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Pre-Hospital Therapeutic Hypothermia: Will it Save a Life

Therapeutic hypothermia has emerged as one of the hottest topics in critical care medicine and although a few continue to debate the proven benefits of induced hypothermia, many have accepted its use as a treatment modality for multiple illnesses and injuries. As the benefit has become more evident within the hospital, practitioners have looked for ways to expand this treatment to even more patients.

One of the ways to expand this treatment and possibly increase survival following sudden cardiac arrest is to implement the protocol in the pre-hospital setting. When looking at pre-hospital therapeutic hypothermia, one must first look at the literature to see if the treatment is warranted outside of the hospital, and then they must look at the obstacles that may prevent implementation.

In 2001, King County Medic One in Seattle, Washington USA started a two-year trial study of the benefits of therapeutic hypothermia for patients that had return of spontaneous circulation (ROSC). The King County Medic One study demonstrated a twenty percent increase in survivability in the ventricular fibrillation patient population (n=29, 69% of ventricular fibrillation patients with therapeutic hypothermia versus 45% of ventricular fibrillation patients without therapeutic hypothermia) (Kim et al. 2008). In 2004, King County Medic One discontinued the trial study in order to evaluate the data and make appropriate recommendations.

In October 2002, the European Resuscitation Council, and the International Liaison for Committee for Resuscitation endorsed therapeutic hypothermia after cardiac arrest. In 2005 the American Heart Association endorsed therapeutic hypothermia as a Class IIA treatment for all ventricular fibrillation and ventricular tachycardia arrests, and made a Class IIB treatment for pulseless electrical activity and asystole arrests that were cardiac in origin. Following the American Heart Association recommendation, Regional One Air Medical Services in Spartanburg, South Carolina USA (a helicopter EMS service staffed with a pilot, flight nurse and flight paramedic) began this treatment for all adult cardiac arrest patients whose etiology was presumed medical in nature.

It is important to note that although therapeutic hypothermia has been endorsed by the American Heart Association, European Resuscitation Council, and the International Liaison Committee on Resuscitation, there was no specific verbiage by any of the recommending bodies regarding the efficacy of starting therapeutic hypothermia in the pre-hospital setting. Instead, the recommendations simply stated, "must be initiated as soon as possible" and left the interpretation regarding time of induction to the individual physicians. Because the recommendations did not specifically address therapeutic hypothermia induction in the pre-hospital setting, many physicians hesitated to push early induction outside of the hospital. A recent study in the United States found that 21 percent of EMS physicians who do not advocate therapeutic hypothermia by paramedics do so only because of the lack of specific wording within the American Heart Association guidelines stating that it should be started pre-hospital (Clumpner and Mobley 2008).

Another stumbling block to the widespread implementation of pre-hospital cooling was the lack of available research clearly indicating increased survivability with early induction. One of the first research trials conducted for pre-hospital therapeutic hypothermia was the Rapid Infusion of Cold Hartmann's for Hypothermia following Cardiac Arrest (RICH Trial) conducted by Dr. Stephen Bernard in Melbourne, Australia. The results of the trial showed no significant increase in survivability with the early induction of therapeutic hypothermia by paramedics. The results of this study were quoted widely by physicians who did not advocate early induction of therapeutic hypothermia. However, upon closer examination of the study, it was found that the lack of increase in survivability was due in part to the failure of the receiving hospitals to continue therapeutic hypothermia. In order for pre-hospital therapeutic hypothermia to be successful, it must be continued in the hospital.

The lack of published data following the RICH trial was because of few pre-hospital agencies practicing the protocol, and the hesitation by EMS physicians to publish data with a small patient population. However, in the last two years, more research has become available from pre-hospital agencies as they have treated more patients and have been practicing the protocol longer. In early 2005, Regional One Air Medical services became the first pre-hospital provider in the world to implement a nontrial therapeutic hypothermia protocol for all adult post-cardiac arrest patients with return of spontaneous circulation who arrested because of non-trauma etiology. Data from this program has shown a three-fold increase in survivability to discharge since protocol implementation.

Data from Wake County EMS (Raleigh, North Carolina, USA) has shown an impressive four-fold increase in survival to discharge following their pre-hospital therapeutic implementation in late 2007. As Dr. Brent Myers, Medical Director for Wake EMS stated, "Our findings not only demonstrate beneficial outcomes for victims of cardiac arrest, but also suggest the possibility that such treatment plans can be implemented for other medical conditions." It is important to note that successful pre-hospital therapeutic hypothermia must look at survival to discharge from the hospital, not simply the return of spontaneous circulation upon discharge at the emergency department. Many EMS services, which do not have a therapeutic hypothermia protocol boast survival rates from cardiac arrest nearing twenty percent. However upon closer examination this only takes into account a patient delivered to the hospital with a pulse following cardiac arrest. When the survival to discharge rate with no neurological deficit is examined, it is often found to be similar to the United States national average of three percent.

Pre-hospital services that have implemented a therapeutic hypothermia protocol average a survival to discharge (with no neurological deficit) success rate of twelve percent, nearly four times that of the national average. It is critical to point out that therapeutic hypothermia is not the magical treatment to increase cardiac arrest survivability. Therapeutic hypothermia needs to be used in tandem with best practices in resuscitation. These best practices include effective chest compressions with minimal interruptions, controlled ventilations with deliberate prevention of hyperventilation (rate of 8-10 breaths per minute with end tidal CO₂ between 35-45 mm Hg), and therapeutic hypothermia induction. Introduction of best practice resuscitation can immediately double or triple survival to discharge (Martin 2008).

Best practice resuscitation is no more evident than with Seattle Washington's King County Medic One with a survival to discharge rate of 16 percent. In 2007 Detroit, Michigan had 561 patients who experienced sudden cardiac arrest and resuscitation was attempted. One patient survived to discharge (Polderman 2008). Implementation of therapeutic hypothermia in this service with 100 percent increase in survivability would still be a statistical anomaly. You have to correct problems in resuscitation to see results in implementation of a therapeutic hypothermia protocol. One of the keys to success in good practices of resuscitation is frequently train and test personnel in CPR. Dr. Marvin Wayne from Whatcom County Medic One, a suburb of Seattle, Washington (USA) said one of the secrets to increasing their cardiac arrest survival rates was to train and test their personnel in CPR three times a year.

Will early induction of therapeutic hypothermia by pre-hospital personnel increase survivability? A study conducted in 1993 showed that some of the most beneficial effects of therapeutic hypothermia are achieved if hypothermia is initiated within 15 minutes of ROSC (Kuboyama et al. 1993). In 2005 the American Heart Association stated, "A clear biological rationale for the earliest possible induction of therapeutic hypothermia exists." A 2008 study by Wolff et al demonstrated that patients who had a lower starting temperature at the beginning of hypothermia induction, and who reach therapeutic temperature sooner showed better neurologic outcome. Furthermore, his study demonstrated that any sixtyminute delay in reaching therapeutic temperature would worsen the likelihood for favourable outcome by 27 percent (Wolff et al. 2008). Although the study was retrospective and had a low patient population (n=28), the results are still promising and warrant further research. It will be of interest to determine if therapeutic hypothermia initiated during resuscitation will increase survivability. This treatment is currently being studied by several EMS services, and hopefully the data will soon be published.

When EMS agencies want to start a therapeutic hypothermia protocol, one of the first questions they want to know is the cost. Therapeutic hypothermia is a relatively inexpensive treatment with a proven outcome (NNT=6) (Nolan et al. 2003). Large EMS systems have implemented therapeutic hypothermia for as little as €3 per patient with total system costs less than €3800. Start up costs are dependent upon the ability to chill fluids, monitor internal temperatures, use of sedative and/or paralytic medications, and external cooling devices such as gel pads or ice packs. Despite the start up costs, therapeutic hypothermia remains as one of the cheapest treatments that can be initiated with the best outcome.

When deciding whether or not to implement therapeutic hypothermia in the pre-hospital setting it is important to review the current recommendations by various committees. The European Resuscitation Council stated that pre-hospital hypothermia is "safe and effective even if there is a lack of experience." Research articles have concluded that "therapeutic hypothermia is safe and feasible and that a prospective and randomised trial in the pre-hospital setting is not feasible nor is it justifiable" and that "withholding therapeutic hypothermia in a pre-hospital control group would be unjustifiable from an ethical point of view" (Scheffold et al. 2008). To underscore this point, there are now lawyers in the United States who are suing medical providers who do not offer therapeutic hypothermia as a treatment modality.

Will pre-hospital therapeutic hypothermia save lives? The data that is currently being published from prehospital providers who are practicing the protocol has shown a remarkable four-fold increase in survival to discharge. Therapeutic hypothermia must be employed in tandem with good resuscitation practices in order to achieve optimal success. As we continue to strive to learn the optimal method to resuscitation patients from sudden cardiac arrest, we must continue to explore every potential treatment modality that may increase survival to discharge.

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