Evaluation of a Progressive Mobility Protocol in Post-Operative Cardiothoracic Surgical Patients

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"On my honor as a student, I have neither given nor received unauthorized aid on this assignment"

Abstract

Cardiothoracic surgical patients are at high risk for complications related to immobility such as increased intensive care unit, hospital length of stay, intensive care unit readmission, pressure ulcers, and deep vein thrombosis/pulmonary embolus. A progressive mobility protocol was started in the thoracic cardiovascular intensive care unit in a rural academic medical center. The purpose of the progressive mobility protocol was to increase mobilization of post-operative patients and decrease complications related to immobility in this unique patient population. To evaluate this progressive mobility protocol a retrospective analysis was conducted. Using Pender's Health Promotion Model to help us understand implications of immobility in the cardiothoracic surgical patients. A matched pairs design was used to compare a randomly-selected sample of the pre intervention group (n=30) to a matched post intervention group (n=30). The analysis compared outcomes including, intensive care unit and hospital length of stay, intensive care unit readmission, pressure ulcer prevalence, and deep vein thrombosis /pulmonary embolism prevalence between the two groups. Although this comparison does not achieve statistical significance ($p<0.05$) for any of the outcomes measured it does show a reduction in hospital length of stay hospital, intensive care unit days, a decline in intensive care unit readmission rate, and a decline in pressure ulcer prevalence which is the overall goal of progressive mobility. This study can lead to a larger study to try and achieve statically significant results in a larger group of cardiothoracic patients. This study does have implications for nursing, hospital administration, and therapy services in regards to staffing and cost savings due to complications of immobility.

Keywords: Progressive Mobility, Cardiothoracic Surgery, Length of Stay, Postoperative complications of Immobility

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Section I

Introduction

Background

Patients undergoing cardiac and thoracic surgery procedures are at high risk for post-operative complications due to pre-operative comorbid conditions and postoperative immobility. According to Sepehri et al., (2014), half of the patients that undergo a cardiothoracic surgery procedure in North America are 75 years old or older. According to the Centers for Disease Control (2015) heart disease and lung disease are the both in the top ten causes of all death in the United States. . Complex surgical procedures are offered to patients who require coordinated postoperative management of the surgical procedure and comorbid conditions. Patients that are admitted to hospitals today would have not survived just a few years ago due to the severity of their chronic illnesses, yet today care of these high risk patients are routine.

Intensive Care Units (ICU) patients admitted after an elective cardiothoracic surgical intervention undergo evaluation of surgical complication risk. The majority of these patients are dealing with different levels of debilitation prior to having a major cardiac or thoracic procedure due to underlying disease processes. Perme, Nalty, Winkelman, Kenji Nawa, and Masud, (2013) analyzed a Cardiac Surgical Intensive Care Unit mobility intervention and found that patients in this ICU, 57% had hypertension and 29% had diabetes. Hypertension may cause tissue perfusion problems and, diabetes can cause changes in sensation effecting patients ability to get out of bed after a chest surgery. The largest patient sample in the Perme et al., (2013) study had undergone lung transplantation. Although lung transplantation is not a common procedure in every institution, this is typical of a very complex patient population that may have negative outcomes related to immobility in the postoperative period.

The University of Virginia Medical Center initiated a progressive mobility protocol (Appendix A) in December 2014 in response to prolonged mechanical ventilation times, increased readmissions to the ICU, and length of stay in the post-operative Thoracic and Cardiovascular Intensive Care Unit (TCV-ICU).

Prior to the initiation of this progressive mobility protocol (PMP) there was no standard activity protocol in use among the different surgical services that are admitted to the thoracic cardiovascular surgery intensive care unit. Some patients received physical therapy and occupational therapy orders to mobilize the patients, but many patients were left to nursing to increase physical activity after surgery. Many patients were only mobilized by nursing, and only if the nursing team had time and staff to do mobility interventions. Due to this non standardization of mobility interventions a progressive mobility protocol was established. The entire multidisciplinary team including physical therapy, occupation therapy, bedside nursing, and patient care assistants received training on the progressive mobility protocol prior to the initiation of the protocol.

This evaluation is a retrospective analysis describing and comparing a pre-intervention and post-intervention group of patients who have undergone complex cardiothoracic surgical procedures. The mobility-related post-operative outcomes compared include:

- length of stay in the ICU and hospital
- readmissions to the ICU during the same hospitalization of the surgical procedure
- incidence of deep vein thrombosis and pulmonary embolism
- incidence of pressure ulcer development

Theoretical Framework

The Ottawa Charter on Health Promotion (World Health Organization, 1986) and the Jakarta Declaration in 1997 encourages empowerment of patients to take control of their own health (Chambers and Thompson, 2008). Pender's Health Promotion Model (HPM; 1987; figure 1) provides a theoretical framework for which the Ottawa Charter can be applied within the acute care hospital setting.

In 1982, Pender developed the Health Promotion Model to help nurses understand the determinants of health behaviors to help base interventions to promote healthy lifestyles. The model centers around eight concepts that encompass the ideas that Pender believes are able to be influenced to promote change in lifestyle and behavior. The eight concepts are able to combined and manipulated to adjust the model to fit behavioral situations and health states. The eight key concepts that Pender's Health Promotion Model (1987) describes are: Person, Environment, Nursing, Health, Illnesses, Individual Characteristics and Experiences, Behavior Specific Cognitions and Affect, and Behavioral Outcome-Health Promotion Behavior.

The first concept and most important is the patient that is affected by acute or chronic disease. The second is the environment in which they are receiving care for their disease process. The patient and the environment are intertwined and are both equally affected by one another. The third concept is nursing and the collaboration between nursing staff, the patient, the environment, and families to promote well-being. The other concepts are the linking concepts that bring the critically ill patient back to wellness thought experiences such as surgery and a lifestyle change to promote wellness after surgeries to correct lifestyle induced disease.

Pender's HPM (Figure 1) allows medical providers and nursing staff the ability to understand barriers and influencers to what might lead to immobility in patients that have undergone cardiothoracic surgical procedures. The HPM can also help providers understand the prior behaviors and personal factors that influence a person's ability to become mobile after cardiothoracic surgery. Pender's HPM also looks at the individual's historical experiences with sedentary behaviors, and prior physical activity that might have contributed to the disease state.

The HPM can then help health care providers intervene with specific activities to establish measureable goals and outcomes for the individual. Pender's HPM helps provide a clinical framework to better establish a plan of care to help influence patient perception based on prior experiences with mobility and activity. This theoretical model can help the post-operative patient to engage in a plan of action that can be maintained and help increase functional mobility, improve physical activity, and overall physical health behaviors. The HPM can help facilitate a mobility plan for patients while receiving the acute care they require during their recovery from acute illness or surgery. According to Pender, Murdaugh, and Parsons, (2011) "illnesses are discrete events throughout the life span of either short (acute) or long (chronic) duration that can hinder or facilitate one's continuing quest for health." In the cardiothoracic surgery population the chronic nature of prolonged heart disease, lung disease, or malignancy hinders the patient's ability to change behaviors that might be influenced by beliefs and historical behaviors.

Pender (1987) notes that health-promoting behaviors almost without exception should be part of everyone's lifestyle and that exercise, stress management, and other health promotion behaviors to be learned. We also know from Pender that the; "Definition of health to which individuals subscribe may influence the extent to which they engage in health promoting behaviors." (Pender, 1987 p. 63). This statement is especially true in post-operative cardiothoracic surgery patients because of the significant lifestyle modifications that are needed to continue to have optimal quality of life. Most patients that undergo chest surgery have either an exposure or behavior that has led to a disease state such as smoking leading to lung cancer or high fat foods leading to coronary disease. Undergoing a surgical procedure to treat a disease is a significant event in a person's life. This is especially true if the surgical procedure could have been avoided by lifestyle modification or changes to promote healthy behaviors prior to disease development.

The framework of the HPM is one model for understanding patient experiences which led to a disease state. For many patients prior behaviors are difficult to change and those recovering from surgery tend to fall back into similar or more disruptive health behaviors. The HPM can help standardize processes and plans of care to encourage early mobility, begin to change this prior unhealthy learned behavior, and develop a plan to incorporate new behaviors into the post-operative mobility, exercise, and cardiopulmonary health.

According to Flynn and Griffin, (1984) nursing has multiple options for incorporating lifestyle changes in caring for hospitalized patients in the early phases of admission. This ability to influence change can be augmented by Pender's HPM. Flynn and Griffin (1984) discuss that nurses are integral to helping hospitalized patients by incorporating health promotion strategies into daily bedside care, and encourage continued activity at discharge from the acute care setting. This multidisciplinary mobility protocol is the first step in assisting postoperative cardiothoracic surgery patients prevent postoperative complications and live a more active lifestyle. The current literature helps validate the idea that mobility helps patients recover from a major surgery.

Cardiothoracic Surgery Patients

Cardiothoracic surgery is a treatment therapy for diseases, injured vessels and organs in the thorax, including the esophagus, trachea, pleura, mediastinum chest wall, diaphragm, heart, and lungs (Gulli, Ettaher, & Mallory, 2004). This surgical specialty is unique in that the surgical opening of the thoracic cavity can affect the way the heart and lungs provide oxygen to other vital organs. The heart and lungs are able to be paused for a short time with use of cardiopulmonary bypass support and extracorporeal membrane oxygenation (ECMO). As the ability to operate within the thoracic cavity has evolved over time, the complexity of the surgical procedures being performed has evolved as well. With this evolution the limits of surgery are being pushed and the potential surgical candidate pool is growing in the United States. Due to the increase in comorbid conditions such as coronary disease and cancer, in the general population of the United States the number of complications associated with chest surgery are more complex (Harskamp et al., 2014). Many of the comorbid conditions that lead to patients undergoing chest surgery increase the risk of postoperative complications.

As the evolution of cardiothoracic surgery continues to advance there have been many different approaches to access the thoracic cavity. Unfortunately all of these approaches still require a significant surgical incision with dissection of vital structures. Multiple types of incisions are used including median sternotomy, lateral thoracotomy, or a clamshell incisional approach to gain access to the structures of the thoracic cavity. This can lead to many different complications that are related to a wide range of factors. Many complications such as surgical site infection, poor wound healing, and immobility due to pain and surgical drains that occur in this patient population are not unique to just the cardiothoracic population. Because of this many hospitals have looked at ways to minimize the severity of these complications in relation to immobility.

Cardiothoracic Surgery Complications

The increase in surgical volumes and the age of the average cardiothoracic surgery patient influence the risk of postoperative complications. It is known that patients that have undergone cardiothoracic surgery are at risk for bleeding, infection, vasospasm, altered platelet function reactions with blood products during cardiopulmonary bypass, and generalized inflammatory response due to cardiopulmonary bypass equipment. These reactions and responses result in low flow in the microcirculation of the heart, brain, and other organs, which leads to end organ dysfunction. The cardiothoracic surgery literature notes in multiple studies that longer ICU stays after cardiothoracic surgery is a predictor for higher morbidity (Harskamp et al., 2014; LaPar, Bhamidipati, Lau, Jones, & Kozower, 2012; Li, Cai, Mukamel, & Cram, 2013; Lucas et al., 2013; Mascio, Pasquali, Jacobs, Jacobs, & Austin, 2011; and Wright et al., 2008). These studies look at multiple types of chest surgical procedure both emergent and elective surgeries which show that as the increase number of days in an intensive care unit increases the risk for morbidity, and increased mortality. With increased morbidity it stands that decreased mobility can lead to post-operative complications that extend the length of stay and the need for intensive care services in this patient's population.

Section II

Review of the Literature

Current Literature

The current literature regarding cardiothoracic surgery patients is robust in how to treat the underlying disease processes, post-operative medical management, and major complications of surgery. Yet once a patient is recovering from cardiothoracic surgery, much of literature in this patient population has been based on critical care management. This management is not specific to this the cardiothoracic population, but rather the treatment of a disease process that many patient populations have. This is the case with cardiothoracic surgery and mobility, after the patient has been returned from the operating room and is hemodynamically stable. Much of the plans of care regarding activity and mobilization are extrapolated from what we have done for many years with no real evidence that it is the best practice. This review was an attempt to find the best practice in regards to progressive mobility in the cardiothoracic surgery population.

Although there are a number of studies that look at patients that have purely medical problems and are in needed of intensive care, the effects of critical illness have only been studied in cardiothoracic surgery population a few times. In one such study by Freeman and Maley, (2013) mobility in the cardiac surgery population that underwent placement of mechanical circulatory devices (MCS) was evaluated. Even though this study was a single center evaluation of their early mobility of MCS patients it showed to be safe and effective in this population.

Immobility in the Critically Ill

According to Knight, Nigam, and Jones (2009) patients that are subjected to bed rest start to see changes in baroreceptors sensitivity within days of being confined to bed. These changes can lead to orthostatic intolerance, physical (muscular), and cardiac deconditioning. The physiological changes noted by Knight, et al. (2009) accompanied with a number of studies by (Bloomfield, 1997; De Jonghe, et al., 2002; Siebens, Aronow, Edwards, & Ghasemi, 2002; Topp, Ditmyer, King, Doherty, & Hornyak, 2002) have shown along with bedrest the longer patients are mechanically ventilated the more muscle mass and functional strength that patients lose. Multiple studies show the functional strength that patients lose when put on bedrest, yet it is still not standard practice in some facilities to have cardiothoracic surgical patients out of bed or even walking until they are weaned from mechanical ventilation. Despite a mounting body of literature in the medical patient population and general surgery population, chest surgery patients have not been well studied in regards to increasing activity and mobilization after surgery. Even though according to Knight et al., (2009) soldiers in World War II were forced to get up and move quickly after all types of surgery including chest wounds, due to lack of adequate space and they recovered quickly from their injuries and infections. This is a unique set of patients in that they were young healthy men that experienced acute trauma, but it does speak to the idea that getting up and mobilizing has some positive effect.

Complications of Immobility

There are multiple consequences of immobility and most can be associated with the lack of activity of hospitalized patients. Deep vein thrombosis (DVT) is a major problem in the hospitalized patient in the United States. According to Brunelli, (2012) it is estimated that 450,000 hospitalized patients develop a DVT, but only 1/3 of these DVT's are clinically diagnosed. It is well known that any type of surgical procedure is a risk factor for development of a venous thrombosis but cardiothoracic surgery patients are at increased risk due to manipulation of the vascular system or underlying disease process of a malignancy. With the ability to decrease or stop the blood flow through certain vessels can lead to stasis of the vessels and increase the risk of clot development. Another problem for the cardiothoracic patient population is the high rate of surgeries performed for suspected or confirmed malignancy, this alone with disruption of blood flow leads to a hypercoagulable or venous stasis state.

Another major complication of immobility is the development of pressure ulcers. Patients that are undergoing major surgery are at high risk for development of pressure ulcers due to positioning during the procedure or post-operative care. According to Schuurman, Schoonhoven, Keller, and van Ramshorst, (2009) between 19% and 66% of patients developed some stage of pressure ulcer after surgery depending on the surgical population studied. In one study of cardiothoracic surgery patients development of a post-surgical pressure ulcer was over 50% in turn other factors extended the cardiothoracic surgery patients length of stay in the intensive care unit (ICU) to 7.4 days on average (Schuurman, et al., 2009). This prolonged time patients are subjected to mechanical ventilation can lead to longer overall lengths of stay.

Delayed Ventilator Weaning

Given that the early mobilization of the cardiothoracic patient population is not well studied to date, but some studies are in process to evaluate mobilization and cost. There are current studies that look at multiple parameters to decrease length of stay and intensive care days in the cardiothoracic surgery population. There have been studies that discuss the idea of “fast tracking” cardiac surgical patients and freeing them from mechanical ventilation and moving them out of the intensive care units quickly. A systematic review by Zhu, Lee, and Chee (2012), looked at twenty five different trials that included a total of 4118 patients. This review looked at many different aspects and outcomes but, a large number of them looked at the ICU length of stay and the cost of prolonged mechanical ventilation in the cardiac surgical population (Zhu et al., 2012). This concept of getting patient recovered from anesthesia, weaned from mechanical ventilation, and out of bed early has been deemed safe and cost effective by the studies in the Zhu et al., (2012) review. This freedom from mechanical ventilation can lead to decreased loss of muscle function and diaphragmatic weakness as well.

Weakness and Muscle Loss

It has been well documented that patients that are on bed rest develop muscle weakness and decreased functional status quickly. During non-weight bearing bed rest the average patients muscle mass decreases by up to 5% per week (Bloomfield, 1997 and Cameron et. al, 2015). This issue of immobility and physical strengthening activities in the intensive care patient is not a new problem. In recent years there have been a number of studies that have looked at a multitude of issues related to patients with critical illness and immobility. Most of these studies are set in the medical or respiratory intensive care setting and primarily look at either safety of mobilizing patients or cost benefit (Morris et al., 2008; Burtin et al., 2009; and Schweickert et al., 2009). Some studies look at outcomes related to a physical therapy intervention or a mobilization protocol that was driven by physical therapy or nursing (Burtin et al., 2009; Chiang, Wang, Wu, Wu, &Wu, 2006; Morris et al., 2009; Morris et al., 2011; and Schweickert et al., 2009). Decreased physical activity along with prolonged periods of poor nutrition prior to surgery can lead to worsening muscle weakness and overall physical functional loss

Malnutrition

Patient that are malnourished prior to surgery have increase complications related to infection, mechanical ventilation, length of stay, and mortality rate (van Venrooij et al., 2012). In the cardiac surgery population rates are 30% to 60 % of patients in the United States are malnourished while in the hospital due to poor nutrition prior to admission or the inability to adequately nourish patients that are admitted due to testing or procedures (Chermesh et al., 2014). Patients that are malnourished due to chronic illness who are planning on undergoing cardiothoracic surgery leads to less than optimal heath status at the time of surgery. This can lead to multiple related complications from large surgeries such as muscle weakness, pressure ulcers, and immobility. All of the aforementioned complications can lead to patients decompensating and returning to the ICU for protracted periods of time.

Readmissions to Intensive Care

Along with increased length of stay being readmitted to an intensive care unit after a surgical procedure is a predictor of increased mortality (Kogan, 2003; and Song, 2007). Although no studies address immobility solely as a risk factor for readmission to an ICU or increased mortality, the severity of illness that patients readmitted to most intensive care units have developed can lead to significant morbidity and mortality. This prolonged time of immobility can have a significant effect on patient outcomes. This in turn leads to increases in complications related to immobility such as myopathies, deep vein thrombus (DVT), and pressure ulcers (PU).

Deep Vein Thrombosis and Pulmonary Embolism

Dr. Rudolf Virchow described the three states that contribute to development of thrombus: venous stasis, vein injury, and hypercoagulable state (Yang, 2005). Critically ill patients that have undergone cardiothoracic surgery have all three of these physiologies during and after their surgical procedure. The modern techniques of vessel cannulation in cardiothoracic surgery lead to vessel injury, and decrease in blood flow. Accompany this with bleeding during the surgical procedure, the use of some blood thinning medication, and blood products which can all lead to a hypercoaguable state. When all of these factors occur together patients develop the perfect situation that can lead to thrombus formation.

The incidence of pulmonary embolism and deep vein thrombosis after cardiothoracic surgery procedures varies widely, it has been reported the pulmonary embolism after coronary artery bypass grafting (CABG) is up to 25 % of patients according to Protopapas, Baig, Mukherjee, and Athanasiou (2011). Yet patients that have undergone some types of heart surgery have very low incidence of pulmonary embolism or acute thrombosis possibly due to the use of anticoagulants during cardiopulmonary bypass for valve replacement and to keep new vascular anastomosis patent. There are no major studies that specifically look at development of thrombosis or embolism across the post-operative cardiothoracic surgery spectrum in regards to mobility.

Critical Illness Myopathies

In a systematic review by Zhou et al., (2014) the group notes that 25% to 45% of critically ill patients in intensive care units have some degree of polyneuropathy and myopathy. These myopathies lead to increase dependence on mechanical ventilation, increased length of stay, and increased immobility (Hermans, De Jonghe, Bruyninckx, & Van den Berghe, 2014). With any increase in the need for mechanical ventilation the cardiovascular dynamic changes and this can lead to a decrease in the ability for a patient to be mobilized. This coupled with the use of stress dose steroids and sometimes the use of paralytic classes of medication for hemodynamic stabilization can also lead to development critical illness myopathies and neuropathy (Zhou et al., 2014).

Immobility and Pressure Ulcer Formation

Pressure ulcers develop when soft tissue is compressed for a period of time that decreases perfusion to the area under pressure (Gillespie et al., 2014). Pressure that impedes the venous capillary pressure can be as little as 8 to 13 mm Hg. At these pressures, the venous return can lead to damage at the skin and muscle, within 2 hours of continuous pressure. By the time the ulcer is visible at the skin level the pressure can have already damaged the underlying tissues. According to Feuchtinger, Halfens, and Dassen, (2005) the incidence of pressure ulcers in cardiac surgical patients is almost 30% this could be related to the use of vasopressors and reduction of core body temperature for slowing of metabolic processes during and after cardiothoracic surgeries.

Health Care Cost

As health care cost rise and accountability for these rising cost are analyzed one area that has been brought forward as a major problem in the majority of health care facilities is immobility in patients undergoing surgical procedures. With the increased awareness of health care cost, there have been many organizations that have focused on the intensive care settings as a major contributor to health care cost. Organizations have studied multiple ways to decrease cost for patients that require intensive or critical care (Knoblauch, Bettis, Lundy, & Meldrum, 2013; and

Lord et al., 2013). Progressive mobility after a surgical procedure seems to be a safe and effective way to decrease cost in some surgical populations such as colorectal, bariatric, esophageal, and orthopedic in the acute care setting (Kehlet & Wilmore, 2008).

Fast-tracking

The idea of weaning and then extubation “fast tracking” of cardiac surgical patients off of mechanical ventilation and out of the intensive care unit has well established in anesthesia and cardiac surgery literature. Unfortunately at this time it does not always seem to translate to general thoracic surgery patient population in bedside practice. Many patients that undergo general thoracic surgery procedures undergo excision of lung tissue or at minimum invasion of the pleural space and then the need for chest tubes to seal leaks in the thoracic cavity. In a review by Campos, (2009) it is noted that general thoracic surgery studies have progressed slowly compared to other surgical specialties in freedom for mechanical ventilation and early post-operative mobilization. The idea of getting thoracic surgery patients out of bed and moving is not without merit. In 2008 Kehlet and Wilmore, did a review that brought in the idea of enhanced postoperative recovery in thoracic surgery patients in line with the general surgery approach to Enhanced Recovery after Surgery (ERAS) protocols.

Enhanced Recovery after Surgery

In recent years enhanced recovery protocols and protocols have been known to reduce the amount of post-operative intensive care unit days as well as total hospital length of stay. Most of the literature that has to do with enhanced recover protocol is provider experience at this point. To date there no multicenter randomized control studies evaluating the intervention of getting cardiothoracic surgery patients that have undergone surgical procedures up and moving early is beneficial in this specific patient population. There is however good evidence that ICU care bundles help improve outcomes across the spectrum of intensive care units.

Bundles

The use of ICU bundles such as "Awakening and Breathing Coordination, Delirium Monitoring and Management, and Early Mobility (ABCDE) bundle" (Balas et al., 2013) protocols, helps put focus on common interventions that can decrease poor outcomes in critically ill patients (Balas et al., 2012). This ABCDE bundle approach has been developed as a multidisciplinary approach to address number of complications related to critical care delivery systems. These bundles have been successful in reducing rates of ventilator associated pneumonia, ICU induced delirium, indwelling vascular, and urinary catheter infection rates in many intensive care units across the United States (Balas et al., 2013).

A major component of the aforementioned bundle approach in critical care units is the "E" which represents early progressive mobility of the critically ill patients. This growing body of evidence regarding intensive care unit bundles show that progressive mobilization of patients that are in an intensive care units that are critically ill is safe and effective (Balas et al., 2014). Thus reducing critical illness immobility related complications such as delirium (Kress, 2013), long term mechanically ventilation (Choi, Tasota, & Hoffman, 2008), morbidity, and mortality (Schweickert et al., 2009).

Progressive Mobility Protocols

The concept of early mobilization is not-new the practice positive outcomes of getting people out of bed and moving soon after surgery was recognized during World War II. This practice enabled medical personal to make room for incoming wounded and decreased the length of time it took for the post-operative wounded to return to battle (Knight et al., 2009). This action of getting patient out of bed and back to a physiologic that state helps the patients and might decrease the risk for complications of mobility. It is well documented in the outpatient literature that getting people active after surgery is one way to improve outcomes after cardiothoracic surgery. Patients that are referred to Cardiac and Pulmonary rehabilitation protocols after cardiothoracic surgical procedures experiences better quality of life scores and improved functional status (Williams et al, 2006 and Rochester, 2008).

Continued evaluation of patients that have undergone cardiothoracic surgery procedures are needed in regards to mobility interventions. As the population ages and the number of patients with comorbid conditions increases in the United States the population. The number of these patients whom need a surgical intervention is increasing as well. As patients age their risk of developing surgical complications after a large chest surgery increases as well, this is why early mobility interventions in this patient population must be studied to evaluate the best practice in dealing with in this growing medically complex patient population.

As the literature on this patient population grows outcome measures will need to be identified as to what interventions are safe and effective given the multiple medical conditions that this patient population deals with. This could be looked at in many ways but one such ways is to study the length of stay and complications that occur with increased length of stay.

Implementation of protocols such in the realm of “fast tracking” or “ERAS” in both cardiothoracic surgery patients is rare in the literature, but studies of these protocols show that mobilization is safe and effective in the general surgery patient. One major component of both of these protocols, are getting patients out of bed soon after a major surgery and advancing their mobility in a systematic and safe manner. This could be extrapolated to most major chest and cardiothoracic surgery cases to improve outcomes, decrease health care complications, and reduce cost. With every intervention that needs to be initiated there are going to be barriers that need to be addressed before and during implementation.

Barriers to Progressive Mobility

With any change in clinical practice there is the need to expect clinicians not to want to change what has been working. In regards to progressive mobility protocols there is not difference. Many clinicians in critical care have the false belief that patients need to rest to be able to recover from surgery or acute illness. While this has validity in some situations the more time that the critically ill continue to remain immobile the more damage that is caused to their overall full recovery. Dang, (2013) discusses physical barriers such as safety concerns, vascular access, patient obesity, and dependence on other disciplines to get patients out of bed. These perceived barriers are all valid but at the same time these barriers can be addressed prior to the implementation of any protocol development and incorporate strategies to help manage or negate these barriers.

Another possible barrier to implementation of progressive mobility protocols in the cardiothoracic population is the lack of evidenced based progressive mobility studies of this population. In the current literature lack of evidence might be due to different terminology that exists between the surgical subspecialty teams. Whether it is early recover protocols, bundling, or fast tracking all of these protocols involve getting the patients out of bed early, and mobilizing them often, after their surgical procedure. Due to the different terminology used amongst the literature many studies that deal with some type mobility interventions in the cardiothoracic surgery population are combined with other surgical populations. Studies that might have included the cardiothoracic surgery patient populations have incorporated this unique population into larger evaluations of general surgical patients that have been mobilized early after a surgical procedure. This has not allowed us to see if progressive mobility actually is effective in the cardiothoracic population. This disconnect among the different subspecialty might be an area for future investigation and evaluation in the cardiothoracic surgical population.

A major void at this time in this literature is the lack of outcome measures regarding pressure ulcers and deep vein thrombosis in regards to the cardiothoracic surgery population. The one study by Schuurman et al., (2009) that was reviewed was looking at the increased length of stay caused by pressure ulcers after cardiothoracic surgeries, but the study did not evaluate progressive mobility as an intervention to decreased pressure ulcer prevalence. There are no studies that could be found that discuss the incidence or prevalence of deep vein thrombosis in regards to early mobility after a cardiothoracic surgical procedure.

These two gaps in the literature increase the need for studies on this very complex patient population. When more studies are done in the cardiothoracic patient population in regards to immobility and complications regarding immobility this might lead to a greater body of knowledge as to if progressive mobility improves outcomes. The current literature is also plagued by the use of different terminology to describe progressive mobility protocols. If this language issue can be simplified it might help reduce one of the gaps in the current literature regarding mobilization of critically ill patients.

Section III

Methods

Introduction

Progressive mobility protocols have been shown to improve outcomes in the critically ill medical patient and may also be effective in the cardiothoracic surgery population. There is little research to support that progressive mobilization of the cardiothoracic surgery patient will reduce hospital LOS, ICU LOS, reduce readmissions to the ICU, decrease the incidence of deep vein thrombosis and decrease the incidence of pressure ulcers in this population. The purpose of this pilot study is to attempt to show that progressive mobility protocols have a positive effect on the aforementioned outcomes in cardiothoracic surgery patients.

Purpose of the study

This immobility intervention was designed as a pilot for a potentially larger study in the future involving different phases of post-operative care. This purpose of this project was to evaluate the implementation of a multidisciplinary progressive mobility protocol that was initiated in the thoracic and cardiovascular intensive care unit at an academic medical center.

Research Design

This was retrospective with descriptive comparative research design to establish the effectiveness of the progressive mobility protocol in cardiothoracic surgery patients that are admitted to an intensive care unit after surgery.

Progressive Mobility Protocol

The progressive mobility protocol developed by, Zomorodi et.al., (2012) is the basis of the PMP initiated in the Thoracic Cardiovascular Intensive Care Unit. This is a protocol of progressive and increasing functional activity leading to mobility. The goal is to progress patients from the bedbound state to active ambulatory state as described in the levels listed below.

Level 1: Active and passive range of motion (ROM) and head of bed at great than 30 degree angle.

Level 2: Having the patient setting on edge of bed with legs dangling in upright position.

Level 3: Having the patient standing up and lateral side stepping along the beds edge.

Level 4: Having the patients get out of bed to a chair with a stand and pivot transfer.

Level 5: Having the patient ambulate less than 50 feet with assistive devices as needed.

Level 6: Having the patient ambulate at least 100 feet with assistive devices as needed

Level 7: Having the patient ambulate greater than 100 feet with assistive devices as needed.

The progression of the patient through the levels of mobility is dependent on the patient's overall physical and clinical stability. Patients may progress or regress depending on clinical factors that are related to the patients overall medical condition.

Research Question

How did the initiation of the progressive mobility intervention in the Thoracic and Cardiothoracic Intensive Care Unit patient population effect; intensive care unit length of stay, hospital length of stay, readmission to the ICU, incidence of new pressure ulcers, and incidence of deep vein thrombosis and pulmonary embolism?

Definition of Terms

For the purpose of this study, the following terms are defined:

Hospital Length of Stay: The number of days from hospital admission through to discharge.

Intensive Care Unit Length of Stay: The number of days from the Intensive Care Unit admission through discharge to a step down unit.

Readmission to ICU: Any event that causes a patient to need an increase in the level of care that is standard for post-operative cardiovascular and thoracic surgery

Pressure Ulcer: Any newly diagnosed area of skin breakdown due to immobility or pressure caused by a medical device or hospital equipment.

Deep Vein Thrombosis: Any new radiologic evidence of new thrombosis in any vessel after a cardiovascular or thoracic surgical procedure.

Post-operative Pneumonia: Any new diagnosis of pneumonia after a cardiovascular or thoracic surgical procedure.

Progressive Mobility Protocol (PMP): a clinical guideline for increasing activity for patients that are hospitalized (See Appendix A).

Description of the Sample

The patients were identified from daily unit census reports collected in the Thoracic and Cardiovascular Intensive Care Unit from June 1, 2014 to November 30, 2014 for the pre intervention group. Using a table of random numbers 15 cardiac and 15 thoracic surgery patients were selected. The patients in the unit from December 1, 2014 to June 30, 2015 for the post intervention group were selected based on a table of random numbers in the same fashion as the pre intervention group. Then matching of the pairs based on surgical procedure, age, and gender from cardiac and thoracic surgery was completed. The variables of interested were then compared between groups. Patient length of stay in the intensive care unit, readmission to intensive care unit, occurrence of new deep vein thrombosis, new pulmonary emboli, and occurrence of new pressure ulcer development.

From June 1, 2014 to June 30, 2015, 1465 patients were admitted to beds in the Thoracic Cardiovascular Intensive Care Unit at the University of Virginia. Of these 424 patients were admitted for non-chest surgeries, and 8 were admitted for aborted or cancelled procedures. Of the 1465 admitted patients, 1041patients were admitted after undergoing a thoracic surgery.

In the cardiac pre progressive mobility cohort there were 517 patients, and in the thoracic pre progressive mobility cohort there were 65 patients. These two cohorts were randomized using a research randomizer (www.randomizer.org) for potential inclusion of 20 patients in each the cardiac and thoracic arm. Once the random number sequence was obtained (appendix G &H) the patients were selected based on their chronologic location on the daily unit census report from June 1, 2014 to November 30, 2014.

In the cardiac post progressive mobility cohort there 392 patients and in the thoracic post progressive mobility cohort there were 59 patients. From this sample patients were chosen and matched based on the patient characteristics (age, type of surgical procedure, gender) of the randomized patients in the pre intervention group. The matched pairs were compared by surgical procedure, age +/- 8 years or age, and gender although this was not always possible. The matched pairs of 30 cardiac surgeries and 30 thoracic were then correlated into one data table for data analysis. (Appendix C)

Inclusion Criteria

Patients admitted to the Thoracic and Cardiovascular Intensive Care Unit, 16 to 99 years of age for any surgery involving the chest based on diagnostic related grouping, (Appendix B) who are mechanically ventilated at the time of arrival to the unit. Both male and female gender will be included.

Exclusion Criteria

Exclusion criteria will include any patient who develops post-operative bleeding that requires re-operation to stop the bleeding during the first 24 hours of intensive care unit stay. Any patient who suffers mortality within 24 to 72 hours post operatively will be excluded from this study. This study will also exclude patients that have required extracorporeal membrane oxygenation for more than 96 hours post operatively or have undergone placement of a ventricular assist device.

Setting

The setting for this study is a 15 bed adult Thoracic and Cardiovascular Intensive Care Unit in an academic medical center located in central Virginia. This unit admits all adult patients that have undergone open heart surgeries to include coronary bypass grafting, valve replacement, and heart transplant. This unit also admits patient undergoing lung resections, esophageal surgeries, and lung transplant. Any adult patient that has received a mechanical circulatory device such as left or right ventricular assist devices or is on extracorporeal membrane oxygenation support also is admitted to this unit.

The unit is staffed with registered nurses and patient care assistance with a usual nurse patient ratio of 2:1 and assistant to patient ratio of 6:1. This unit also has dedicated Registered Respiratory Therapist on the unit 24 hours a day. This unit is staffed by providers ranging from attending physicians, resident physicians, and nurse practitioners that manage the medical needs of the patients that are admitted for post-operative care.

Measures

The data for this study was collected in a retrospective analysis of the electronic records of patients who meet the study criteria retrieved by a Registered Nurse. All data was retrieved from and reviewed from the EPIC® electronic medical record. The relevant information was recorded in the study data collection tool. This data collection tool is in a spread sheet format (Appendix C) with subject numbers and relevant data needed for statistical analysis. No confidential health information was entered into this spreadsheet.

- Demographics: Patients age, race, and sex was retrieved from the electronic medical record unit the patient demographic section.

- Diagnoses: The diagnosis was established by ICD 9 code given to the patient at time of admission to the hospital found in the electronic medical record..
- Surgical procedure: The surgical procedure code that is listed in the operative notes written in the patients progress note in the electronic medical record.
- Intensive care unit length of stay: Number of days the patient is actively receiving intensive care in the Thoracic Cardiovascular Intensive Care Unit this was retrieved from the billing and code sections of the electronic medical record.
- Hospital length of stay: Number of days the patients is admitted to the hospital this was retrieved from the billing and code sections of the electronic medical record.
- Pressure ulcer prevalence: This will be established by any new diagnosis of pressure ulceration by diagnosis code found in the electronic medical record.
- Deep vein thrombosis and pulmonary embolism: This was established by any new diagnosis of DVT or PE by diagnosis code found in the electronic medical record.

The reliability of each finding was dependent on the data entry process conducted by bedside nursing staff, provider, and coding staff based on diagnosis coding.

Data Analysis

Demographic data for both groups was compared using descriptive statistics. T-test or Mann-Whitney U will be used for hospital length of stay, and ICU length of stay. Chi Square will be used for the presence of pressure ulcer, deep vein thrombosis and pulmonary embolism.

Protection of Human Subjects

Approval to conduct this study was obtained from the Unit Manager. (Appendix D) This research proposal was approved by to the University of Virginia Institutional Review Board for Health Sciences Research (IRB-HSR) on August 24, 2015. Evaluation of a Progressive Mobility

Protocol in Cardiovascular Surgical Patients was assigned study number 18139. (Appendix E) All patient level data collected during this analysis was stored on an approved health system computer with secured access and not be removed from the continuous areas of the University of Virginia Health System. This data is maintained on a single protected drive on a secure server in a private office accessible only to these investigators.

The PI monitored for adverse event(s) continuously. The PI was responsible for ensuring that any adverse events are reported to the University of Virginia IRB-HSR in compliance with board requirements. Summary reports that are reviewed will always be void of personal identifiers to protect confidentiality. If any changes in the protocol are warranted, the PI or study coordinator will notify the University of Virginia IRB-HSR per board policies and procedures.

Results

Demographic Analysis

Data was analyzed using SPSS software version 23. (IBM, 2015) Demographic data analysis for age and gender of both groups was compared using descriptive statistics. Between the two groups (cardiac and thoracic) age range was from 46 to 85 years old, all patients in this study were adults per study protocol.

The pre intervention cardiac group consisted of 15 patients between the ages of 49 and 85. (Table 1) The post intervention cardiac group consisted ages of 46 to 76 years old. (Table 2) The pre intervention thoracic sample consisted of patients aged 50 to 78 years old, (table 3) the post thoracic intervention group consisted of patients aged 52 to 76 years old. (Table 4) Demographics for gender comparison showed the study sample was of comprised of 75 percent male and 25 percent female participants. This male to female ratio was similar in the entire population cohort examined for this study.

Data Analysis

Hospital LOS and ICU LOS were evaluated with Mann-Whitney U analysis. The mean hospital LOS for all study participants was 9.4 days and the mean ICU LOS was 4 days. The descriptive statistics reveal subtitle differences between the pre and post intervention groups but no statistical significance was found. The pre intervention cardiac group hospital LOS was 8.6 days and ICU LOS was 2.7 days compared to the post intervention cardiac group hospital LOS of 6.5 days and ICU LOS of 2.6 days between the LOS in the pre and post intervention cardiac groups. Although not statistically significant (p=.502) there was an overall decrease in the hospital LOS after the progressive mobility protocol was initiated on this unit.

Hospital length of stay pre intervention for thoracic surgery patients was 12.6 days compared to 9.8 days after the progressive mobility protocol was in place. The ICU LOS for the pre intervention thoracic groups was 6.3 days compared to 4.6 days for the post intervention thoracic groups although a decrease in patient days was noted this was found to be not statically significant (p=.779).

Chi Square compared the presence of pressure ulcer, deep vein thrombosis and pulmonary embolism in the pre and post intervention groups. In evaluating the outcomes of readmission to ICU after transfer out of ICU there was a decreased in the number of patients that were readmitted to the ICU; however, the Chi squared analysis showed no statistical significance between the two groups with a $p = 0.301$. The outcomes of deep vein thrombosis showed an increase (n=1) after the mobility protocol was initiated but analysis showed no statistical significances. (p=0.15) This DVT was thought to have been present prior to the surgical procedure but the patient was not imaged until after the surgical intervention. For the outcome of pulmonary emboli there was one incidence of PE in the post intervention group that was an incidental finding on computerized tomography scan, but was not statistically or clinically significant. The outcome of pressure ulcer was also decreased after the mobility protocol intervention but, did not achieve statistical significance with a p value of 0.313.

Discussion

Summary

After the introduction of a progressive mobility protocol in a Cardiothoracic Surgical ICU the overall hospital length of stay decreased, and the number of immobility related complications decreased. However the statistical evaluation did not show statically significance changes in any of the tests. This might be the first of its kind analysis in the cardiothoracic surgery population in regards to the use of a progressive mobility protocol to evaluate specific outcome measures. The lack of statistical significates in this study should not deter the use of progressive mobility protocols in the cardiothoracic population. These results do show a decrease in cardiothoracic surgery patients outcomes similar to outcomes demonstrated in the medical, colorectal, and trauma patient populations. (Choi, Tasota, &Hoffman 2008, Morris e.t al, 2008, Freeman & Maley, 2013, Cameron et. al, 2015).

The lack of statistical significances may be due to the small sample size analyzed for this evaluation, given the N=30 in both pre intervention group and post intervention group. The size of the groups may not be a diverse enough to show significant change. Analysis of a larger sample size of this patient population might one day show significance related to decreased hospital patient days, decreased ICU day, decreased ICU readmissions, pressure ulcer, deep vein thrombosis, and the overall health care costs due to the complication of immobility.

Nursing Practice Implications

As the population of the United States ages the number of patients undergoing elective and emergency thoracic and cardiac surgeries will increase. Evidence in this evaluation suggests that progressive mobility interventions at time of admission for the critically ill cardiothoracic population may help decrease complications related to prolonged bed rest and immobility. This intervention may improve patient outcomes, promote faster patient progression through the acute post-operative phase of care, decrease health care cost, and increase patient satisfaction.

This evaluation has specific implications for nursing and the multidisciplinary team in regards to timing and safety while progressing patient through a progressive mobility protocol. There must me a multidisciplinary team approach to working with patients that are not able to actively participate in mobility, but can benefit from early range of motion and bedrest activity. If these very complex patient are expected to progress nursing must take the lead with increasing the activity level of these patients while restricted to bed.

Relation to other evidence

As the body of literature continues to grow the evidence is showing that increasing patient's mobility either after hospital admission or quickly after a surgical procedure improves outcomes. This evaluation although small did show reduction in three of the five outcomes evaluated. In facilities that do a large volume of cardiothoracic surgical procedures annually such as academic medical centers, this has multiple fiscal and quality implications. As the health care payer system evolves quality measure such as readmission and prevention of nosocomial events will help facilities understand the importance of progressive mobility protocols for all patients admitted.

Limitations

Knowledge gained in this evaluation has provided an initial assessment of the ability of the progressive mobility protocol to decreases length of stay and complications from immobility in cardiothoracic surgery patients. The findings of this evaluation provided a foundation for future studies with larger samples, to evaluate variables that can lead to improved outcomes and decrease complications. This evaluation will assist in the development of progressive mobility protocols specific to cardiothoracic surgery patients and specialty units to help decrease complications and reduce complications from immobility.

A weakness is this is a single center evaluation in a rural academic medical center with a homogenous patient population. Another weakness is that the two different groups pre and post intervention are grouped six months prior to the initiation of the progressive mobility protocol and six months after the initiation of the progressive mobility protocol. This could lead to some variation due to time of year, staff experience, staffing levels, and patients that are selected due to the changes in surgical procedures.

Conclusions

While statically significant differences ($p<0.05$) were not found in the outcomes between the pre and post intervention groups in this evaluation, it is clear that there were decreases in hospital LOS, ICU readmission rates, deep vein thrombosis, and pressure ulcer prevalence. This has several implications for hospital administration and nursing administration to help better understand why some patients do not progress to discharge as fast as others. This study should is a jumping board to a larger study that looks at the cardiothoracic population as a whole and not just a snapshot of time. This study also has financial implications when bed space is limited and what role progressive mobility protocols aids in recovery of critically ill patients. This study can also help us better understand the complications that leads to the complications that slow the throughput of complex cardiothoracic surgical patients.

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Table 1

Pre Intervention Cardiac Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Age (Years)	15	49.0	85.0	66.600	9.9843
Race	15	1	1	1.00	0.000
Hospital LOS (Days)	15	4.0	47.0	8.667	10.8408
ICU LOS (Days)	15	1.0	12.0	2.733	3.1502
		Female	Male		
Sex (M/F)	15	3.0	12.0	.800	.4140

Test Statistics[a]	Age (Years)	Race	Hospital LOS (Days)	ICU LOS (Days)	Readmission to ICU (Y/N)	Evidence of DVT (Y/N)	Evidence of PE (Y/N)	Evidence of PU (Y/N)
Mann-Whitney U	54.000	62.500	32.500	59.000	62.500	62.500	62.500	60.000
Wilcoxon W	69.000	387.500	47.500	384.000	387.500	387.500	387.500	75.000
Z	-.474	0.000	-1.706	-.202	0.000	0.000	0.000	-.447
Asymp. Sig. (2-tailed)	.635	1.000	.088	.840	1.000	1.000	1.000	.655
Exact Sig. [2*(1-tailed Sig.)]	.666[b]	1.000[b]	.096[b]	.872[b]	1.000[b]	1.000[b]	1.000[b]	.914[b]

a. Grouping Variable: Sex (M/F)

b. Not corrected for ties.

Table 2

Post Intervention Cardiac Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Age (Years)	15	46.0	76.0	64.867	8.8145
Race	15	1	1	1.00	0.000
Hospital LOS (Days)	15	4.0	12.0	6.533	2.4162
ICU LOS (Days)	15	1.0	6.0	2.600	1.4041
		Female	Male		
Sex (M/F)	15	2.0	13.0	.867	.3519

Test Statistics[a]	Age (Years)	Race	Hospital LOS (Days)	ICU LOS (Days)	Readmission to ICU (Y/N)	Evidence of DVT (Y/N)	Evidence of PE (Y/N)	Evidence of PU (Y/N)
Mann-Whitney U	12.500	13.000	4.000	9.000	13.000	13.000	13.000	13.000
Wilcoxon W	15.500	104.000	7.000	100.000	104.000	104.000	104.000	104.000
Z	-.085	0.000	-1.552	-.702	0.000	0.000	0.000	0.000
Asymp. Sig. (2-tailed)	.932	1.000	.121	.483	1.000	1.000	1.000	1.000
Exact Sig. [2*(1-tailed Sig.)]	.933[b]	1.000[b]	.171[b]	.571[b]	1.000[b]	1.000[b]	1.000[b]	1.000[b]

a. Grouping Variable: Sex (M/F)

b. Not corrected for ties.

Table 3

Pre Intervention Thoracic Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Age (Years)	15	50.0	78.0	61.400	7.4431
Race	15	1	3	1.47	.834
Hospital LOS (Days)	15	4.0	30.0	12.667	7.6873
ICU LOS (Days)	15	1.0	30.0	6.333	7.8163
		Female	Male		
Sex (M/F)	15	4.0	11.0	.733	.4577

	Age (Years)	Race	Hospital LOS (Days)	ICU LOS (Days)	Readmission to ICU (Y/N)	Evidence of DVT (Y/N)	Evidence of PE (Y/N)	Evidence of PU (Y/N)
Mann-Whitney U	21.500	14.000	17.000	19.000	20.500	18.000	22.000	22.000
Wilcoxon W	31.500	80.000	27.000	29.000	86.500	28.000	88.000	88.000
Z	-.066	-1.348	-.656	-.397	-.282	-.885	0.000	0.000
Asymp. Sig. (2-tailed)	.948	.178	.512	.691	.778	.376	1.000	1.000
Exact Sig. [2*(1-tailed Sig.)]	.949[b]	.343[b]	.571[b]	.753[b]	.851[b]	.661[b]	1.000[b]	1.000[b]

a. Grouping Variable: Sex (M/F)

b. Not corrected for ties.

Table 4

Post Intervention Thoracic Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Age (Years)	15	52.0	76.0	62.600	6.8013
Race	15	1	2	1.13	.352
Hospital LOS (Days)	15	3.0	21.0	9.867	5.2354
ICU LOS (Days)	15	1.0	16.0	4.600	4.4529
		Female	Male		
Sex (M/F)	15	6.0	9.0	.600	.5071

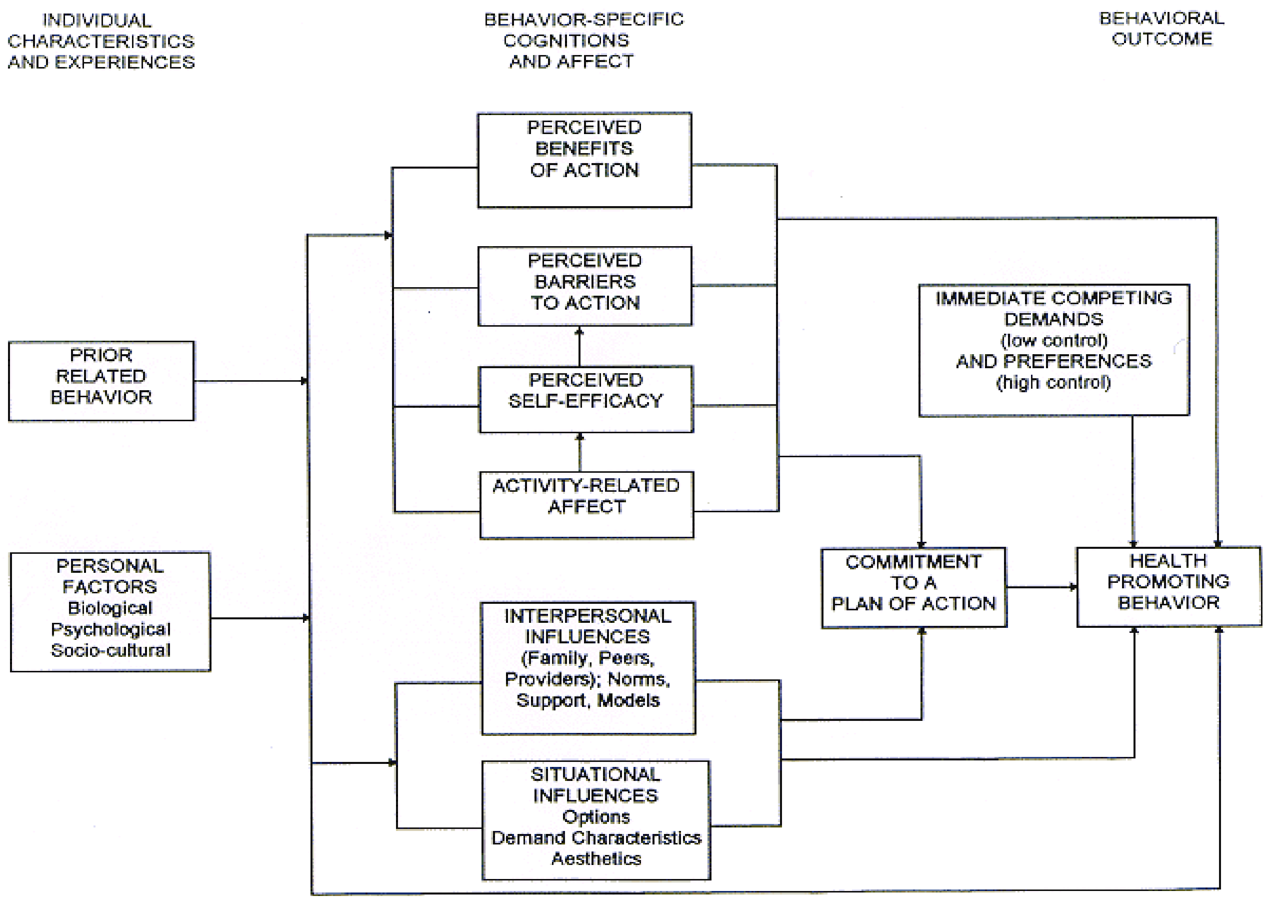
Test Statistics[a]	Age (Years)	Race (C/B/A/O)	Hospital LOS (Days)	ICU LOS (Days)	Readmission to ICU (Y/N)	Evidence of DVT (Y/N)	Evidence of PE (Y/N)	Evidence of PU (Y/N)
Mann-Whitney U	25.000	18.000	25.000	20.000	24.000	27.000	22.500	27.000
Wilcoxon W	70.000	63.000	46.000	65.000	45.000	72.000	67.500	72.000
Z	-.236	-1.797	-.237	-.844	-.816	0.000	-1.225	0.000
Asymp. Sig. (2-tailed)	.813	.072	.813	.399	.414	1.000	.221	1.000
Exact Sig. [2*(1-tailed Sig.)]	.864[b]	.328[b]	.864[b]	.456[b]	.776[b]	1.000[b]	.607[b]	1.000[b]

a. Grouping Variable: Sex (M/F)

b. Not corrected for ties.

Figure 1.

Nola Pender’s Health Promotion Model is the idea theoretical framework to help establish a plan to help patients start an exercise regimen and identify barriers to stop exercising.



Revised Health Promotion Model

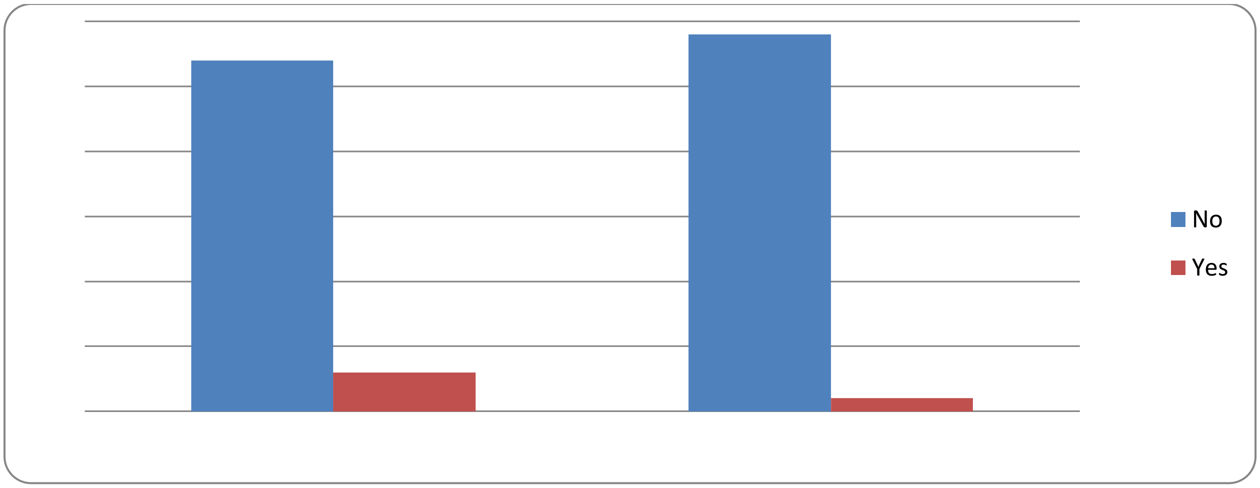
Nola Penders HPM Diagram 1987 take from

http://deepblue.lib.umich.edu/handle/2027.42/85351

Figure 2

Chi Square Analysis

Readmission to ICU



Count

		Readmission to ICU		Total
		No	Yes	
Group	pre	27	3	30
	post	29	1	30
Total		56	4	60

No sign

	Value	df	Asymptotic Significance (2-sided) P=Value	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1.071[a]	1	.301		
Continuity Correction[b]	.268	1	.605		
Likelihood Ratio	1.118	1	.290		
Fisher's Exact Test				.612	.306
N of Valid Cases	60				

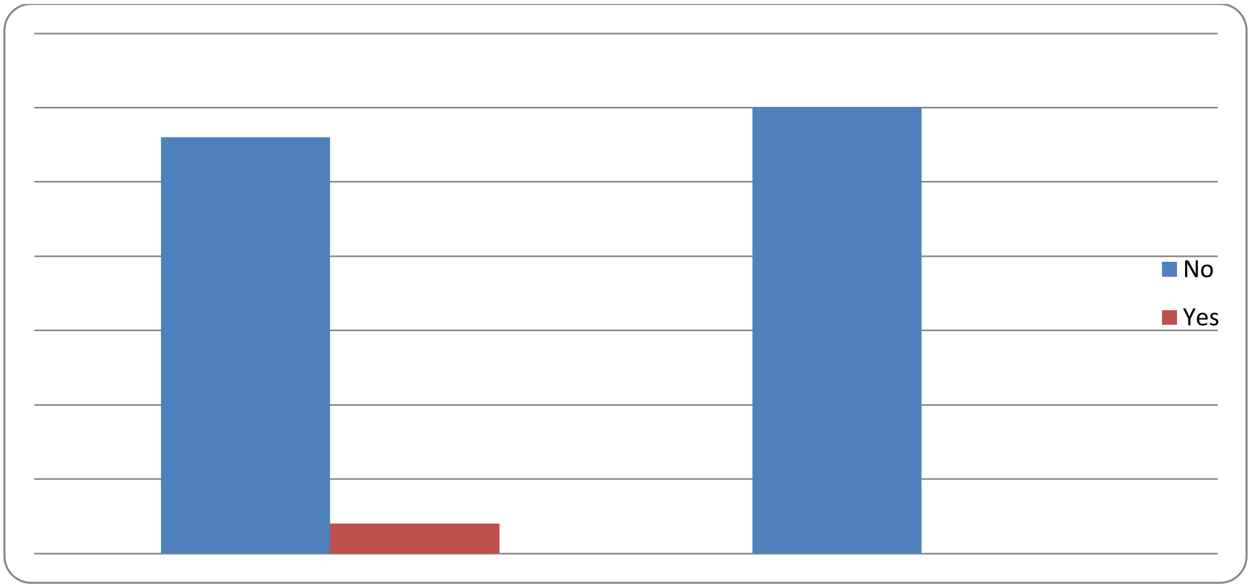
a. 2 cells (50.0%) have expected count less than 5. The minimum expected count is 2.00.

b. Computed only for a 2x2 table

Figure 3

Chi Square Analysis

Evidence of DVT



Count

		Evidence of DVT (Y/N)		Total
		No	Yes	
Group	Pre	28	2	30
	Post	30	0	30
Total		58	2	60

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	2.069[a]	1	.150		
Continuity Correction[b]	.517	1	.472		
Likelihood Ratio	2.842	1	.092		
Fisher's Exact Test				.492	.246
N of Valid Cases	60				

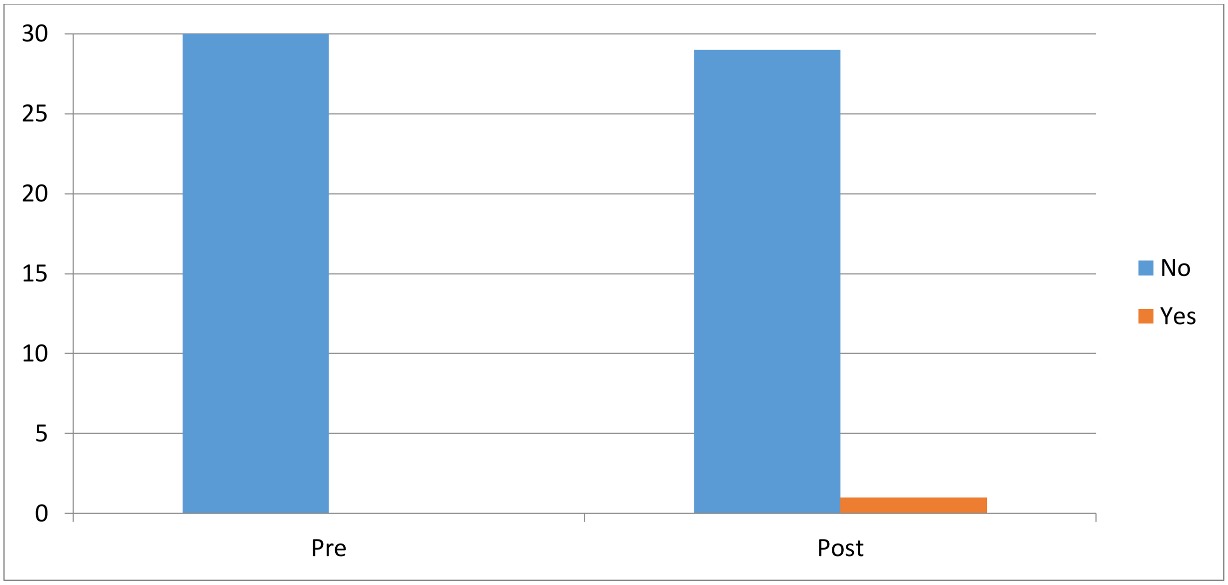
a. 2 cells (50.0%) have expected count less than 5. The minimum expected count is 1.00.

b. Computed only for a 2x2 table

Figure 4

Chi Square Analysis

Evidence of Pulmonary Emboli



Count

		Evidence of PE (Y/N)		Total
		No	Yes	
Group	Pre	30	0	30
	Post	29	1	30
Total		59	1	60

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1.017[a]	1	.313		
Continuity Correction[b]	0.000	1	1.000		
Likelihood Ratio	1.403	1	.236		
Fisher's Exact Test				1.000	.500
N of Valid Cases	60				

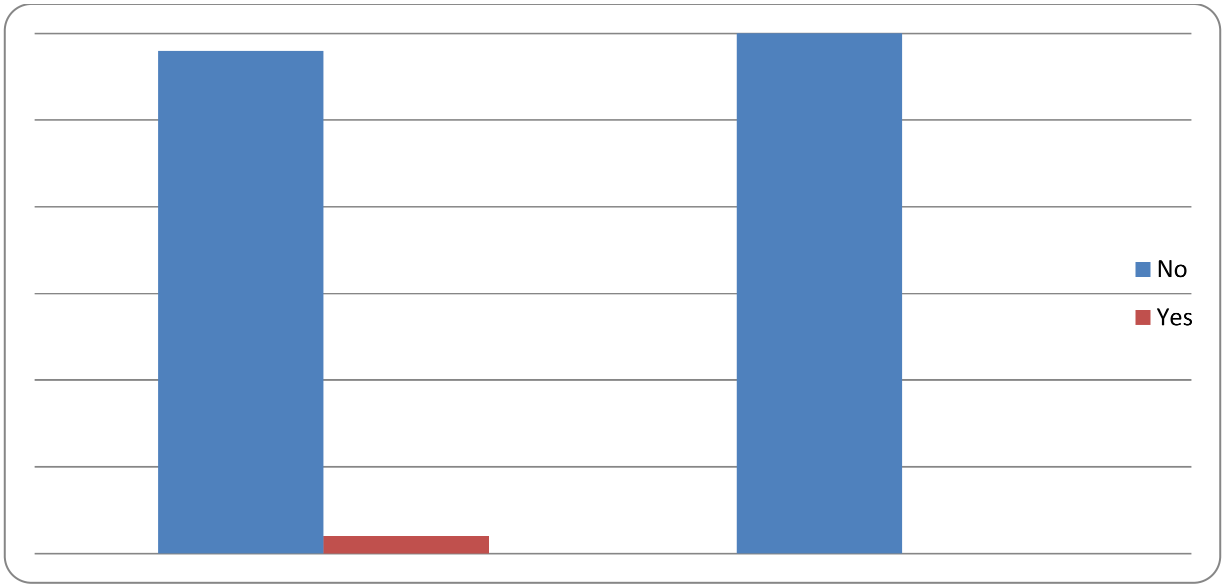
a. 2 cells (50.0%) have expected count less than 5. The minimum expected count is .50.

b. Computed only for a 2x2 table

Figure 5

Chi Square Analysis

Evidence of Pressure Ulcer



Count

		Evidence of PU (Y/N)		
		No	Yes	Total
Group	Pre	29	1	30
	Post	30	0	30
Total		59	1	60

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1.017[a]	1	.313		
Continuity Correction[b]	0.000	1	1.000		
Likelihood Ratio	1.403	1	.236		
Fisher's Exact Test				1.000	.500
N of Valid Cases	60				

a. 2 cells (50.0%) have expected count less than 5. The minimum expected count is .50.

b. Computed only for a 2x2 table

Appendix A

December 1 2014 on the cardiovascular surgery units. The goal of this protocol was to work in a multidisciplinary team to increase the number or patients being ambulated and working acutely to increase mobility in the bedbound patients. This protocol is a progressive level protocol that takes into account patient's clinical situation and allows for progression or regression based on the patient's clinical situation.

Level 1: Active and passive range of Motion (ROM) and head of bed at great than 30 degree angle.

Level 2: Having the patient setting on edge of bed with legs dangling in upright position.

Level 3: Having the patient standing up and lateral side stepping along the beds edge.

Level 4: Having the patients get out of bed to a chair with a stand and pivot transfer.

Level 5: Having the patient Ambulate less than 50 feet with assistive devices as needed.

Level 6: Having the patient Ambulate at least 100 feet with assistive devices as needed

Level 7: Having the patient Ambulate greater than 100 feet with assistive devices as needed.

Appendix B

Diagnostic Related Groups for Chest Surgery

001 Heart transplant or implant of heart assist system w MCC
002 Heart transplant or implant of heart assist system w/o MCC
007 Lung transplant
163 MAJOR CHEST PROCEDURES W MCC
164 MAJOR CHEST PROCEDURES W CC
165 MAJOR CHEST PROCEDURES W/O CC/MCC
166 OTHER RESP SYSTEM O.R. PROCEDURES W MCC
167 OTHER RESP SYSTEM O.R. PROCEDURES W CC
168 OTHER RESP SYSTEM O.R. PROCEDURES W/O CC/MCC
175 PULMONARY EMBOLISM W MCC
176 PULMONARY EMBOLISM W/O MCC
180 RESPIRATORY NEOPLASMS W MCC
181 RESPIRATORY NEOPLASMS W CC
182 RESPIRATORY NEOPLASMS W/O CC/MCC
183 MAJOR CHEST TRAUMA W MCC
184 MAJOR CHEST TRAUMA W CC
185 MAJOR CHEST TRAUMA W/O CC/MCC
186 PLEURAL EFFUSION W MCC
187 PLEURAL EFFUSION W CC
188 PLEURAL EFFUSION W/O CC/MCC
189 PULMONARY EDEMA & RESPIRATORY FAILURE
207 RESPIRATORY SYSTEM DIAGNOSIS W VENTILATOR SUPPORT 96+ HOURS
208 RESPIRATORY SYSTEM DIAGNOSIS W VENTILATOR SUPPORT <96 HOURS
215 OTHER HEART ASSIST SYSTEM IMPLANT
216 CARDIAC VALVE & OTH MAJ CARDIOTHORACIC PROC W CARD CATH W MCC
217 CARDIAC VALVE & OTH MAJ CARDIOTHORACIC PROC W CARD CATH W CC
218 CARDIAC VALVE & OTH MAJ CARDIOTHORACIC PROC W CARD CATH W/O CC/MCC
219 CARDIAC VALVE & OTH MAJ CARDIOTHORACIC PROC W/O CARD CATH W MCC
220 CARDIAC VALVE & OTH MAJ CARDIOTHORACIC PROC W/O CARD CATH W CC
221 CARDIAC VALVE & OTH MAJ CARDIOTHORACIC PROC W/O CARD CATH W/O CC/MCC
226 CARDIAC DEFIBRILLATOR IMPLANT W/O CARDIAC CATH W MCC
227 CARDIAC DEFIBRILLATOR IMPLANT W/O CARDIAC CATH W/O MCC
228 OTHER CARDIOTHORACIC PROCEDURES W MCC

229 OTHER CARDIOTHORACIC PROCEDURES W CC
230 OTHER CARDIOTHORACIC PROCEDURES W/O CC/MCC
231 CORONARY BYPASS W PTCA W MCC
232 CORONARY BYPASS W PTCA W/O MCC
233 CORONARY BYPASS W CARDIAC CATH W MCC
234 CORONARY BYPASS W CARDIAC CATH W/O MCC
235 CORONARY BYPASS W/O CARDIAC CATH W MCC
236 CORONARY BYPASS W/O CARDIAC CATH W/O MCC
237 MAJOR CARDIOVASC PROCEDURES W MCC
238 MAJOR CARDIOVASC PROCEDURES W/O MCC
242 PERMANENT CARDIAC PACEMAKER IMPLANT W MCC
243 PERMANENT CARDIAC PACEMAKER IMPLANT W CC
244 PERMANENT CARDIAC PACEMAKER IMPLANT W/O CC/MCC
245 AICD GENERATOR PROCEDURES
246 PERC CARDIOVASC PROC W DRUG-ELUTING STENT W MCC OR 4+ VESSELS/STENTS
247 PERC CARDIOVASC PROC W DRUG-ELUTING STENT W/O MCC
248 PERC CARDIOVASC PROC W NON-DRUG-ELUTING STENT W MCC OR 4+ VES/STENTS
249 PERC CARDIOVASC PROC W NON-DRUG-ELUTING STENT W/O MCC
250 PERC CARDIOVASC PROC W/O CORONARY ARTERY STENT W MCC
251 PERC CARDIOVASC PROC W/O CORONARY ARTERY STENT W/O MCC
252 OTHER VASCULAR PROCEDURES W MCC
253 OTHER VASCULAR PROCEDURES W CC
254 OTHER VASCULAR PROCEDURES W/O CC/MCC
258 CARDIAC PACEMAKER DEVICE REPLACEMENT W MCC
259 CARDIAC PACEMAKER DEVICE REPLACEMENT W/O MCC
260 CARDIAC PACEMAKER REVISION EXCEPT DEVICE REPLACEMENT W MCC
261 CARDIAC PACEMAKER REVISION EXCEPT DEVICE REPLACEMENT W CC
262 CARDIAC PACEMAKER REVISION EXCEPT DEVICE REPLACEMENT W/O CC/MCC

Appendix C

Project data collection template

Subject ID	Age (Years)	Race (C/B/A/O)	Sex (M/F)	Diagnosis (ICD9/10)	Surgical Procedure (DRG code)	Hospital LOS (Days)	ICU LOS (Days)	Readmission to ICU (Y/N)	Evidence of DVT (Y/N)	Evidence of PE (Y/N)	Evidence of PU (Y/N)
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											
Data Key											
Race	B=Black	A= Asian	O= Other	C=Caucasian							
Y=1											
N=0											

Appendix D

RE: Capstone Proposal Page 1 of 1

RE: Capstone Proposal

White, Marcia P (Marcy) *HS

Sent: Tuesday, April 21, 2015 6:56 PM

To: Floyd, Shawn M. *HS

Cc: Topley, Darla K *HS

Sounds good..

Thanks

From: Floyd, Shawn M. *HS
Sent: Tuesday, April 21, 2015 6:17 PM
To: White, Marcia P (Marcy) *HS
Cc: Topley, Darla K *HS
Subject: Capstone Proposal

Marci,

As you might remember I am working on my DNP and have been working with Darla in regards to mobility. A draft of capstone proposal is attached but the brief version is this: I would like to evaluate 30 patients pre and 30 patients post the initiation of progressive mobility program that Darla has put in place. This would be a retrospective chart analysis that I will hope to be using for quality improvement so the IRB might consider this an exempt project. I need to get approval from the unit manager to conduct this project and if you have any questions please let me know

Shawn Floyd NP
DNP Student.

https://email.healthsystem.virginia.edu/owa/?ae=Item&t=IPM.Note&id=RgAAAAB6lRsz... 4/22/2015

Appendix F

University of Virginia
Institutional Review Board for Health Sciences Research
Protection of Human Subjects Approval
Assurance Identification/Certification/Declaration
(Common Federal Rule)

HSR # 18319		
Event: Approval New Protocol - Expedited	**Type:** Protocol	**Sponsor(s):** **Sponsor Protocol #:** **Principal Investigator:** Dorothy Tullmann
Title: Evaluation of a Progressive Mobility Program in Cardiovascular Surgical Patients		
Assurance: Federal Wide Assurance (FWA)#: 00006183		
Certification of IRB Review: The IRB-HSR abides by 21CFR50, 21CFR56, 45CFR46, 45CFR160, 45CFR164, 32CFR219 and ICH guidelines. This activity has been reviewed by the IRB in accordance with these regulations.		
Event Date: 08/24/15 **Protocol Expiration Date:** 08/23/16 **Number of Subjects:** 60 **HSR Protocol Version Date:** 08/18/15		
Current Status: Open to enrollment		
Consent Version Dates:		
Committee Members (did not vote):		

Comments: The IRB determined this protocol met the criteria for approval per the federal regulations and thus it was approved.

The purpose of this retrospective medical record review is to learn more about the effectiveness of a progressive mobility program that was implemented as part of clinical care in the postoperative cardiothoracic surgery population at UVa.

There is no outside sponsor for this study.

N= 60 subjects

Ages: 16-99 years

ISPRO approval on file.

No additional committee approvals are required.

No compensation.

REGULATORY INFORMATION:

The IRB determined this protocol met the criteria of minimal risk.

Protocol Expedited by Category #5: Research involving materials (data, documents, records or specimens) that have been collected solely for non-research purposes (such as medical treatment and/or diagnosis).

This protocol has been granted a Waiver of Consent to identify potential subjects via 45CFR46.116.

This protocol has been granted a waiver of consent under 45CFR46.116 for the main study.

This protocol has been granted a waiver of HIPAA authorization under 45CFR 164.512(i)(2) for the main study.

The following HIPAA identifiers will be collected: Name, All elements of dates, Medical Record number, Other information that could be used alone or in combination with other information to identify an individual.

The minimum necessary PHI to be collected includes: demographics; hospital and ICU length of stay; incidence of pressure ulcer, deep vein, and pulmonary embolism during surgical admission.

Subjects may not be contacted by any method (email, phone, in person etc.) to obtain more information for this study without additional IRB-HSR approval.

No identifiable health information will be taken or shared outside of the UVa HIPAA covered entity.

PLEASE REMEMBER:

* If an outside sponsor is providing funding or supplies, you must contact the SOM Grants and Contracts Office/ OSP regarding the need for a contract and letter of indemnification. If it is determined that either of these documents is required, participants cannot be enrolled until these documents are complete.
* You must notify the IRB of any new personnel working on the protocol PRIOR to them beginning work.
* You must obtain IRB approval prior to implementing any changes to the approved protocol or consent form except in an emergency, if necessary to safeguard the well-being of currently enrolled subjects.
* If you are obtaining consent from subjects, prisoners are not allowed to be enrolled in this study unless the IRB-HSR previously approved the enrollment of prisoners. If one of your subjects becomes a prisoner after they are enrolled in the protocol you must notify the IRB immediately.
* You must notify the IRB-HSR office within 30 days of the closure of this study.
* Continuation of this study past the expiration date requires re-approval by the IRB-HSR.

The official signing below certifies that the information provided above is correct and that, as required, future reviews will be performed and certification will be provided.

Name: Lynn R. Noland , RN PhD Title: Vice Chair, Institutional Review Board for Health Sciences Research Phone: 434-924-9634 Fax: 434-924-2932	Name and Address of Institution: Institutional Review Board for Health Sciences Research PO Box 800483 University of Virginia Charlottesville, VA 22908
Signature: Lynn R. Noland	Date: 8/24/15

Appendix G

Research Randomizer

RESULTS

1Set of 20 Unique Numbers

Range: From 2 to 518- Sorted from Least to Greatest

Set #1

p1=21,p2=62, p3=110, p4=124, p5=148, p6=176, p7=211, p8=233, p9=247, p10=258, p11=288, p12=339,p13=348, p14=354,p15=356, p16=423, p17=445, p18=454,p19=474, p20=509

https://www.randomizer.org/ 8/26/2015

Appendix H

Research Randomizer

RESULTS

1Set of 20 Unique Numbers

Range: From.2 to 66-Sorted from Least to Greatest

Set #1

p1=3,p2=7,p3=9,p4=12,p5=14,p6=15,p7=16,p8=20,p9=22,p10=24,p11=25,p12=28,

p13=30,p14=35,p15=39,p16=45,p17=51,p18=58,p19=61,p20=63

https://www.randomizer.org/ 8/26/2015

Submission to the Journal of Cardiovascular Nursing

Evaluation of a Progressive Mobility Protocol in Post-Operative Cardiothoracic Surgical Patients

Shawn Floyd DNPc, RN, ACNP [1]
Sarah W. Craig, PhD, RN, CNS [2]
Darla Topley, DNP, RN, CNS [3]
and
Dorothy Tullmann, PhD, RN, CNL [2]

1 University of Virginia Transplant Services

2 University of Virginia School of Nursing

3 University of Virginia Thoracic and Cardiovascular ICU

Abstract

Cardiothoracic surgical patients are at high risk for complications related to immobility such as increased intensive care and hospital length of stay, intensive care unit readmission, pressure ulcer development, and deep vein thrombosis/pulmonary embolus. A progressive mobility protocol was started in the thoracic cardiovascular intensive care unit in a rural academic medical center. The purpose of the progressive mobility protocol was to increase mobilization of post-operative patients and decrease complications related to immobility in this unique patient population. A matched pairs design was used to compare a randomly-selected sample of the pre-intervention group (n=30) to a matched post-intervention group (n=30). The analysis compared outcomes including, intensive care unit and hospital length of stay, intensive care unit readmission, pressure ulcer prevalence, and deep vein thrombosis /pulmonary embolism prevalence between the two groups. Although this comparison does not achieve statistical significance ($p < 0.05$) for any of the outcomes measured it does show a reduction in hospital length of stay hospital, intensive care unit days, a decline in intensive care unit readmission rate, and a decline in pressure ulcer prevalence which is the overall goal of progressive mobility. This study has implications for nursing, hospital administration, and therapy services in regards to staffing and cost savings related to fewer complications of immobility. Future studies with a larger sample size and other populations are warranted.

Keywords: Progressive Mobility, Cardiothoracic Surgery, Length of Stay, Postoperative complications of Immobility

Evaluation of a Progressive Mobility Protocol in Post-Operative Cardiothoracic Surgical Patients

Background

The complexity of surgical procedures that are routinely preformed today were considered impossible twenty years ago. Complex surgical procedures are offered to patients who require coordinated postoperative management of the surgical procedure and comorbid conditions. Patients that are admitted to hospitals today would have not survived just a few years ago due to the severity of their chronic illnesses, but yet today these are some of the routine patients that we take to the operating room for surgery.

Patients undergoing cardiac and thoracic surgery procedures are at high risk for post-operative complications due to pre-operative comorbid conditions such as peripheral vascular diseases, hypertension, heart disease, diabetes mellitus, lung disease, and malignancy. According to Sepehri et al., (2014), half of the patients that undergo a cardiothoracic surgery procedure in North America are 75 years old or older. According to the Centers for Disease Control (2015) heart disease and lung disease are the both in the top ten causes of all death in the United States

Along with heart and lung diseases causing morbidity and mortality in the United States, immobility after a surgical procedure causes multiple medical problems. According to Knight, Nigam, and Jones (2009) patients that are subjected to bed rest start to see changes in baroreceptors sensitivity within days of being confined to bed. These changes can lead to orthostatic intolerance, physical (muscular), and cardiac deconditioning. The physiological changes noted by Knight, et al. (2009) accompanied with a number of studies by (Bloomfield, 1997; De Jonghe, et al., 2002; Siebens, Aronow, Edwards, & Ghasemi, 2002; Topp, Ditmyer, King, Doherty, & Hornyak, 2002) have shown along with bedrest the longer patients are mechanically ventilated the more muscle mass and functional strength that patients lose. Multiple studies show the functional strength that patients lose when put on bedrest, yet it is still not standard practice in some facilities to have cardiothoracic surgical patients out of bed or even walking until they are weaned from mechanical ventilation. Despite a mounting body of literature in the medical patient population and general surgery population, chest surgery patients have not been well studied in regards to increasing activity and mobilization after surgery. Even though according to Knight et al., (2009) soldiers in World War II were forced to get up and move quickly after all types of surgery including chest wounds, due to lack of adequate space and they recovered quickly from their injuries and infections. This is a unique set of patients in that they were young healthy men that experienced acute trauma, but it does speak to the idea that getting up and mobilizing has some positive effect. Recently in experts in critical care from around the world have come together to make recommendations for the mobilization of ventilated critically ill adult patients in multiple populations. This consensus statement reviewed the current literature and found that it is safe and effective to mobilize patients while on stable mechanical ventilation. (Hodgson et al., 2014)

Numerous patients that are admitted to an Intensive Care Units (ICU) after a cardiothoracic surgical intervention have undergone planned elective procedures that allow time for evaluation of surgical risk. The majority of these patients are dealing with different levels of debilitation prior to having a major cardiac or thoracic procedure due to underlying disease processes. Perme, Nalty, Winkelman, Kenji Nawa, and Masud, (2013) analyzed a Cardiac Surgical Intensive Care Unit mobility intervention and found that patients in this ICU, 57% had hypertension and 29% had diabetes. Hypertension may cause tissue perfusion problems and, diabetes can cause changes in sensation effecting patients ability to get out of bed after a chest surgery. The largest patient sample in the Perme et al., (2013) study had undergone lung transplantation. Although lung transplantation is not a common procedure in every institution, this is typical of a very complex patient population that may have negative outcomes related to immobility in the postoperative period. In the critical care literature the ABCDE bundle approach has been developed as a multidisciplinary approach to address number of complications related to critical care delivery systems. These bundles have been successful in reducing rates of ventilator associated pneumonia, ICU induced delirium, indwelling vascular, and urinary catheter infection rates in many intensive care units across the United States (Balas et al., 2013). All of these issues effect cardiothoracic surgery patients that have undergone a major surgical procedure and require critical care post-operatively.

Our medical center initiated a progressive mobility protocol in December 2014 in response to prolonged mechanical ventilation times, increased readmissions to the ICU, and length of stay in the post-operative Thoracic and Cardiovascular Intensive Care Unit (TCV-ICU). Prior to the initiation of this progressive mobility protocol (PMP) there was no standard activity protocol in use among the different surgical services that are admitted to the thoracic cardiovascular surgery intensive care unit.

Due to the lack of standardization for mobilization of post-operative patients, some patients received physical therapy, some received occupational therapy, and some received both and were mobilize by different therapist daily. The mobilization of many patients had been left to bedside nursing to decide when to increase physical activity after surgery, but with no set plan of care on what to focus on. Due to this lack of set plans of care, patients that were only mobilized by nursing, where mobilized only if the bedside nurse had time and staffing allowed for the patient to be worked with.

This non standardization of mobility interventions lead to a progressive mobility protocol being established to help standardize the process of mobilizing patients after surgery. The multidisciplinary team including physical therapy, occupation therapy, bedside nursing, and patient care assistants. All members of the team received training on the progressive mobility protocol prior to the initiation of the protocol. The team also received current literature to help build the foundation of why mobilization of intensive care units patients is an important and worthwhile intervention.

Purpose of the study

The purpose of this student was to evaluate the effectiveness of a progressive mobility protocol (PMP) on patient outcomes related to immobility: length of hospital and ICU length of stay, ICU readmission and the incidence of pressure ulcers and deep vein thrombosis/pulmonary embolus. The protocol was initiated in December of 2014 in our adult Thoracic and Cardiovascular Intensive Care Unit (TCVICU).

Research Design

This is retrospective study with a descriptive comparative research design using matched pairs.

Progressive Mobility Protocol

The PMP was developed by, Zomorodi et.al. (2012) and is the basis of the protocol initiated in the Thoracic Cardiovascular Intensive Care Unit (TCVICU). This is a protocol of progressive and increasing functional activity leading to mobility. The goal is to progress patients from the bedbound state to active ambulatory mobilization with minimal assistance. The progression of the patient through the levels of mobility is dependent on the patient's overall physical and clinical stability. Patients may progress or regress depending on clinical factors that are related to the patients overall medical condition.

Methods

Setting

The setting for this study is the 15 bed adult TCVICU in an academic medical center located in central Virginia. This unit admits all adult patients that have undergone open heart surgeries including coronary bypass grafting, valve replacement, and heart transplant. The TCVICU also admits patient undergoing lung resections, esophageal surgeries, and lung transplant. Any adult patient that has received a mechanical circulatory device such as left or right ventricular assist devices or is on extracorporeal membrane oxygenation support are also is admitted to this unit.

The unit is staffed with registered nurses and patient care assistants with a usual nurse patient ratio of 2:1 and assistant to patient ratio of 6:1. This unit also has dedicated Registered Respiratory Therapist on the unit 24 hours a day. The TCVICU is staffed by providers ranging from attending physicians, resident physicians, and nurse practitioners who manage the medical needs of the patients admitted for post-operative care.

Inclusion and Exclusion Criteria

Patients admitted to the TCVICU were eligible if they were 16 to 99 years of age for any surgery involving the chest based on diagnostic related grouping and were mechanically ventilated at the time of arrival to the unit. Both males and females were included. Patients were excluded if they developed post-operative bleeding that required re-operation to stop the bleeding during the first 24 hours of intensive care unit stay. Other exclusion criteria included death within 24 to 72 hours post operatively, patients that required extracorporeal membrane oxygenation for more than 96 hours post operatively or placement of a ventricular assist device.

Description of the Sample

The patients in both the pre-intervention and post-intervention groups were identified from daily unit census reports collected in the TCVICU. The pre-intervention group was selected from the 517 eligible cardiac and 65 eligible thoracic patients in the unit from June 1, 2014 to November 30, 2014. Patients in the post-intervention group were identified from the 392 eligible cardiac patients and 59 eligible thoracic patients in the unit from December 1, 2014 to June 30, 2015. Using a table of random numbers 15 cardiac and 15 thoracic surgery patients were selected from the pre-intervention group. These cases were matched by surgical procedure (cardiac or thoracic) as well as age (+/- eight years) and gender when possible. The variables of interest were then compared between groups.

Measures

The data for this study was collected in a retrospective analysis of the electronic records of patients who meet the study criteria retrieved by a Registered Nurse. All data was retrieved from and reviewed from the EPIC® electronic medical record. The following information was recorded in the study data collection tool.

- Demographics: Patient’s age, race, and sex
- Diagnoses: ICD 9 code given to the patient at time of admission to the hospital
- Surgical procedure: Surgical procedure code listed in the patient’s operative notes progress note

- Intensive care unit length of stay: Number of days the patient is actively receiving intensive care in the TCVICU
- Hospital length of stay: Number of days the patients is receiving care in the hospital
- Pressure ulcer prevalence: Any new diagnosis of pressure ulceration by ICD 9 code
- Deep vein thrombosis (DVT) or pulmonary embolism (PE): Any new diagnosis of DVT or PE by ICD 9 code

Data Analysis and Protection of Human Subjects

All data was analyzed using SPSS software version 23 (IBM, 2015). Demographic data for both groups was compared using mean and standard deviation. Hospital length of stay and ICU length group comparisons were analyzed using *t*-test or Mann-Whitney U. The incidence of new pressure ulcers or DVT/PE in the two groups were analyzed using Chi Square. This study was approved by the organization's Institutional Review Board.

Results

Demographics

The pre intervention cardiac group consisted of n = 15 patients with a mean age of 66.6 years and the post intervention cardiac group consisted of n = 15 patients with a mean age of 64.9 years. The pre intervention thoracic sample consisted of n = 15 patients with a mean age of 61.4 years and the post thoracic intervention group consisted of n = 15 patients with a mean age of 62.6 years. All groups had more men (9 – 13) than women (2 – 6). The mean age of all participants and the male to female ratio was similar in all study groups (Table 1).

Hospital and Intensive Care Unit Length of Stay

The pre intervention cardiac group mean hospital length of stay (LOS) was 8.6 days and the mean ICU LOS was 2.6 days compared to the post intervention cardiac group mean hospital

LOS of 6.5 days and mean ICU LOS of 2.6 days. Although not statistically significant (*p* = .502) there was an overall decrease in the hospital LOS after the progressive mobility protocol was initiated on this unit. Mean hospital LOS for the pre intervention thoracic group was 12.6 days compared to 9.8 days after the progressive mobility protocol was in place. The mean ICU LOS for the pre intervention thoracic groups was 6.3 days compared to 4.6 days for the post intervention thoracic groups. Although a decrease in patient days was noted this difference was not statically significant (*p* =.779; Table 2).

Intensive Care Unit Readmission

Of the total pre-intervention group (cardiac and thoracic; n = 30) there were n = 3 readmissions within 30 days. In the post-intervention group (n = 30) there was only n = 1 30-day readmission. Although not statistically significant (*p* = 0.301) the clinical and economic benefits of this outcome is important.

Deep Vein Thrombosis/Pulmonary Embolism and Pressure Ulcers

In the combined (cardiac and thoracic) pre-intervention group there were n = 2 patients who developed a DVT and none in the post-intervention group. No patients in the pre-intervention group developed a PE and n = 1 in the post-intervention group. However, this was an incidental finding on a post-operative computerized tomography scan and was not statistically or clinically. Neither comparison (DVT: *p* = 0.492; PE: *p* = 1.0) was statistically significant. There was n = 1 patient with a pressure ulcer in the pre-intervention group and none in the post-intervention group showing no statistically significant difference (*p* = 0.313).

Discussion

Summary

The purpose of this study was to evaluate the effectiveness of a progressive mobility protocol (PMP) on patient outcomes related to immobility: length of hospital and ICU length of stay, ICU readmission and the incidence of pressure ulcers and deep vein thrombosis/pulmonary embolus in a thoracic cardiovascular intensive care unit (TCVICU). After the introduction of a PMP in the TCVICU the overall hospital length of stay decreased and the number of immobility related complications decreased with the exception of an incidental pulmonary embolism. Although the small sample size did not reveal statically significance difference in any of the outcomes, the clinical and economic significance of these changes are important.

This is the first evaluation study of a PMP in the cardiothoracic surgery population on specific mobility-related outcome measures. These results do show a decrease in cardiothoracic surgery patients outcomes similar to outcomes demonstrated in the medical, colorectal, and trauma patient populations. (Choi, Tasota, &Hoffman 2008, Morris e.t al, 2008, Freeman & Maley, 2013, Cameron et. al, 2015). The lack of statistical significates in this study should not deter the use of PMPs in the cardiothoracic population.

As the body of literature continues to grow in the cardiothoracic surgery population, the evidence is showing that increasing patient's mobility after hospital admission and/or quickly after a surgical procedure improves outcomes. For facilities that do a large volume of cardiothoracic surgical procedures annually such as academic medical centers, improved mobility and its positive outcomes has multiple fiscal and quality implications. As the health care payer system evolves quality measure such as readmission and prevention of complications will help promote PMPs for all patients.

Nursing Practice Implications

As the population of the United States ages the number of patients undergoing elective and emergency thoracic and cardiac surgeries will increase. Evidence in this evaluation suggests that PMPs initiated at time of admission for the critically ill cardiothoracic population may help decrease complications related to prolonged bed rest and immobility. This intervention may improve patient outcomes, promote faster patient progression through the acute post-operative phase of care, decrease health care cost, and increase patient satisfaction. As the only care provider continually at the bedside, nurses play a key role in this process by coordinating the multidisciplinary team which is essential for a successful PMP. Patients who are hemodynamically unstable pose a particular risk for immobility and its related complications and a nurse who recognizes the benefits of early range of motion and bedrest activity can make the difference in all the outcomes evaluated in this study. If these very complex patient are expected to progress nursing must take the lead with increasing the activity level of these patients while restricted to bed.

Limitations

Some limitations of this study include a small sample size, a single center evaluation in a rural academic medical center and a relatively homogenous patient population. Another limitation is that the pre- and post- intervention groups were identified and selected over a year's time—six months prior to the initiation of the PMP and six months after. This time span could lead to some variation due to time of year, staff experience, staffing levels, and patients that are selected due to the changes in surgical procedures.

Conclusions

While statically significant differences ($p<0.05$) were not found in the outcomes between the pre and post intervention groups in this evaluation, it is clear that there were decreases in hospital LOS, ICU readmission rates, deep vein thrombosis, and pressure ulcer prevalence. This has several implications for hospital administration and nursing administration to help better understand why some patients do not progress to discharge as fast as others. It also has financial implications when bed space is limited and what role progressive mobility protocols aids in recovery, and eventual throughput of complex cardiothoracic surgical patients.

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Table 1

Pre-intervention and Post-intervention Group Age and Sex

	Pre-Intervention Cardiac n = 15	Post-Intervention Cardiac n = 15	Pre-Intervention Thoracic n = 15	Post-Intervention Thoracic n = 15
Age (years)				
• Range	49-85	46-76	50-78	52-72
• Mean (SD)	66.6 (9.98)	64.9 (8.81)	61.4 (7.44)	62.6 (6.80)
Sex				
• Female	3	2	4	6
• Male	12	13	11	9

Table 2

Pre-intervention and Post intervention Group Lengths of Stay (LOS)

	Pre-Intervention Cardiac n = 15	Post-Intervention Cardiac n = 15	Pre-Intervention Thoracic n = 15	Post-Intervention Thoracic n = 15
Hospital LOS (days) • Range • Mean (SD)	4-47 8.6 (10.84)	4-12* 6.53 (2.41)	4-30 12.6 (7.69)	3-21** 9.8 (5.24)
ICU LOS (days) • Range • Mean (SD)	1-12 2.6 (3.15)	1-6 2.60 (1.40)	1-30 6.33 (7.82)	1-16 4.60 (4.45)

* p = .502 ** p = .779