Implementing the 2005 American Heart Association Guidelines, Including Use of the Impedance Threshold Device, Improves Hospital Discharge Rate After In-Hospital Cardiac Arrest

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OBJECTIVE: To determine the impact of the 2005 American Heart Association cardiopulmonary resuscitation (CPR) guidelines, including use of an impedance threshold device (ITD), on survival after in-hospital cardiac arrest. METHODS: Two community hospitals that tracked outcomes after in-hospital cardiac arrest pooled and compared their hospital discharge rate before and after implementing the 2005 American Heart Association CPR guidelines (including ITD) in standardized protocols. In CPR we used the proper ventilation rate, allowed full chest-wall recoil, conducted continuous CPR following intubation, and used an ITD. We compared historical control data from a 12-month period at St Cloud Hospital, St Cloud, Minnesota, to data from a subsequent 18-month intervention phase. We compared historical control data from a 12-month period at St Dominic Hospital, Jackson, Mississippi to a subsequent 12-month intervention phase. 507 patients received CPR during the study period. Patient age and sex were similar in the control and intervention groups. RESULTS: The combined hospital discharge rate for patients with an in-hospital cardiac arrest was 17.5% in the control group (n = 246 patients), which is similar to the national average, versus 28% in the intervention group (n = 261 patients) (P = .006, odds ratio 1.83, 95% CI 1.17–2.88). The greatest benefit of the intervention was in patients with an initial rhythm of pulseless electrical activity: 14.4% versus 29.7% (P = .014, odds ratio 2.50, 95% CI 1.15, 5.58). Neurological function (as measured with the Cerebral Performance Category scale) in survivors at hospital discharge was similar between the groups. CONCLUSIONS: Implementation of improved ways to increase circulation during CPR increased the in-hospital discharge rate by 60%, compared to historical controls in 2 community hospitals. These data demonstrate that immediate care with improved means to circulate blood during CPR significantly reduces hospital mortality from in-hospital sudden cardiac arrest. Key words: cardiac arrest; sudden death; impedance threshold device; cardiopulmonary resuscitation; CPR; pulseless electrical activity; ventricular fibrillation. [Respir Care 2010;55(8):1014–1019. © 2010 Daedalus Enterprises]
has been no significant change in the in-hospital survival rate for decades. At present the national survival rate for in-hospital cardiac arrest is only about 17%.5

While the cause of in-hospital cardiac arrest is often considered different from out-of-hospital cardiac arrest, the process in both settings requires immediate treatment.4 10 In 2005, the American Heart Association (AHA) issued new evidence-based CPR guidelines that fundamentally changed the focus of initial resuscitation efforts to emphasize improved circulation. The highly recommended new interventions included more compressions per minute, fewer interruptions in chest compressions, delivery of chest compressions before defibrillation, full chest-wall recoil to enhance refill of the heart with blood after each compression, reducing the tidal volume and inspiratory time of each breath, and use of an impedance threshold device (ITD) that significantly improves blood flow to the heart and brain during CPR.11

**Methods**

This research was performed at St Cloud Hospital, St Cloud, Minnesota, and St Dominic Hospital, Jackson, Mississippi.5

Data were prospectively gathered following training and implementation of the 2005 AHA guidelines (including ITD use) in 2 medium-size community hospitals: St Cloud Hospital, St Cloud, Minnesota, and St Dominic Hospital, Jackson, Mississippi, which were early adopters of the new CPR methods and the ITD. Both hospitals have a Code Blue Committee, a code team staffed by physicians and nurses, respiratory therapists, a full complement of board-certified cardiology and intensive care unit staff, educators dedicated to training and retraining hospital staff on proper CPR technique, and a comprehensive data-collection process incorporated into their standard quality-assurance program that provided accurate intervention and historical control data. Both hospitals have family practice residents or hospitalists at times on the wards, but the code team is directed by board-certified internists or emergency physicians.

Publication of these conglomerate quality-assurance data was approved by the institutional review boards of both St Cloud Hospital and St Dominic Hospital.

St Cloud Hospital is a 489-bed hospital with approximately 13 in-hospital cardiac arrests per month. The historical control data were obtained from the 12 months (2005) prior to the intervention, and the intervention group data were obtained over 18 months (July 2006 through December 2007) immediately following a 6-month period of training, in-services, and implementation of the 2005 AHA guidelines (with ITD use). St Cloud Hospital participates in the National CPR Registry program. Data related to the incidence rate and outcomes after cardiac arrest were gathered from those report forms.

St Dominic Hospital is a 570-bed hospital with approximately 12 in-hospital cardiac arrests per month. The historical control data were obtained from the 12 months (June 2005 to June 2006) prior to the intervention, and the intervention-group data were obtained from the subsequent 12 months following implementation of the 2005 AHA guidelines (with ITD use). St Dominic Hospital began to track the incidence rate and clinical outcomes after cardiac arrest in 2004, using a quality-assurance data-collection process and recording system similar to the National CPR Registry.

In both hospitals, family practice residents or hospitalists rotate through the wards, but the medical management of all codes is directed by board-certified internists or emergency physicians. Patients who had a cardiac arrest after admission to the hospital, including those in intensive care, in a step-down unit, in the emergency department, and on the wards, were included. Patients who had a do-not-resuscitate order and those who had out-of-hospital cardiac arrest admitted to the emergency department with ongoing CPR were excluded from analysis.

Following publication of the AHA guidelines in 2005,11 efforts were independently undertaken at both hospitals to develop a training and implementation process. To this end, the new guidelines ranked the new recommendations based on evidence levels of 1, 2a, 2b, 3, and indeterminate. A level-3 recommendation is reserved for interventions thought to be dangerous, and the indeterminate category indicates interventions that require more science before adopting. The Code Committee in both hospitals decided to adopt the guideline recommendations that had evidence

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Ken Thigpen RRT has disclosed a relationship with Advanced Circulatory Systems. Tom P Aufderheide MD has disclosed relationships with Take Heart America, Medtronic, and Jolife. The other authors have disclosed no conflicts of interest.

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levels of 2b or higher, and those recommendations constituted the hospital training curriculum, including:

- A change in the Basic Life Support compressions-to-ventilations ratio, to 30:2 (evidence level 2a)
- Continuous chest compressions, with asynchronous ventilations at 10 breaths/min, with a duration of no more than one second per breath for Advanced Life Support CPR (evidence level 2a)
- Reduction of the tidal volume to approximately 500 mL/breath (evidence level 2a)
- Minimizing pauses for pulse check (evidence level 2a)
- Allowing full chest-wall recoil after each compression (evidence level 2b)
- Chest compression before and after defibrillation if CPR was started greater than 4 min after the cardiac arrest (evidence level 2b)
- Use of the ITD (evidence level 2a)

The ITD (ResQPOD, Advanced Circulatory Systems, Minneapolis, Minnesota) shown in Figure 1 was initially used on a face mask and then transferred to an advanced airway device as needed. When the ITD was used on a face mask, a 2-handed technique was implemented to maintain a continuous tight seal between the face and the mask during compressions and ventilations. Once intubated, the ITD was transferred to the advanced airway, and the timing lights were activated to guide ventilation frequency and compression rate. These changes were emphasized in handouts to medical personnel, and in refresher courses offered every 6 months. Training for and implementation of the ITD began through the respiratory therapy departments at both hospitals and was subsequently extended to the intensive care unit staff, emergency department staff, and medical staff in the hospital responsible for cardiac arrest response. Training focused on didactic and psychomotor skills, using a manikin. In St Dominic Hospital, respiratory care personnel carried the ITD in a small pack attached to their belt. The device was stocked together with the resuscitator bag and masks on the crash carts in both hospitals. To increase compliance with the protocols, use of the ITD was added to the check-off list on the code sheets in both hospitals.

Data were collected prospectively at both hospitals and pooled together with the intent to publish the conglomerate data. At the time the study was proposed, the data from the 2 hospitals represented the largest controlled clinical experience with the new CPR techniques and ITD use. The primary end point was hospital discharge rate. Hospital discharge data from the historical control phase and the intervention phase were analyzed separately for each hospital, and together. Data were compared using Fisher’s exact test (2-sided). A P value of < .05 was considered evidence of statistical significance.

Results

Both hospitals implemented a rapid-response team during the study, in an attempt to reduce the incidence of cardiac arrest. Despite this, the incidence of cardiac arrest remained fairly constant through the control, training/implementation, and intervention phases at both hospitals: 12 arrests per month at St Cloud Hospital, and 13 arrests per month at St Dominic Hospital.

In the 2 hospitals, 246 patients suffered cardiac arrest and received CPR in the historical phase, and 261 patients in the intervention phase. The average age and male:female ratio were similar in both phases. In the historical phase the mean age was 69 ± 15 years, and in the intervention phase it was 68 ± 14 y (difference not significant). During the historical phase 63% of the patients were male, versus 70% during the intervention phase (difference not significant).

Combining data from both hospitals, survival to hospital discharge was 17.5% in the control phase, versus 28%
during the intervention phase ($P = .006$, odds ratio 1.83, 95% CI 1.17–2.88) (Table 1). The study had 79.2% power to detect a difference in combined survival rate as large as that observed (17.5% vs 28.0%), with a 2-sided alpha of .05.

Full compliance with the new protocol continued to improve with additional retraining, as did hospital discharge rate. Prior to implementation of the new CPR interventions in St Cloud Hospital, it was uncommon to have more than 5 patients discharged alive each month. Using the National CPR Registry format, the incidence rate of cardiac arrest and the number of patients discharged each month are shown for St Cloud Hospital in Figure 2. The number of survivors per month began to increase once the 2005 AHA guideline implementation process was initiated.

Survival data from both hospitals combined, based on a subgroup analysis of presenting cardiac arrest rhythm, are shown in Table 2. Patients in the intervention group who presented with ventricular fibrillation, pulseless electrical activity, and asystole demonstrated better survival than the control population. However, the benefits of the new intervention were statistically significant in this subgroup analysis only for patients with an initial rhythm of pulseless electrical activity. For patients with an initial rhythm of pulseless electrical activity there was a greater than 2-fold increase in survival to hospital discharge ($P = .014$). No other subgroups based upon initial rhythm had a statistically significant difference in outcome. There were 5 patients in the historical control phase and 12 patients in the intervention phase for whom the initial rhythm could not be identified or was missing from the chart.

Conglomerate data from both hospitals demonstrated that the overall percentages of patients discharged with good neurological function were high and not statistically different between the control and intervention groups. A total of 70.7% (29/41) of the patients in the control phase in the combined hospital-discharge data had a Cerebral Performance Category score of 1 (normal) or 2 (mild cognitive impairment), compared to 79.6% (43/54) in the intervention group ($P = .343$).

The results of the study were summarized in odds ratios. The group differences can also be summarized by relative risk estimates (ratios of survival rates) or estimates of differences in survival rate to determine the absolute risk reduction. For example, based upon the data in Table 1:

St Cloud:
Relative risk ratio 1.56, 95% CI (0.93–2.77)
Difference: 10.02%, 95% CI (1.65 to 21.13%)

St Dominic:
Relative Risk ratio 1.62, 95% CI (1.05–2.56)
Difference: 10.74%, 95% CI (0.97–20.50%)

Combined:
Relative risk ratio 1.60, 95% CI (1.15–2.25)
Difference: 10.49%, 95% CI (3.19 –17.76%)

The direction of the comparisons (better results for the intervention having higher relative risks or positive differences) was chosen to be consistent with the original direction used for odds ratios. By inverting these ratios the emphasis is focused on risk reduction and not improvement. The results between the 2 sites are remarkably close on all measures of risk. Based upon these analyses, the relative risk ratio of 1.60 for the combined data can be used to conclude that one would expect 10 more survivors for every 100 patients treated with the new intervention over that expected otherwise (the odds ratio is 1.83). In order words, on average, one more life is saved per ten uses of the new intervention.

There were no known complications reported with use of the new CPR interventions, compared to the historical

Table 1. Survival to Hospital Discharge*

<table>
<thead>
<tr>
<th>Hospital</th>
<th>Control</th>
<th>Intervention</th>
<th>$P$†</th>
<th>Odds Ratio</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>St Cloud</td>
<td>16/89 (18.0)</td>
<td>35/125 (28.0)</td>
<td>.105</td>
<td>1.77</td>
<td>0.87–3.71</td>
</tr>
<tr>
<td>St Dominic</td>
<td>27/157 (17.2)</td>
<td>38/136 (27.9)</td>
<td>.034</td>
<td>1.87</td>
<td>1.03–3.41</td>
</tr>
<tr>
<td>Combined‡</td>
<td>43/246 (17.5)</td>
<td>73/261 (28.0)</td>
<td>.006</td>
<td>1.83</td>
<td>1.17–2.88</td>
</tr>
</tbody>
</table>

* N = 507.
† Via Fisher’s exact test (2-sided).
‡ Combined St Cloud and St Dominic Hospitals data.

![Figure 2](image-url)
controls, and there were no reported ITD malfunctions with the patients treated with ITD during the intervention phase. The incidence of gastric inflation was not reported to be higher during the intervention phase. Although therapeutic hypothermia was used routinely in St Cloud hospital for patients with out-of-hospital cardiac arrest, it was rarely used for patients with in-hospital cardiac arrest. Only one survivor to hospital discharge from St Cloud Hospital during the intervention phase was treated with therapeutic hypothermia, and no patients were treated with hypothermia in St Dominic Hospital.

Discussion

This is the first report of the impact on survival of the 2005 AHA guidelines (including ITD use) for patients with in-hospital cardiac arrest. Results from this study demonstrate that implementation of the 2005 AHA guidelines (including ITD use) increased the hospital discharge rate by 60% for patients with in-hospital cardiac arrest (P = .006). The control rate of 17.5% is similar to the rate reported by the National CPR Registry in data from nearly 15,000 patients. These data support the hypothesis that increasing circulation during CPR improves the overall survival rate. Based upon the calculated relative risk ratios, implementation of the 2005 AHA guidelines (including ITD use) for patients with in-hospital cardiac arrest resulted in one additional patient surviving to hospital discharge for every ten patients treated.

In this study, proper implementation of the new CPR approach was the focus of training and retraining efforts by hospital personnel. Respiratory therapists played a central role in implementing many aspects of the new guidelines, including proper ventilation technique and use of the ITD. CPR is performed by various hospital personnel, whereas airway management is typically performed predominantly by respiratory therapy staff. While the ITD enhances circulation to the heart and brain, it is attached to the airway. Accordingly, respiratory care personnel were taught ITD use and the importance of proper 2-handed face mask technique (see Fig. 1). Furthermore, all personnel were encouraged to correct colleagues when CPR was not performed according to the AHA guidelines. The implementation process was an intense and coordinated process by personnel from respiratory care, the intensive care unit, and the emergency department. To maintain high-quality CPR, retraining efforts were organized every 6 months, especially as most personnel had to relearn a new approach to CPR. This included lifting the palm of the compressing hand off the chest during each decompression phase to assure full chest-wall recoil.

Rather than study the impact of a single intervention for patients in cardiac arrest, it was the expressed intent of this study to combine multiple interventions known to improve survival rate in both patients and animals in a unified protocol to maximize circulation during CPR. This approach is similar to new protocols designed to treat other disease states associated with severe hypotension, such as the bundled therapies for treatment of sepsis. In addition to enhancing forward blood flow, recent data show that allowing full chest-wall recoil, limiting the ventilation rate, and use of the ITD all decrease intracranial pressure during the decompression phase of CPR. This mechanism, together with the increase in forward blood flow to the heart and brain during the compression phase (as a result of improved cardiac refilling), may also have contributed to the positive results.

The greatest benefit of these synergistic therapies was in patients with pulseless electrical activity. This survival improvement in patients with pulseless electrical activity was higher than that reported when a similar series of changes were made in the out-of-hospital setting. The time from arrest to start of CPR is typically much shorter for patients with in-hospital cardiac arrest. Accordingly, the data from this study generate the hypothesis that the faster adequate circulation is achieved during CPR, the greater the likelihood of survival.

Limitations

This investigation used the only appropriate clinical control groups possible when evaluating the impact of the AHA recommendations, and, as such, is subject to the limitations and potential confounders of historical controls. The study was not blinded, as blinding is not possible with use of these CPR techniques. Second, it is not
possible to determine which aspects of the new intervention had the most impact on overall survival rate, since each intervention that enhances circulation affects the next. However, as noted above, we believe that no single therapy alone is primarily responsible for improved outcome for this complex disease state. Third, initial rhythm strips were not captured by the quality-assurance programs used in this study for 5 patients in the historical control group and 12 patients in the intervention group, introducing limited but potential bias in patient subgroup analysis. Finally, the lack of significance at St Cloud (a subgroup analysis) relative to St Dominic is almost entirely a factor of the smaller sample size. Similar issues with small sample sizes affect whether statistical significance was demonstrated in the subgroup analyses by heart rhythm.

Conclusions

Implementation of improved ways to increase circulation during CPR resulted in a 60% increase in in-hospital discharge rates, compared to historical controls in 2 community hospitals. These data demonstrate that immediate care with improved means to circulate blood during CPR can significantly reduce hospital mortality rates after in-hospital sudden cardiac arrest.

REFERENCES

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.

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 al4:

• 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. 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 disconnection protocols have demonstrated improved patient outcomes. 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 al4 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 H2O to 3.3 ± 4.2 cm H2O, 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 a 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. 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 American Heart Association released updated guidelines for cardiopulmonary resuscitation (CPR) in 2005. These guidelines changed the focus of CPR away from ventilation to strategies to improve circulation. Recommendations included more rapid chest compressions, fewer interruptions in chest compressions, delivery of chest compressions before defibrillation, full chest wall recoil between compressions, lower tidal volume and inspiratory time, and use of an impedance threshold device (ITD). Thigpen and colleagues evaluated the impact of these guidelines in 2 community hospitals. They found that implementation of the new CPR guidelines resulted in an increase in survival from 17.5% to 28%, with similar neurological function in the 2 groups. These results suggest that the newer CPR guidelines that focus on improved circulation may reduce hospital mortality from in-hospital sudden cardiac arrest. As Barnes points out in his editorial, respiratory therapists (RTs) are represented on virtually every hospital CPR team and rapid response team. As such, RTs are in the position to provide leadership in this area, particularly as related to evidence-based approaches such as ventilation strategies and use of the ITD during CPR.

The 6-minute walk test (6MWT) is commonly used for the evaluation of exercise tolerance in patients with pulmonary and cardiac disease. Few studies have evaluated the reliability and validity of the 6MWT in patients with cystic fibrosis (CF). Ziegler et al found that, although the 6MWT distance was reproducible, the wide limits of agreement exceeded the minimum important difference for this test. This indicates that, in the routine evaluation of CF patients, at least 2 6MWTs are required on any testing occasion to obtain a reliable estimate of the 6MWT distance.

We are pleased to publish 7 papers this month from the New Horizons symposium, “Airway Management: Current Practice and Future Directions.” This symposium was presented as part of the 2009 AARC International Respiratory Congress in San Antonio, Texas. As an introductory paper and as reviewed by guest editor Ulrich H Schmidt, these papers provide a state-of-the-art overview of airway management.

Emergency airway management is associated with a high complication rate. This topic is reviewed by Gudzenko et al. As they discuss, the complication rate associated with emergency airway management may be reduced by careful prior patient evaluation, appropriate pharmacology during intubation, and monitoring of cardiopulmonary stability in the immediate post-intubation period.

As described by Hurford, the development of less expensive, smaller, and more reliable video cameras has revolutionized the design of laryngoscopes and the technique of endotracheal intubation. Hurford groups video laryngoscopes into 3 different designs: stylets, guide channels, and video modifications of traditional laryngoscope blades. He then describes the strengths, weaknesses, and best applications for each.

Modification of the endotracheal tube to reduce microaspiration and/or biofilm formation may play a role in prevention of ventilator-associated pneumonia. These approaches include specialized cuffs, providing suction above the cuff (subglottic aspiration), silver coating of the tube, and combinations of these. Whether or not these newer endotracheal tube designs make a clinical difference is reviewed by Deem and Treggiari. As they correctly state, despite numerous studies of various such interventions, there is insufficient evidence upon which to base strong recommendations. Moreover, important safety concerns remain regarding the use of some of these devices and their cost-effectiveness.

Tracheostomy tubes are placed for a variety of reasons, including failure to wean from mechanical ventilation, inability to protect the airway, inability to manage excessive secretions, and upper-airway obstruction. Hurford reviews tracheostomy, which is one of the most frequent procedures performed in the intensive care unit (ICU). A tracheostomy tube is required in approximately 10% of patients receiving mechanical ventilation. As he points out, the only advantage of tracheostomy with supporting evidence is earlier discharge from the ICU and the hospital. The appropriate timing of tracheostomy in mechanically ventilated patients remains elusive. But many agree that it should occur as soon as the need for prolonged intubation (longer than 14 d) is identified. Bedside techniques to perform tracheostomy, such as percutaneous dilation techniques, are safe and efficient, allowing timely tracheostomy with low morbidity.

There are few data available to guide the timing of routine tracheostomy tube changes. Thus the paper by White et al is welcome. The first tracheostomy tube change carries some risk and should be performed by a skilled clinician in a safe environment. The risk associated with changing the tracheostomy tube then usually diminishes over time as the stoma matures. Endoscopy can be helpful to ensure optimal positioning of a replacement tracheostomy tube.

Although much has been written about the timing of extubation, little has been written about the timing of tracheostomy decannulation. Issues related to decannulation are discussed by O'Connor and White. The presence of a tracheostomy tube can be the source of a number of complications, which include tracheal stenosis, bleeding, infection, aspiration pneumonia, and fistula formation from the trachea to either the esophagus or the innominate artery. Final removal of the tracheostomy tube is an important step in the recovery from chronic critical illness and can usually be done once the indication for the tube placement has resolved.

As described by Deutsch, pediatric patients for whom tracheostomy is considered have different anatomy, medical conditions, and prognoses than adults. Even the tracheostomy tubes are different. Subglottic stenosis is an important indication for tracheostomy in children. This paper includes important discussions of the benefits, risks, impact on families, techniques for tracheostomy tube changes, and alternatives to tracheostomy.

We publish 2 case reports this month. The first, by Fuschillo et al, presents a case of severe respiratory and skeletal muscle involvement in a carrier of dysferlinopathy with chronic obstructive pulmonary disease. The second is by Chen et al and describes a case of mediastinal teratoma with pulmonary involvement presenting as massive hemoptysis in 2 patients. The Teaching Case of the Month is by Schumann et al and describes the removal of an aspirated foreign body with a flexible cryoprobe.

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