The use of algorithms in cardiac arrest management

By Heather Mercer, RN

Managing a cardiac arrest can be a highly stressful and anxiety-provoking event for emergency nurses. This article describes how the use of algorithms in training and practice can aid nurses in functioning competently and efficiently, ensure nursing actions are based on best practice standards, and decrease the stress and anxiety of the event. Current standards for emergency cardiovascular care, with suggestions for how algorithms can be taught and introduced into clinical nursing practice, will be outlined. Implications for individual nursing practice will be examined, as, ultimately, using algorithms as a management tool for cardiovascular emergency care has the goal of improving patient clinical outcomes.

Nurses' experiences with cardiac arrests

Many nurses rate participating in the management of a cardiac arrest as one of the most stressful job situations they find themselves in (Manderino et al., 1986; Covell, 2006). In a study investigating critical incident debriefing, Mitchell (1984) found that the psychological aspects of dealing with a cardiac arrest included very high anxiety. Nurses identified working against the clock, having no second chance to do things, and sudden swings between quiet times and great activity as stress-producing aspects of cardiac arrest management (Farrington, 1995). Another source of stress was confusion during the arrest, as staff struggled to find which role to take, and reduced stress when a team leader was recognized/appointed (O'Donnell, 1990; Covell, 2006). Nurses have repeatedly expressed fear surrounding the "code" process despite what was considered adequate preparation (McCarthy, 2007).

Nursing preparation is key for competent performance during cardiovascular emergencies. In an analysis of cardiac arrests occurring in an emergency department and managed by nurses, Daniele (2012) found that although more than 96% of emergency nurses had recently completed Advanced Cardiac Life Support (ACLS) and triage training, only two-thirds of them felt safe in the management of a cardiac arrest. In another study of U.S. hospitals, 62% of ACLS-certified nurses felt prepared to lead a resuscitation event, and only 44% of nurses thought the ACLS course provided sufficient training to lead a cardiac resuscitation team (Besser et al., 2010).

Some of the techniques that health agencies and schools use to teach nurses emergency cardiovascular care (ECC) include traditional classroom instruction, simulation labs, and hands-on experience (Manderino et al., 1986; Covell, 2006). However, many studies have demonstrated a deterioration in CPR performance within months of a course, as knowledge retention is low in critical incidents (Oermann et al., 2011; Kaye & Mancini, 1986). An established process is necessary so that nurses do not need to depend solely on procedures committed to memory when the stakes are high.

Why best practice matters

McKibbon (1998) describes evidence-based practice as "an approach to healthcare wherein health professionals use the best evidence possible, i.e., the most appropriate information available, to make clinical decisions for individual patients". Evidence-based nursing practice is a model for nursing care that bases decisions and actions on current best evidence in order to deliver the best outcomes. Sometimes the "evidence" may be obtained through research studies or meta-analyses of studies, or it may be an amalgamation of traditional expertise and experience that has previously generated exceptional outcomes. One reason that practice standards are incorporated into and enforced by nursing management is so that nurses are consistently making decisions that are proven to yield the desired outcomes. Studies show that nurses who are confident about their skills perform more competently during a cardiovascular emergency, and yield better outcomes (Covell, 2006).

Advanced Cardiovascular Life Support (ACLS) guidelines have changed in recent years to reflect new evidence leading towards better outcomes. For example, studies showed that many nurses and other health care providers were unable to quickly and accurately identify a pulse in a crisis situation or with hemodynamically challenged patients (Sullivan, 2008). Research also indicated that a delay of merely seconds to minutes in starting chest compressions was inversely proportional to survival rates of patients (Hazinski, 2010). Because of these and other findings, the American Heart Association (AHA) changed their recommendations for emergency cardiovascular care to commence chest compressions without first ascertaining an absolute lack of pulse (Barill & Dare, 2011). This is an example of new evidence informing changes in practice standards.

The American Heart Association is the North American leader in researching, promoting and publishing guidelines for cardiovascular care, and the European Resuscitation Council (ERC) is their European counterpart. The AHA and ERC both publish similar guidelines and algorithms for use by nurses, doctors, paramedics and lay people for managing cardiovascular emergencies and many of these guidelines are adopted by health authorities and hospitals as standards of practice for their staff to follow (American Heart Association, 2011; Barill & Dare, 2011). Provincial organizations such as the Heart and Stroke Foundation of British Columbia use adapted versions of the AHA's recommendations, which are based on research studies and incorporated into practice standards all across Canada and the U.S., and become part of best practice for nurses to follow.

Guidelines from the AHA and other agencies ensure that nurses are able to achieve optimal outcomes for emergency cardiovascular care. The AHA publishes algorithms that are taught in ACLS courses and used as part of core curriculum for emergency nursing preparation. They caution that particular algorithms rarely correspond exactly to real-life patient situations, and don't replace a flexible and thorough understanding of patient care (McCann, 2006). However, they are useful in clinical scenarios to make sure nothing is missed, to direct an initial treatment approach, to summarize a large amount of information, and to ensure evidence-based best practice.

Some of the algorithms they publish include general overviews for adult cardiac arrest, acute coronary syndrome, atrial fibrillation/flutter, and algorithms for special populations such as pregnant patients, among others (McCann, 2006; AHA, 2011; Barill & Dare, 2011). Their universal adult acute cardiovascular life support algorithm is used as a standard in health authorities across British Columbia (American Heart Association, 2011; Barill & Dare, 2011).

Current standards for emergency cardiovascular care

Current standards for emergency cardiovascular care (ECC) in a hospital setting are available from the AHA. The universal guidelines are established to support the 'chain of survival', which includes early access, early CPR, early defibrillation, and early ACLS (McCann, 2006). After initial assessment and CPR initiation, many of the algorithms direct the nurse to identify the type of rhythm present in the patient, as this will determine which algorithm to continue with. Nurses can assist in attaching leads, monitors or defibrillator pads for a 12-lead ECG (Deakin & Nolan, 2005; Awar & Walinsky, 2003).

In between rhythm assessment, nurses can continue with chest compressions, establish IV/IO access, assist with endotracheal intubation or other ventilation efforts, administer medications, monitor vital signs, document actions taken during the code, perform secondary surveys and carry out many other interventions (McCann, 2006; Barill & Dare, 2011; Gonzales et al., 2010). Although there are many different algorithms available for different situations, the universal algorithm is still useful in all situations because evidence indicates that the most likely arrhythmia underlying cardiac arrest is ventricular fibrillation (VT), which is managed with the universal algorithm (Jennings, 1993). In addition, non-VT rhythms are still treated the same way initially (McCann, 2006).

Another current standard for ACLS recommended by the AHA is quality CPR, which is defined in their guidelines and has demonstrated improved patient outcomes, as opposed to ad-hoc bystander CPR (Barill & Dare, 2011). The AHA and ERC also recommend simultaneously attempting to treat reversible causes, such as hypothermia or cardiac tamponade (Hazinski, 2010). Other standards include guidelines for cardiac drug use, and each algorithm has corresponding recommendations for dosing and administration. For example, epinephrine is recommended to increase cardiac output and peripheral resistance for non-ventricular fibrillation/tachycardia, as well as ventricular fibrillation/tachycardia (Barill & Dare, 2011; McCann, 2006). Following the initial management of a cardiac arrest is post-arrest care, for which algorithms are also available that direct therapeutic induced hypothermia and transfer to a specialized care unit (Chapman, Dietrich, & Lutes, 2009).

Teaching and using algorithms

As mentioned previously, nurses would benefit from having established flow processes and guidelines for managing ECC that did not force them to recall large amounts of critical information during crisis situations. Having algorithms such as those published by the AHA available for use would serve an ideal purpose. Flow diagrams or algorithms focus the nurse on the priority actions when it is easy to get distracted by procedures such as establishing airways or intravenous access (American Heart Association, 2000). There are several keys to training and supporting nurses in using algorithms.

First, it is important for nurses to be trained as part of an interdisciplinary team. Because in-hospital code management is almost always performed with a group of multi-skilled interdisciplinary personnel, it is essential for each member of the team to understand the roles of the others and be able to complement them (American Heart Association, 2000). While the character of the team leader of the resuscitation attempt is important, what has a greater impact on outcome is the character of the team as a whole (Zaritsky et al., 1995). One way this might be accomplished is by training nurses in ACLS alongside physicians, respiratory therapists and other health care providers and instructing them in recognizing who would fill each specific role. Some of the recommended ECC actions, such as treatments for reversible causes of arrhythmias, may fall outside the scope of registered nurses and need to be performed by another team member, and nurses need to know who that is going to be (CARNA, 2006).

A second component for training in ACLS is using simulated situations where nurses can practise hands-on skills. A study of nursing students who practised CPR skills on mannequins that gave automated feedback and increased their proficiency at motor skills found that they retained the skills longer than students who were taught the procedures in traditional didactic lecturing (Oermann et al., 2011). Algorithms can facilitate this process by summarizing key information so that nurses and nursing students have it available to refer to during practice. It is important that these skills are reviewed and practised, as studies have shown that CPR performed by nurses is often not consistent with practice standards (Abella et al., 2005).

A third way that the use of algorithms can support and facilitate nursing practice is by having them readily available in emergency departments and other hospital units for staff to easily access. Often laminated charts or books are stocked as part of a crash cart, such as *The Handbook of Emergency Cardiovascular Care for Health Care Providers* published by the AHA (2010). This ensures that the most current evidence is available to support decision-making in spite of being in a crisis situation where knowledge-retention from training is quite low. The key features of an algorithm or flowchart are easy-to-remember summaries of important information, such as the traditional A-B-C approach to lifesaving, which has been successfully indoctrinated into lay-persons' language (McCann, 2006).

Algorithms can be used during ACLS instruction as a focal point for summarizing more complex information, as a class outline, or as an educational aid to take home or memorize. They can be printed on the back of staff nametags, be available on the walls of nursing stations, or on crash carts. As periodic updates based on current evidence from either local or international sources become available, the updated versions can be distributed to staff. Because of the team-based nature of emergency cardiovascular care, the same algorithms with appropriate corresponding details should be given to all members of the code team, not just nurses.

Implications for nursing practice

Researching the usefulness of ACLS algorithms has given me an opportunity to appreciate the importance of integrating current evidence with practice standards and daily nursing care. I recently participated in a stressful code blue response to a cardiac arrest in hospital and found the environment to be chaotic, disorganized, and created a large amount of tension and anxiety among nursing staff. Long after the event, I replayed it in my mind and examined my practice to see where I could have performed better. Since participating in ACLS courses and continuing to take part in cardiac arrest management in the emergency department, as well as reviewing algorithms, I have felt my sense of competence growing. Covell and colleagues found that adequate preparation for and use of appropriate algorithms decreases nurses' anxiety and gives them a sense of competence that translates into improved patient outcomes (2006). By constantly seeking to examine their practice and basing actions on evidence, nurses can move towards optimal outcomes for their patients. One

way this is reassessed is by yearly CPR recertification and notification of new changes to evidence-based recommendations.

Even without the opportunity to apply algorithms during cardiac arrests, nurses can still apply the principles of evidence-based practice standards and prioritization of actions to other critical care situations. For example, sepsis management, protocols for acute asthma exacerbation, and trauma nursing. Each crisis situation is an opportunity to learn more and become more efficient and competent for the next instance that comes up and, although preparing ahead is crucially important, having easily accessible information is another key to successful practice.

Conclusions

Although emergency cardiovascular care has the potential to be a difficult, stress-producing experience for nurses; through proper training and with the use of flexible, clear guidelines in the form of algorithms, nurses can be well prepared. Although mastering advanced cardiac life support may require years of practice and encountering a variety of experiences, novice nurses can get a head start by learning to prioritize actions in crisis situations. Algorithms aid in summarizing the most current and best evidence to guide nurses' practice, and they can be easily distributed and taught in a hospital setting. Future research needs to be done examining the efficacy of having practice standards and flow process standards available for nurses and their direct influence on outcomes.

About the author

Heather Mercer is an RN working in Kelowna General Hospital Emergency. She has a background in chemistry and medicine and is happy to have found her way to emergency nursing, as it is a great fit for her. She lives with her husband and cat and enjoys playing hockey, gardening, and hanging out with 14 nieces and nephews.

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