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The Effects of Nursing Activities on the Intra-Abdominal Pressure for Patients at Risk of Intra-Abdominal Hypertension

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THE EFFECTS OF NURSING ACTIVITIES ON THE INTRA-ABDOMINAL PRESSURE FOR PATIENTS AT RISK OF INTRA-ABDOMINAL HYPERTENSION

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PRESSURE FOR PATIENTS AT RISK OF INTRA-ABDOMINAL HYPERTENSION

CAPSTONE PROJECT

by

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2010

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Abstract

Background: Intra-abdominal hypertension (IAH) occurs frequently in critically ill patients, and adds to their morbidity and mortality. There is no published evidence on the effects of nursing activities on the intra-abdominal pressure (IAP) for patients at risk of IAH.

Purpose: The purpose of this study was to identify the effects of hygiene care on the IAP of patients at risk for IAH.

Theoretical Framework: Katharine Kolcaba's comfort theory was used

Methods: This study was implemented in two phases. The first phase was the implementation of a nurse driven protocol to screen for risk factors of IAH and to implement IAP monitoring. The second phase involved providing hygiene care to at risk patients. IAP was measured prior to initiating the hygiene care, immediately after and 10 minutes later. This was a quasi-experimental, pre-test/ post-test design.

Results: The 10 minute post hygiene care measurement of the IAP was significantly lower than the pre or immediate post measurement of the IAP. There were no significant changes in the mean arterial pressure (MAP) or the abdominal perfusion pressure (APP).

Conclusions: It is safe and possibly therapeutic to provide hygiene care to patients at risk for IAH.

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Finally, I would like to thank the patients who participated in this study. It is believed that they have contributed to the body of knowledge in nursing science.

Dedication

I wish to dedicate this capstone project to my children and granddaughter. My children William and Veronica have been my anchors to the real world and what is important in life. My granddaughter, Erynn Rose, has shown me the joy of being a grandmother and the simplicity of that joy.

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CHAPTER ONE

BACKGROUND OF THE PROBLEM

Intra-abdominal hypertension (IAH) and abdominal compartment syndrome (ACS) have been implicated as a source of morbidity and mortality in patients who are acutely or critically ill. Both human and animal studies have shown single and multi-system organ failure (MSOF) due to unrelieved IAH (Malbrain, 2007). Intra-abdominal hypertension is a persistent problem in intensive care units (ICU). The prevalence (a one day snapshot) of IAH is 58% in critically ill medical and surgical patients (Malbrain, et al., 2004). The incidence (new occurrences over time) has been shown to be at 66% (Vidal et al., 2008). In 2004, a group of international physicians and surgeons formed the World Society of the Abdominal Compartment Syndrome (WSACS, n.d.). To date, WSACS has developed standardized, evidence- based definitions, guidelines, and patient treatment algorithms. This paper will rely on the recommendations and definitions of WSACS.

Conditions that cause IAH are identified as either primary (surgical), secondary (medical), or recurrent (Malbrain et al., 2006). Primary conditions are defined as "A condition associated with injury or disease in the abdomino-pelvic region that frequently requires early surgical or interventional radiological intervention" (Malbrain , 2006, p.1728). Secondary conditions are defined as conditions that do not originate from the abdomino-pelvic region (Malbrain , 2006). Recurrent ACS refers to the condition in which ACS redevelops following previous surgical or medical treatment of primary or secondary ACS (Malbrain , 2006). Risk factors for IAH fall into 4 broad categories: diminished abdominal wall compliance, increased intra-luminal contents, increased abdominal contents, capillary leak/ fluid resuscitation (Cheatham et al., 2007). See Appendix B for a detailed list of risk factors falling into these categories.

Intra-abdominal pressure (IAP) is defined as the steady state pressure within the abdominal cavity (Malbrain et al., 2006). In the normal individual, IAP may range from 0 to 5mmHg (Muckart, Ivatury, Leppaniemi, & Smith, 2006). It varies inversely with intra-thoracic pressure during normal breathing. However, various factors can cause it to increase drastically for short periods, such as with a cough, sneeze, or loud singing and then returning easily to baseline.

Critically ill patients tend to have an average IAP of 5 to7 mmHg (Malbrain et al., 2006). Persistent elevations ≥ 12 mmHg are defined as IAH (Malbrain et al., 2006). Abdominal compartment syndrome (ACS) is defined as a sustained IAP > 20 mmHg (with or without an abdominal perfusion pressure (APP) < 60 mmHg) that is associated with new organ dysfunction/failure (Malbrain et al., 2006). APP is calculated by subtracting the IAP from the mean arterial pressure (MAP – IAP = APP) (Malbrain et al., 2006). Current WSACS guidelines recommend keeping the APP > 60mmHg for patients at risk for IAH or ACS (Cheatham et al., 2007).

Malbrain and colleagues (2004) conducted a prevalence study that included 97 patients admitted in 13 ICUs. The overall prevalence was 58.8% having IAH (IAP > 12 mm Hg) with the surgical patients having a prevalence of 65% and the medical patients having a prevalence of 54.4%. However, the medical patients had a higher prevalence of increased IAP > 15 mm Hg than the surgical patients (29.8% vs. 27.5%). The medical patients also had a higher prevalence for ACS than the surgical patients (10.5% vs. 5%).

Vidal and colleagues (2008) studied the incidence of IAP in 83 critically ill patients admitted to one ICU. Of these, 31% had IAH on admission to the ICU and another 33% developed it after admission. Patients with IAH were noted as “sicker” and had a higher mortality rate (53%) than those patients who did not (27%); ACS developed in 12% of the patients.

Reintam, Parm, Kitus, Kern and Starkopf (2008) performed a study with the objective to identify the differences in incidence, course and outcome of primary versus secondary IAH, as well as to assess if IAH is an independent risk factor for death. Two hundred and fifty- seven ventilated patients were enrolled in the study. Repeated measures of IAP were done. IAH developed in 95 of the patients, 60 patients had primary IAH and 35 had secondary IAH. The mean IAP decreased for the patients with primary IAH over the first three days, while the mean IAP increased significantly (p=0.05) for the secondary IAH. The patients with IAH had a significantly higher mortality than those patients who did not have IAH. The ICU mortality for IAH versus no IAH was 37.9% versus 19.1% (p = 0.001); 28-day mortality was 48.4% versus 27.8% (p = 0.001); and the 90-day mortality was 53.7% versus. 35.8% (p = 0.004). Patients with secondary IAH had a significantly higher mortality than those that had primary IAH (p = 0.032). The investigators concluded that the development of IAH is an independent risk factor for death. They further concluded that secondary IAH does not occur as often, and has a different development course than primary IAH, with worse outcomes.

These three studies identify that IAH occurs frequently enough, and may worsen the outcome for those patients. In a synopsis regarding the importance of surveillance for IAH, Malbrain, De laet, and DeWaele (2009) identify the following: “(1) IAH is a frequent problem in critically ill patients; (2) IAH is an important problem as it causes morbidity and mortality; (3) IAH can be detected at an early stage; (4) IAH and ACS can be treated; (5) daily IAP measurement is necessary for optimal patient management in IAH/ACS" (pp. 1110-1111). In summary, screening and monitoring the IAP of patients at risk for IAH needs to become a standard in the Critical Care Unit.

Physiological Effects of Increased Intra-abdominal Pressure

The abdomen can be considered a compartment unto itself with its edges being comprised of the spine, pelvis, and costal arch as its rigid edges and the diaphragm and abdominal wall as its more pliable edges (Malbrain, 2007). The internal contents of this compartment are comprised of the stomach, large and small intestine, omentum, liver, spleen, pancreas, gall bladder, kidneys, adrenals, ureters, bladder, and the uterus in females. Major blood vessels also course through this compartment. The abdominal aorta, with its branches of the celiac axis, superior mesenteric and inferior mesenteric arteries, perfuses the gut and the accessory organs. All the venous blood from the gut drains into the portal vein to the liver and leaves the liver via the hepatic vein to drain into the inferior vena cava. This compartment contains solid organs, hollow organs, fluid, gas, solids, and adipose tissue. When a condition arises that persistently increases pressure in the abdominal cavity, not only is the gut affected but all major body systems can be affected and could lead to multisystem organ failure and death.

The effect of IAH on the splanchnic organs leads to diminished gut perfusion, ischemia, and acidosis of the mucosal bed, intestinal edema, and translocation of gut bacteria (Ivatury & Diebel, 2006). An IAP of up to 20 mmHg can decrease mesenteric perfusion by 40%, and pressures up to 40 mmHg can decrease mesenteric perfusion by

70% (Wendon, Biancofiore, &Auzinger, 2006). Correction of IAH can lead to an ischemia/reperfusion injury and send inflammatory cytokines to other organs setting the ground work for MSOF (Malbrain & De Iaet, 2009). The compression of the abdominal wall by IAH leads to its decreased compliance, further compounding the IAH. The decreased blood flow leads to poor abdominal wound healing and dehiscence.

The vascular liver is very susceptible to IAH. Persistent pressures as low as 10 mmHg can decrease hepatic perfusion and impair liver function (Ivatury & Diebel, 2006; Wendon, Biancofiore, & Auzinger, 2006). In the presence of varices, this same pressure can lead to increased variceal stress and possible rupture (Malbrain, Deeren, & De Potter, 2005). While IAP increases, both hepatic arterial flow and portal vein flow decreases, leading to altered glucose metabolism, mitochondrial malfunction, and decreased lactate clearance (Wendon, Biancofiore, & Auzinger, 2006).

Impaired renal function has been associated with IAH as identified in a review of the research literature by Sugrue, Hallal, and D’Amours (2006). Persistent pressures of ≥ 15 mmHg have been independently associated with renal impairment and increased risk of death. The acute kidney injury accompanying IAH is multi-factorial. A decreased cardiac output leads to decreased renal arterial perfusion, glomerular filtration, and oliguria. This precipitates activation of the renin-angiotensin system, with concomitant vasoconstriction, release of aldosterone and antidiuretic hormone (ADH). The further re-absorption of sodium and water by these hormones adds to the abdominal edema. Pressure on the inferior vena cava (IVC) adds to the increased pressure placed on the kidneys (Lui, Sangosanya, & Kaplan, 2007).

As the abdomen distends with gas, fluid, or swollen organs, the diaphragm is pushed upwards impinging on the thoracic cavity. Approximately 50% of the intra-abdominal pressure is dispersed across the diaphragm and affects respiration (Malbrain & De Iaet, 2009). Pulmonary dysfunction may be one of the earliest signs of ACS (Mertens zur Borg, Verbrugge, & Olvera, 2006). Since the lungs cannot expand fully, respiratory depth is decreased, and carbon dioxide ($CO_{2)}$) is retained. Compression atelectasis adds to the ventilation/ perfusion (V/Q) mismatch, decreasing PaO_2/FIO_2 ratio, and hypoxia. Hospital- or ventilator- acquired pneumonia may develop secondary to the compression atelectasis.

The IAP may cause increases in peak airway and plateau pressures for the ventilated patient. The increase in these ventilator pressures may lead the collaborative team to entertain a diagnosis of acute lung injury (ALI) and a shift to lung protective strategies and low tidal volumes. When ALI is not present but ACS is, low tidal volumes will not improve the respiratory picture (Lui, Sangosanya, & Kaplan, 2007). In the presence of ACS, ALI or acute respiratory distress syndrome (ARDS) can be sequelae.

One of the conundrums of IAH is its effect on the cardiovascular system. The increased intra-thoracic pressure compresses the heart and major vessels causing a tamponade-like picture. Central venous pressures and pulmonary artery occlusion pressures are falsely elevated (Cheatham & Malbrain, 2006), leading clinicians to surmise that the patient is volume loaded or overloaded. The components of cardiac output, which are preload, afterload, and contractility, are all negatively affected by an increasing IAH.

Due to inferior vena cava (IVC) compression, there is a decreased venous return to the heart, affecting preload and causing a drop in cardiac output. Contractility is affected mainly by changes in right heart mechanics. The elevated intra-thoracic pressure caused by IAH also increases pulmonary vascular resistance (PVR) and right heart afterload. The right ventricle is a thin walled chamber that normally acts as a passive conduit in pumping blood to the left heart. In adapting to the increased PVR, the right ventricle dilates and has to increase its workload. The increased workload increases myocardial oxygen demand. Through the sympathetic nervous system's compensatory measures to maintain the arterial pressure the systemic vascular resistance (SVR) increases. Add to that, direct compression of the abdominal aorta due to IAH, and that further increased the SVR and the workload on the heart (Cheatham & Malbrain, 2006; Malbrain & De Iaet, 2009).

There have been animal and human studies correlating the effects of IAH on intracranial pressure (ICP) (Citerio & Berra, 2006; Scalea, Grant, Habashi et al., 2007). Cerebrospinal fluid and the brain's venous drainage both leave the brain via the jugular vein (Ropper & Samuels, 2009). Elevations in IAP transfer into the thoracic compartment. Increased intrathoracic pressure is a known cause for increasing intracranial pressure. In a patient that has an increased ICP, the effects of IAH can further increase ICP and decrease cerebral perfusion pressure (CPP).

Research Problem Statement

Despite evidence of the causal relationship between IAH and morbidity and mortality, patients at risk for IAH are not consistently monitored for changes in IAP. There has been no published nursing research on the effects of nursing activities on the

IAP for patients at risk for IAH. While it is possible that a variety of routine nursing interventions may adversely affect IAP, it is not known whether nursing activities adversely affect IAP of patients that are at risk for IAH.

Purpose of the Study

The purpose of this study is to assess the effects of a specific and common nursing activity, which is hygiene care, on the IAP of patients who are at risk for IAH.

Research Question

Does the nursing activity of hygiene care cause an increase in intra-abdominal pressure in patients at risk for IAH?

Theoretical Framework

Kolcaba's (2001) middle range theory of comfort provides the theoretical framework on which the project is based. The project is based on the theory of comfort. The theory has previously been used been used in a variety of nursing settings such as orthopedics (Panno, Kolcaba, & Holder, 2000), peri-anesthesia (Kolcaba & Wilson, 2002; Wilson & Kolcaba, 2004), hospice (Kolcaba, Dowd, Steiner, & Mitzel, 2004; Novak, Kolcaba, Steiner, & Dowd, 2001; Vendlinski & Kolcaba, 1997), urological nursing (Dowd, Kolcaba, & Steiner, 2002), gerontologic nursing (Kolcaba, Schirm, & Steiner, 2006) and breast cancer (Kolcaba & Fox, 1999). Additionally, the theory has been used in nursing education (Kolcaba, 1992) to develop a framework for nursing care.

The theory originated from the theorist's own nursing experience as a nurse manager on an Alzheimer's unit. One of the major constructs in the original work was *comfort*. She conceptualized the construct of comfort through analysis of its use in nursing as well as the disciplines of medicine, psychology, theology, psychiatry and ergonomics (Kolcaba, 2003).

As Kolcaba continued to expand and refine her theory, she incorporated theoretical definitions from various other disciplines and theorists including the psychologist Henry Murray (Kolcaba, 2003). Kolcaba recognized the contributions of the nursing theorists Ida Jean Orlando with *relief* as a type of comfort and Virginia Henderson with *ease* as a type of comfort. Paterson and Zderad's grand theory was the basis from which she defined *transcendence* as a comfort type (Kolcaba, 2001).

Kolcaba's (1992) definition of comfort is, "Holistic comfort is defined as the immediate experience of being strengthened through having the needs for relief, ease, and transcendence met in four contexts of experience (physical, psychospiritual, social, and environmental)" (p. 6). Kolcaba (2003) further identifies the types of comfort in this taxonomic structure as: "*Relief* –- the state of having a specific comfort need met, *Ease* –- the state of calm or contentment and *Transcendence* -– the state in which one can rise above problems or pain" (p. 15).

Comfort occurs within the context of the physical, psycho-spiritual, environmental and socio-cultural dimensions. Kolcaba (2003) defined these contexts as:

> *Physical* –- pertaining to bodily sensations, homeostatic mechanisms, and immune function. *Psychospiritual* -– pertaining to internal awareness of self, including esteem, identity, sexuality, meaning in one's life, and one's understood relationship to a higher order or being. *Environmental* –- pertaining to the external background of human experience (temperature, light, sound, color, odor, furniture, landscape, etc.). *Sociocultural* -- pertaining to interpersonal, family,

> and societal relationships (finances, teaching, health care personnel, and family traditions, rituals, and religious practices. (p. 15)

The theory accepts the traditional domains of nursing and provides the following definitions (Kolcaba, 2007):

> *Nursing* -- the intentional assessment of comfort needs, design of comfort measures to address those needs, and re-assessment of patients' families or community comfort after implementation of comfort measures, compared to a previous baseline. *Patient* -- an individual, family, or community in need of health care. *Environment* -- exterior influences (physical room or home, policies, institutional, etc.), which can be manipulated to enhance comfort. *Health* -- optimum function of a patient/family/community facilitated by attention to comfort needs.

Usually, nurses perceive providing hygiene care and fresh linens to their patients as a comfort measure. However, although this may provide external comfort to the patient, does it cause internal discomfort? Do the nursing activities of hygiene care and a linen change cause a significant and persistent elevation in IAP? In order to meet both the internal and external comfort needs of the patient, the nurse needs to know the effect of his/ her care on these needs. An adaptation of Kolcaba's theory was used to identify if hygiene care and a linen change meet both the internal and external needs of the patient at risk for IAH.

The theory proposes that nurses identify the patient's comfort needs that have not been met by existing support systems. Nurses design interventions to address those needs. The intervening variables are taken into account in designing the interventions. If enhanced comfort is achieved, patients are strengthened. Best practices may be developed from these patient outcomes. (See Figure 1)

Definition of Terms

Health Care Needs

Theoretical definition. The healthcare need is the control of intra-abdominal hypertension. This is defined as a persistent intra-abdominal pressure ≥ 12mmHg. It represents a situation in which the normal physiological adaptive mechanisms are unable to achieve homeostasis.

Operational definition. Intra-abdominal pressure that equals or exceeds 12 mm Hg is considered to be IAH. The gold standard for indirect intra-abdominal pressure measurement recommended by the WSACS is intra-vesicular pressure via the urinary bladder. This is accomplished by attaching pressure tubing and a transducer to an indwelling urinary catheter. Standards have been set by WSACS to assure uniform reading of pressures (Cheatham et al., 2007).

Comforting Interventions

Theoretical definition. Comforting interventions are those actions intentionally carried out by nurses designed to target a health care need (Kolcaba 2007). Critically ill patients need to be kept clean in order to promote health and well-being. The comforting intervention for this study will be the nursing activity of hygiene care.

Operational definition. Hygiene care is operationally defined as providing oral hygiene to the patient, a complete bed bath, a one-minute backrub, and linen change with a left and right lateral turn.

Intervening Variables

Theoretical definition. Intervening variables are those factors that each patient brings to the health care situation, which nurses cannot change, and that have an impact on the success of the interventions (Kolcaba, 2007).

Operational definition. Intervening variables are operationally defined as risk factors for intra-abdominal hypertension (see Appendix B).

Health Seeking Behaviors

Theoretical definition. Health seeking behaviors are those internal behaviors in which the patient engages that facilitate health (Kolcaba, 2007). In order to maintain internal homeostasis, the patient must have an adequate abdominal perfusion pressure.

Operational definition. Health seeking behaviors will be operationally defined as an abdominal perfusion pressure $\geq$ 60mmHg. This will be calculated by taking the Mean Arterial Pressure and subtracting the intra-abdominal pressure (MAP-IAP = APP).

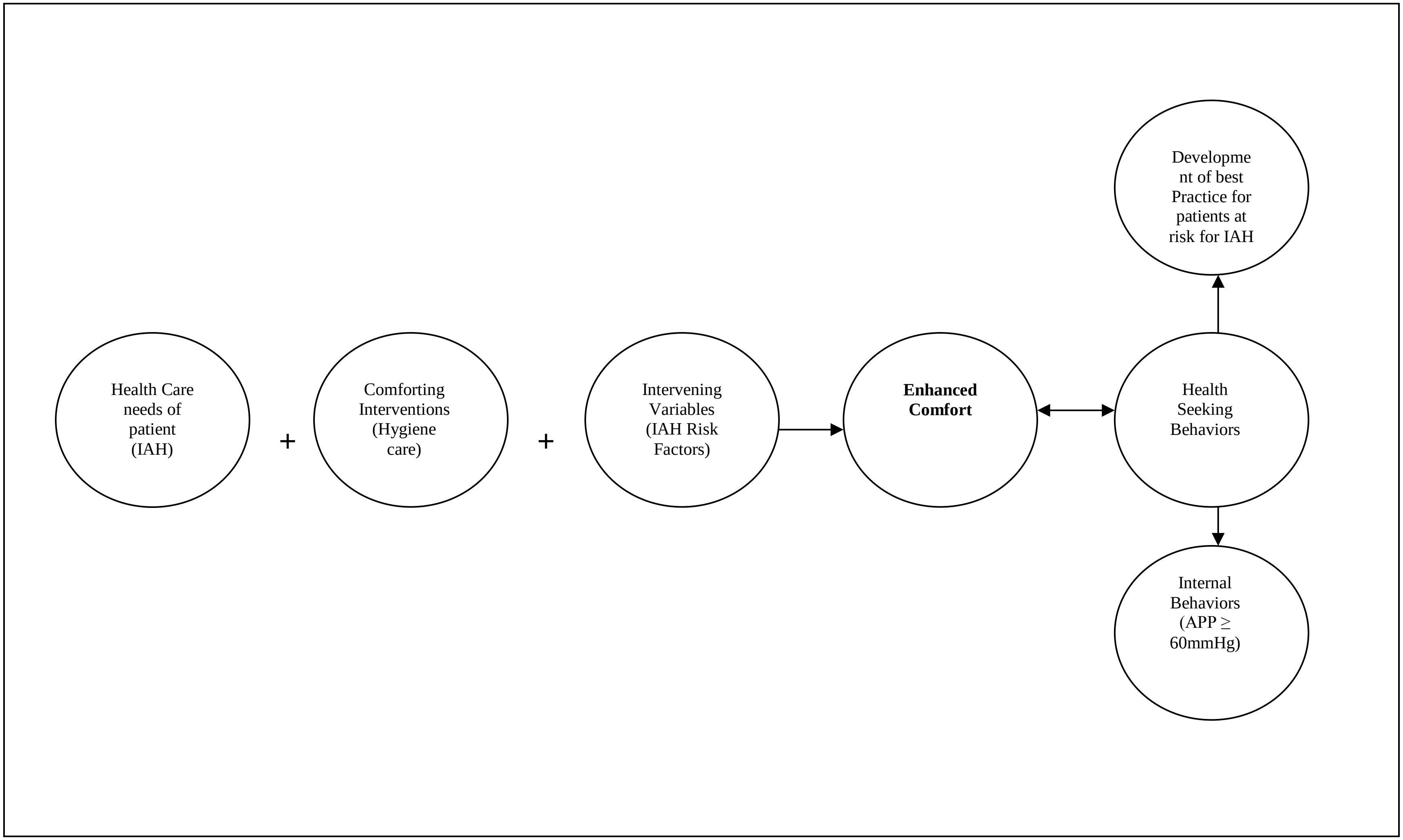

Figure 1. Adaptation of conceptual framework for Kolcaba's comfort theory (Kolcaba, 2007).

Assumptions

The following theoretical and research assumptions are herein accepted without documented evidence

Theoretical Assumptions

The theory of comfort accepts the assumptions (Kolcaba, 2007) that human beings have holistic responses to complex stimuli. Comfort is a desirable holistic outcome that is germane to the discipline of nursing. Human beings strive to meet, or to have met, their basic comfort needs. It is an active endeavor. When comfort needs are met, patients are strengthened.

Research Assumptions

It is further assumed herein that the intra-abdominal pressure monitoring device measures IAP correctly and consistently. Nurses are experienced in providing hygienic procedures to patients. Normalized IAP is a favorable outcome for the patient at risk for IAH. Favorable patient outcomes are important to the patient, family, nurse, and hospital administration.

Significance of the Study

Currently, there are no published nursing studies on the effects of nursing activities in the IAP of patients at risk for IAH. Nurses need to know if their care has a physiological consequence to the patient.

Nursing Education

Basic nursing education teaches concepts of patient cleanliness and hygiene. For the majority of the patient population, the concepts of hygiene care hold true. However, in special patient populations, these basic concepts may need to be adapted to meet patient needs. The significance of this study to nursing education may be the need to modify basic nursing activities in special populations as part of the curricula.

Nursing Practice

Nursing activities are an important part of a patient's healing and comfort. Knowing when and how to carry out nursing care activities is an important component of nursing. Nurses may need to incorporate into their practice, modifications of a patient's hygienic routine if the patient is at risk for IAH.

Nursing Research

This will be the first nursing study to examine the effects of nursing activities on IAP in patients at risk for IAH. Further nursing research will need to be carried out in order to refute or support the findings of this study. It is hoped this will stimulate nurses to research other nursing activities that may increase or decrease the IAP of patients who are at risk for IAH. Nurses who are aware of the effects of their actions on the patient's physiological state can adapt their practices to minimize any increase in IAP.

Public Policy

Nurses assess a patient's blood pressure, pulse, and respiratory rate prior to initiating an activity as standard policy. The findings of this study may indicate a policy change in measuring IAP consistently for those who are at risk, and prior to and after specific activities. Critical Care Units may develop standards of care for patients who are at risk. Eventually, this measurement may need to be done in step-down units and regular nursing floors. This will entail an increased budget for the IAP measuring device, education and training of the nursing staff, as well as maintenance of competency.

Limitations

Threats to Internal Validity

The threat identified to internal validity is in the instrumentation. There is a standardized protocol to measure IAP with a standard IAP measuring device. There is a possibility that nurses may deviate from this protocol when zeroing and measuring the IAP. To minimize this threat the Primary Investigator (PI) will do all the IAP measurements for this study.

Threats to External Validity

The threat to external validity may be in the setting and treatment interaction. The study will be carried out in one hospital with a convenience sample. The findings may not be able to be generalized to a larger population.

Chapter Summary

Intra-abdominal hypertension is a prevalent problem in acutely and critically ill patients that adds to their morbidity and mortality. One of the tasks of nursing is to provide hygienic care as a source of comfort and aesthetics. It is not known whether nursing activities adversely affect the intra-abdominal pressure of patients who are at risk for IAH. Using Kolcaba's theory of comfort, the effects of nursing hygienic activities on IAP for patients at risk for IAH will be examined. The results will have implications in the areas of nursing education, practice, research, and policy.

CHAPTER TWO

LITERATURE REVIEW

The literature was extensively reviewed. The electronic databases utilized were the Cumulative Index to Nursing and Allied Health Literature (CINAHL), Medline, OVID, and PubMed. The searches were performed with subject headings and key words of: intra-abdominal pressure, intra-abdominal hypertension, abdominal compartment syndrome, nursing activities and physiologic monitoring, nursing activities and intracranial pressure monitoring, nursing activities and mixed venous oxygen saturation monitoring. The WSACS website (www.wsacs.org) was visited frequently, as the website posted alerts when new articles on the topic were published. Reference lists of significant articles were searched for relevant articles. Personal communication with Dieter Debergh, the Clinical Trials Working Group Coordinator for the World Society of the Abdominal Compartment Syndrome, provided guidance regarding the current physician research on the effects of activities on IAP.

Critical care nurses have learned to use the monitoring tools in their ICUs to assess the effect their care has on patients. Continuous EKG, pulse oximetry, and blood pressure monitoring by the nurse indicates whether the patient is tolerating a particular activity or body position. This chapter will review the literature on how nurses utilize critical care monitoring tools to determine the effects of nursing activities on patients. The monitoring tools to be reviewed will be intracranial pressure monitoring (ICP) and continued mixed venous oxygen saturation monitoring. Several non-nursing studies involving the effects of patient positioning on intra-abdominal pressure will be presented.

Nursing Studies on Intracranial Pressure Monitoring

Mitchell and Mauss (1978) published the first nursing study on the relationship of patient- nurse activity to variations in the intracranial pressure. In this descriptive observational study, nine patients requiring ICP drainage were observed by trained observers for up to 24 hours. The ICP drains were not connected to pressure transducers; they would drain into a burretrol if the ICP met a preset level. The observer would document the incidence and length of time cerebrospinal fluid (CSF) drained in relation to patient and nurse activity. The nursing activities that were found to increase the incidence and duration of CSF drainage were suctioning a patient without hyper-oxygenating first, flexing of the patient's hips and turning the patient in a lateral position. One patient exhibited a prolonged duration of drainage when many activities were carried out consecutively. The limitations to this study were its small sample size, yet it was a seminal work for nursing as nurses began to realize the effects of their care on patients at risk for increased intracranial pressure.

Mitchell, Ozuna, and Lipe (1981) further studied the effects of activity on the patient's ICP. The researchers performed a quasi-experimental study with 20 patients requiring ICP monitoring. They performed eight nursing care activities on each of the 20 patients with a 15 minute rest period. The activities included: passive hip flexion and extension, head rotation to the right and to the left, and turns to four positions (supine to right lateral, right lateral to supine, supine to left lateral, and left lateral to supine). ICP measurements were taken at baseline and then one and five minutes after the activity. There were significant time related findings of increased ICP with the head rotation to the right ($p = 0.04$) at five minutes. There was also a strong time related correlation with each of the four turns ($p < 0.001$) at five minutes. The researchers identified that one unexpected but clinically important finding was the effect of cumulative activity (the activities were strictly spaced 15 minutes apart) prevented the ICP from going back to baseline and caused a persistent elevation in ICP. The authors recommended spacing out activities for longer than 15 minutes to allow the ICP to come back to baseline.

Olson, Thoyre, Bennett, Stoner, and Graffagnino (2009) studied the effects of chest percussion on patients at risk for increased ICP. This was a randomized controlled trial with 28 patients, 15 in the control group (no chest percussion) and 13 in the intervention group (chest percussion at noon). The patients had a primary neurologic diagnosis that required ICP monitoring. They were also on a specialty bed that could provide chest percussion as a therapy. The researchers did not identify if the patients were receiving mechanical ventilation. The patients' vital signs and ICP measurements were attained 10 minutes before the intervention. The patient was placed in a supine with head of bed (HOB) elevated to 30^0. All patients were on a specialty bed that has the capability of mechanical percussion. The percussion property was turned on for ten minutes for the intervention group. Vital signs and ICP were measured every minute during the treatment and every minute for 10 minutes after the treatment ended. No nursing activities took place during this intervention, nor did the patients receive any osmotic agents to reduce ICP. The control group had its ICP measured for the same time period. The results found that there was no significant difference between the ICP measurements of the control group and the intervention group before during or after the intervention. The researches concluded that it was safe to use mechanical percussion on patient at risk for increased ICP.

In summary these three nursing studies identified the nursing activities of suctioning a patient without pre-oxygenating, flexing the hips, laterally turning the body and head as increasing the ICP significantly. These studies have guided nurses' practice for years. The study of chest percussion and its effects on ICP did not find any significant elevations in ICP. All three studies were small, and none were duplicated in a larger multi-site trial.

Nursing Studies on Mixed Venous Oxygen Saturation

Continuous mixed venous oxygen saturation (SVO_2) is a monitoring tool used in conjunction with a pulmonary artery catheter (Pinsky & Payen 2005). Via fiber optics at the tip of the catheter the venous oxygen reserve is continuously displayed on a bedside monitor. A normal SVO_2 is considered 75%, but may range from 60-80%. From the venous oxygen reserve, can be calculated the oxygen delivery and oxygen consumption of a patient. The nurse working with a patient can immediately see the effects of nursing care or medical interventions on the patient's oxygen reserve. Shively and Clark (1986) wrote about SVO_2 monitoring, "Nurses should recognize the potential of this physiologic parameter not only for assessment purposes but also as a valuable research instrument" (p 56). In 1990, three studies were published by a group of nurses on the effects of specific nursing activities on the SVO_2 in a group of patients. This was a multisite study titled "Nursing Interventions and Mixed Venous Oxygen Saturation" (Clark, Winslow, Tyler, & White, 1990) The activities studied were endotracheal suctioning, lateral turn and a one minute back rub.

Clark, Winslow, Tyler, and White (1990) performed a quasiexperimental, nonrandomized study with a convenience sample of 180 patients on the effects of endotracheal suctioning on heart rate (HR) and SVO_2. The patients were all intubated, requiring mechanical ventilation. Prior to suctioning, the patient was placed supine, with HOB elevated to 20^0 and one pillow under the head. The patient was left undisturbed for five minutes and baseline heart rate and SVO_2 were recorded. The patient was then hyperoxygenated with three breaths prior to the suctioning, in between the suctioning and after the suctioning. Each suctioning attempt lasted 10 seconds or less. Data was collected every minute during the procedure and for a total of four minutes. The results showed there was a significant drop in SVO_2 immediately after the suctioning, from 67% to 64% (range 40% - 88%, SD 8.9%) (p = 0.0001), with a return to the baseline readings within three minutes. The mean baseline HR was 99 beats per minute, after suctioning the mean HR rose to 104 beats per minute. The range was 63 – 160 beats per minute, SD 17 beats per minute (p = 0.001) with a return to baseline within four minutes. The researchers concluded that the drop in SVO_2 was statistically and clinically significant, whereas the increase in HR was only statistically significant. They recommended continued hyperoxygenation pre, during, and post endotracheal suctioning to minimize the drop in SVO_2.

The second study performed by this group looked at the effects of a lateral turn on SVO_2 and HR (Winslow, Clark, White, Tyler, 1990). One hundred and seventy-four patients completed this part of the study. In this procedure, patients were given a 10 minute rest period, and baseline data was collected immediately prior to the lateral turn. The investigators turned the patient to the side (85% turned right side, 15 % left side), at a 60^0 angle with one pillow behind the back, one pillow between the legs, and the HOB at 20^0. Immediately after the turning, and every minute for four minutes, the HR and SVO_2 were recorded. Immediately after the turn the SVO_2 dropped significantly (p = 0.001) from a baseline of 67% to 61%, but within four minutes returned to 66%. The HR also had statistically significant findings (p = 0.0001) with a baseline mean of 99 beats per minute to 102 beats per minute, with a mean heart rate of 101beats per minute after four minutes. The researchers concluded that although the findings were statistically significant they were not clinically significant. Their recommendations were to monitor the patient upon turning; if the patient did not return to baseline SVO_2 and HR within four minutes the patient should be repositioned promptly.

The third study by this group of nurse researchers investigated the effects of a one minute back rub on SVO_2 and HR (Tyler, Winslow, Clark, and White, 1990). One hundred and seventy-three patients completed this arm of the study. The patient was positioned in a side-lying position as mentioned in the previous study and allowed to rest for fifteen minutes. HR and SVO_2 data were gathered immediately prior to the back rub, the back rub lasted for one minute. Immediately after the back rub, the data was collected every minute for four minutes. Again they found a significant mean decrease in SVO_2 ($p = 0.001$) and increase in HR ($p = 0.001$). Although these findings were statistically significant, they were not found to be clinically significant. The recommendations of the authors was that it is acceptable to give a critically ill patient a one minute back rub, but that individual responses need to be assessed.

Lewis et al. (1998) further looked at the effects of turning and back rubs on the SVO_2 in critically ill men in a surgical ICU. Fifty-seven patients participated in the study; with a repeated measures design. The timing of the intervention and the direction of turn was randomly assigned. One measure was the patient would be turned and immediately given a one minute back rub, the other measure was a turn, a five minute equilibration period, and one minute back rub. The results indicated a statistically significant drop in SVO_2 with a left lateral turn and immediate back rub. At the end of the back rub the SVO_2 was significantly lower in those lying on their left side than those lying on their right side. Also the two interventions of turning and immediate backrub had a significantly greater decrease in SVO_2 than those that had a five minute equilibration period between the turn and the back rub. The researchers concluded that a five minute interval between interventions is appropriate practice in critically ill patients.

Gawlinski and Dracup (1998) studied the effects of positioning on the SVO_2 of patients with a cardiac ejection fraction of $\leq$ 30%. Forty-two critically ill patients requiring continuous

SVO_2 monitoring and having an ejection fraction of $\leq 30\%$ were included in the study. The investigators used an experimental two-group repeated measures design with a sample of convenience. The convenience sample was randomly assigned to one of two groups. Group 1 had 17 patients and were placed first in the supine position, then right lateral and finally left lateral. Group 2 had 25 patients placed in the supine position and then left lateral and finally right lateral. Patients maintained each position for 25 minutes. There were no statistical differences between the demographics of Groups 1 and 2. SVO_2 data were collected at baseline, every minute for the first five minutes, once at 15 minutes and 25 minutes. There was a statistically significant drop in SVO_2 (p = 0.001) across time. The most severe drop was within the first minute of the turn with a return to baseline by five minutes. There was no difference between the decreases in SVO_2 with a left or right turn. The authors recommended that a patient's SVO_2 should return to baseline within five minutes of a turn.

In summary, the SVO_2 studies done by the "Nursing Interventions and Mixed Venous Oxygen Saturation" group of nurse researchers were strong multisite studies with over 100 patients. Their recommendations that the nursing activities studied, did not significantly alter the SVO_2 is reassuring to the nurse. The last two studies replicate the initial studies in special populations with the same outcomes.

Non-Nursing Studies on the Effects of Activity on Intra-abdominal Pressure Monitoring

Malbrain, Mieghem, Verbrugghem, Daelemans, and Lins, (2003), all physicians performed multiple IAP measurements on 10 patients in the supine, upright, trendelenberg, and reverse trendelneberg positions. All 10 patients were mechanically ventilated. The IAP was measured using an indwelling urinary catheter connected to a pressure transducer. The IAP was significantly higher in the upright and the reverse trendelenberg positions versus the supine and trendelenberg position (p = 0.001). The investigator's conclusion was that IAP should always be measured in the supine position.

McBeth et al. (2007), all physicians, studied the effects of various degrees of head of bed (HOB)positions on IAP. The concern of the researchers was that ventilator associated pneumonia (VAP) is more likely to occur when the HOB is elevated less than 30^0. Yet, patients who are at risk for IAH have their lowest IAP readings in the supine position. This was a single site prospective study. Three hundred measurements were taken on 37 patients from a range of 0^0, 10^0, 20^0, 30^0, and 45^0 HOB elevations. The IAP was measured via a fluid manometry measurement device connected to the urinary bladder. The study showed a statistically significant (p = 0.001) and independent relationship between IAP and HOB elevations. The elevations of 10^0 and 20^0 were clinically insignificant. However, the elevations of 30^0 and 45^0 were clinically relevant.

Cheatham et al (2009), all physicians, performed a multi-site, prospective cohort study with 132 critically ill medical and surgical patients. All patients were mechanically ventilated and sedated to ensure that abdominal muscle contractions were absent. The patients had at least one risk factor for IAH. The IAP was measured using the urinary catheter transducer method. Triple IAP measurements were taken at four hour intervals with the patient in the supine, 15^0, and 30^0 HOB elevations. The results showed a significant increase of the IAP at each increase in HOB measurement (p = 0.001). These increases were deemed clinically significant. Recommendations were made to ideally measure IAP in the supine position. If this was not possible due to patient, condition the investigators recommended measuring the IAP at a consistent HOB elevation.

De Keulenaer et al. (2009) studied the effects of the lateral decubitus position versus the supine position on the IAP. This was a small study with 10 patients at one hospital; all patients were mechanically ventilated and sedated to ensure that abdominal muscle contractions were absent. IAP was measured in each patient three times a day at least six hours apart in both the lateral (left or right) and supine position for a total of 60 IAP measurements. The IAP was measured using the urinary catheter and the transducer method. The IAP was measured in the lateral semi-recumbent position with the HOB at 30^0 elevation and the supine position with HOB flat. There was a statistically significant difference in the lateral position versus the supine position with the lateral position having higher IAP pressures. The researchers presented these comparisons of means as related to the time of day (morning $p < 0.001$; afternoon $p < 0.0005$; and evening $p < 0.001$). There was no difference in IAP measurements if the patient was in the right lateral versus the left lateral position. The incidence of IAH was 3.3% in the supine position but rose to 26.6% in the lateral position. The researchers recommended not measuring the IAP in the lateral position.

In summary, these studies researched the effects of various body positions on IAP readings. All researchers concluded that IAP readings are best taken in the supine position with the HOB flat. There is no indication in these studies if the various position changes caused a sustained elevation of IAP.

CHAPTER THREE

METHODS

The purpose of this study was to assess the effects of nursing hygiene care activities on the IAP of patients who are at risk for IAH. Currently, there is no published nursing research in this area. Nurses need to know the most prudent method in caring for these at-risk patients. This study will be carried out in two phases. The first phase comprised of converting the critical care unit's (CCU) current Intra-abdominal pressure monitoring protocol to a nurse driven protocol. The second phase was the evaluation of the effects of hygiene care on patients at risk for intra-abdominal hypertension.

Research Design

A pre-experimental one group pretest-posttest design was used to identify differences in IAP at rest and IAP after a nursing activity.

Setting

The setting was a 145-bed nonprofit community hospital in south Florida. The hospital provides general medical and surgical services, as well as obstetrics, pediatrics, and emergency services. The hospital serves suburban and rural populations. The CCU is a 15-bed unit that cares for both medically and surgically ill patients that require critical care services.

Sampling Strategies

A non-probability sampling technique was used as the sampling strategy. A convenience sample of patients meeting the eligibility criteria admitted to the CCU was used. The weaknesses of this sampling plan are that there is a risk for bias and questionable generalizability to the entire population. The strength is that the subjects are easily accessible to the researcher.

Eligibility Criteria

Inclusion Criteria

The inclusion criteria for this study was of an adult patient aged 18 or older, admitted to the CCU with an indwelling urinary catheter in place. The patient met at least one criterion and two risk factors for IAH (WSACS, 2006). The criteria are: new admission to a critical care unit or presence of new or progressive organ failure. The risk factors are listed in Appendix B.

Exclusion Criteria

Any individual that did not meet the WSACS criteria and risk factors were excluded. Further excluded were any individuals that did not have an indwelling urinary catheter or had bladder trauma, bladder surgery, or neurogenic bladder; these patient conditions preclude an accurate IAP reading via the urinary catheter (Malbrain, 2004). Only patients admitted to the CCU were to be included; therefore, patients admitted to other units were excluded.

Determination of Sample Size: Power Analysis

A priori computation was carried out in order to identify the optimal number of subjects for this study. In order to reduce the likelihood of committing a Type I or a Type II error the alpha ($\sigma = 0.05$) and power ($1-\beta$ error probability = 0.80) had been set. Anticipating a moderate effect size ($dz = 0.5$) and using a two-tailed *t*-test of two dependent means for matched pairs, G*Power (Buchner, Erdfelder, & Faul 2001) indicated that a total sample of 34 is needed. Allowing for the potential for up to 20% attrition due to incomplete data sets, procedure violations, and patient dropout, a total of 41 individuals were planned to be recruited.

Protection of Human Subjects

The study was approved by the Barry University Investigational Review Board (IRB) and the hospital system IRB. This study was requested as an expedited review as no experimental treatments took place. The hygienic procedures carried out by nurses, for all patients, are an accepted and expected practice. Measuring IAP for those at risk is evidence-based and based on the legal prerogative of the physician. Consent for the nursing activities and IAP measurement are covered under the general consent for treatment the patient signs on admission to the hospital.

Risks and Benefits of Participation

There were no anticipated risks for participants. All participants received the standard of care regarding hygienic care from the PI. The decision to measure IAP was via a physician approved nurse-driven protocol (see Appendix C) or under the direction of the patient's physician and documented in the medical chart by means of the physician's order. Measuring IAP is a required clinical competency for the CCU nurses at the research site. This is validated by the clinical nurse specialist or one of the unit experts trained by the clinical nurse specialist and assessed annually (see Appendix D) for competency assessment). For this study, the PI, who is the clinical expert for the unit, performed all the baths and IAP readings.

There were no perceived benefits from participating directly in the study. However, adding to the body of knowledge on how nurses need to manage the care of patients at risk for IAH may be a benefit for both nurses and future patients. A hospital that is striving for the American Nurses Credentialing Center Magnet designation needs to have completed nursing research studies as part of the application process (ANCC, 2008). This research study may assist in fulfilling that requirement.

Data Storage

All data was stored in a password-protected computer in the researcher's office. The office remains locked when not in use. The data will be maintained for five years and then deleted from the computer. There were no printed copies of the patients' medical records, as the needed data is electronically stored in the hospital's electronic medical record (EMR). The researcher was able to obtain the needed data from the EMR.

Procedures

Patients were accepted into the study once they have met the eligibility criteria. The nurse screened the patient for risk factors of IAH and initiated the nurse driven protocol (see Appendix C), or upon a physician's order. The PI measured IAP at rest. The PI then performed the nursing activities consisting of oral hygiene, a bed bath, one minute back rub and linen change. The IAP was measured immediately after these nursing activities and again 10 minutes later.

The procedure for measuring IAP followed the recommendations of the WSACS (2006). The IAP was measured at end-expiration in the complete supine position after ensuring that abdominal muscle contractions were absent and with the transducer zeroed at the level of the mid-axillary line at the iliac crest. Twenty milliliters of sterile normal saline were instilled into the bladder via the AbViser an intra-abdominal pressure monitoring device. The PI then waited approximately 30-45 seconds for bladder detrusor muscle relaxation and for the bedside monitor to equilibrate before taking the reading. This reading and the calculated APP were recorded in the EMR.

Instrumentation

Demographic Information

Demographic data was collected (see Appendix E for the Case Report Form) including age, gender, body mass index (BMI), CCU diagnosis, and Acute Physiology and Chronic Health Evaluation (APACHE II) score and the Sequential Organ Failure Assessment Score (SOFA).

The length of stay in CCU when the IAP was measured and the criterion and risk factors for IAH were collected. The pre- and post-nursing activity measurements of IAP and abdominal perfusion pressure (APP) were also collected.

Measurement of Intra-abdominal Pressure

Intra-abdominal pressure will be measured by means of the AbViser Autovalve produced by AbViser, Wolfe-Tory Medical, Salt Lake City, UT. This device is a pre-assembled kit that contains a closed system set-up (ABV 300). Included in this kit is the IV tubing, white striped pressure tubing (a safety precaution to set it apart from hemodynamic pressure tubing), a 20 ml syringe with a protective sleeve, and the automatic valve with a timed release closure that has an area for connection to the urinary catheter and the drainage bag. The nurse will also obtain a single pressure transducer and a bag of sterile saline. The pressure monitoring set up will be connected to the bedside monitor.

Numerous studies have been done that validate measuring IAP via the urinary bladder as a valid and reliable indirect measurement of IAP (Cheatham & Safcsak, 1998; Fusco, Martin, & Chang, 2001; Iberti, Kelly, Gentili et al., 1987; Iberti, Lieber, & Benjamin, 1989; Kron, 1989; Kron, Harman, & Nolan, 1984; Malbrain, 2004; Sagraves, Cheatham, Johnson et al., 1999). In 2007, the executive committee of the WSACS published recommendations that bladder pressure monitoring be the gold standard for indirect pressure monitoring (Cheatham, Malbrain, & Kirkpatrick et al., 2007). Specifically the AbViser has been validated by in vitro and in vivo testing (Kimball, Mone, Wolfe, Baraghoshi, & Adler, 2007; Wolfe & Kimball, 2005). The same studies identified that intra-rater and inter-rater reliability were highly reliable. The WSACS deemed the AbViser as an acceptable tool for measuring IAP.

Data Analysis

Data were entered into and analyzed using the Statistical Package for Social Sciences (SPSS) version 17 for Windows (2009).

Data Cleaning

Demographic data and the IAP measurements were reviewed for completeness, by the researcher. The researcher manually summed the scores and entered the data into SPSS to be summed by the computer. The two sets of sums were compared; this was a quality check to assure data were entered correctly.

Only complete data sets were used for analysis. Outliers were defined as those IAP readings that scored greater than two standard deviations (*SD*) above or below the mean (*M*). Outliers were included in the data analysis as it is currently unknown what the effects of nursing activities are on the IAP.

Descriptive Data

Descriptive statistics, frequencies, and percentages, were computed to describe the sample. Values obtained on the measures of IAP were reported as *M*s with *SD*s. The distribution of the scores for IAP was evaluated both by means of visualization of histogram with the normal curve imposed and calculation of the Kolmogorov-Smirnov Test statistic (*D*). The distribution of the scores was further described by means of the values for skewness and kurtosis.

Hypothesis Testing

The hypothesis states: There will be a significant increase in the mean post-hygiene intra-abdominal pressure as compared to the mean pressure values obtained prior to the hygiene care activities among patients at risk for intra-abdominal hypertension.

This hypothesis compares the scores for IAP obtained on a pre- and post- intervention measurement for the same individuals, matched pairs. Therefore a *t*-test for the difference between two dependent means was used.

Chapter Summary

This project employed a pre-experimental research design to test one research hypothesis. The dependent variable of IAP was measured both pre and post hygiene care provided to patients meeting inclusion criteria. A standardized and reliable instrument according to the recommendations of the World Society of the Abdominal Compartment Syndrome was utilized. The sample size had been calculated to be adequate to detect a medium effect. As inferential statistical methods were used to test the differences in the means of the measures, prior to hypothesis testing, the scores for the measures of the dependent variable, IAP, were subjected to tests to assure that they meet the assumptions of normal distribution and variance. A dependent *t*-test evaluated for the statistical significance of the differences in the means.

CHAPTER FOUR

RESULTS

The purpose of this study was to assess the effects of the specific and common nursing activity of hygiene care, on the IAP of patients who are at risk for IAH. Initially, the implementation of the first phase, the nurse driven protocol, will be discussed. The results of the second phase will be reported in two sections. The first section reports the characteristics of the study sample. The second section reports the findings of the three measurement periods and the correlations. The statistics were calculated utilizing the Predictive Analytics Software 17.0 (PASW).

Phase I: Implementation

In 2006, the System-wide Adult Critical Care Committee for Baptist Health Systems had developed and approved a physician-driven protocol for the measurement of intra-abdominal pressures. Each hospital CCU then adjusted it to meet its patients' needs. Upon a physician's order, the nurse would initiate the monitoring and would notify the ordering physician if the patient exceeded the prescribed parameters.

It was identified by both the CCU nurses and the surgeon practicing at the research site that IAP monitoring was usually ordered after an abdominal catastrophe had been surgically corrected. A discussion was held where it was recognized that earlier implementation of IAP monitoring might prevent or minimize these abdominal catastrophes. In January 2010, Homestead Hospital requested permission to implement a pilot program of the nurse-driven protocol for IAP monitoring. Permission was granted by the System-wide Adult Critical Care Committee. The proposal was then presented to the Critical Care Committee and the Performance Improvement Steering Council of the research site. Approval was given by both groups. The medical director of the CCU and the surgeon were the physician champions for this project.

The Clinical Nurse Specialist (CNS) for the CCU drafted the nurse-driven protocol (Appendix C) and had it reviewed by the nursing staff. Per the nurses' recommendations, the protocol was revised to include a screening tool that identified the patient's risk for IAH and nursing interventions for a patient with elevated intra-abdominal pressures. The CCU nurses identified that if the protocol was implemented on a non-surgical patient that the attending physician (usually a hospitalist) may not have an appreciation of the deleterious effects of IAH that could increase the patient's risk of death in the CCU. This CCU was also remotely monitored by a telemedicine unit staffed by critical care nurses and physicians. This telemedicine unit monitors all the CCU beds within a five-hospital system. All CCU units are fully staffed with RNs; the telemedicine unit offers an extra measure of safety and quick physician backup for the nurse when needed. The CCU nurses identified that the telemedicine staff would also need to understand the protocol as the telemedicine physicians may be called upon to intervene. After conferring with the medical directors of the hospitalist group and the telemedicine group, it was identified that more knowledge was needed on this subject. The CNS met with the hospitalist group and the telemedicine staff to in-service them on the protocol. The physicians were given the medical management algorithm (Appendix F) developed by the World Society of the Abdominal Compartment Syndrome (2009) to guide them in their treatment of the patient. The physicians and telemedicine nurses were receptive to the protocol and confirmed their role in the process.

When nurse-driven protocol was implemented, the CNS, during daily interdisciplinary rounds would identify potential patients that met the criteria for IAP monitoring. After rounds, the CNS would assist each nurse in screening his or her patients to ascertain if they qualified for the protocol. The screening tool (Appendix G) used was not a part of the medical record. Approximately one month after the initiation of the nurse-driven protocol, the CCU nurses were taking the initiative to screen and implement the protocol without the assistance of the Clinical Nurse Specialist.

Phase II: The Effects of Hygiene Care on Intra-abdominal Pressure

Study Sample

After obtaining approval by both the Barry University and Baptist Health Systems IRB, the study was conducted over a three-month period. A total of 17 patients were included; this was less than the recommended 34. Patients were screened by the CCU nursing staff per the nurse driven IAP protocol (Appendix C) upon admission to the CCU or the new onset of organ dysfunction or failure. The average daily census was 12 patients, with approximately four admissions per day. Nearly 235 patients were screened during this time period. Two surgical patients in the study had physician orders to measure the IAP by the surgeon. The remainder of the patients in the study (n = 15) had the IAP measurements initiated by the nurse-driven protocol. The PI would round on the patients requiring IAP measurements daily, which included a review of the medical record and a physical assessment of the patient. The PI would then discuss with the patient's nurse and appropriate family/significant others the best time to give the patient a bath. Written consent was not needed from the patient or the health care surrogate as there were no experimental procedures performed. Each patient was used only once in the study.

Fifty-nine percent (n=10) of the sample was male, and 41% (n= 7) female. The mean age was 58.65 years with a range from 27 years to 92 years. The mean body mass index (BMI) was 30.49 with a range from 17.53 – 55.85. The Centers for Disease Control (CDC) identifies that a

BMI less than 18.5 is underweight, 18.5 – 24.9 is normal, 25 – 29.9 is overweight, and 30 or greater is obese (CDC 2009). The mean Acute Physiology and Chronic Health Evaluation II (APACHE II) score was 21.94 with a range from 8 – 33. The APACHE II scoring system is a valid and reliable severity of illness tool that is closely correlated with in hospital risk of death (Knaus, Draper, Wagner, & Zimmerman, 1985). The scores may range from 0 – 71; the higher the score the more severe the illness and the higher the risk of death. Therefore, the mean APACHE II score in this study meant that the patients had approximately a 40% risk of death. The Sequential Organ Failure Assessment (SOFA) score mean was 8.24 with a range from 2 – 14. The SOFA score is a scoring system used to determine a critically ill patient's rate of organ dysfunction or failure (Ferreira, Bota, Bross, Melot, & Vincent, 2002). The scores may range from 0 – 24; the higher the score the more organ dysfunction/ failure. A score of 7 or less indicates a probable recovery from organ failure; a score of 11 or greater indicates a poor outcome. The mean number of risk factor for IAH was 3 with a range from 1 – 6. Eighty-eight percent (n= 15) of the patients had secondary (medical) IAH, whereas, 12% (n = 2) had primary (surgical) IAH. Sepsis was the main CCU admission diagnosis for 35.3% (n = 6) of the sample size, with 29.4% (n = 5) having a diagnosis of acute respiratory failure. Other diagnoses were gastrointestinal (GI) bleed (11.8%; n = 2), acute kidney failure (5.9%; n = 1), cardiac arrest (5.9%; n = 1), congestive heart failure (CHF) (5.9%; n = 1), and ischemic bowel (5.9%: n = 1). Twelve of the patients (70.6%) were on mechanical ventilation, whereas 5 (29.4%) were spontaneously breathing.

Hygiene Activity

An explanation of the hygiene activity was given to the patient and the family, if present. A measurement of the IAP was taken in the supine position with the head of bed flat prior to the start of the hygiene activity. If the patient was receiving mechanical ventilation, oral hygiene was given with a prepackaged oral care kit that included a toothbrush, plaque removal solution, and lip emollient. The patient was suctioned orally prior to the hygiene and after. If the patient was breathing spontaneously, the patient would either brush his or her own teeth with a toothbrush and toothpaste or the PI would perform this if the patient was too weak. The bed bath entailed cleansing the patient starting with the head and face, proceeding to the right and then the left arm. The torso would be cleansed next, along with the right and then the left leg. If present, the anti-embolic hose and/or the sequential compression device for the calf were removed. The genitalia were then cleansed. One of the staff nurses would assist the PI in turning the patient first to the patient's left side where the back and buttocks were cleansed and a one-minute backrub using the effleurage technique was provided. The linens were then changed in the standard fashion of an occupied bed. A clean fitted sheet, draw sheet, and underpad were applied to the right side of the bed, as the dirty sheets were rolled to the center of the bed. The patient was then turned to the right to complete the linen change. Upon completion of the linen change, the patient was placed supine with head of bed flat for the immediate post measurement of the IAP. The patient remained in this position until the last reading was taken. Then, the anti-embolic hose and/or sequential compression calf device were replaced. Ten minutes after the post-bath reading, the last IAP reading was taken. The patient was then placed in a position of comfort.

Data Analysis

The curve shape of the sample was not normally distributed, perhaps due to the small sample size. The IAP measurement curves of the three time periods were all skewed to the right. Because the sample curve was not normally distributed, the plan to use parametric testing had to be abandoned. Therefore, nonparametric statistical tests were used (Polit & Hungler, 2007). Table 1 represents the statistics for the Intra-abdominal Pressure (IAP), Mean Arterial Pressure (MAP), and Abdominal Perfusion Pressure (APP) measurements taken prior to the bath, immediately after, and then 10 minutes after the bath. The mean readings were pre-bath MAP 73.94mmHg, pre-bath IAP 9.18mmHg, and pre-bath APP 64.76mmHg. Immediate post-bath mean readings were MAP 78.06mmHg, IAP 9.12mmHg, and APP 68.94mmHg. The 10- minute post-bath mean readings were MAP 74.47mmHg, IAP 7.88mmHg, and APP 66.59. The MAP means all stayed within the normal range of 70 – 100mmHg (Pinsky & Payen 2005). The APP means of all three time periods also stayed above 60mmHg, as recommend by WSACS, to maintain perfusion to the abdominal organs. The IAP means were higher than normal IAP pressures (0-5mmHg), yet they did not reach the level of intra-abdominal hypertension (≥ 12mmHg).

Table 1

Measurements Taken Pre-Bath, Immediate Post-Bath, and 10 Minutes Post-Bath

Time Period	MAP		IAP		APP	
n = 17	M	SD	M	SD	M	SD
Pre-Bath	73.94	11.63	9.18	4.362	64.76	11.562
Post-Bath	78.06	14.485	9.12	4.662	74□47	12.140
10 minute Post	74.47	12.140	7.88	4.807	66.59	14.418

APP = Abdominal Perfusion Pressure; IAP = Intra-abdominal Pressure; MAP = Mean Arterial Pressure

The nonparametric Friedman Test was used, as this statistic will analyze the differences of repeated measures studies within a single sample (Polit & Hungler, 2007). When significance was found within the three time points, post hoc testing utilizing the Wilcoxon Signed Rank Tests (using a Bonferonni adjusted alpha value) was carried out to identify which of the time periods had statistical significance. The Wilcoxon Signed Rank Test is a calculation of the difference between paired scores and a ranking of the difference (Norman & Streiner, 2007).

The Bonferonni adjustment is used when the researcher intends to compare each group with one another; this helps to control for a Type I error, rejecting the null hypothesis when it is true (Polit & Hungler, 2007). When using the Bonferroni adjusted alpha, the chosen alpha ($\alpha = 0.05$), is divided by number of tests used.

The results of the Friedman Test of the MAP measurements indicated that there was a statistically significant difference ($p = 0.039$) in the MAP measurements across the three time points (pre-bath, immediate post-bath, and 10 minutes post-bath) (Table 2). Using the Bonferonni approach, the adjusted *p* - value was calculated to be .05/3 = .017. The level of significance for the testing will now be $p = 0.17$. The Wilcoxon Signed Ranks Test indicated that there was no statistically significant difference between the three time periods of MAP measurement (Table 3).

Table 2

Friedman Test Statistic for Mean Arterial Pressure

N	Chi-Square	df	Significance
17	6.478	2	.039

Table 3

Wilcoxon Test Statistics for Mean Arterial Pressure

Measurement	Z Score	Significance
Post MAP - Pre-MAP	-1.992[a]	.046
10 min MAP - Pre-MAP	-.095[b]	.924
10 min MAP - Post MAP	-2.203[b]	.028

a. Based on negative ranks.
b. Based on positive ranks.

The results of the Friedman Test of the IAP measurements indicated that there was a statistically significant difference (0.003) in the IAP measurements across the three time points (pre-bath, immediate post-bath, 10 minutes post-bath) (Table 4). Using the Bonferonni approach, the adjusted *p* - value was calculated to be .05/3 = .017. The Wilcoxon Signed Ranks Test was then carried out with a comparison of the three time periods. The comparison of the pre-IAP measurement with the immediate post-IAP measurement showed no statistical difference ($p = 0.949$) (Table 5). The comparison of the pre-IAP measurement with the 10-minute post-IAP measurement did show statistical significance ($p = .005$) (Table 5). The comparison of the immediate post IAP measurement with the 10-minute post-IAP measurement also showed statistical significance ($p = .007$).

Table 4

Friedman Test Statistic for Intra-abdominal Pressure

N	Chi-Square	df	Significance
17	11.483	2	.003

Table 5

Wilcoxon Test Statistics for Intra-abdominal Pressure

Measurement	Z Score	Significance
Post IAP - Pre-IAP	-.064[a]	.949
10 min IAP - Pre-IAP	-2.793[b]	.005
10 min IAP - Post IAP	-2.689[b]	.007

Note: IAP = Intra-abdominal pressure
a. Based on negative ranks.
b. Based on positive ranks

The Abdominal Perfusion Pressure (APP) is a calculation derived from subtracting the IAP from the MAP. An APP of ≥ 60mmHg is considered ideal in order to adequately perfuse the abdominal organs (Cheatham et al., 2007). The results of the Friedman Test of the APP measurements indicated that there was no statistically significant difference ($p = 0.146$) in the IAP measurements across the three time points (pre-bath, immediate post-bath, 10 minutes post-bath) (Table 6), so no further analysis was carried out.

Table 6

Friedman Test Statistic for Abdominal Perfusion Pressure

N	Chi-Square	df	Significance
17	3.851	2	.146

Discussion of Findings

The purpose of this study was to assess the effects of a specific and common nursing activity of hygiene care on the IAP of patients who are at risk for IAH. While it is possible that a variety of routine nursing interventions may adversely affect IAP, it was not actually known whether nursing activities adversely affect IAP of patients that are at risk for IAH. The nursing activity of hygiene care in this small study showed no statistical or clinically significant differences in the MAP or the APP. There were statistically significant differences between the pre-IAP measurement and the 10 minute post-bath measurement as well as the immediate post-bath measurement and the 10 minute post-bath measurement. However, the differences were not clinically significant. The post-IAP measures were hypothesized to be higher, but these results show the 10-minute post IAP measurements to be lower, yet still not within the normal range of 0-5mmHg.

In comparing this study to the nursing studies on ICP (Mitchell & Mauss 1978; Mitchell, Ozuna, & Lipe 1981; Olson, Thoyre, Bennett, Stoner, & Graffagnino 2009) and SVO_2 (Clark, Winslow, Tyler, & White, 1990; Winslow, Clark, White, & Tyler, 1990; Tyler, Winslow, Clark, and White, 1990; Lewis et al. 1998; Gawlinski & Dracup 1998), there is a contrast in the findings. The ICP studies identified that nursing activities could raise the ICP for patients at risk for increased ICP. The researchers also made the observation that when multiple activities (bathing, turning) were done in one time period, the ICP increased and took longer to return to baseline than when only one activity was performed. The recommendation was to space out the activities for those patients. The SVO_2 studies identified that nursing activities may be carried out if the patient's SVO_2 returned to baseline within 10 minutes. The patient's SVO_2 was used to assess tolerance to activity. These ICP and SVO_2 studies indicated that nursing activities may have a deleterious effect on critically ill patients.

Although all 17 patients had risk factors for IAH, the interesting and unexpected finding was that 10 minutes after the nursing hygiene activity the IAP actually decreased. The hygiene activity entailed several activities carried out consecutively (oral hygiene, complete bed bath, backrub, and linen change). There was a statistically significant decrease in the 10-minute post-IAP from the pre-IAP and immediate post-IAP. The means of all the IAP measurements were less than 12 mmHg. Intra-abdominal hypertension is defined as a persistent elevation of the IAP to 12mmHg or greater; normal IAP ranges from 0-5mmHg. Currently, there are no similar findings of the IAP decreasing in the literature.

Several explanations for why the IAP decreased will be postulated. Perhaps the relaxation of the one-minute backrub or the bed bath caused a muscular relaxation in the patient. Another reason that the IAP decreases may be the act of mobilizing the patient from one side to another with a 10-minute waiting period. In contrast to the ICP and SVO_2 studies, this study on IAP measurements indicated no significant change in pre- or post-MAP or pre- or post-APP with the hygiene activity. The mean results were within normal range. This may indicate that giving hygiene care to a critically ill patient at risk for IAH is a safe and perhaps comforting activity.

The theoretical framework used in this study was Katharine Kolcaba's (2003) theory on comfort. The theory proposes that nurses identify the patient's comfort needs that have not been met by existing support systems. Nurses design interventions to address those needs. If enhanced comfort is achieved, patients are strengthened and best practices may be developed.

Using Kolcaba's (2007) conceptual framework, the healthcare need of the patient was operationally defined as the control of intra-abdominal hypertension. The comforting intervention was defined as the hygiene activity (oral hygiene, complete bed bath, backrub, and linen change). The query regarding this comforting intervention was will it enhance the comfort of patients at risk for IAH, or will it have a deleterious effect? The intervening variables were defined as those risk factors the patient had for IAH. Health-seeking behaviors may be internal physiologic parameters indicating homeostasis, or external changes in behavior leading to a healthier lifestyle. In this study, the health-seeking behavior was defined as an APP $\geq$ 60mmHg. The findings of this study support that the comforting intervention of hygiene care in a patient at risk for IAH can be safely given. Repeating this study with a larger sample size may confirm the findings of this study. Perhaps, if a clinically significant decrease in the 10-minute post IAP is found, it may be proposed as a therapeutic measure to lower IAP.

Strengths and Limitations

Currently, there are no published nursing studies on the effects of nursing activities on the IAP of patients at risk for IAH. Nurses need to know if their care has a physiological consequence to the patient. This study supports the findings that the hygiene care as reported in this study may have a beneficial effect on a patient's elevated intra-abdominal pressure.

The limitations of this study are the small sample size, and it was carried out in only one CCU. This will make it difficult to generalize to the CCU population.

Implications of the Findings

The American Association of Colleges of Nursing (AACN) (2006) has identified eight essentials for doctoral education for advanced nursing practice. This capstone project is in partial fulfillment of the Doctorate of Nursing Practice (DNP) degree. The implications for nursing education, practice, research, and public policy will be presented in light of these essentials.

Nursing Education

Basic nursing education teaches concepts of patient cleanliness and hygiene and is viewed as a therapeutic nursing intervention in most patient circumstances. However, in special patient populations these basic concepts may need to be adapted to meet patient needs. This study may be the start of evidence based education on the risks and benefits of providing hygiene care to a patient at risk for IAH.

IAH and ACS have been shown to increase the morbidity and mortality of critically ill patients. It also occurs frequently in this population. The American Association of Critical Care Nurses (AACN 2010) develops the core curriculum and the certification exam blueprint for the bedside critical care nurse (www.aacn.org). Unfortunately at this time, the topic of IAH and ACS is a part of the core curriculum or on the exam. This is a malady that can be screened for and monitored with early intervention provided but only if the CCU nurse at the bedside is aware of it. The DNP graduate employs leadership skills with intraprofessional teams to create changes in practice guidelines (AACN, 2006). As a result of this capstone project, this DNP researcher will contact the certification arm of AACN and make a valid argument to include this in the core curriculum and the certification exam for critical care nurses.

The project was conducted in an agency that is part of a five-hospital healthcare system with a centralized nursing education department. A system-wide basic critical care course, titled the “Critical Care Academy,” educates and trains nurses to work in the critical care units. The pathology of IAH and ACS has now been included into the system-wide Critical Care Academy as a result of this capstone project.

The doctor of nursing practice perspective integrates nursing science with knowledge from other health-related fields as well as ethics. The DNP graduate also utilizes science-based theories to determine the nature and significance of health care delivery phenomena (AACN, 2006). This study used the nursing science based comfort theory to identify that giving hygiene care as outlined in this study may have a beneficial effect on a patient’s intra-abdominal pressure.

Nursing Practice

This study may impact nursing practice by supporting the theoretical perspective that nursing activities are an important part of a patient’s healing and comfort. Knowledge of timing, implementation, and possible consequences of carrying out nursing care activities is an important component of nursing. In the area of hygiene care activities, nurses may plan the patients’ care without worrying if the activity is causing an increase in the IAP and a decrease in the APP.

The DNP graduate is able to conduct a comprehensive and systematic assessment of illness in complex situations and to develop therapeutic interventions based on nursing sciences and other sciences. A clear example of this is best identified in the nurse-driven protocol developed in Phase I. A nursing intervention plan (see Appendix C) was developed from the WSACS Medical Management Algorithm (see Appendix F). In the role of advanced nursing practice, this researcher guided and mentored several of the CCU nurses to become unit experts in the protocol.

It is important for the DNP researcher to develop and sustain partnerships with other healthcare professionals to facilitate optimal care and outcomes. In pursuing research on the topic of intra-abdominal hypertension, this researcher has made international collegial relationships through membership in the World Society of the Abdominal Compartment Syndrome. Advice has been received and given in this international community of experts.

Nursing Research

One of the outcomes of DNP education is to be able review and critically analyze existing literature in order to develop best practices. This is evident with the development of the nurse-driven protocol for IAP measurement. Relevant findings were applied to develop nursing practice guidelines for the patient at risk for intra-abdominal hypertension and raised physician awareness of this complication, thereby promoting early identification and intervention for IAH.

As a result of this study, the hospital has appointed this DNP researcher to the chairmanship of the hospital's Evidence Based Practice & Research Council. The knowledge and skill set developed in the DNP program has assisted the researcher in guiding this council. This leadership position promotes collaboration and consultancy with other nurses, respiratory therapists, physical therapists, and physicians in the hospital and the healthcare system on research projects that would add to the science of nursing. An example of this is that this DNP researcher is currently the PI for an early mobilization protocol for ventilator patients at another hospital within this healthcare system. This is a collaborative project that includes physicians, nurses, respiratory therapists, physical therapists, pharmacists, and dietitians. It is a pre, post study comparing the outcomes of patients prior to the protocol being implemented and after.

The hospital in this study is currently on its Magnet journey to become a designated center of nursing excellence (ANCC, 2008). Completed nursing research and nurses with advanced degrees in nursing are requirements for this application. Therefore, the hospital is committed to supporting nurses that pursue the degree of Doctorate in Nursing Practice.

This study is important to nursing research as it is the first nursing study to examine the effects of nursing activities on IAP in patients at risk for IAH. Further nursing research will need to be carried out in order to refute or support the findings of this study. It is hoped this will stimulate nurses to research other nursing activities that may increase or decrease the IAP of patients who are at risk for IAH. Nurses who are aware of the effects of their actions on the patient's physiological state can adapt their practices to minimize any increase in IAP.

Public Policy

Nurses assess a patient's blood pressure, pulse, and respiratory rate prior to initiating an activity as standard policy. The findings of this study may indicate a policy change in measuring IAP consistently for those who are at risk and before and after specific activities. Critical Care Units may develop standards of care for patients who are at risk. Eventually, this measurement may need to be done in step-down units and regular nursing floors. This will entail an increased budget for the IAP measuring device, education, and training of the nursing staff, as well as maintenance of competency.

The DNP graduate is able to educate and influence policy makers at all levels regarding nursing care and patient care outcomes (AACN 2006). At the time this study occurred, the hospital was developing the policy for prevention of catheter associated urinary tract infections (CAUTI). This is a nurse-sensitive indicator, which reflects on the quality of nursing care. Currently, the Centers for Disease Control (CDC) guidelines do not list the risk of intra-abdominal hypertension as an appropriate indication for the use of a urinary catheter (Gould, Umschied, Agarwal, Kuntz, & Pegues, 2009). As a result of the findings of this project, a surgeon was able to convince this hospital that keeping a urinary catheter in place for patients at risk for IAH is an appropriate use of the catheter. The hospital's policy was changed to include this as an indication. The researcher also had a personal conversation with Dr. Michael Cheatham, the current president of the World Society of the Abdominal Compartment Syndrome (WSACS), regarding the CDC's indications for catheter use. He was urged to speak out on behalf of WSACS to the CDC, regarding adding the risk of IAH as an appropriate indication for the use of a urinary catheter. WSACS will be holding its World Congress in Orlando in August 2011; this DNP graduate will continue to press this issue. On a more local level, at the next meeting of our System-wide Adult Critical Care Committee, in December 2010, this issue will be placed on the agenda for discussion. The goal would be to have the rest of the system hospitals adapt this to their Catheter Associated Urinary Tract Infections (CAUTI) policy.

Summary

The American Association of Critical Care Nurses has identified that the role of the critical care nurse is to provide safe passage to patients and their families when the patient's needs require the expertise of critical care therapeutics (Curley, 1998). Critical care nurses have modified patient care to meet the patient's needs and the patient's level of activity without evidence-based support. Contrary to what has been found in the literature, this capstone project has provided preliminary criteria that the activity of giving hygiene care does not negatively affect the hemodynamic status of a patient at risk for intra-abdominal hypertension. In fact, it may even be a therapeutic intervention to lower intra-abdominal pressures. This study has opened the door for further nursing research to build an evidence-based body of knowledge in managing the patient at risk for intra-abdominal hypertension.

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APPENDIX A

BARRY UNIVERSITY

OFFICE OF THE PROVOST
INSTITUTIONAL REVIEW BOARD

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Research with Human Subjects
Protocol Review

Date:	July 29, 2010
Protocol Number:	100609
Title:	The effects of routine hygiene care on the intra-abdominal pressure for patients at risk of intra-abdominal hypertension
Approval Date:	7/28/10
Name:	Rosemary Koehl Lee
Address:	2201 SE 23rd Terrace Homestead, FL 33035
Sponsor:	Dr. Andra Hanlon
School:	Nursing

Dear Ms. Lee:

On behalf of the Barry University Institutional Review Board (IRB), I have verified that the specific changes requested by the IRB have been made. Therefore, I have granted final approval for this study as exempt from further review.

As principal investigator of this protocol, it is your responsibility to make sure that this study is conducted as approved by the IRB. Any modifications to the protocol or consent form, initiated by you or by the sponsor, will require prior approval, which you may request by completing a protocol modification form.

It is a condition of this approval that you report promptly to the IRB any serious, unanticipated adverse events experienced by participants in the course of this research, whether or not they are directly related to the study protocol. These adverse events include, but may not be limited to, any experience that is fatal or immediately life-threatening, is permanently disabling, requires (or prolongs) inpatient hospitalization, or is a congenital anomaly cancer or overdose.

The approval granted expires on July 1, 2011. Should you wish to maintain this protocol in an active status beyond that date, you will need to provide the IRB with and IRB Application for Continuing Review (Progress Report) summarizing study results to date.

If you have questions about these procedures, or need any additional assistance from the IRB, please call the IRB point of contact, Mrs. Barbara Cook at (305)899-3020 or send an e-mail to dparkhurst@mail.barry.edu . Finally, please review your professional liability insurance to make sure your coverage includes the activities in this study.

Sincerely,

Doreen C. Parkhurst, MD, FACEP

Doreen C. Parkhurst, M.D., FACEP
Chair Institutional Review Board
Associate Dean, SGMS &
Program Director, PA Program
Barry University
Box SGMS
11300 NE 2nd Avenue
Miami Shores, FL 33161

cc: Dr. Andra Hanlon

Note: The investigator will be solely responsible and strictly accountable for any deviation from or failure to follow the research protocol as approved and will hold Barry University harmless from all claims against it arising from said deviation or failure.

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May 4, 2010

Rosemary Lee, RN
Homestead Hospital
975 Homestead Way
Homestead, FL 33035

RE: IRB 10-020: The effects of nursing activities on the intra-abdominal pressure of patients at risk for inta-abdominal hypertension (PI initiated)

Dear Ms. Lee:

Your application for the study listed above was reviewed and approved by the Baptist Health South Florida Institutional Review Board. This study qualifies for expedited reviewed under 45 CFR 46.110(5) research involving the use of data that have been collected solely for non-research purposes. The approval date for this study is 5/3/2010 and the expiration date for this study is 5/2/2011.

The study is next subject to continuing review on or before 5/2/2010 unless closed before that date. You will receive a written notice reminding you to submit a progress report.

Please note that any changes to the study must first be approved by the IRB before they can be implemented.

You may contact the IRB Office at 786-596-4846 if you have any questions or require further information.

Sincerely,

Maria J. Arnold, CIP
Clinical Research Manager
Baptist Health South Florida
Institutional Review Board

APPENDIX B

Risk Factors for Intra-abdominal Hypertension/ Abdominal Compartment Syndrome

1. Diminished abdominal wall compliance
    - Acute respiratory failure, especially with elevated intra-thoracic pressure
    - Abdominal surgery with primary fascial or tight closure
    - Major trauma/ burns
    - Prone positioning, or head of bed > 30^0
    - High body mass index (BMI), central obesity
2. Increased intra-liminal contents
    - Gastroparesis
    - Ileus
    - Colinic psudo-obstruction
3. Increased abdominal contents
    - Hemoperitoneum/ pneumoperitoneum
    - Ascites/ liver dysfunction
4. Capillary leak/ fluid resuscitation
    - Acidosis (pH < 7.20)
    - Hypotension (MAP < 65mmHg, or Systolic pressure < 90mmHg)
    - Hypothermia (core temperature < 33^0C)
    - Polytransfusion (> 10 units of blood/ 24 hrs.)
    - Coagulopathy (platelets < 55,000; or prothrombin time (PT) > 15 seconds, or International Standardized Ratio (INR) > 1.5, or partial thromboplastin time (PTT) > 2 times normal)

- Massive fluid resuscitation (> 5L/ 24 hrs.)
- Pancreatitis
- Oliguria
- Sepsis
- Major trauma/ burns
- Damage control laparotomy

APPENDIX C

SUBMITTED BY:	Rosemary Lee RN-CNS, MSN	**APPROVED BY:**	
Title:	Clinical Nurse Specialist, Critical Care	**Title:**	
		Responsible Department	Critical Care
Creation Date:	July 2007		
Review Date:			
Revision Date:	12/2009; 3/2010; 9/2010		

THIS PROCEDURE SUPPORTS THIS POLICY:

HH 100-05 Scope of Service (Critical Care)

PROCEDURE TITLE:
Intra-abdominal Pressure Monitoring: Nurse Driven Protocol

PROCEDURE STATEMENT:
The purpose of this procedure is to identify the patients that would be at risk for intra-abdominal hypertension and would benefit from intra-abdominal pressure monitoring, and to outline the procedure for intra-abdominal pressure monitoring.

RESPONSIBLE DEPARTMENT / PERSONNEL: (Optional)

Critical Care Nurses

DEFINITIONS: (Optional)

1. Intra-abdominal pressure (IAP) is the pressure concealed within the abdominal cavity
2. Normal IAP is approximately 5-7 mmHg in critically ill adults
3. Intra-abdominal Hypertension (IAH) is defined by a sustained or repeated pathologic elevation of IAP greater than 12mmHg
4. Abdominal Perfusion Pressure (APP) is a calculation of the perfusion pressure of the abdominal organs. It s calculated by subtracting the IAP from the mean arterial pressure (MAP). APP should be kept ≥ 60mmHg.
5. Abdominal compartment syndrome (ACS) is defined as a sustained IAP > 20 mmHg (with or without an APP < 60 mmHg) that is associated with new organ dysfunction / failure.

PROCEDURES FOR IMPLEMENTATION (INCLUDING FORMS / SYSTEMS):

<u>Considerations:</u>

Patients should be screened for intra-abdominal hypertension/ abdominal compartment syndrome risk factors upon ICU admission and in the presence of new or progressive organ failure
Intra-abdominal pressure monitoring may be initiated:

- Upon a physician's order **OR**
- May be initiated by the critical care nurse if the patient meets ONE of the following criteria and at least TWO of the risk factors for IAH and the patient has a urinary catheter already in place.

<u>Criteria:</u>

1. New Critical Care Unit admission
2. Evidence of clinical deterioration or new organ failure

Once one of the criteria has been met, then screen patient for risk factors. Patient must have at least 2 of the risk factors for nursing initiated IAP monitoring.

<u>Risk Factors for Intra-abdominal Hypertension/ Abdominal Compartment Syndrome</u>

1. Diminished abdominal wall compliance
    - Acute respiratory failure, especially with elevated intrathoracic pressure
    - Abdominal surgery with closure of the abdomen
    - Major trauma/ burns
    - Prone positioning

2. Increased intra-luminal contents
    - Gastroparesis
    - Ileus
    - Colonic pseudo-obstruction

3. Increased abdominal contents
    - Hemoperitoneum/ pneumoperitoneum
    - Ascites/ liver dysfunction

4. Capillary Leak/ fluid resuscitation
    - Acidosis pH less than 7.20
    - Hypotension (systolic pressure < 90mmHg, or Mean arterial pressure < 60mmHg)
    - Hypothermia (core temperature less than 33^0 C or 91.4^0 F)
    - Polytransfusion (greater than 10 units of blood/ 24 hours)
    - Coagulopathy
        - o platelets less than 55,000/mm^3 **OR**
        - o Activated Partial Thromboplastin Time (APTT) greater than 2x normal **OR**
        - o International Normalized ration (INR)greater than 1.5
    - Massive fluid resuscitation greater than 5L/ 24 hours
    - Oliguria
    - Sepsis
    - Major trauma/ burns
    - Damage control laparotomy (major abdominal trauma only)

Initiating Intra-abdominal Pressure Monitoring

Equipment:

- Abviser Autovalve Intra-abdominal Pressure Monitoring System (Omnicell)
- Single set-up transducer
- 500ml IV bag of Normal Saline
- Alcohol or chlorahexadine swab
- Clean gloves

Set-Up

1. Once considerations are met, if the patient does not have a urinary catheter drainage system in place, obtain an order for catheter insertion. Make sure the patient has no contraindication for having a urinary catheter placed prior to placing one. Contraindications may be:
   a. Recent bladder surgery
   b. Recent bladder trauma
   c. Note: Neurogenic bladder can cause inaccurate readings

2. Follow manufacturer's directions in setting up the intra-abdominal pressure monitoring system using alcohol or chlorhexadine to cleanse the catheter/ urinary drainage connection prior to connecting the AbViser Autovalve to the catheter. Use a 500ml IV bag of Normal Saline connected to the tubing for the 20 ml syringe that will be used to instill the fluid into the bladder. Use non vented caps in order to maintain a closed system.

3. Level transducer at the iliac crest in line with the mid-axillary line. The transducer may be mounted on the patient's thigh, or on a towel roll placed next to the patient's hip at the iliac crest.

4. Zero the transducer
   - Label as P1 on the monitor
   - Use Scale 0-30 for better waveform readings

Measuring Intra-abdominal Pressure:

1. Position patient in the supine position with head of bed (HOB) flat. Ensure that abdominal muscle contractions are absent.

2. Level transducer at the iliac crest in line with the mid-axillary line.

3. Draw up 20 ml sterile normal saline via the intra-abdominal pressure monitoring system, and instill into bladder.

4. Wait at least 30 seconds before taking reading to allow bladder detrusor muscle relaxation. The Autovalve will automatically open in 1-3 minutes after instillation of normal saline in the bladder.

5. Take reading at end expiration (which corresponds to the trough on the vented patient's respiration waveform, and the peak in a non-vented patient's respiration waveform) and record. Record and mount strip the beginning of each shift and if there is a change of greater or lesser than 5 mmHg. Notify eICU to supply lines in VISICU for documentation of IAP & APP.

6. Reposition patient when reading complete to appropriate position as per patient condition and physician orders.

7. Take IAP readings and record initially every 1-2 hours for 12 hours and then every 4 hours and PRN for as long as the IAP monitoring device is in place, unless otherwise ordered.

8. Deduct the NS instilled into the bladder from the urinary output for accurate calculation of output.

9. Decrease the frequency of IAP measurement or discontinue measurements once IAH has resolved. If clinical deterioration returns re-initiate IAP monitoring.

Hemodynamic Effects of Intra-abdominal Hypertension:

1. IAH causes false elevations of the central venous pressure (CVP) and the pulmonary capillary wedge pressure (PCWP).

2. In order to negate the effect of IAH on the CVP and PCWP, use the following calculations:

   - CVP Corrected = CVP measured - (IAP/2)
   - PCWP Corrected = PCWP Measured - (IAP/2)

3. Document corrected pressures with a **"c"** next to the reading. Since IAP is not a continuous reading this will only need to be done for every time an IAP is taken and recorded along with a CVP and/or PCWP. If no IAP is taken, record your CVP and PCWP as usual.

Significance of IAP Measurements:

1. Grading System
   - Grade I – 12-15 mmHg
   - Grade II – 16-20 mmHg
   - Grade III – 21-25 mmHg
   - Grade IV greater than 25 mmHg

2. The Abdominal Perfusion Pressure (APP) is considered a better indicator of abdominal perfusion.
   - Calculating APP: APP = Mean Arterial Pressure (MAP) - IAP
   - APP should be maintained at or above 60 mmHg to ensure adequate perfusion
   - Record the APP along with the IAP in the eCare Manager Flowsheet.

3. **Notify Physician for a persistent IAP greater than 20mmHg or an APP less than 60mmHg**

Nursing Interventions to decrease IAP

1. Methods to decrease IAP if patient has increased intra-luminal contents
   a. Obtain an order from physician to insert nasogastric (NG) tube to low intermittent suction
   b. Maintain patency of NG tube if already in place
   c. Monitor for daily bowel movement.
      i. If patient is constipated obtain orders for laxative and stool softener
      ii. Assess patient for impaction. If impaction is present contact physician for orders to dis-impact.
   d. Discuss with the nutritionist and physician about minimizing or discontinuing enteral nutrition
   e. Discuss with physician if a rectal tube or an enema will assist with decompression
   f. Discus with physician if gastro/ coloprokinetic agents are appropriate for the patient
      i. Examples of prokinetic agents:
         - Metoclopramide (Reglan)
         - Erythromycin
         - Neostigmine

2. Methods to decrease IAP if patient has decreased abdominal wall compliance

a. Ensure adequate sedation and analgesia as ordered
b. Remove constrictive clothing
c. Discuss with surgeon about modifying constrictive abdominal binders/ dressings
d. Avoid the prone position
e. Avoid head of bed (HOB) elevation > 20^0
f. Consider reverse Trendelenberg position
g. If patient on a ventilator discuss with pulmonary physician if neuromuscular blockade will assist in increasing abdominal wall compliance.

3. Methods to optimize fluid balance
   a. Avoid excessive fluid intake if possible
   b. Maintain strict I & O
   c. Attempt to aim for a zero or negative fluid balance by day 3 in the ICU
   d. Assess responsiveness to diuretics ordered, notify physician if response is < 0.5ml/Kg/ hour.

4. Methods to optimize systemic and regional perfusion:
   a. If patient has an arterial line, monitor the patient with the Vigileo-Flo-Trac using the stroke volume variation parameter for fluid resuscitation (see Policy # HH-ICU-200-17)
   b. If unable to maintain APP ≥ 60mmHg contact physician to consider:
      i. Fluid challenge
      ii. Inotropes
      iii. Vasopressors

RENEWAL / REVIEW:

- This protocol will be reviewed/ renewed every 3 years or sooner as the scientific evidence is accepted into practice.

Related Polices:

- **HH-100-01-** Nursing Services Standards
- **HH-100-02 -** Generic Standards of Patient Care/Practice
- **HH-200-20 -** Communication with Physicians
- **HH -330-01 -** Infection Control
- **HH-330 -06A -** Indwelling Urinary Catheter Management
- **HH 370-00 -** Practices Common to Most Procedures
- **220 -** CRITICAL CARE INFECTION CONTROL POLICIES
- **80 -** PATIENT/FAMILY EDUCATION CRITICAL CARE UNITS

References:

Websites:

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Articles:

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- [ ] Administrative
- [x] Departmental

APPENDIX D

Intra-abdominal Pressure (IAP) Monitoring Competency

Name:________________________ **Date:_________________**

Evaluator:______________________

CRITICAL ELEMENTS	Met	Not Met
INTRA-ABDOMINAL PRESSURE MONITORING SET-UP		
1. OBTAINS EQUIPMENT NEEDED TO MEASURE INTRA-ABDOMINAL PRESSURE: • Abviser Autovalve Intra-abdominal Pressure Monitoring System • Single transducer • 500ml IV bag of Normal Saline • Alcohol or chlorahexadine swab • Clean gloves		
2. SPIKES THE SALINE BAG		
3. ATTACHES TRANSDUCER AT AREA PROVIDED BETWEEN THE SYRINGE AND THE AUTO-VALVE		
4. PRIMES THE TUBING INCLUDING THE TRANSDUCER WITH THE SALINE		
5. PLACES CLOSED CAP ON END OF TRANSDUCER		
6. CLEANSES FOLEY CONNECTION WITH ALCOHOL OR CHLORHEXADINE		
7. DISCONNECTS FOLEY FROM DRAINAGE BAG 8. CONNECTS ABVISER AUTOVALVE TO FOLEY 9. CONNECTS DRAINAGE BAG TO DRAIN CONNECTOR		
10. Level transducer at the iliac crest in line with the mid-axillary line		
11. Use Scale 0-30mmHg for better waveform readings, uses label “P”		
12. ZEROES THE TRANSDUCER		
INTRA-ABDOMINAL PRESSURE MONITORING		
13. Position patient in the supine position with head of bed (HOB) flat		
14. Level transducer at the iliac crest in line with the mid-axillary line.		
15. DRAW UP 20 ML STERILE NORMAL SALINE VIA THE INTRA-ABDOMINAL PRESSURE MONITORING SYSTEM, AND INSTILL INTO BLADDER		
16. Wait 30 seconds before taking reading to allow bladder detrusor muscle relaxation and the monitor to equilibrate. The Autovalve will automatically open in 1-3 minutes after instillation of normal saline in the bladder. • Deducts the 20ml from the patient’s output		
17. TAKE READING AT END EXPIRATION (WHICH CORRESPONDS TO THE TROUGH ON THE VENTED PATIENT’S RESPIRATION WAVEFORM, AND THE PEAK IN A NON-VENTED PATIENT'S RESPIRATION WAVEFORM)		
18. IDENTIFIES SIGNIFICANCE OF READINGS: • Grade I –12-15 mmHg - decompression not indicated		

• Grade II - 16-20mmHg treatment based on patient's clinical condition. Requires close monitoring • Grade III – 21-25mmHg Abdominal decompression is indicated even in the absence of overt signs and symptoms • Grade IV – over 25mmHg- Surgical emergency		
19. CALCULATES ABDOMINAL PERFUSION PRESSURE (APP) • Mean Arterial Pressure (MAP) – IAP = APP • APP should be maintained at or above 60 mmHg to ensure adequate perfusion		
20. CALCULATES THE CORRECTED CVP PRESSURE OR PCWP WITH THE FOLLOWING FORMULA: • CVP corrected = CVP measured – (IAP/2) • PCWP corrected = PCWP measured – (IAP/2)		

APPENDIX E

Case Report Form – IAP Study

Research # ____

Age:______ Gender: M F BMI:________

Apache II Score:_______ SOFA Score:_______

ICU Admission Diagnosis:____

ICU Admit Date: ____________ Study Date:_____________

PATIENT SCREENING

Please indicate that the following inclusion criteria have been met:

Yes No Patient is at least 18 years of age

Yes No Urinary Catheter in place

Patient has at least one of the following criteria:

☐ New Critical Care Unit admission

☐ Evidence of clinical deterioration or new organ failure

Indicate any and all risk factors patient exhibits (must have at least 2):

Diminished abdominal wall compliance

☐ Acute respiratory failure, especially with elevated intrathoracic pressure
☐ Abdominal surgery with primary fascial closure
☐ Major trauma/ burns
☐ Prone positioning

Increased intra-luminal contents

☐ Gastroparesis
☐ Ileus
☐ Colonic pseudo-obstruction

Increased abdominal contents

- ☐ Hemoperitoneum/ pneumoperitoneum
- ☐ Ascites/ liver dysfunction

Capillary Leak/ fluid resuscitation

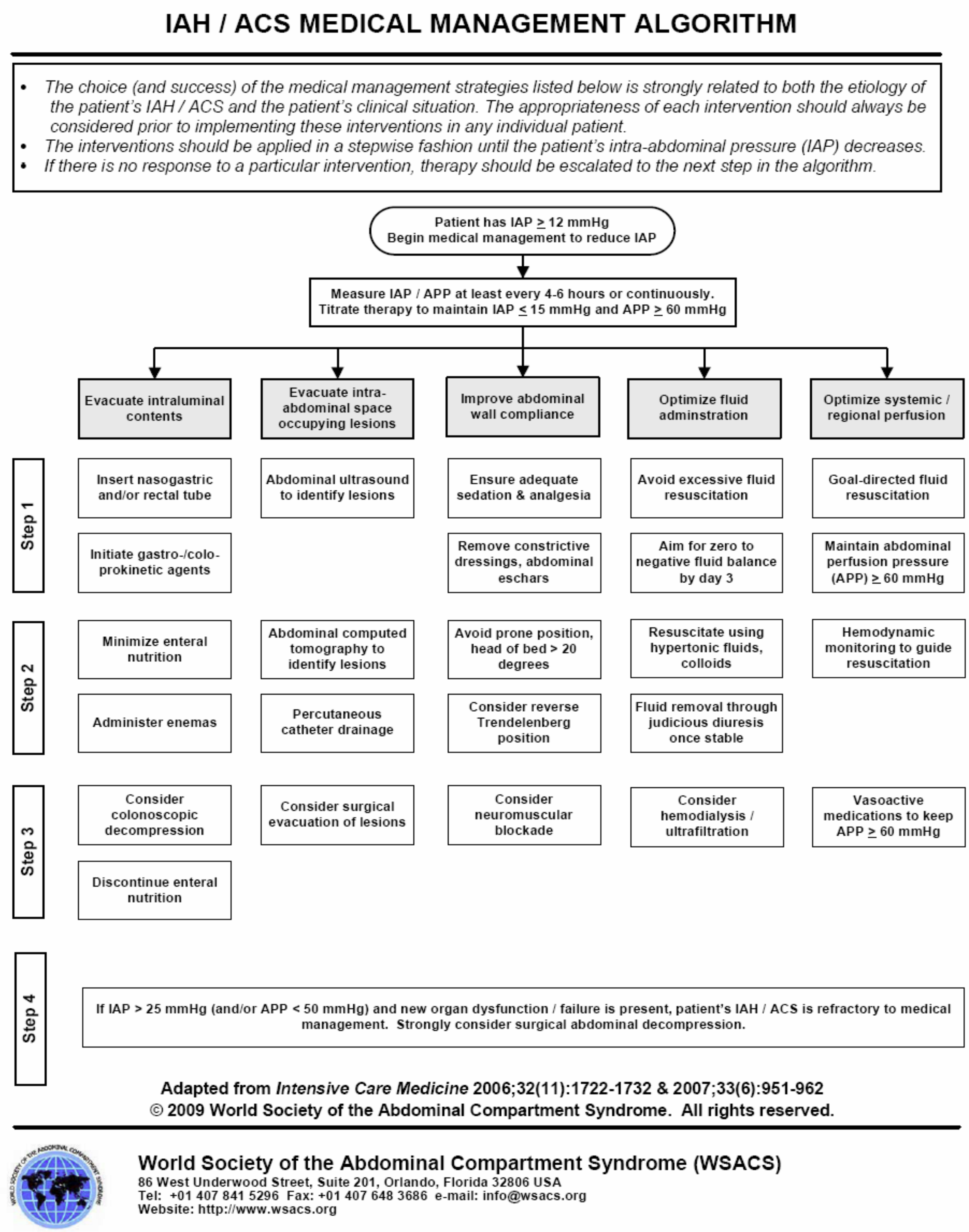
- ☐ Acidosis pH less than 7.20
- ☐ Hypotension
- ☐ Hypothermia (core temperature less than 33^0 C or 91.4^0 F)
- ☐ Polytransfusion (greater than 10 units of blood/ 24 hours)
- ☐ Coagulopathy
  - ☐ platelets less than 55,000/mm^3 **OR**
  - ☐ APTT greater than 2x normal **OR**
  - ☐ INR greater than 1.5
- ☐ Massive fluid resuscitation greater than 5L/ 24 hours
- ☐ Oliguria
- ☐ Sepsis
- ☐ Major trauma/ burns
- ☐ Damage control laparotomy

Measurements:

Timing	Time	MAP	IAP	APP
Pre-hygiene				
Immediately post-hygiene				
10 minutes post hygiene				

NOTES:

APPENDIX F


IAH / ACS MEDICAL MANAGEMENT ALGORITHM
• The choice (and success) of the medical management strategies listed below is strongly related to both the etiology of the patient's IAH / ACS and the patient's clinical situation. The appropriateness of each intervention should always be considered prior to implementing these interventions in any individual patient.
• The interventions should be applied in a stepwise fashion until the patient's intra-abdominal pressure (IAP) decreases.
• If there is no response to a particular intervention, therapy should be escalated to the next step in the algorithm.
Patient has IAP ≥ 12 mmHg
Begin medical management to reduce IAP
Measure IAP / APP at least every 4-6 hours or continuously.
Titrate therapy to maintain IAP ≤ 15 mmHg and APP ≥ 60 mmHg
Evacuate intraluminal contents
Evacuate intra-abdominal space occupying lesions
Improve abdominal wall compliance
Optimize fluid adminstration
Optimize systemic / regional perfusion
Step 1
Insert nasogastric and/or rectal tube
Abdominal ultrasound to identify lesions
Ensure adequate sedation & analgesia
Avoid excessive fluid resuscitation
Goal-directed fluid resuscitation
Initiate gastro-/colo-prokinetic agents
Remove constrictive dressings, abdominal eschars
Aim for zero to negative fluid balance by day 3
Maintain abdominal perfusion pressure (APP) ≥ 60 mmHg
Step 2
Minimize enteral nutrition
Abdominal computed tomography to identify lesions
Avoid prone position, head of bed > 20 degrees
Resuscitate using hypertonic fluids, colloids
Hemodynamic monitoring to guide resuscitation
Administer enemas
Percutaneous catheter drainage
Consider reverse Trendelenberg position
Fluid removal through judicious diuresis once stable
Step 3
Consider colonoscopic decompression
Consider surgical evacuation of lesions
Consider neuromuscular blockade
Consider hemodialysis / ultrafiltration
Vasoactive medications to keep APP ≥ 60 mmHg
Discontinue enteral nutrition
Step 4
If IAP > 25 mmHg (and/or APP < 50 mmHg) and new organ dysfunction / failure is present, patient's IAH / ACS is refractory to medical management. Strongly consider surgical abdominal decompression.
Adapted from Intensive Care Medicine 2006;32(11):1722-1732 & 2007;33(6):951-962
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APPENDIX G

Does your patient need their IAP measured?

Patient Screening for Intra-abdominal Hypertension

In order to implement the nurse driven intra-abdominal pressure (IAP) monitoring protocol the patient must meet one (1) of the two (2) criteria and have at least two (2) of the risk factors:

Patient has at least one of the following criteria: (if one checked go to next section)

- ☐ New Critical Care Unit admission
- ☐ Evidence of clinical deterioration or new organ failure

Indicate any and all risk factors patient exhibits (must have at least 2). If 2 risk factors are present implement IAP monitoirng:

Diminished abdominal wall compliance

- ☐ Acute respiratory failure, especially with elevated intrathoracic pressure
- ☐ Abdominal surgery with primary abdominal wound closure
- ☐ Major trauma/ burns
- ☐ Prone positioning

Increased intra-luminal contents

- ☐ Gastroparesis
- ☐ Ileus
- ☐ Colonic pseudo-obstruction

Increased abdominal contents

- ☐ Hemoperitoneum/ pneumoperitoneum
- ☐ Ascites/ liver dysfunction

Capillary Leak/ fluid resuscitation

- ☐ Acidosis pH less than 7.20
- ☐ Hypotension (systolic < 90mm Hg; MAP < 60mmHg)
- ☐ Hypothermia (core temperature less than 33^0 C or 91.4^0 F)
- ☐ Polytransfusion (greater than 10 units of blood/ 24 hours)
- ☐ Coagulopathy (not on anticoagulation)
  - ☐ platelets less than 55,000/mm^3 **OR**
  - ☐ APTT greater than 2x normal **OR**
  - ☐ INR greater than 1.5
- ☐ Massive fluid resuscitation greater than 5L/ 24 hours

- ☐ Oliguria
- ☐ Sepsis
- ☐ Major trauma/ burns
- ☐ Damage control laparotomy

Do not implement if:

- ☐ Patient does not require a urinary catheter
- ☐ current bladder trauma or surgery
- ☐ neurogenic bladder

VITA

October 16, 1951	Born Cleveland, Ohio
1973	BSN, Marquette University Milwaukee, WI
1991	MSN, University of Miami Coral Gables, FL
2006	Post Masters Certificate, Acute Care Nurse Practitioner, Barry University Miami Shores, FL
2010	Doctor of Nursing Practice Barry University Miami Shores, FL

PUBLICATIONS

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WORK EXPERIENCE

Ms. Lee has worked in the critical care setting for the majority of her 38 years in nursing. For the last 17 years, she has primarily worked in the role of the Clinical Nurse Specialist. Currently, she is working as the Clinical Nurse Specialist in the Critical Care Unit at Homestead Hospital, Homestead, Florida.