IMPACT OF THE 2005 AHA GUIDELINES ON RESUSCITATION OUTCOMES

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Introduction

Recommendations for the management of cardiac arrest have been developed, refined, and organized into easy-to-follow algorithms for both the lay person and trained medical professional. These algorithms establish consistent and standardized treatments for resuscitation.

Every 5 years, the International Liaison Committee on Resuscitation (ILCOR) reviews current resuscitation literature and publishes an evaluation of the evidence. From 2003 to 2005, 380 international experts on resuscitation were convened by the ILCOR to rigorously analyze existing scientific literature related to cardiopulmonary resuscitation and emergency cardiovascular care. (1) Findings were presented and discussed at the 2005 Consensus Conference on Cardiopulmonary Resuscitation (CPR) and Emergency Cardiovascular Care (ECC).

A revised set of Guidelines for CPR and ECC were published in late 2005. Significant modifications were made to the existing 2000 Guidelines in an effort to improve survival from cardiac arrest.

This issue of the *Code Communications* newsletter will highlight the major changes from 2000 AHA guidelines to the 2005 AHA guidelines. Current practices and data from some of the published outcomes for both out-of-hospital and in-hospital resuscitation due to cardiac arrests will be reviewed.

What Modifications Were Made?

A historical snapshot of the modifications that have been made over the years is presented below, adapted with permission from a review article written by David J. Klocko, MPAS, PA-C (2).

Year	*Compression-to-Ventilation Ratio*	*Rate of Compression*	*Initial Breaths*	*Ventilation Rate*
1974	1 rescuer 15:2 2 rescuers 5:1	60/min 80/min	“4 staircase”	12/min
1980	Same as 1974	Same as 1974	Same as 1974	Same as 1974
1986	Same as 1974	80-100/min	2 “full” breaths	Same as 1974
1992	Same as 1974	Same as 1986	Same as 1986	10-12/min
2000	1 & 2 rescuers 15:2	100/min	2 breaths	Same as 1992
2005	1 & 2 rescuers 30:2	100/min	2 breaths	10-12/min 8-10/min advanced airway

Why Were These Modifications Made?

The specific modifications that will be further discussed below are:

Intervention	*2000 AHA Guidelines*	*2005 AHA Guidelines*
Compression-to-Ventilation Ratio	15:2	30:2
Shocking for Defibrillation	3 Stacked Shocks	1 Shock, Followed by CPR
Providing Compressions or Defibrillation First for Unwitnessed Cardiac Arrest	Immediate Shock	5 cycles of CPR before shock
When to check for a pulse or identify the rhythm	After each shock	After 5 cycles of CPR

When the 2005 AHA guidelines were introduced to the public, two common themes emerged. The first theme was that the guidelines were streamlined for all persons providing resuscitation. The second theme was even simpler; perform high quality compressions and minimize interruptions.

The evidence that led to the modifications is presented below. These key components were placed into the 2005 AHA guidelines in order to create the greatest potential impact on survival.

Compression-to-Ventilation Ratio

The 2000 AHA guidelines recommended three different compression-to-ventilation ratios based on age. No human data currently exists to determine the optimal ratio for victims of any age (3).

The change was recommended for a number of reasons, including:

- ♥ CPR skills quickly decreased after the completion of a course (4).
- ♥ Studies demonstrated that an inadequate number and depth of compressions were being performed by trained medical professionals during resuscitation. (5,6)
- ♥ Frequent interruptions and excessive ventilation were also noted. (5,6).

Experts created the ratio of 30:2 for a single rescuer and 15:2 for infants and children after a thorough evaluation of evidence. The goals of the universal compression to ventilation ratios are to achieve quality compressions at a consistent rate with minimal interruptions. Effective compressions provide the necessary perfusion to the heart, coronary, and cerebral arteries. Maintaining the new ratio will increase the likelihood of a successful resuscitation attempt. The 2005 AHA guidelines also put emphasis on performing an effective compression by allowing the chest to recoil after each compression. The two ratios create much less memorization for the trained medical professional or lay person.

Shocking for Defibrillation

The 2000 AHA guidelines recommendation for a cardiac arrest victim in ventricular fibrillation (VF) or pulseless ventricular tachycardia (VT) was to use a sequence of three stacked shocks, primarily using monophasic defibrillators. According to Ali and Zafari (7), "no evidence *proves* that one shock is better than three stacked shocks."

The recommendation for the one shock was made, in part because:

- The 2000 AHA guidelines create delays in resuming CPR, up to 40 seconds in this particular study (8).
- Biphasic defibrillators have a high first shock efficiency. Further shocks would not be beneficial as providing quality compressions (9,10).

The 2005 AHA guidelines recommend the following Joules for specific types of defibrillators:

- Monophasic waveform - 360 Joules
- Biphasic waveform, typically for a rectilinear waveform - 120 Joules
- Biphasic waveform, typically for a truncated exponential waveform - 150 to 200 Joules

Unwitnessed Cardiac Arrest: Providing Compressions versus Defibrillation First

The treatment algorithm for pulseless VT or VF according to the 2000 AHA guidelines directed that the victim receive shocks immediately. The 2005 AHA guidelines differentiate between a witnessed and unwitnessed cardiac arrest.

Listed below are some of the reasons why modifications were made to the recommendation:

- Experts felt that recent evidence was insufficient to recommend CPR before defibrillation for all victims of VF cardiac arrest. (3)
- Survival rates in a study by Cobb, et al. showed that victims who received CPR before defibrillation had an improved survival rate compared to the group who received defibrillation first (11).
- Victims with unwitnessed cardiac arrest are most likely in the circulator phase of cardiac arrest (7), which is four to ten minutes from the time of the arrest (12). CPR provides the perfusion that may improve the metabolic state of the heart, resulting in a better response to defibrillation (13).

When to Check for a Pulse or Identify the Rhythm

In the 2000 AHA Guidelines, the pulse or rhythm identification occurred after each shock. The change recommended was to resume CPR immediately without a pulse or rhythm check after defibrillation.

This adjustment to the algorithm was made because:

- ♥ Initial rhythms after the first defibrillation 60% of the times result in asystole or non-perfusing rhythm (8, 14, 15, 16).

Out-of-Hospital Outcomes

Emergency Medical Services (EMS) and firefighters all over the United States and internationally have contributed their experiences and data on cardiac arrest efforts through clinical papers in numerous journals.

There is a wide variability in the reporting of survival rates for communities. The AHA has suggested that cardiac arrests out-of-hospital should be a reportable disease (17). Although no formal process has been created to collect data, many EMS communities have been tracking their outcomes for years.

Much of the out-of-hospital cardiac arrest research has focused on regional differences and improvements in the chain of survival. Efforts, such as improving bystander CPR and use of AED have also been discussed.

Few studies exist which explore the outcomes of providing resuscitation using the 2000 AHA guidelines compared to the 2005 AHA guidelines. Here are some examples of EMS groups that have documented their data.

The Wake County Experience (North Carolina) (18)

This community analyzed data during a baseline phase in which the 2000 AHA guidelines were used to treat victims in cardiac arrest. Three phases were then introduced to roll out aspects of the 2005 AHA guidelines. Phase one focused on minimal interruptions during chest compressions, one shock for defibrillation, control of ventilation rates and the use of the intraosseous route for medications. Phase two introduced an impedance threshold device and phase three implemented hypothermia pre-hospital.

Victims survival to hospital discharge improved by 7.3% from the baseline phase to full implementation of all phases. This number represents three more lives that can be saved per 100,000. Survival rates improved for bystander-witnessed arrests by 17.6%.

Five EMS Systems (Anoka County MN, Northwest Harris County TX, Omaha NE, Pinellas County FL, and Wake County NC) (19)

These locations were selected to due to their experiences with the 2005 AHA guidelines. Data was pooled to compare the control group (victims treated using the 2000 AHA guidelines) and the intervention group (victims treated using the 2005 AHA guidelines).

Survival to hospital discharge was 10.1% in the control group and 13.1% (p=0.007) in the intervention group. The victims who had VT or VF as a rhythm when EMS arrived had a survival to hospital discharge for the control group of 20% versus the intervention group, which was 32.3% (p=<0.001).

Neurological data was compiled from three of the five sites. The overall neurologic outcome improved more than 75% in the intervention group compared to the controls. If the victim had good cerebral performance at discharge, they received a score of Cerebral Performance Category (CPC) 1. If the victim had moderate cerebral disability with sufficient cerebral function, they received a CPC score of 2. 33% of the control group received a CPC neurological score of 1 or 2 as compared to the intervention group, which was 59.6% (p=0.038).

Oslo, Norway EMS (20)

Between May 2003 and April 2005 data was collected for adult patients according to a modified 2000 AHA guideline (the "pre-group"). After the implementation of a Norwegian version of the 2005 AHA guidelines, data was collected for victims of cardiac arrest from January 2006 to December 2007 (the "post-group").

Overall survival to hospital discharge for the pre-group was 11%, followed by 13% (p=0.287) for the post-group. A favorable neurological outcome, using the same scale as described in the previous study was 10% for the pre-group and 12% (p=0.544) for the post-group. Survival rates for victims with bystander witnessed cardiac arrest found to be in VF was 27% for the pre-group and 31% (p=0.622) for the post-group.

Overall Limitations to All These Studies

While these studies all seem to document improvement in survival rates, much of the actual data is not statistically significant. One must consider many factors when attempting to generalize all of the findings. It is difficult to determine what aspect of the 2005 AHA guidelines may have had the most impact on survival rates since each intervention enhances circulation.

In-Hospital Outcomes

The most up-to-date published research for in-hospital cardiac arrest area of resuscitation has explored topics such as performance debriefing (21) and survival rates that vary depending on the day of the week and time of the day (22).

Hospitals all over the United States have shared their outcome data from in-hospital cardiac arrests through the national registry of CPR (NRCPR) and through national conferences and scientific meetings.

Edelson et al (21) conducted a study to evaluate the effects of weekly debriefing sessions of the resuscitations from the prior week based with medical residents. A baseline cohort of patients was studied without feedback sessions when the 2000 AHA guidelines were in place. The intervention cohort of patients was studied from March 2006 – February 2007 with residents using the 2005 AHA guidelines for resuscitation.

The use of feedback sessions improved the rate of return of spontaneous circulation from 45% in the baseline cohort to 59% ($p=0.03$) in the intervention cohort. Survival to discharge was indistinguishable between cohorts, with the baseline cohort had a 9% of patients who survived to discharge compared to the intervention cohort 7% ($p=0.69$).

The Medical Center of the Rockies (23) implemented the mechanical cardiac support into some of their cardiac arrests occurring on in-patient units. Prior to 2007, the survival to discharge rate was between 15-21%. In 2007, the survival to discharge rates improved to 43% of the patients, 33% in 2008, and 44% in 2009. The hospital also added a number of interventions to improve their outcomes, such as pharmacists assisting in cardiac arrests, increasing training for code team members and providing hypothermia to patients who qualify.

The University of California San Diego (24) in 2007 introduced a resuscitation bundle to improve their outcomes from cardiac arrest. The bundle included a rapid response team, training in the new 2005 AHA guidelines, debriefing, use of defibrillators with real time feedback and aggressive post-resuscitation care. Survival to discharge increased from 21% to 42% and neurological outcomes (CPC 1 and 2) doubled.

Conclusion

Outcomes for resuscitation from a cardiac arrest, whether out-of-hospital or in-hospital, are improving, according to the latest scientific evidence. It is certainly possible that the Hawthorne effect was in place, which may have contributed to the positive efforts by the trained medical professionals.

There are many topics that were not explored in this newsletter that may contribute to the future success of next set of guidelines. Understanding the importance of bystander resuscitation efforts and coordination of EMS in communities, and strengthening the chain of survival may also help improve survival rates.

Other areas that need further exploration include studies that focus on compressions only, access to automatic external defibrillators, passive oxygen insufflation, hypothermia protocols, mechanical cardiac support, end tidal CO_2, and automated or visual cue feedback defibrillators.

More studies are required to help determine the impact of the 2005 AHA guidelines. Those interested in resuscitation science will be eager to see how the current research affects the guidelines coming out later this year.

References

1. Alshpach, G. 2005 AHA guidelines for CPR and ECG: New, but improved? *Critical Care Nurse* 2006;26:8-13.
2. Klocko, D. Have the latest CPR guidelines improved cardiac arrest outcomes? *JAAPA* 2009;22(11):30-39.
3. Hazinski, M., Nadkarni, V., Hickey, R., O'Connor, R., Becker, L. & Zaritsky, A. Major changes in the 2005 AHA guidelines for CPR and ECC: Reaching the tipping point for change. *Circulation* 2005;112:IV-206-IV-211.
4. Kaye, W., Mancini, M. Retention of cardiopulmonary resuscitation skills by physicians, registered nurses and the general public. *Critical Care Medicine* 1986;14:620-622.
5. Wik, L. Kramer-Johansen, J., Myklebust, H., Sorebo, H., Svensson, L, Fellows, B., & 5teen, P. Quality of cardiopulmonary resuscitation during out-of-hospital cardiac arrest. *JAMA* 2005;293:299-304.
6. Abella, B., Alvarado, J., Myklebust, H., Edelson, D. Barry, A., O'Hearn, N., et al. Quality of cardiopulmonary resuscitation during in-hospital cardiac arrest. *JAMA* 2005; 293;305-310.
7. Ali, B., & Zafari, M. Narrative review: Cardiopulmonary resuscitation and emergency cardiovascular care: Review of the Current Guidelines. *Annals of Internal Medicine* 2007;147:171-179.
8. van Alem, A., Chapman, F., Lank, P., Hart, A. & Koster, R. A prospective, randomised and blinded comparison of first shock success of monophasic and biphasic waveforms in out-of-hospita cardiac arrest. *Resuscitation* 2003;58:17-24.
9. White, R., Blackwell, T., Russell, J., Snyder, D., & Jorgenson, D. Transthoracic impedance does not affect defibrillation, resuscitation or survival in patients with out-of-hospital cardiac arrest treated with a non-escalating biphasic waveform defibrillator. *Resuscitation* 2005;64:63-69.
10. Morrison, L., Dorian, P., Long, J., Vermeulen, M., Schwartz, B., Sawadsky, B. et al. Out-of-hospital cardiac arrest rectilinear biphasic to monophasic damped sine defibrillation waveforms with advanced life support intervention trial (ORBIT). *Resuscitation* 2005;66:149-157.
11. Cobb, L., Fahrenbruch, C., Walsh, T., Copass, M., Olsufka, M., Breskin, M., e al. Influence of cardiopulmonary resuscitation prior to defibrillation in patients with out-of-hospital ventricular fibrillation. *JAMA* 1999;281:1182-1188.
12. Weisfeldt, M. & Becker, L. Resuscitation after cardiac arrest: a 3-phase time-sensitive model. *JAMA* 2002;288:3035-3038.
13. Kern, K., Garewal, H., Sanders, A., Janas, W., Nelson, J., Sloan, D., et al. Depletion of myocardial adenosine triphosphate during prolonged untreated ventricular fibrillation: effect on defibrillation success. *Resuscitation* 1990;20:221-229.
14. Berg, M., Clark, L., Valemzuela, T., Kern, K., & Berg, R. Post-shock chest compression delays with automated external defibrillator use. *Resuscitation* 2005;64:287-291.

15. Carpenter, J., Rea, T., Murray, J., Kudenchuck, P., & Eisenberg, M. Defibrillation waveform and post-shock rhythm in out-of-hospital ventricular fibrillation cardiac arrest. *Resuscitation* 2003;59:189-196.
16. White, R., & Russel, J. Refibrillation, resuscitation, and survival in out-of-hospital sudden cardiac arrest victims treated with biphasic automated external defibrillators. *Resuscitation* 2002;55:17-23.
17. Nichol, G., Rumsfeld, J., Eigel, B., et al. Essential features of designating out-of-hospital cardiac arrests as a reportable event: a scientific statement from the American Heart Association Emergency Cardiovascular Care Committee; Council on Cardiopulmonary, Perioperative, and Critical Care; Council on Clinical Cardiology; and Quality of Care and Outcomes Research Interdisciplinary Working Group. *Circulation* 2008;117(11):2299-2308.
18. Hincey, P., Myers, J., Lewis, R., De Maio, V., Reyer, E., Licatese, D., et al. Improved out-of-hospital cardiac arrest survival after the sequential implementation of 2005 AHA guidelines for compressions, ventilations, and induced hypothermia: the Wake county experience. *Annals of Emergency Medicine* 2010; Epub Ahead of print.
19. Aufderheide, T., Yannopoulos, D., Lick, C., Myers, B., Romig, L., Stothert, J., et al. Implementing the 2005 American Heart Association guidelines improves outcomes after out-of-hospital cardiac arrest. *Heart Rhythm* 2009, doi:10.1016/j.hrthm.2010.04.022.
20. Olasveengen, T., Vik, E., Kuzovlev, A., & Sunde, K. Effect of implementation of new resuscitation guidelines on quality of cardiopulmonary resuscitation and survival. *Resuscitation* 2009;80:407-411.
21. Edelson, D., Litzinger, B., Arora, V., Walsh, D., Kim, S., Lauderdale, D., et al. Improving in-hospital cardiac arrest process and outcomes with performance debriefing. *Arch Intern Med* 2008;168(10):1063-1069.
22. Perberdy, M., Ornato, J., Larkin, G., Braithwaite, R., Kashner, T., Carey, S., et al. Survival from in-hospital cardiac arrest during night and weekends. *JAMA* 2008;299(7):785-792.
23. Reported data from the Medical Center of the Rockies
24. Reported data from the University of California San Diego