Editorial

Improving Survival From In-Hospital Cardiac Arrest

The national survival rate to hospital discharge for patients with in-hospital cardiac arrest has previously been documented by the National Cardiopulmonary Resuscitation (CPR) Registry as 17%.[1] More recently, Peberdy et al reported that in 86,748 adult, consecutive in-hospital cardiac arrest events in the National CPR Registry, with data obtained from 507 medical/surgical participating hospitals from January 1, 2000, through February 1, 2007, the survival-to-discharge rate was 18.1%.[2] Survival of in-hospital cardiac arrest is influenced by arrest time of day and day of week,[2] and by the use of mechanical ventilation and vasopressors in intensive care units.[3] The survival-to-discharge rate for cardiac arrest has been reported to drop from 19.8% on the day/evening shifts (7:00 AM to 10:59 PM) to 14.7% on night shifts (11:00 PM to 6:59 AM).[2] Reasons given for the drop in survival observed on night shifts include less use of monitoring technology, fewer witnessed arrests, and higher incidence of asystole versus pulseless ventricular tachycardia and ventricular fibrillation. Hospital staffing patterns at night are different, with fewer physicians, nurses, respiratory therapists (RTs), and supervisors on duty. At night, with fewer healthcare professionals available to respond to a resuscitation event, the demands placed on RTs on the code are increased beyond what would normally be expected on day/evening shifts.

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In this issue of RESPIRATORY CARE, Thigpen et al[4] report on a study conducted by 2 hospitals to determine the effect of implementing the 2005 American Heart Association (AHA) CPR guidelines,[5] including the use of the impedance threshold device, on the survival rate for in-hospital cardiac arrest. They report a 60% increase in survival to discharge from cardiac arrest, and they attribute the improved survival rate to a unified protocol that was used to maximize circulation during CPR. The protocol bundles together major changes recommended by the 2005 AHA CPR guidelines[4] to enhance forward blood flow during resuscitation of cardiac arrest. The protocol initiated by the 2 hospitals was approved by their hospital code committees and included in the hospital CPR training curriculum. The bundled protocol[4] included several changes in how CPR was done by the code team, including:

- A change in the compressions-to-ventilations ratio, to 30:2
- Continuous asynchronous ventilations, with a low rate
- Inspiratory time of < 1 second
- Small tidal volumes (500 mL)
- Minimized pauses for pulse checks
- Full chest recoil after each compression
- Before and after defibrillation CPR
- Use of an impedance threshold device (ITD)

Most respiratory care departments provide a 24/7 staffing pattern of RTs who respond to every "code" call to help resuscitate patients in cardiac arrest. They are the ventilation and airway experts on the code team. The 2009 American Association for Respiratory Care (AARC) human resources study reported that 56% of respiratory care departments provide an emergency tracheal intubation service, 69% of RTs are certified by the AHA in advanced cardiac life support, and 95% are members of hospital rapid-response teams.[6] It is not surprising that the Thigpen et al study reports that RTs held a central role in implementing many aspects of the new bundled protocol, including proper ventilation technique and use of the ITD, and were encouraged to correct colleagues when CPR was not performed according to the AHA guidelines.[4] The respiratory care department worked with staff from the intensive care unit and emergency department to implement a 6-month period of training and in-services on the 2005 AHA guidelines. Training for and implementation of the ITD became the responsibility of RTs who carried the device in a small pack attached to their belt.

Role of Respiratory Therapists in Clinical Research

The AARC's 2015 Conference 2, "Educating the Future Respiratory Therapist Workforce: Identifying the Options,"[7] reached general agreement on 7 major competency areas that will be needed in 2015 and beyond. One of the major competency areas identified by the conference was evidence-based medicine and respiratory care protocols. Several competency definitions in this area include skills that Thigpen and his RT colleagues needed to improve survival rate from cardiac arrest in their hospitals:

- Apply evidence-based medicine to practice.
- Review and critique published research.

- Use evidence-based medicine in the development and application of hospital-based respiratory care protocols.
- Explain the meaning of general statistical tests.

These are the competencies that graduate RTs in the future will need to participate in clinical research. It is not too soon to get started, as RTs in these 2 hospitals have so capably demonstrated. The forces that are driving change in healthcare also drive respiratory care, but the role of the RT in 2015 will also be driven by biomedical innovation such as the ITD and evidence-based medicine. RTs will need to be able to analyze studies on emergency care to determine if the findings are appropriate for their practice, and be able to critique the findings and apply them when appropriate. This will require a clear understanding of research methods and statistics. The bundled protocol adopted by the code teams at Saint Cloud and Saint Dominic hospitals led to significant improvement in the overall survival rate for in-hospital cardiac arrest but needs to be replicated with larger sample sizes. RTs are positioned to lead the further research that is needed to answer the following research questions raised by Thigpen et al[4]:

- Does the bundled protocol significantly improve the survival-to-discharge rate for resuscitation of ventricular fibrillation and asystole when the sample size is larger?
- Can the survival to discharge after cardiac arrest be replicated by only one hospital that uses a larger sample size?
- Can the ITD be used with 2-person bag-valve-mask ventilation without causing gastric inflation?

It should be noted that frequently the respiratory care department is charged with the responsibility of gathering data from each cardiac arrest incident for submittal to the AHA National CPR Registry.[8] The data they collect should allow RTs to develop ideas for research projects where they can be actively involved in development and implementation of bundled protocols to improve survival from in-hospital cardiac arrests. Evidence-based ventilator weaning and discontinuation protocols have demonstrated improved patient outcomes.[9,10] It is time for RTs to take a more active leadership role in development of protocols in emergency care.

Emergency Care Leadership by Respiratory Therapists

RTs are in a position to demonstrate leadership attributes on code teams. The AARC 2015 Conference 2 specifically identified the need for RTs to be involved with bedside decision making. The bundled protocol described by Thigpen et al[4] requires a great deal of training and in-service education that needs to be offered not only initially but repeated at 6-month intervals. The delivery of ventilation with ITD and asynchronous chest compressions requires knowledge of the how the negative airway pressure facilitates the refilling of the heart. Equally important is the limitation of tidal volume to 500 mL delivered in less than 1 second. The peak inspiratory flow with these parameters will be close to 30 L/min: the threshold where gastric inflation becomes an important factor.[11]

The use of 2-person bag-valve-mask ventilation creates a potential for delivering a tidal volume larger than 500 mL if the bag is squeezed with 2 hands by the second person. In order to create the protocol-required ITD-generated negative thoracic pressure during the expiratory phase of ventilations and during the recoil phase of chest compressions, the mask must be held tightly to the face with 2 hands so that no mask leak occurs. During 2-person ventilation all of the bag's stroke volume will enter the laryngopharynx, and if airway pressure exceeds the lower esophageal sphincter opening pressure, gastric inflation may occur.

Following a cardiac arrest the lower esophageal sphincter opening pressure has been shown in a porcine model to decrease over 7 min, from a mean baseline of 18.0 ± 3.0 cm H_2O to 3.3 ± 4.2 cm H_2O, thereby facilitating gas entry to the stomach.[12] The rapid drop of the lower esophageal sphincter opening pressure will require the RTs on the code team to assist with or perform tracheal intubation as soon as possible. With the focus on asynchronous chest compressions the code team will be reluctant to interrupt CPR to secure the airway, and any attempt to place a tube must be done quickly. The respiratory care department must provide an emergency intubation service and assure that all RTs who carry the code beeper are competent to intubate the trachea of a cardiac arrest victim.

Equally important, they must be capable of doing 2-person bag-valve-mask ventilation with an ITD. To assume a leadership role they must be certified in advanced cardiac life support, preferably at the instructor level. Advanced cardiac life support certification for all RTs carrying the code beeper should be a prerequisite if they will be asked to correct colleagues when CPR is not performed according to AHA guidelines and the approved bundled CPR protocol.

The AHA conducted an exhaustive 3-year evidence-based search of the research on resuscitation of cardiac arrest that led to the develop the 2005 guidelines for CPR and emergency cardiovascular care.[13] The research review for the AHA 2010 guidelines for CPR and emergency cardiovascular care will be completed by December 2010 and will provide information for two AHA publications: the *Consensus on Science and Treatment Recommendations*, and the *2010 AHA Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care*. You can review more than 400 International Liaison Commit-

tee on Resuscitation worksheets that have been posted at a special AHA web site.[14] These worksheets include published scientific evidence from peer-reviewed journals that is analyzed and categorized into level-of-evidence grids with detailed summaries. The AHA/International Liaison Committee on Resuscitation worksheets provide a wealth of new information on resuscitation of cardiac arrest that should lead to ideas for bench and clinical research that RTs can conduct with their healthcare colleagues. Thigpen et al have shown that lives can be saved with a bundled protocol based on the 2005 AHA CPR guidelines to improve survival from in-hospital cardiac arrest. Now it is time for RTs and their colleagues to reexamine their CPR protocols after review of the evidence that has been gathered for the AHA 2010 guidelines.[14]

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The author has disclosed no conflicts of interest.

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