency department (ED) for nontraumatic cardiopulmonary arrest met the NAEMSP criteria for TOR and all were pronounced dead in the ED.²¹ In an analysis of the implementation of TOR protocols for traumatic cardiopulmonary arrest, a survey of 33 urban EMS medical directors demonstrated that, despite the NAEMSP/American College of Surgeons Committee on Trauma (ACS-COT) recommendations,²² 21% would transport a patient in asystole from blunt trauma and 46% would transport a patient in asystole from penetrating trauma.²³ Despite evidence demonstrating the low likelihood of a successful suit for wrongful death,²⁴ in a random survey of 928 emergency physicians, 92% of the respondents cited fear of litigation as a reason for continuing resuscitation in futile cardiopulmonary arrest.²⁵

There are likely many reasons that EMS systems are hesitant to implement TOR protocols. Results from focus groups at the NAEMSP annual meeting demonstrated three groups whose policies have created barriers to implementation of TOR protocols:

payers that incentivize transport, legislators that mandate prehospital resuscitation, and community expectations that EMS will transport for resuscitation.²⁶ In addition, within the EMS community, the prevalent “rescue culture” of EMS providers and concerns about liability have also been barriers to implementation of TOR protocols.²⁶ In a study on barriers to removing pediatric intubation from an EMS system, Youngquist et al. found that the most common reasons for barriers to change were a feeling that “... more evidence is needed” and a cultural belief that “... results do not apply to [one’s] EMS system.”²⁷ However, despite these cultural norms, a cross-sectional study of members of the National Association of Emergency Medical Technicians indicated that they would withhold resuscitation in futile situations. While most respondents reported having local EMS guidelines for TOR, 23% considered the guidelines to be inadequate, suggesting that standardization through national evidence-based TOR guidelines may be viewed more favorably.²⁵ Therefore, it is possible that the challenges with understanding current national guidelines and the presence of cultural norms have also prohibited the widespread adoption of TOR guidelines. Development of a more simplified protocol may be of more utility for EMS system medical directors and providers.

After a policy change was enacted in Los Angeles County allowing paramedics to forgo resuscitation if the family provided verbal consent or if the patient showed signs of poor outcome (asystole or at least 10 minutes between collapse and cardiopulmonary resuscitation [CPR]), it was found that paramedics were significantly more likely (odds ratio [OR] 1.67, $p = 0.024$) to withhold resuscitation and less likely to attempt resuscitation than they had been prior to the protocol change.²⁸ Moreover, when surveyed, the paramedics unanimously felt that the policy empowered their decision-making abilities and thought that the benefits to patients, family, EMS, and the public outweighed the risks and improved care.²⁹ The findings of this study are mirrored by a study by Ponce et al. showing that a short educational program on death notification was able to positively impact communication between EMS providers and the patient’s family in the setting of an unsuccessful resuscitation attempt.³⁰ Furthermore, Morrison et al. demonstrated that EMS providers are able to correctly apply TOR protocols with a comfort level exceeding 70%; providers were more comfortable in the application of TOR protocols when more than one provider at the scene was able to correctly apply the protocol.³¹

COMFORT OF FAMILY WITH TERMINATION OF RESUSCITATION

Regarding the acceptance of TOR by family members of patients in cardiopulmonary arrest, a number of

studies have demonstrated that families do accept the practice. In a study comparing cardiopulmonary arrest cases with a do-not-resuscitate (DNR) order with cases with irreversible death (defined by the presence of lividity or rigor mortis) in which EMS providers withheld resuscitation, in the greater majority of the cases the family had called EMS because they did not know what to do, and in 30% of the cases the family had expected death, as per observation of the emergency medical technician (EMT).³² Delbridge et al. published a prospective study of the families of patients in non-traumatic cardiopulmonary arrest showing that 24 of 25 (96%) family members studied were satisfied with the decision for TOR in the field.³³ In a phone interview study by Schmidt and Harrahill for patients who had TOR in the field, no family members believed that the patient should have been transported and most felt that the EMS provider had informed the family in a professional (81%) and gentle (74%) manner.³⁴ Therefore, the available literature demonstrates that in the setting of nontraumatic cardiopulmonary arrest, EMS providers are able to perform TOR in the field and the majority of the family members of the deceased patients also support TOR by EMS providers.

CONDITIONS FOR TERMINATION OF RESUSCITATION

Review of the EMS literature makes it evident that there has been extensive analysis of various factors as criteria to determine TOR in nontraumatic cardiopulmonary arrest in the out-of-hospital setting. Aprahamian et al. examined 445 cases of out-of-hospital cardiopulmonary arrest and determined that resuscitation should not be initiated in patients with an unwitnessed arrest greater than 15 minutes prior to EMS arrival and an initial rhythm of asystole.³⁵ They also recommended TOR at the discretion of an online physician when an initial rhythm terminates to asystole, especially if the arrest was unwitnessed and the onset of symptoms to the time of initiation of emergency cardiac care was greater than 15 minutes. Although the paper does not clearly define “onset of symptoms,” this likely refers to the onset of cardiopulmonary arrest.

Based on the work of Aprahamian et al., Marsden et al. created a set of TOR criteria: 1) greater than 15 minutes from onset of arrest to arrival of EMS providers; 2) no bystander CPR; and 3) no pulse or breathing on arrival of EMS providers. On retrospective review of 414 patients from the Scottish Ambulance Service database, there was one survivor who experienced arrest 15 minutes prior to ambulance arrival and had a shockable rhythm. There were no survivors among the 240 patients who did not have a shockable rhythm. Based on their results, Marsden et al. developed an

algorithm for EMS providers in determining patients who were safe for TOR: 1) no shockable rhythm; 2) no evidence of CPR in the past 15 minutes; 3) no evidence of drowning, hypothermia, poisoning or overdose, age <18 years, or pregnancy; 4) no return of spontaneous circulation (ROSC) after 1 minute of CPR; and 5) asystole for 10 seconds.³⁶

Kellermann et al. conducted a prospective, multi-hospital study of 1,068 patients in the Memphis EMS system. Their single most important variable in predicting nonsurvival was failure to achieve ROSC prior to EMS transport (99.6% negative predictive value).³⁷ Bonnin et al. derived a distinct set of TOR criteria from a prospective examination of 1,461 patients in Houston, Texas: 1) adult cardiopulmonary arrest (not associated with trauma, body temperature aberration, respiratory etiology, or drug overdose); 2) standard Advanced Cardiac Life Support (ACLS) for 25 minutes; 3) no ROSC for at least one 5-minute period; and 4) absence of persistently recurring or refractory ventricular fibrillation (VF)/ventricular tachycardia (VT) or any continued neurologic activity (spontaneous respiration, eye opening, or motor response).³⁸

The 2000 NAEMSP position statement on TOR in nontraumatic cardiopulmonary arrest recommended that TOR in the prehospital setting be considered after a requisite "full resuscitative effort" is made, including 1) definitive airway management; 2) intravenous access; 3) defibrillation/cardioversion if necessary; 4) CPR; and 5) 20–30 minutes of treatment following ACLS guidelines and/or local protocols.³ Cone et al. validated this recommendation with both prospective and retrospective data from two northeast academic medical centers, demonstrating a specificity and positive predictive value of 100% for predicting death.³⁹

Verbeek et al. derived an out-of-hospital TOR guideline for EMTs equipped with automated external defibrillators (EMT-Ds). Their criteria for the consideration of TOR following EMT-D resuscitation attempts were as follows: 1) arrest was not witnessed by EMS personnel; 2) no shock was delivered; and 3) there was no ROSC prior to ambulance transport. The Verbeek criteria have been retrospectively applied to the study population, demonstrating a sensitivity of 100% for identifying survivors and a negative predictive value of 100% for identifying nonsurvivors.⁴⁰

The Verbeek TOR guideline, now commonly referred to as the "BLS [basic life support] TOR rule," has been examined by several prospective validation studies. Morrison et al. applied the clinical prediction rule to a study population in 12 urban and rural regions in Canada and demonstrated a positive predictive value of 99.5% for death and a specificity of 90.2% for recommending transport of survivors.⁴¹ Sasson et al. performed a prospective evaluation of the BLS TOR rule using data from eight U.S. cities that submitted data to the Cardiac Arrest Registry to Enhance Survival (CARES) network and found a positive predictive

value of 99.8% and a specificity of 98.7%.⁴² Richman et al. also performed an independent external validation using retrospective data from Arizona and found a 99.9% positive predictive value for death.⁴³

Based on their prospective cohort data of cardiac arrest patients in southern California, Stratton and Rashi suggested the addition of two additional independent termination criteria to the clinical prediction rule: 1) arrest was not witnessed by bystanders; and 2) no bystander CPR was performed.⁴⁴ Subsequently, the authors of the original BLS TOR rule derived a new TOR clinical prediction rule with these two additional criteria.⁴⁵ However, their secondary analysis of data collected originally for the Ontario Prehospital Advanced Life Support (OPALS) study did not demonstrate a difference in sensitivity (both 100%) or negative predictive value (both 100%) when comparing the newly derived advanced life support (ALS) TOR rule with the BLS TOR rule. Moreover, the ALS TOR rule had a lower specificity than the BLS TOR rule did (32% vs. 50%) and a lower rate of pronouncement of death (30% vs. 48%) in the field, meaning a higher transport rate using the ALS TOR criteria.⁴⁵

Skrifvars et al. compared the ALS TOR rule with the Helsinki DNR guidelines^{46,47} and the European Resuscitation Council (ERC) guidelines for resuscitation⁴⁸ in a secondary analysis of 20,484 patients in a non-shockable rhythm from the Swedish Cardiac Arrest database. The specificities for each guideline were as follows: ALS TOR rule 99.1%, Helsinki DNR guideline 71%, and ERC guideline 95%. The positive predictive values were as follows: ALS TOR rule 99.9%, Helsinki DNR guideline 99.4%, and ERC guideline 99.9%.⁴⁹ Ong et al. performed a secondary analysis of a prospective cohort study of 2,269 patients in Singapore comparing TOR guidelines by Marsden et al.,³⁶ Petrie et al.,⁵⁰ and Verbeek et al.⁴⁰ Ong et al. calculated the following sensitivities for predicting survival for the three guidelines: Marsden 90.6%, Petrie 93.8%, and Verbeek 81.3%. The negative predictive values were as follows: Marsden 99.8%, Petrie 99.7%, and Verbeek 99.6%.⁵¹

Haukoos et al. created three decision models to predict "meaningful survival," defined by Glasgow Coma Score (GCS) at hospital discharge, under the premise that previously derived rules have been created for predicting survival, rather than for the outcome of meaningful survival.⁵² The first model, to predict survival with a GCS >13, required a witnessed arrest or age <78 years. In a retrospective analysis of 754 patients transported to the Department of Emergency Medicine at Harbor-UCLA Medical Center, this first rule had a positive predictive value of 5% for survival and a negative predictive value of 99.8%. The second model, to predict survival with a GCS >14, required initial rhythm of nonasystole, witnessed arrest, or age <78 years. This rule had a positive predictive value of 5% and a negative predictive value of 99.6%. Finally, the third model, to predict survival with GCS >15,

required only that the downtime between arrest and initiation of life support be 5 minutes or less. This rule had a positive predictive value of 2% and a negative predictive value of 99.8%. Although the definition of "life support" in the study is not clear, this presumably refers to the initiation of basic cardiopulmonary life support with chest compressions.

Ruygrok et al. compared the BLS TOR and ALS TOR rules alongside the second predictive rule of Haukoos et al. In a retrospective, secondary analysis of 715 patients from the Denver Cardiac Arrest Registry, Ruygrok et al. found that all three rules had identical ability to identify survivors with good neurologic outcome (defined as Cerebral Performance Category Scale score of 1 or 2), with 100% of patients identified. The BLS TOR rule, however, also showed the highest specificity, at 36%, as compared with the ALS TOR rule, at 25%, and the Haukoos rule, at 6%. Therefore, the BLS TOR rule would have resulted in the lowest transport rate, without compromising the ability to identify survivors.⁵³

Morrison et al. conducted a further validation of both the BLS TOR and ALS TOR rules on an identical retrospective prehospital patient cohort served by a system using both BLS and ALS providers, with data originally collected by the University of Toronto for the Resuscitation Outcomes Consortium Epistry-Cardiac Arrest trial. Their results mirrored their previous comparative study, with identical specificities and positive predictive values (both 100%) and a higher transport rate with the ALS TOR rule (69% vs. 45.6%).⁵⁴ The authors suggested the use of the three BLS TOR criteria as a universal TOR clinical prediction rule to be used by EMS systems staffed by any level of provider.

The AHA released updated guidelines for cardiopulmonary resuscitation and emergency cardiovascular care in 2010.⁵⁵ The chapter on the ethics of resuscitation discussed several exceptions to the universal rule that rescuers should provide emergency treatment to cardiac arrest patients: 1) situations that would place the rescuer at risk of serious injury or death; 2) obvious signs of irreversible death (eg, rigor mortis, dependent lividity, decapitation, transection, decomposition); and 3) a valid, signed, and dated advance directive indicating that resuscitation is not desired, or a valid, signed, and dated DNR order. In addition, the AHA defined the conditions under which a BLS rescuer should terminate resuscitative efforts, referring to the Verbeek BLS TOR rule.⁵⁵

TIME TO DECISIONS REGARDING RETURN OF SPONTANEOUS CIRCULATION

The BLS TOR rule developed by Verbeek et al. included the provision that EMS providers should consider TOR in patients who do not achieve ROSC prior to EMS transport.⁴⁰ The 2010 AHA guidelines ex-

panded on this, with the provision of TOR if no ROSC is present after "... 3 full rounds of CPR and automated external defibrillator analysis,"⁵⁵ which should take only about 6–8 minutes. The dimension of time as a determinant and an indicator for survival could provide an additional means of guiding TOR. In the out-of-hospital environment, the lapse of time from cardiopulmonary arrest to determining ability or failure to achieve ROSC is of primary interest as it could offer EMS personnel a tangible pathway to terminate or continue resuscitation efforts.

Since TOR protocols that emphasize in-field resuscitation may increase the proportion of successful resuscitations due to avoidance of compression interruptions associated with movement for transportation, there is value to a review of the available nontraumatic TOR literature to see whether a crucial time frame exists. If it is evident that survivors of an out-of-hospital nontraumatic cardiopulmonary arrest achieved ROSC after a specific time lapse, a recommendation for time as an additional criterion for TOR in the field could potentially be made. However, based on the inconsistency and variation of the definition of time as a variable as well as limited findings in the literature, no significant numerical value can be confidently recommended. Therefore, while the recommendation from Verbeek et al. regarding ROSC prior to EMS transport is vague because it does not include a specific time prior to determining that ROSC will not be achieved, this recommendation takes into account the fact that there is not a well-validated, scientific basis for any other recommendation that does include a specific time prior to determining that ROSC will not be achieved.

OTHER CONSIDERATIONS

In the development of a TOR protocol, it is important to consider the potential role of organ donation as a reason to continue resuscitative efforts. The majority of successful organ donations after cardiopulmonary arrest are in controlled "donation after cardiac death" (DCD),^{56,57} defined as harvesting of organs after a controlled withdrawal of life support, leading to a witnessed cardiopulmonary arrest in an intensive care unit or operating room. Controlled DCD is different from traditional "donation after brain death" (DBD) because of a planned period of warm ischemia between cardiopulmonary arrest and chilled organ reperfusion.⁵⁸

Regarding attempts for organ donation in the setting of traumatic cardiopulmonary arrest, Rosemergy et al. studied 138 patients who had out-of-hospital CPR; all the patients in this study died and 8% underwent tissue procurement of the cornea for transplantation.⁵⁹ Advances in the science of "uncontrolled donation after cardiac death" (uDCD) predict a promising option that may increase the availability of transplantable

organs in the future.^{60–62} However, given the paucity of data of uDCD retrieved from cardiopulmonary arrest in the prehospital setting and the ethical challenges with this practice, organ donation, in and of itself, is not currently a valid reason to continue resuscitative efforts with plans for concurrent transport with warning lights and sirens. However, there may be value to a TOR protocol that takes into account transport of a patient to an acute care facility without warning lights and sirens after TOR for the purposes of harvesting corneas and any other organ that may still be viable.

The implementation of an out-of-hospital TOR protocol requires a process for the management of deceased patients in the field. The exact requirements for the management of deceased patients will depend on local and state regulations. At a minimum there should be involvement of the local coroner and law enforcement agencies. Further, there should be a process in place to involve pastoral care and/or social work for family and friends.

INDIRECT MEDICAL OVERSIGHT

The implementation of TOR protocols requires active physician oversight. While this updated NAEMSP position on TOR in nontraumatic arrest is intended to be applicable to all EMS systems, it is important to recognize that each system has its own unique characteristics. Therefore, minor variability in the protocol to meet system-specific parameters may be necessary. However, variations in the protocol should still be, as much as possible, evidence-based and take into account the primary goal of protecting the public health.

In addition to the role of physicians in modification of protocols, there is also a need for indirect physician oversight of quality improvement (QI) activities. It is important that EMS systems that use TOR protocols have continuous review of the outcomes of the protocols. Involvement of a medical director in review of every TOR case will likely enhance the quality of the program, as system-specific and provider-specific modifications that need to be made will only be identified through a QI program that involves active physician oversight.

EXCLUSIONS TO TERMINATION-OF-RESUSCITATION PROTOCOLS

In developing TOR protocols, EMS medical directors may consider exclusions under certain situations. Since the literature supporting inclusion or exclusion of these situations for TOR protocols is lacking, medical directors should consider system-specific factors with regard to these situations: pediatric patients,

pregnant and hypothermic patients, patients struck by lightning, and conditions deemed unsafe for EMS providers.

Pediatric cardiopulmonary arrest (patient age <18 years) may be considered as a possible exclusion since the literature has thus far been limited and inconsistent in methodology and definition. The causation and likelihood of survival of pediatric arrest vary significantly between age cohorts (e.g., infants, children, and adolescents), and further research is needed for clinical rules to be established.^{55,63,64}

While there may be significant discussion of cardiopulmonary arrest during pregnancy, there is inadequate literature on the termination of resuscitative efforts. In addition, this may be counter to cultural norms. In certain cases, an emergency cesarean section may be appropriate during and following maternal cardiopulmonary arrest, depending on the gravid uterus and the effect on maternal hemodynamics. If resuscitative efforts are unsuccessful for the life of the mother, an emergency cesarean section can still be performed in an attempt to preserve the life of the fetus.⁶⁵

In cases of cardiopulmonary arrest where the patient is hypothermic, a depression of critical body function may make the patient appear clinically dead. However, resuscitative and warming efforts can have dramatically successful results and thus a TOR protocol may not be appropriate. This assumption holds for cases of patients who have been struck by lightning as well, where patients can have an excellent chance of recovery even if the interval before resuscitation is prolonged, since the mechanism of the arrest is unique to the injury. Additionally, lightning strikes elicit a diverse and often unpredictable outcome, discouraging an establishment of guidelines.⁶⁵ In other unsafe conditions, such as cases in which EMS providers are surrounded by large crowds at public events, it may be best to continue resuscitative efforts until the EMS providers have removed themselves and the patient from the scene. Once in a more secure environment, a TOR protocol may be enacted.

AREAS FOR RESEARCH

The previous NAEMSP position on nontraumatic cardiopulmonary arrest included the statement that "...online medical direction should be established prior to termination of resuscitation."³ To date, there is no scientific literature to support the need for direct medical oversight in the application of TOR protocols. Since standardized written protocols are more likely to be consistently applied in a systematic manner, there may be benefit to not requiring direct medical oversight in the application of TOR protocols. Further research is needed to fully understand the benefit or harm of direct medical oversight in the application of TOR protocols.

Because of the challenges of developing research methodologies to examine questions in pediatric resuscitation and the potential psychological ramifications of TOR in pediatric patients, there is limited research examining TOR protocols in pediatric populations. However, the complexity of the science of pediatric resuscitation does not mean that there is no utility to TOR in pediatric populations. There may be value to future research examining the utility of TOR in pediatric populations.

As discussed above, a well-validated, scientific basis for a recommendation of the time from onset of nontraumatic cardiopulmonary arrest to determining that ROSC will not be achieved does not exist. Therefore, this is a critical area that needs further research. Future study of TOR protocols should examine whether there is a valid time (or number of cycles of CPR) before determining that a patient will not achieve ROSC prior to EMS transport.

CONCLUSION

As the science of resuscitation is in evolution, so too is the science of TOR. In an effort to protect the public health, there is value to a scientifically based out-of-hospital TOR protocol. In the setting of nontraumatic cardiopulmonary arrest, an evidence-guided TOR protocol includes arrest not witnessed by EMS providers, no identifiable shockable rhythm, and no ROSC prior to EMS transport. In general, resuscitation for nontraumatic cardiopulmonary arrest should occur on scene rather than during transport. Further research is needed to determine the appropriate field time prior to EMS providers' deciding that it will not be possible to achieve ROSC before transport and the potential benefit or harm of direct medical oversight in out-of-hospital TOR.

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