Rural Healthcare Quality Network

Hospital Peer Review

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Hospital Peer Review is a monthly newsletter sponsored by the Rural Healthcare Quality Network to alert Critical Access Hospitals regarding findings from the Peer Review Program. Summarized are a few of the key findings and best practices that would be helpful for other critical access hospitals to be knowledgeable about. This newsletter is edited by Myron Bloom, Medical Director and he can be reached at drmbloom@msn.com.

Should we adopt CCR instead of CPR for Witnessed Cardiac Arrest?

The "2005 AHA Guidelines for CPR" emphasize the importance of quality chest compressions with adequate rate, depth, chest recoil, and minimal interruptions. To limit the frequency of interruptions, the 2005 Guidelines increased the compression-to-ventilation ratio to 30:2 for adult victims with interruptions (including to deliver rescue breaths) limited to 10 seconds or less. However, studies have shown that bystanders performing CPR take an average of 16 seconds instead of the prescribed 4 seconds.

To increase the likelihood of bystander CPR, the "HANDS –ONLY (COMPRESSION ONLY) CARDIOPULMONARY RESUSCITATION: A CALL TO ACTION FOR BYSTANDER RESPONSE TO ADULTS WHO EXPERIENCE OUT OF HOSPITAL SUDDEN CARDIAC ARREST"(*Circulation,* 2008;117;2162-2167) updated the 2005 guidelines to allow compression only CPR (CO-CPR) – but did it go far enough? Unfortunately, this "one size fits all" CPR protocol has been advocated for two entirely different pathophysiologic conditions: primary cardiac arrest and primary respiratory arrest. Perhaps the approach to two different mechanisms of arrest should be different, as the recommendations appropriate for one may not be ideal for the other. And what would best apply for a witnessed arrest in the hospital?

Several observational nonrandomized studies of human bystander CO-CPR were published in 2007, demonstrating no adverse impact on survival when ventilations were omitted. Using a 30-day or 1 year survival with favorable neurological outcome, it was found that survival after bystander CO-CPR did not differ from conventional bystander CPR for adult patients with witnessed out-of-hospital cardiac arrests for both "cardiac" and "non-cardiac" causes.

Cardiopulmonary resuscitation by bystanders with chest compression only (SOS-KANTO): an observational study. *The Lancet.* March 17, 2007;369(9565):920–926.

Iwami T, Kawamura T, Hiraide A, et al. Effectiveness of bystander-initiated cardiac-only resuscitation for patients with out-of-hospital cardiac arrest. *Circulation*. December 2007;116(25):2900–2907.

Bohm K, Rosenqvist M, Herlitz J, et al. Survival is similar after standard treatment and chest compression only in out-of hospital bystander cardiopulmonary resuscitation. *Circulation*. December 2007;116(25):2908–2912

A more detailed study of 9,592 out-of-hospital arrests (including 424 that were witnessed arrests) was published in 2005. Bystander CPR was provided in 1,324 cases (31%), and the type of bystander CPR was documented in 1,151 cases; while 2,917 cases (69%) did not have bystander

CPR. Of those who received CPR, 712 victims (62%) received chest compression plus mouth-to-mouth ventilation and 439 victims (38%) received only chest compression. Neurologically, normal survival at 30 days was 8.2% in those who did not receive any bystander CPR, and 11.2% in those who received chest compression plus mouth-to-mouth resuscitation, and 19.4% for those who received chest compression without assisted ventilation. The authors concluded that CO-CPR may be the preferred approach to resuscitation for out-of-hospital cardiac arrest in adults.

Nagao K, et al. SOS-KANTO study group. Chest compression alone during bystander cardiopulmonary resuscitation. *Circulation*. 2005;112(suppl II):II-324.

Unlike primary respiratory arrests with hypoxia and hypotension and a secondary cardiac arrest, patients with witnessed primary cardiac arrests should theoretically not initially need assisted ventilation because their arterial oxygen content should be sufficient for several minutes of CO-CPR. And in subjects who gasp, the arterial oxygen content may remain adequate for up to 15 minutes during CO-CPR. Because the perfusion of the brain and heart are so marginal during resuscitation efforts, interrupting or delaying chest compressions for ventilation or any other interventions (intubation), except defibrillation, is therefore deleterious and positive pressure ventilation is actually pathophysiologically harmful.

With normal ventilation, breathing results in a negative intra-thoracic pressure enhancing venous return to the heart while causing air to enter the lungs. In contradistinction, positive pressure ventilation increases intra-thoracic pressure, decreasing blood return to the chest and decreasing blood flow to the brain. Aufderheide put it this way, “there is an inversely proportional relationship between mean intra-thoracic pressure, coronary perfusion pressure, and survival from cardiac arrest.” Positive pressure ventilation inhibits venous return to the thorax and right heart and thus results in decreased coronary and cerebral perfusion.

Aufderheide TP, Sigurdsson G, Pirrallo R, et al. Hyperventilation-induced hypotension during cardiopulmonary resuscitation. *Circulation.* 2004;109:1960–1965.

Aufderheide TP and Lurie KG. Death by hyperventilation: a common and life threatening problem during cardiopulmonary resuscitation. *Critical Care Medicine*. September 2004;32(9 Suppl):S345–S351.

If a cardiac arrest is witnessed, the Cardio-Cerebral Resuscitation (CCR) approach is immediate defibrillation, as it is in routine CPR. If the arrest is not witnessed and adequate chest compressions have not been administered, then 200 chest compressions are performed before the first defibrillation. When doing CCR, 200 uninterrupted chest compressions (at 100 per minute) should be done before each rhythm analysis (& shock), then immediately resume another 200 chest compressions before repeat rhythm analysis. The CCR protocol recommends opening the airway with an oropharyngeal device and the administration of high-flow oxygen by a non-rebreather mask. Assisted ventilation and insertion of an advanced airway are not performed until either there is a return of spontaneous circulation or three cycles of chest compressions and analysis. Then, when positive-pressure ventilations are instituted, they should be limited to a rate of 6-10 per minute to minimize adverse intra-thoracic effects.

CCR discourages endotracheal intubation during the electrical and circulatory phases of cardiac arrest due to ventricular fibrillation. Defibrillator pad electrodes are applied and the patient is given 200 chest compressions and a single defibrillation shock that is immediately followed by 200 more chest compressions before the rhythm and pulse are analyzed. The 200 compressions at 100/minute for 2 minutes of chest compression before defibrillation is based on the publications of Cobb et al. who showed improved survival with 90 seconds of chest

compressions before shock, and Wik et al. who showed improved survival with 3 minutes of chest compression prior to defibrillation. After each shock, 200 more chest compressions are provided before rhythm and pulse analysis. This is based on a porcine model of out-of-hospital cardiac arrest observing that after prolonged ventricular fibrillation, an effective shock almost never produces a perfusing rhythm.

Weisfeldt M and Becker L. Resuscitation after cardiac arrest: a 3-phase time-sensitive model. *JAMA*. 2002 Dec 18;288(23):3035–3038.

Cobb LA, Fahrenbruch CE, Walsh TR, et al. Influence of cardiopulmonary resuscitation prior to defibrillation in patients with out-of-hospital ventricular fibrillation. *JAMA*. 1999 Apr 7;281(13):1182–1188.

Wik L, Hansen TB, Fylling F, et al. Delaying defibrillation to give basic cardiopulmonary resuscitation to patients with out-of-hospital ventricular fibrillation: a randomized trial. *JAMA*. 2003 Mar 19;289(11):1389–1395.

CCR was instituted in Tucson, Arizona, in 2003; in Rock and Walworth Counties of Wisconsin in 2004; in metropolitan Phoenix and then throughout Arizona starting in 2005; and in Kansas City, Missouri in 2006 and Kansas City, Kansas, in 2007. In 2008, CCR spread to other areas of Wisconsin.

At the American Heart Association's 2006 Scientific Sessions in Chicago, Dr. Ewy presented data from the Emergency Medical Services in the Phoenix Metropolitan Area showing that 9% of out-of-hospital cardiac arrest victims survived after the implementation of CCR - a three fold increase compared to the 3 % survival rate when first responders used guideline CPR. Another study from Arizona, including the Phoenix metropolitan area, showed survival of such patients more than tripled, from 5% to 18%. Emergency Medical Services in the two Wisconsin counties were also able to increase the neurologically normal survival rates three-fold (15% to 45%) in the first year after they switched from guideline CPR to CCR. First responders applying the new protocol were able to resuscitate the majority (58 percent) of out-of-hospital witnessed cardiac arrest victims, provided they had a "shockable" initial heart rhythm. The third was a three-year follow-up of the Rock and Walworth County results, in which survival increased from 15% to 40%, including one patient who received post-resuscitation hypothermia.

Kellum MJ, Kennedy KW, and Ewy GA. Cardiocerebral resuscitation improves survival of patients with out-of-hospital cardiac arrest. *American Journal of Medicine*. 2006 Apr;119(4):335–40.

Bobrow BJ, Clark LL, Ewy GA, et al. Minimally interrupted cardiac resuscitation by emergency medical services for out-of-hospital cardiac arrest. *JAMA*. 2008 Mar 12;229(10):1158–1165.

Kellum MJ, Kennedy KW, Barney R, et al. Cardiocerebral resuscitation improves neurologically intact survival of patients with out-of-hospital cardiac arrest. *Annals of Emergency Medicine*. 2008 Sept;52(3)244-252.

More recently, Bobrow BJ et al. retrospectively analyzed data for 1,019 adult patients who received minimally interrupted CPR for out-of-hospital VF/VT cardiac arrest in Arizona from 2005 to 2008. Rates of neurologically intact survival were compared for the 560 patients who received initial positive pressure ventilation (BVM at 8 breaths per minute) and the 459 patients who received initial passive ventilation CO-CPR at the paramedic's discretion. Rates of neurologically intact survival were higher in the CO-CPR passive ventilation group than in the BVM group among patients with witnessed arrest (38.2% vs. 25.8%; adjusted odds ratio, 2.5); but rates were more similar in the two groups of patients with unwitnessed arrest (13.8% and 7.3%; adjusted OR, 0.5). Passive ventilation was associated with higher rates of neurologically intact survival than those with BVM in patients with witnessed VF/VT cardiac arrest.

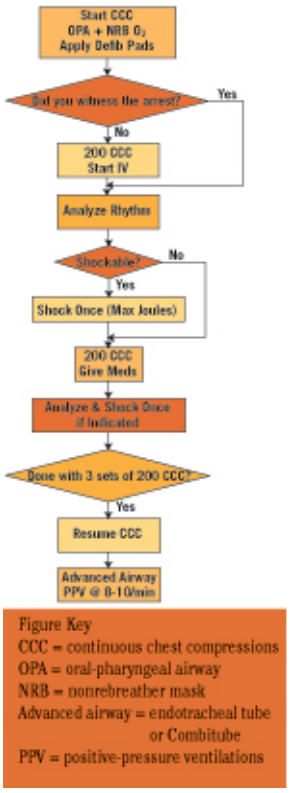
Bobrow BJ, Ewy GA, Clark L, et al. Passive oxygen insufflation is superior to bag-valve-mask ventilation for witnessed ventricular fibrillation out-of-hospital cardiac arrest. *Annals of Emergency Medicine*. 2009 Nov;54(5):656-662.

The CCR protocol (*Figure 1*) seems logical for primary cardiac arrest -i.e., witnessed unexpected collapse in or out of the hospital. In all other situations, AHA guidelines (30:2) ACLS should still be used.

Summary:

CCR is a new advanced cardiac life support algorithm that emphasizes minimal interruptions of chest compressions, deemphasizes positive-pressure ventilations, delays endotracheal intubation, prioritizes defibrillation according to the three-phase time-sensitive model of ventricular fibrillation. CCR promotes continuous chest compressions (CCC) at a rate of 100 per minute for three cycles before assisted ventilation. Epinephrine is administered via IV or IO ASAP when appropriate. Another component of CCR is the establishment of cardiac arrest centers that can provide optimal care including urgent cardiac catheterization, controlled mild therapeutic hypothermia, and standardized supportive care for patients in coma after resuscitation from cardiac arrest.

Figure 1: The Cardiocerebral Resuscitation protocol



Additional Resources:

- Ewy GA. Cardiocerebral resuscitation: The new cardiopulmonary resuscitation. *Circulation*. 2005;111:2134–2142.
- Ewy GA. Cardiac arrest-guideline changes urgently needed. *The Lancet*. 2007 Mar 17;369(9565):882–884.
- More information is also available on the Save Hearts in Arizona Research and Education (SHARE program) website, http://www.azshare.gov/index.htm.

How effective are the drugs used in CPR?

A randomized trial of 851 consecutive adult patients with out-of-hospital cardiac arrest in Oslo, Norway from 2003 to 2008, comparing ACLS without IV access or ACLS with IV access and drug administration found the rate of hospital admission for patients with ROSC was significantly higher in the group with IV access than in the group without IV access (32% vs. 21%). However, no significant differences were found between the IV-access and no-IV-access

groups in rates of survival to discharge (10% and 9%), survival with favorable neurological outcome (10% and 8%), or survival at 1 year (10% and 8%).

In the group that received ACLS without IV access, IV access was established within 5 minutes after return of spontaneous circulation (ROSC). In both groups, patients with ventricular fibrillation received cardiopulmonary resuscitation for 3 minutes before the first shock and between unsuccessful series of shocks. Endotracheal intubation was standard, and post-resuscitation therapeutic hypothermia was instituted, regardless of initial rhythm or course of arrest. Quality of CPR was determined by transthoracic impedance signals from defibrillators. The results are consistent with those from other studies in which epinephrine, atropine, and amiodarone improved short-term, but not long-term, outcomes when compared to placebo.

Olasveengen TM, Sunde K, Brunborg C, et al. Intravenous drug administration during out-of-hospital cardiac arrest: A randomized trial. *JAMA*. 2009 Nov 25;302(20):2222-2229.