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Effects of Early Initiation of Induced Therapeutic Hypothermia

by

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A thesis submitted to the faculty of
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Abstract

Cardiac arrests are responsible for about 325,000 deaths annually in the United States (Heart Rhythm Foundation, 2010). The majority of these cardiac arrests occur outside the hospital setting, with a dismal national survival rate of 8% (American Heart Association, 2010). The Bernard (2002) and HACA (2002) studies demonstrated that by initiating therapeutic hypothermia as a treatment modality for cardiac arrests the survival rate could be as high as 49% and 55% respectively. Therapeutic hypothermia can be initiated in many different settings. The question remains, does the setting of the initiation of therapeutic hypothermia effect patient outcomes? The purpose of this study was to compare the effects of initiation of therapeutic hypothermia by EMS, Emergency Departments, and ICU nurses on cardiac arrest patient outcomes as measured by the Glasgow Coma Scale at discharge

This study utilized a convenience sample of 178 consecutive cardiac arrest patients admitted from 2008-2010 in an 800-bed hospital in Western North Carolina. From the overall sample, 57 patients had a favorable neurological outcome (32% overall survival rate). EMS initiated therapeutic hypothermia in 24 instances with 7 patients surviving to discharge (29% survival rate). The Emergency Department initiated therapeutic hypothermia in 17 instances with 8 patients surviving to discharge (47% survival rate). ICU nurses initiated therapeutic hypothermia in 137 instances with 42 patients surviving to discharge (31% survival rate).

Study results reproduced previous findings demonstrating the efficacy of therapeutic hypothermia in the treatment of cardiac arrests. The results also indicate a possible advantage to the initiation of therapeutic hypothermia by Emergency Departments.

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Chapter I

Statement of the problem

Cardiac arrest is a condition where the heart starts beating erratically (ventricular fibrillation) or stops beating completely. According to the Heart Rhythm Foundation it is the leading cause of death annually (Heart Rhythm Foundation, 2010). This event is primarily due to an electrical conduction problem, a blockage in a coronary artery, a cardiac arrhythmia, or other causes. Cardiac arrests are responsible for about 325,000 annual deaths (Heart Rhythm Foundation, 2010). The majority of cardiac arrests occur out of the hospital, with a national survival rate of 8% (American Heart Association, 2010).

Background and need

To understand the purpose of this study it was necessary to examine previous research and studies in the field. The background literature for this study focused on therapeutic hypothermia treatment articles published between 2002 and 2010. The initial key word search on hypothermia, in CINAHL for articles on the topic yielded 2229 articles (1994-2010). However, a narrowing down of the search using key words - therapeutic hypothermia, yielded 190 articles for the same period. This study focused on the articles from 2002 -2010. The primary basis for including articles from 2002 was to allow inclusion of the groundbreaking Bernard and HACA studies published that year in The New England Journal of Medicine (Collins & Samworth, 2008).

The Bernard study, a randomized controlled European trial that consisted of 77 patients, demonstrated favorable neurological outcomes for 49% of the patients that received therapeutic hypothermia versus 26% in the group that did not receive the treatment (Bernard, 2002). The Hypothermia After Cardiac Arrest (HACA) Group study,

a randomized controlled Australian trial that consisted of 275 patients, demonstrated favorable neurological outcomes for 55% of the patients that received therapeutic hypothermia versus 39% in the group that did not receive treatment (HACA, 2002). The studies each had several limitations; however, their results have been the basis for the initiation of the American College Cardiology 2005 and 2010 guideline recommendations in support of therapeutic hypothermia. Both studies concluded that hypothermia treatment for cardiac arrest patients improved outcomes (Collins & Samworth, 2008). There have been several studies conducted since these but they have not been as large, randomized or completed.

Purpose of the Study

The purpose of the study was to compare the effect of initiation of therapeutic hypothermia by EMS personnel as compared to emergency room nurses and ICU nurses on patient outcomes as measured by the discharge Glasgow Coma Scale in cardiac arrest patients. The focus of this study was on the early initiation of hypothermia by emergency department nurses or EMS paramedics as compared to intensive care unit nurses at an 800 bed primary care facility in Western North Carolina.

Each year, two hundred thirty-six thousand to three hundred twenty-five thousand deaths can be attributed to out of hospital cardiac arrests. These deaths may also be looked upon as a number that can be decreased through the use of induced hypothermia (Nichol et al., 2010). This study served to gather data about patient mortality outcomes with early initiation of induced hypothermia as measured by the Glasgow Coma Scale. The findings from this study will be utilized to support the initiation of a regional cardiac arrest system that employs induced hypothermia as a treatment as well as adding to the general knowledge in the field.

Significance

The study results will add to the evidence based knowledge about therapeutic hypothermia. The results of the study will help to increase EMS provider as well as nursing awareness of therapeutic hypothermia and early initiation with cardiac arrest patients. The data will help support the need for regional cardiac arrest systems and the early initiation of therapeutic hypothermia by regional emergency departments and EMS systems. The patients that received the hypothermia treatment within the study may have had an increased chance of survival based upon the low survival rate of cardiac arrest patients who do not receive treatment versus those who do.

Research Question

The research question that was examined by this study- Comparatively does the initiation of therapeutic hypothermia by emergency room nurses or EMS paramedics or ICU nurses, decrease mortality for cardiac arrest patients?

Definition of terms

The following definition of terms will provide a guide to better understand therapeutic hypothermia.

Arrhythmia is an electrical heart rhythm disorder (Heart Rhythm Foundation, 2010).

Asystole is the absence of any cardiac rhythm.

Myocardial infarction is defined as a blockage in the coronary arteries that can lead to heart muscle tissue death (American Heart Association, 2010).

Pulseless Electrical Activity is an observed cardiac rhythm without a palpable pulse.

Sudden cardiac arrest is an unexpected failure of the heart's electrical system which results in an abnormal beating of the heart (American Heart Association, 2010).

Therapeutic hypothermia is the process to lower a patient's temperature through infused cold saline, ice packs, cooling blanket or a mechanical device

Ventricular Fibrillation is an irregular rapid heartbeat in which the heart ventricles spasm but do not pump blood to the body (Heart Rhythm Foundation, 2010).

Ventricular Tachycardia is a very rapid regular heartbeat that is initiated in the ventricles of the heart which may lead to ventricular fibrillation or more serious conditions (Heart Rhythm Foundation, 2010).

Theoretical Framework

Faye Abdellah's Patient-Centered Approaches in Nursing theory will be the theoretical framework used to describe the elements of the study. Abdellah's theory places emphasis on the patient as opposed to the disease. It is a grand theory which by definition is a wide-ranging conceptual framework for nursing practice. Abdellah developed a grand theory that defines twenty-one human need nursing problems that the nurse problem-solves through caring for the patient as a whole being.

The role of the nurse in therapeutic hypothermia as the problem solver is a strong indication for the application of this theory for the study. The nurse will be focused on the cardiac arrest patient from the moment they enter the emergency department and they will play a major role in the initiation of therapeutic hypothermia. The management of the patient's physiological needs will be great and will require the nurse to assess all the systems at once in order to decrease the already high risk of mortality already associated with cardiac arrest.

Chapter II

Literature Review

Out of hospital cardiac arrests are responsible for 236,000 to 325,000 annual deaths in the United States (Nichol et al, 2010). The median survival rate for patients is 8.4% (Nichol et al, 2010). The survival rate can be misleading due to the reality that most “survivors” are not neurologically intact, thus making the quality of life survival rate even lower. These statistics elucidate the need for interventions that can result in favorable outcomes. Therapeutic hypothermia is that intervention. Trials such as HACA (2002) and Bernard (2002) have demonstrated favorable outcomes as high as a 55% survival rate. These trials were both randomized and included 275 and 77 patients respectively (HACA, 2002; Bernard, 2002).

This study examined the initiation of therapeutic hypothermia by regional EMS agencies and emergency room nurses as an intervention for out of hospital cardiac arrests. This was a non randomized retrospective study that measured various data elements including patient mortality, and neurological status upon discharge. The data from this research study will be utilized to demonstrate the development and initiation of a regional therapeutic hypothermia system that may be replicated in other areas as well as adding to the general knowledge in the field of cardiac arrests.

The literature review reflects data from the CINAHL database from 2005-2010. The key words utilized were hypothermia, induced hypothermia, therapeutic hypothermia, and cardiac arrest. The search was limited to articles published in English, from 2005 and on, full text, and peer reviewed of which 8 were chosen as representative of the data. The literature review combines surveys, trials, a case study, and prior literature reviews in order to give a complete history and current state of hypothermia.

The major gaps are lack of current large randomized studies and lack of trials that include the pre-hospital initiation of therapeutic hypothermia. The following article summaries illustrate the gaps in knowledge that justified this study.

An internet survey was conducted by Kennedy, Green and Stenstrom (2008) to examine the use hypothermia treatment for cardiac arrest patients by Canadian Emergency Room physicians. The study consisted of 247 completed surveys from ER physicians and residents. The researchers determined that a total of 47% of the respondents had used hypothermia treatment for cardiac arrest patients. The researchers derived that the main influential factor for hypothermia use was the presence of a policy or protocol defining its use (Kennedy, Green and Stenstrom 2008).

A convenience questionnaire study was conducted by Suffoletto, Salcido, and Menegazzi (2008) to examine the prevalence of EMS agencies utilizing Induced Hypothermia and the barriers to implementation. The researchers utilized 145 completed questionnaires from physicians at the National Association of EMS Physicians which represented 59% of the physicians present. The researchers found that only 6.2% of the physicians had hypothermia protocols in place in their respective EMS services. The researchers tabulated the main barriers to initiation of a hypothermia protocol as: a) EMS overburdened with other tasks- 62.1%, b) short transport times- 60.7%, c) no refrigeration equipment – 60%, d) and lack of continuation of hypothermia treatment at the hospital receiving the patient- 56.6%. The researchers believed the low use of induced hypothermia will increase with the initiation of cold saline as an acceptable cooling method (Suffoletto, Salcido, and Menegazzi, 2008).

A retrospective clinical audit was conducted by Hay, Swann, Bell, Walsh and Cook (2007) to examine therapeutic hypothermia in relation to: case mix of admitted Out

of Hospital Cardiac Arrests and features that predict positive outcomes, the use of a clinical pathway, treated patient outcomes, and LOS and utilization of resources. Data from 139 ICU patients between January 2002 and December 2005, who were admitted with cardiac arrest, were used in the study. The researchers found that 27% of all patients treated had a positive outcome with the largest subgroup of the case mix being those presenting with VF, 41% (Hay, Swann, Bell, Walsh & Cook, 2007). The researchers concluded that the introduction of the hypothermia clinical pathway improved the number of patients being cooled and the proportion of the patients achieving the cooling targets. Researchers found that 21% of patients included in the trial that received hypothermia treatment would not have been included in a previous large European clinical trial. The researchers illustrated the median ICU LOS for all patients in the study was 1.9 days and the median length of the total hospital stay was 2.4 days. The findings from the study support the use and implementation of therapeutic hypothermia for cardiac arrest patients (Hay et al., 2007).

A literature review was conducted by Collins and Samworth (2008) to evaluate the studies about the utilization of therapeutic hypothermia on cardiac arrest patients. The researchers analyzed related studies from numerous databases for the period of 1997-2007. The researchers found that there were two randomized controlled trials which provided apparent support for the use of therapeutic hypothermia in the treatment of cardiac arrest patients. The researchers suggest further research about the use of in hospital arrest and earlier initiation is needed. The researchers recommend that hospitals should devise therapeutic hypothermia policies/procedures since favorable outcomes from the studies support its use (Collins and Samworth, 2008).

A literature review was conducted by Koran (2008) to evaluate the use of hypothermia and to develop a therapeutic hypothermia protocol for the emergency department. The literature review focused on nine studies from 2005 -2008 that ultimately were the basis for the specifics of the protocol. The researcher described how the protocol was successfully initiated and evaluated. The study demonstrated the method for developing and initiating a therapeutic hypothermia protocol but also stated the need for all emergency departments to have one based upon previous evidence based findings (Koran, 2008).

A literature review was conducted by Zeitzer (2008) to examine the effectiveness of inducing hypothermia on cardiac arrest patients in order to decrease neurological deficits. The researcher included data from six studies from the period of 1997-2002. The researcher found that all of the studies demonstrated favorable neurological outcomes, one as high as 55% and four demonstrated a decrease in mortality. Zeitzer's study illustrated that inducing hypothermia for a cardiac arrest patient resulted in decreasing neurological deficits and mortality rates (Zeitzer, 2005).

The case study by Bader, Rovzar, Baumgartner, Winokur, Cline, and Schiffman (2007) demonstrated the positive neurological outcome from the initiation of hypothermia on a cardiac arrest patient. The researchers described the favorable results from two previous studies and presented the case study to illustrate the treatment. The researchers support the use and implementation of therapeutic hypothermia for cardiac arrest. Open communication between providers is stressed in order to promote better care (Bader, Rovzar, Baumgartner, Winokur, Cline, and Schiffman, 2007).

A study by Olson, Kelly, Washam, and Thoyre (2008) examined the ICU nursing workload with Induced Hypothermia patients. The researchers utilized a questionnaire

that asked 107 ICU nurses to estimate the amount of time it would take to complete certain tasks given various scenarios. The results indicated that nurses performed the most appropriate task based upon the scenario regardless of the time it took to complete. The mean times for interventions related with induced hypothermia were longer indicating that the nurse would spend more time with these patients (Olson, Kelly, Washam, and Thoyre, 2008).

CHAPTER III

Method

The aim of this paper was to examine patient mortality as a result of early initiation of induced hypothermia treatment to cardiac arrest subjects by emergency medical technicians and emergency departments as compared to that of ICU nurses utilizing the discharge Glasgow Coma Scale. The focus was on the early initiation of induced hypothermia by emergency medical paramedics or emergency department nurses as compared to intensive care unit nurse initiation. Each year, two hundred thirty-six thousand to three hundred twenty-five thousand deaths could be attributed to out of hospital cardiac arrests, these deaths may also be looked upon as a number that can be decreased through the early initiation of induced hypothermia (Nichol et al., 2010).

Participants

A convenience sampling method was utilized for the study. The patients were included because they were in the right place at the right time. There are not a great many out-of-hospital cardiac arrest patients that have return of a spontaneous pulse that survive to present in an emergency department. However new regulations in the NC office of EMS have initiated new protocols for emergency medical paramedics to treat these patients and transport them to primary care hospitals that have the ability to care for them. This may have increased the possible number of patients in the study during the 2010 calendar year. A convenience sample of consecutive out of hospital cardiac arrest patients admitted from 2008 – 2010 in which induced therapeutic hypothermia was initiated was utilized for this study.

The sampling or eligibility criteria that determined the target population for the

study included: 1) cardiac arrest diagnosis, 2) initial presenting rhythm, 3) return of spontaneous circulation and transfer to hospital, 4) initial Glasgow coma scale less than or equal to **five**, and 5) initiation of hypothermia treatment. The data on all these criteria was carefully evaluated and reviewed in order to support the use of convenience sampling. Due to the use of convenience sampling, generalizations to populations were made with caution.

The purpose of the study was to compare the effect of initiation of therapeutic hypothermia by EMS personnel vs emergency room nurses vs ICU nurses on patient outcomes as measured by the Glasgow Coma Scale in cardiac arrest patients. This was a quasi-experimental study design (Burns & Grove, 2009). The early initiation of hypothermia by emergency medical paramedics or ED nurses was the experimental treatment (the independent variable) and patient mortality as evidenced by the discharge Glasgow Coma Scale was the dependent variable that was measured. The selection of subjects was the primary threat to the study. There was no randomization so every patient that had hypothermia initiated from 2008-2010, was included in the study. The other threat was the manipulation of the treatment. The initiation of hypothermia may have been somewhat subjective based upon the ED physician and/or the paramedic and their knowledge and experience with hypothermia treatment initiation. The study had several threats to validity that were determined very carefully before it was undertaken.

Instrumentation

The purpose of my research project was to measure the effectiveness of induced hypothermia in the treatment of out of hospital cardiac arrest patients. The outcomes measured were mortality and neurological function at discharge. The instrument utilized to measure neurological function at discharge was the Glasgow Coma

Scale (Zuercher, Ummenhofer, Baltussen, & Walder, 2009). The tool uses a rating scale that assigns a score of 3-15, based upon eye opening, verbal and motor levels of functioning (Figure 1).

The initial data was collected and placed in the therapeutic hypothermia database concurrently by clinical nurse specialists and educators upon the patient's admission to the hospital. The initial data was based upon the admitting diagnosis of cardiac arrest and the initiation of induced hypothermia. Once the patient was placed in the database, they were followed until discharge or participant death before discharge. The data collection was consistent and had strict research controls in place in order to decrease the effects of outside variables. The patients that were admitted from 2008-2010 and placed in the database were included in the study. Verifiable, valid and accurate results were provided in order to substantiate the study findings.

Prior to conducting the data collection, permission was obtained from the Institutional Review Board (IRB) for Gardner-Webb University as well as from the 800 bed cardiac arrest center in Western North Carolina. The IRB waived consent from the participants prior to data collection.

Induced hypothermia studies have been conducted in the past; however they have been limited in size and more importantly by the clinical knowledge available at the time. The last ten years has wielded increased knowledge and awareness of the benefits of induced hypothermia. The American Heart Association and the International Liaison Committee on Resuscitation have recognized these advances and included induced hypothermia guidelines for out of hospital cardiac arrests in recent years (Cushman, Warren & Livesay, 2007). This study will aid in advancing the knowledge base for induced hypothermia and improved outcomes.

Chapter IV

Results

The findings from the retrospective study of the therapeutic hypothermia initiation demonstrated overall positive outcomes. The subjects consisted of a convenience sample from the hospital therapeutic hypothermia database of patients admitted in the 2008-2010 calendar years. The therapeutic hypothermia program was initiated in the hospital in June 2007. The data from patients for this study were selected from the period of January 1, 2008 to December 31, 2010.

Study Population

There were 178 patients included in this study. All the patients had an admission Glasgow Coma Scale of 5 or less. The patients were assigned an identification number from 2-179 in the study in order to differentiate the data and maintain confidentiality.

Tables & Figures

The following tables and figures illustrate the demographics and the results of the patients included in the study:

Table 1-Population

Gender of Patients	Actual Number	Percentage
Male	123	69%
Female	55	31%
Total	178	100%

Table 2- Presenting Rhythms

Initial Presenting Rhythm	Total Number	Percentage
Asystole or Pulseless Electrical Activity	91	52%
Ventricular Tachycardia or Ventricular Fibrillation	77	43%
Unknown or Other Rhythm	10	5%

Table 3- Neurologically Intact Discharge Rates

	Total Number	Percentage*
Overall Neurologically Intact Discharge Rate	57	32%
Initial Presenting Rhythm	Total Number of Neurologically Intact Discharged Patients	Percentage of Neurologically Intact Discharged Patients*
Asystole or Pulseless Electrical Activity	22	39%
Ventricular Tachycardia or Ventricular Fibrillation	31	54%
Unknown or Other Rhythm	4	7%

*Discharge Glasgow Coma Scale – 13 or greater.

Table 4- Discharge Rate Based upon Initiation

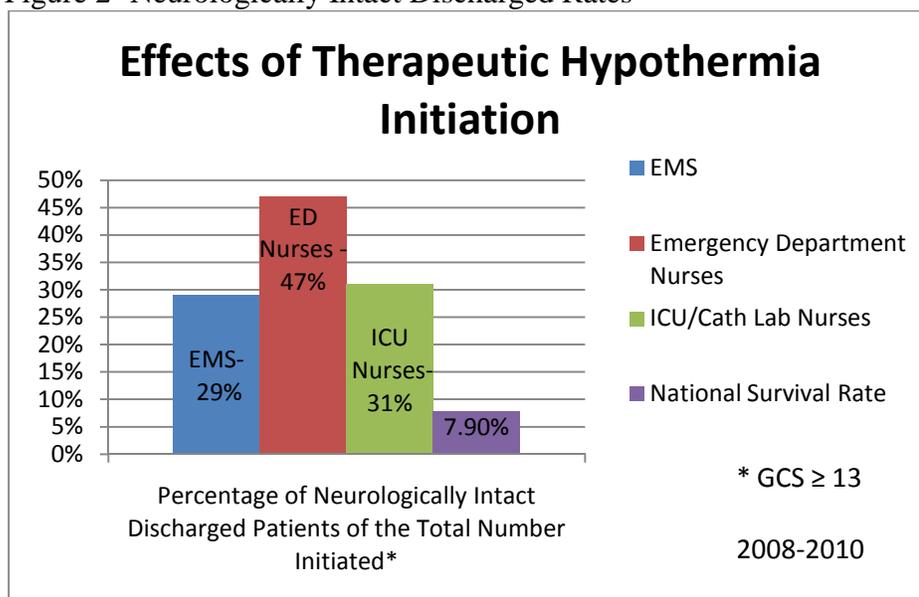
Initiation of Hypothermia	Total Number Initiated	Percentage of Overall	Total Number of Neurologically Intact Discharged Patients*	Percentage of Neurologically Intact Discharged Patients of the Total Number Initiated*
EMS	24	13%	7	29%
Emergency Department Nurses	17	10%	8	47%
ICU/Cath Lab Nurses	137	77%	42	31%

*Discharge Glasgow Coma Scale – 13 or greater.

Figure 1- The Glasgow Coma Scale

Glasgow coma scale		
		Score
Eye opening	spontaneously	4
	to speech	3
	to pain	2
	none	1
Verbal response	orientated	5
	confused	4
	inappropriate	3
	incomprehensible	2
	none	1
Motor response	obeys commands	6
	localises to pain	5
	withdraws from pain	4
	flexion to pain	3
	extension to pain	2
	none	1
Maximum score		15

Figure 2- Neurologically Intact Discharged Rates



Statistical Presentation

A total of 178 patients were included in the study. There were 123 males and 55 females. Males accounted for 69% of the total population. This was representative of the larger incidence of cardiovascular events in males however the number was still independently elevated (Table 1).

The initial presenting rhythms of the patients were illustrated in Table 2 in order to demonstrate that the hospital accepted and initiated therapeutic hypothermia on all patients. The majority of the patients 91(52%) had Asystole or Pulseless Electrical Activity (PEA) as their initial rhythm. This hospital chose to treat all cardiac arrest patients with therapeutic hypothermia regardless of their presenting rhythm. There are other institutions that choose to initiate this treatment only on patients that present with Ventricular Tachycardia or Ventricular Fibrillation. This decision to selectively treat

based upon rhythm is derived from more favorable outcomes from the initial HACA (2002) and Bernard (2002) studies. Patients are able to be defibrillated if they are in Ventricular Fibrillation or Ventricular Tachycardia (American Heart Association, 2010). In this study 77(43%) of the patients presented in Ventricular Fibrillation or Ventricular Tachycardia. There were 10 patients whose initial presenting rhythms were not documented.

The primary purpose of the study was outlined in the findings on Table 3 & 4. 57 out of 178 patients discharged neurologically intact. The overall hospital percentage for this period was 32% or 57 out of the 178 patients. Although the percentage was lower than the results of other studies it is important to note that this institution initiated therapeutic hypothermia on all presenting rhythms, as compared to other studies which were selective in which patients received therapeutic hypothermia. The largest category of patients discharged presented with Ventricular Fibrillation or Ventricular Tachycardia, 31(54%) out of the 57 patients. The next largest group represented the patients that presented in Asystole or in Pulseless Electrical Activity (PEA). There were 22 (39%) out of the 57 patients discharged neurologically intact.

The discharge Glasgow Coma Scale was the tool utilized to measure these survival rates. For the purposes of this study, a score of 13 or higher was established as the criteria to classify a successful recovery from the cardiac arrest. A total of 44 patients had a discharge Glasgow Coma of 15, which represents 77% of all the discharged patients and the highest level of functionality.

The 57 patients discharged neurologically intact were represented in Table 4 under the three categories of; EMS, Emergency Room nurse or ICU nurse initiation. The research question proposed: *Comparatively, does the initiation of therapeutic hypothermia by emergency room, ICU nurses or EMS paramedics decrease mortality for cardiac arrest patients?* was answered. EMS initiated therapeutic hypothermia in 24 of the 178 patients and 7 were discharged neurologically intact. This resulted in an EMS survival rate of 29% (based upon the number initiated). Three of the discharged patients that were cooled by EMS, had a presenting rhythm of Asystole or PEA. The initiation of therapeutic hypothermia by emergency room nurses yielded a survival rate of 47%. The ER nurses initiated therapeutic hypothermia in 17 cases with 8 of them being discharged neurologically intact. The ICU nurses initiated therapeutic hypothermia in the majority of the patients. They initiated the treatment in 137 patients resulting in a discharge rate of 31% or 42 patients. A summary of the specific findings of each area was illustrated on Figure 2.

Chapter V

Discussion

Interpretation of Findings

The purpose of this study was to study the effect of therapeutic hypothermia initiation after cardiac arrest. The study examined mortality and discharge outcomes based upon the Glasgow Coma Scale. It compared outcomes based upon initiation by EMS, emergency room nurses and ICU nurses.

The findings support the mortality benefit of early initiation of therapeutic hypothermia by EMS and emergency room nurses. The hospital discharge rate of 32% as compared to the EMS (29%) and ER nurse (47%) may correlate with the premise of quicker initiation improving outcomes in cardiac arrest patients.

The findings validate the utilization of therapeutic hypothermia as a treatment modality in all cardiac arrests regardless of presenting rhythm. The 22 patients that presented in Asystole or PEA were given therapeutic hypothermia treatment and an evidence-based opportunity to have better neurological outcome. This finding represents a group that has not often been represented due to the fact that in many previous studies they were not treated with therapeutic hypothermia and subsequently may not have had favorable outcomes.

Implications for Nursing

Faye Abdellah's Patient-Centered Approaches may be intuitive in healthcare however; they can help to guide care since they specifically place a holistic emphasis on

patient care. The emergency room or ICU nurse must take into account all aspects of the patient since these patients are chemically sedated and paralyzed. The nurse is the problem solver and directs patient care through care of the whole patient. This study demonstrated a higher success rate for earlier initiation of therapeutic hypothermia. The nurse is focused on the cardiac arrest patient from the moment the patient enters the emergency department or the ICU and they will play a major role in the initiation of therapeutic hypothermia.

Implications for Further Research

A subsequent study that follows the patients after discharge should be considered in order to gather long term outcome data. The patients could be assessed using the Glasgow Outcome Scale (Jennet, Snoek, Bond & Brooks, 1981). The rating scale (1-5) assigns a level of 1-5 based upon the patient's functional ability. The rating scale begins by assigning a level 1 if the patient is dead, this level will measure patient mortality. A level 2 assignment indicates the patient is in a vegetative state which is defined as unable to interact and unresponsive. A level 3 classification indicates the patient has a severe disability and unable to live independently. A level 4 classification indicates the patient has moderate disability but unable to return to work or school. Finally, level 5 indicates that the patient is classified as able to resume normal activity (Jennet et al, 1981).

The primary limitation of the study was the number of patients included within each category. Future studies might include a greater number of participants with possible

randomization. The OEMS of North Carolina will develop and implement specific guidelines for cardiac arrest care in the near future that may enhance or limit EMS's ability to initiate therapeutic hypothermia on all patients. This study included data from EMS agencies that were currently able to initiate this treatment on all patients.

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