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INTRAOPERATIVELY ACQUIRED PRESSURE ULCERS IN SPINAL SURGERY PATIENTS: A RETROSPECTIVE STUDY

by Ellice Mellinger

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STATEMENT BY THE AUTHOR

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ABSTRACT

Pressure ulcers can result from having spinal surgery. Medical records of 142 spinal surgery patients were examined for incidence of pressure ulcers and to identify factors associated with ulcer development. Early stage pressure ulcers (persistent skin redness and/or blistering) were documented in 24.6% of the records. The mean surgery length for those acquiring pressure ulcers was 4.2 $\pm$ 1.6 hr, compared to 3.3 $\pm$ 1.5 hr for those who did not (p=0.002). The average age of those developing pressure ulcers was 60.1 $\pm$ 13.8 yr, compared to 50.5 $\pm$ 16.3 yr for ulcer free patients (p=0.002). Mean intraoperative blood loss was 1551 $\pm$ 1185 ml for those developing pressure ulcers, compared to 1081.6 $\pm$ 1104.2 ml for those who did not (p=0.049). Finally, pressure ulcer development was associated with diabetes mellitus and a higher preoperative blood sugar value. These findings may help identify spinal surgery patients at risk for pressure ulcers.

CHAPTER 1

INTRODUCTION

Statement of the Problem

Hospitalized patients develop pressure ulcers which are characterized by redness, bruising and/or skin breakdown. Surgical patients undergoing lengthy surgical procedures are at risk for pressure ulcers (Martin, 1987). Periods of immobility and unrelieved, sustained pressure required by the surgical procedure, and the inability of the patient to self reposition due to anesthesia place surgical patients at risk for the development of pressure ulcers (Martin).

Spinal surgery patients positioned prone for lengthy surgical procedures are at particularly high risk for developing skin breakdown. Redness, bruising, and breakdown of the patients' skin after lengthy spinal surgery procedures have been identified as a clinical problem by nurses caring for these patients in the perioperative period.

Identification of patient characteristics, surgical events, and medical/nursing interventions have the potential to influence the prevention or development of intraoperatively acquired pressure ulcers during spinal surgery. Among these characteristics, the length of surgery, the age of the patient, and the amount of intraoperative blood loss are possible independent variables influencing the development of intraoperatively acquired pressure ulcers in spinal surgery patients.

Purpose of the Study

The purpose of this study was to determine if there are associations between the development of intraoperatively acquired pressure ulcers in spinal surgery patients and the length of surgery, the age of the patient, and the amount of intraoperative blood loss as independent variables. In addition, other variables were examined for possible associations in the development of intraoperatively acquired pressure ulcers. These

included gender, race, height, weight, preoperative laboratory values, the surgical procedure, previous medical problems, and the length of hospital stay.

Research Questions

The following research questions were addressed.

1. Is the development of an intraoperatively acquired pressure ulcer in spinal surgery patients related to length of surgery greater than four hours (hr)?
2. Is the development of intraoperatively acquired pressure ulcers in spinal surgery patients related to patients over the age of 65 years (yr)?
3. Is the development of intraoperatively acquired pressure ulcers in spinal surgery patients related to the amount of intraoperative blood loss greater than 1500 milliliters (ml)?
4. Do other variables for spinal surgery patients influence the development of intraoperatively acquired pressure ulcers?

Definition of Terms

1. Pressure Ulcer

For this study, a pressure ulcer was defined as redness, bruising, or skin breakdown documented in the medical record.

2. Redness

Redness was defined as any documented redness of the skin present twenty-four or more hours after surgery.

3. Spinal Surgery Patient

A spinal surgery patient was defined as a patient, who has had a laminectomy or spinal fusion surgery with or without instrumentation (implanted prostheses such as rods, plates, and screws to stabilize or repair a spinal problem), and was positioned in the face down (prone) position for the surgery.

Significance of the Study

Pressure ulcers cause discomfort and pain, increase costs, and necessitate additional medical and nursing interventions (Bergstrom et al., 1994). The length of hospitalization may be increased impacting costs and lengthening recovery time. By examining the associations between the development of intraoperatively acquired pressure ulcers and the independent variables; length of surgery, age of patient, and the amount of intraoperative blood loss, the intended consequence was to provide an increased understanding of risk factors which influence the development of intraoperatively acquired pressure ulcer development. Characteristics such as age, gender, and past medical history would not be modifiable, yet some surgical, medical, and nursing interventions may be risk factors that can be modified thus decreasing the likelihood of pressure ulcer development.

CHAPTER 2

CONCEPTUAL FRAMEWORK AND REVIEW OF THE LITERATURE

Conceptual and Theoretical Frameworks

The conceptual orientation for this study incorporated the associations between the development of intraoperatively acquired pressure ulcer in spinal surgery patients and patient characteristics, surgical events, and medical/nursing interventions required during surgery. Accordingly, patient characteristics, surgical events, and medical/nursing interventions impact the development of a pressure ulcer during the intraoperative phase of a patient's hospitalization (Figure 1). Patient characteristics include age, gender, race, previous medical problems, preoperative laboratory values, and the condition of the skin preoperatively. Surgical events are defined as the length of surgery, the amount of blood loss during surgery, the surgical procedure, the patient's position during surgery, and the number of hypotensive episodes during surgery. Medical/nursing events are defined as preoperative assessment of the patient, management of the patient during the intraoperative phase, i.e.: maintenance of anesthesia, positioning aides and positioning techniques, and body temperature maintenance.

This study focused on the length of surgery, patient age, and the amount of intraoperative blood loss. In adapting this conceptual framework into Betty Neuman's Nursing Systems Model (Neuman, 1989), intraoperative pressure ulcer development was examined as a result of stressors on the body's lines of defense.

Neuman's Systems Model

According to Neuman's model, the body is dynamic protecting its wellness level through primary, secondary, and tertiary prevention levels (Figure 2). Nursing's major concern is to keep the patient stable to achieve optimum wellness (Parker, 1990). Primary prevention retains wellness. Secondary prevention attains wellness or treats

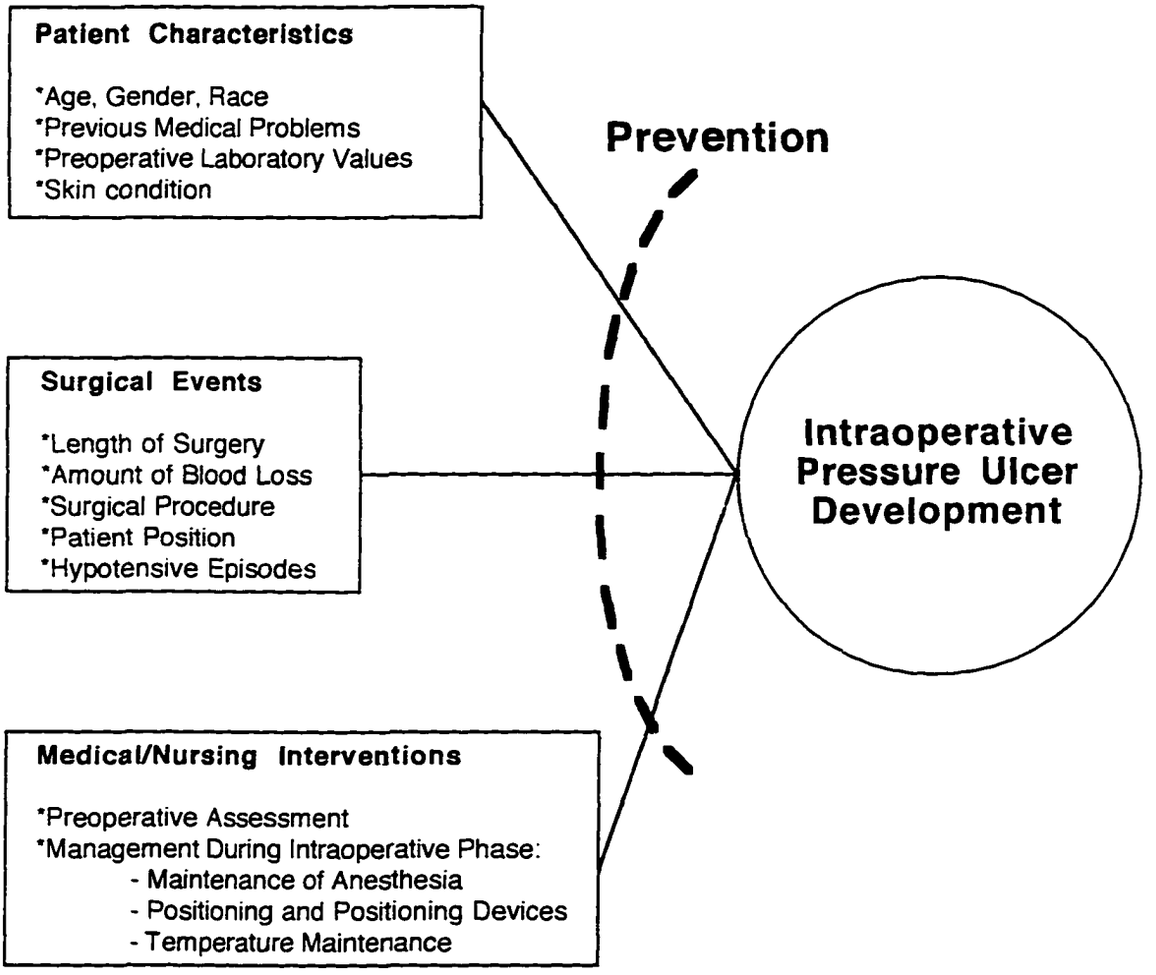

Figure 1. Conceptual Framework for intraoperatively acquired pressure ulcers.

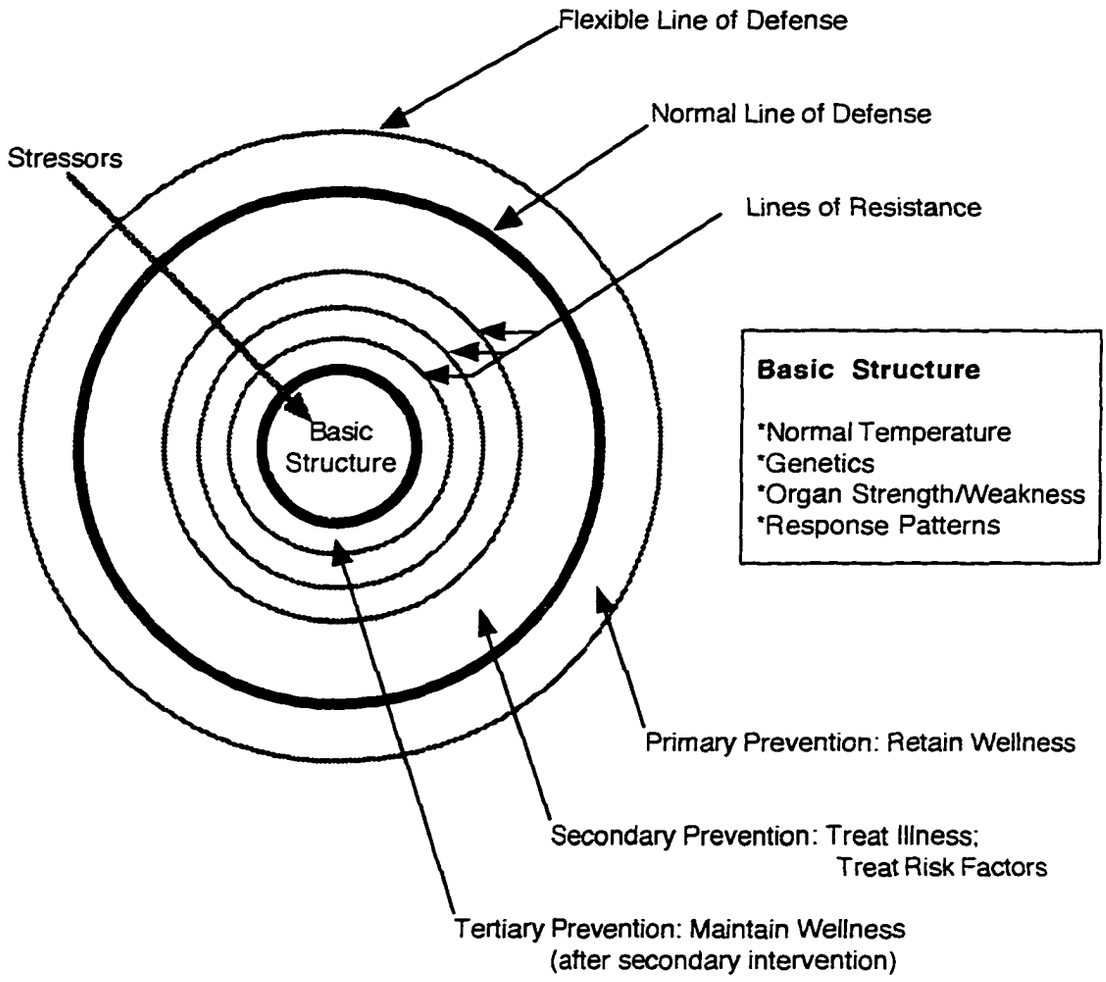

Figure 2. The Neuman Systems Model. Adapted from Neuman, B. (1989) The Neuman Systems Model Norwalk, CT: Appleton & Lange.

illness. Tertiary prevention maintains wellness following secondary prevention measures (Parker).

Neuman's Systems Model is conceptualized as the ability of the body to handle stress. The patient is described as a dynamic system represented by concentric circles surrounding and protecting the basic structure (Neuman, 1989) (Figure 2). The outer system boundary is a flexible line of defense protecting the normal line of defense which represents the wellness level. A reaction is caused by a stressor on the normal line of defense and when these lines fail, the system's (patient's) energy depletes or fails (Neuman).

Preventive therapy to reduce risk factors would also strengthen lines of defense. Environment is defined as internal or external factors or influences surrounding the patient (Parker, 1990). Environmental influences are considered stressors and the outcome of the interaction with the client (the patient) may be beneficial or harmful. Energy flow is continuous between the client and the environment. Health is equated with optimum patient system stability; the best possible health condition at any given time (Parker).

Adaptation of Neuman's System Model to Intraoperatively Acquired Pressure Ulcers

The intent of this study was to focus on the primary prevention aspects of Neuman's Systems Model. Primary prevention measures to decrease the development of intraoperatively acquired pressure ulcers include assessment of the patient preoperatively including hydration and nutritional assessment and the use of padding and positioning aides during the surgical procedure. Secondary prevention may include treating risk factors intraoperatively such as the alterations in physiologic status. Tertiary prevention would support secondary prevention designed to enhance the healing if a pressure ulcer developed (Figure 3).

A patient's past medical history, risk factors for the development of pressure

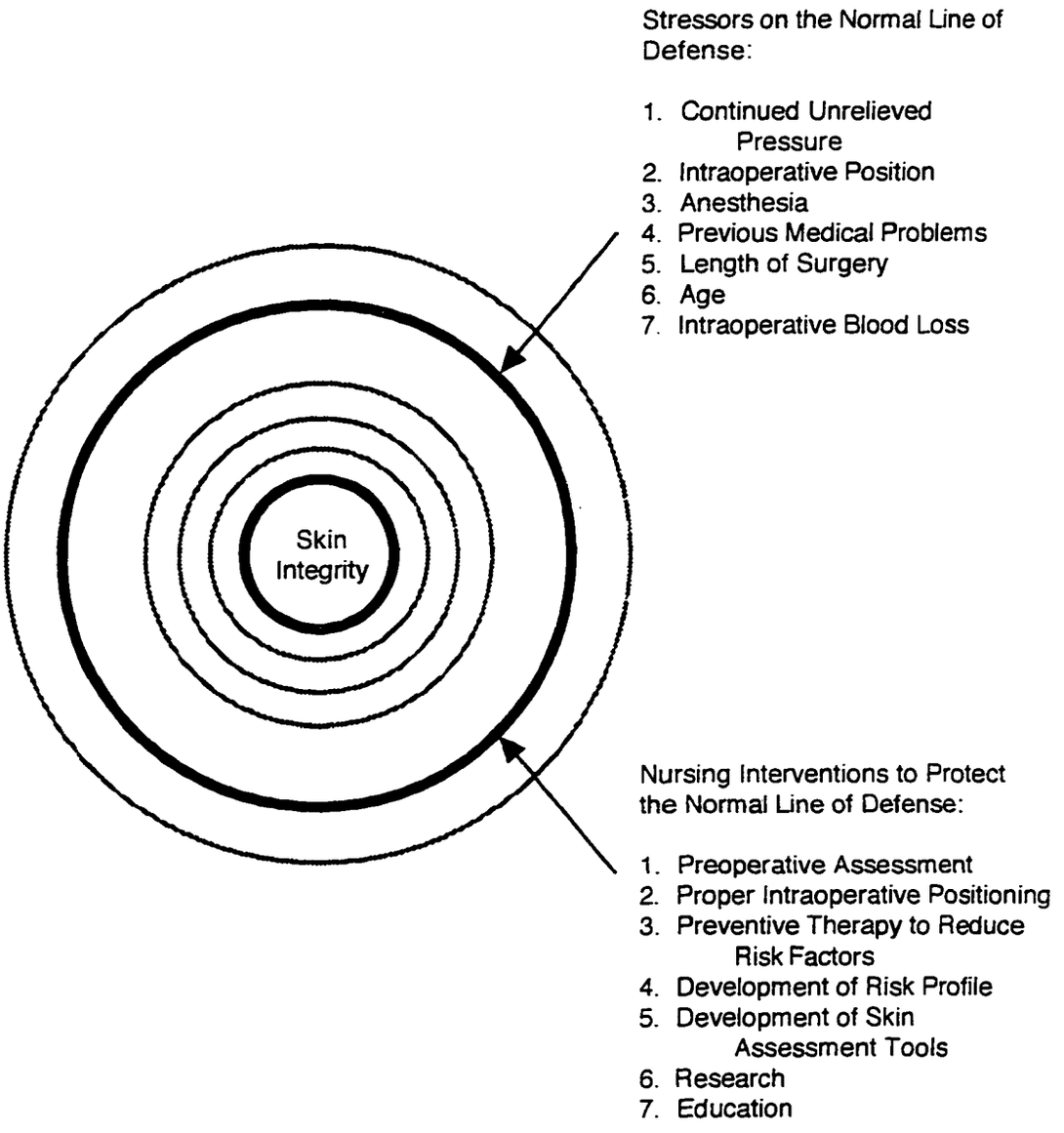

Figure 3. Application of Neuman's Model to spinal surgery patients.

ulcers, continued unrelieved pressure, lengthy surgery, patient positioning, and anesthesia, are examples of stressors challenging the first line of defense, the skin, and to the underlying structures (Figure 3). Nursing interventions to properly position with padding and positional aides and maintaining natural body alignment enhance lines of defense weakened by the surgical position and unrelieved sustained pressure during the surgical procedure. Preventive therapy to reduce risk factors would also strengthen lines of defense.

Many factors may influence the development of intraoperatively acquired pressure ulcers (Figure 1). This study focused on three variables of the conceptual framework, the length of surgery, the age of the patient, and the amount of intraoperative blood loss as perceived stressors to the first line of defense, the skin, when patients were positioned prone for lengthy surgical procedures. Other possible stressors included the position of the patient during spinal surgery, continued unrelieved pressure during immobilization for surgery, anesthesia, previous medical problems, and the length of the hospital stay.

REVIEW OF THE LITERATURE

Between 200,000 and 500,000 patients are scheduled for spinal surgery each year (Insinger & Bailes, 1993). Complex procedures, new instrumentation, and new equipment have resulted in longer surgery times (Massie, Heller, Abitol, McPherson, & Garfin, 1992). Longer surgery time, in which the patient is anesthetized, is associated with post operative disorders, increased wound infection, greater blood loss, and an increased risk for the development of pressure ulcers (Gillette & Caruso, 1992; Massie, et al., 1992).

Pressure Ulcer Development

Incidence and Financial Impact of Pressure Ulcers

Pressure ulcers may date back to the time of the Pharaohs as evidenced by a mummified Egyptian priestess (Thompson-Rolling, 1961). At present, the reported incidence of hospitalized patients who acquire pressure ulcers ranges from 2% to 29% (Bergstrom et al., 1994). The incidence and prevalence of pressure ulcers is difficult to determine due to the problems in methodology of research addressing this issue. Groups for research are not comparable, as some studies use direct patient observation and others use retrospective review of hospital medical records, and there has been inconsistencies in the terms used to describe pressure ulcers (Bergstrom et al.).

The incidence of pressure ulcers from all causes is highest among the elderly population (Allman et al., 1986). The incidence of the development of pressure ulcers in surgical patients has been reported to range from 12% to 17% with a 66% incidence in patients with fractured hips (Kemp, Keithley, Smith, & Morreale, 1990; Scott, Mayhew, & Harris, 1992; Versluysen, 1986).

The yearly total cost of pressure ulcers has been estimated at 1.335 billion dollars (Bergstrom et al., 1994). Treatment of one pressure ulcer has been reported to range in

cost from $5,000 to $40,000 (Kemp et al., 1990; Stotts, 1988). Complications from pressure ulcers include osteomyelitis and sepsis which increase the length of hospital stay (Allman et al.,1986).

Stages of Pressure Ulcer Development

The Agency for Health Care Policy and Research (AHCPR) was established in 1988 to enhance quality, appropriateness, and effectiveness of health services and to develop clinical practice guidelines to assist health practitioners (Bergstrom et al.,1994). A multi-disciplinary panel of experts appointed by AHCPR agreed upon categories for pressure ulcers as follows:

Stage I Non blanchable erythema (redness) of intact skin, the heralding lesion of skin ulceration. In individuals with darker skin, discoloration of skin, warmth, edema, induration, or hardness also may be indicators.

Stage II Partial thickness skin loss involving epidermis, dermis, or both. The ulcer is superficial and presents clinically as an abrasion, blister, or shallow crater.

Stage III Full thickness skin loss involving damage to or necrosis of subcutaneous tissue that may extend down to, but not through, underlying fascia. The ulcer presents clinically as a deep crater with or without undermining of adjacent tissue.

Stage IV Full thickness skin loss with extensive destruction, tissue necrosis or damage to muscle, bone, or supporting structures (e.g. tendon, joint capsule). Undermining and sinus tract may also be associated with Stage IV pressure ulcers (Bergstrom et al., 1994, pg. 12).

Limitations of the stages include Stage I skin is intact, not an ulcer in the usual sense and not always reliably assessed particularly in persons with dark skin (Bennett, 1995). If eschar (blackened, necrotic tissue) is present, one cannot stage the ulcer until the eschar is removed. Lyder (1991) also described a Stage I pressure ulcer as redness of

the skin that does not resolve after two hours of pressure relief. Bergstrom et al. (1987) described a Stage I pressure ulcer as redness that did not resolve after twenty-four hours of pressure relief. Bergstrom et al. definition for a Stage I pressure ulcer was used for this study.

For this study, the expectation was to find Stage I and Stage II, and possibly Stage III pressure ulcers. The more severe Stage IV pressure ulcer was not expected in this population of patients undergoing spinal surgery.

Theories for Development of Pressure Ulcers

Pressure ulcers develop initially in muscle and subcutaneous tissues progressing outward to the skin layers (Shea, 1975). A "closed pressure sore" is the result of prolonged pressure combined with shear stress. Muscle becomes damaged first because pressure is greatest over bone (Shea). The closed pressure ulcer may be classified a Stage III and the skin may be intact eventually rupturing and revealing a deep draining wound (Vermillion, 1990).

A pressure ulcer may appear as an ecchymotic (blue or purplish) area over a bony prominence which may rapidly progress to a ulcerative state and tissue necrosis (Gruendemann & Fernsebner, 1995). Skin remains intact until late in the development of a pressure ulcer and shows minimal outward signs even when damage is present internally. Muscle and deep tissue are more pressure sensitive than skin and undergo more necrosis (tissue death). Damage from pressure originates deep within tissue adjacent to the bone (Gruendemann & Fernsebner). Healing may not begin until the twelfth postoperative day (Vermillion, 1990).

Papantonio et al. (1994) indicated three types of pressure ulcers developing after surgery. The Stage I pressure ulcer with erythematous intact skin was caused by pressure, friction, or moisture. Non-blanchable erythema which soon sloughs was a

Stage II or Stage III pressure ulcer. An ecchymotic or purple pressure ulcer as previously described by Vermillion (1990) may not appear until a few days after surgery (Papantonio, Wallop, & Kolodner).

Numerous factors have been proposed to contribute to the development of pressure ulcers. Duration and intensity of pressure and the tolerance of the skin and the supporting structures are the critical determinants of pressure ulcer development (Bergstrom, Braden, Laguzza, & Holman, 1987). Koziak (1959) reported pressure ulcer development is a function of a time-pressure relationship.

Causes of Pressure Ulcer Development

Why does skin breakdown and pressure ulcers occur? Intensity of pressure and duration of pressure are major causes of pressure ulcers (Wagner, 1994). A long period of low pressure causes more damage than a short period of high pressure (Clarke & Kadhom, 1988). Goodman et al. (1990) described three theories; neuropathic, shear, and direct pressure as causes for the development of pressure ulcers. The neuropathic theory describes a loss of nerve stimulation to the nutritional centers which reduce tissue tolerance to pressure. Healthy tissue starves and ulcerates.

The shear theory is when blood vessels from muscle to skin are damaged by stretching and pulling. Shear occurs when the outer layer of skin slide which results in a tear of the underlying tissue (Wagner, 1994). Shear exerts a parallel force that occludes the capillary flow and pressure exerts a perpendicular force on the soft tissue (Gendron, 1980). Compressive forces cause tissue damage at a bony prominence and, damage to other sites (other than bony prominences) indicate damage by shear forces (Gendron).

A lower pressure may cause a pressure ulcer when pressure and shear are combined (Schubert & Heraud, 1994). Reduced tissue thickness and reduced elasticity predispose the elderly patient to pressure and shear injuries. Shear forces mainly affect

the vascular system of deeper tissue and is not as easily observable as a pressure only stress (Schubert & Heraud).

Direct pressure is the primary cause of tissue ischemia and ulcer formation (Goodman, Thomas, & Rappaport, 1990). When pressure is in excess of arterial capillary pressure (32mmHg) over a period of time, capillaries are occluded and tissues deprived of oxygen and nutrients become ischemic and necrotic (Goodman et al.). In the prone position as occurs in spinal surgery, the knees and the chest may withstand 50mmHg of pressure (Goodman et al.).

Tissue Responses to Restoration of Blood Flow

When pressure is relieved, a reactive hyperemic response (excessive blood flow to the area) occurs in the capillaries and surrounding tissues (Oertwich, Kindschuh, & Bergstrom, 1995; Longe, 1986). The tissues are flooded with oxygen-enriched blood proportional to the needs of the tissue which is important to prevent cell death (Oertwich et al.). Ironically, the reestablishment of blood flow also causes injury. It is hypothesized an ischemia-reperfusion injury occurs primarily during reperfusion secondary to the production of toxic oxygen metabolites (Das, 1993). Reperfusion supplies the necessary oxygen, oxygen metabolites are generated, and injury to the cells occur (Das). The potential for occluding capillary flow and potential for cell injury exists during the time a patient is positioned on an operating room table (Kemp & Krouskop, 1994). With a surgical patient, prevention protocols to relieve pressure to promote blood flow to the tissues under pressure is impractical because the patient is immobilized for the duration of the surgical procedure.

Risk Factors for Pressure Ulcer Development

Much research has been conducted in the areas of pressure ulcers and the elderly population yet the amount of research in intraoperatively acquired pressure ulcers is

lacking. Primary risk factors for pressure ulcer development in the elderly population are immobility, limited activity levels, decreased sensory perception, increased moisture, increased friction, increased shear, malnutrition, increased age, and decreased arterial pressure (Braden & Bergstrom, 1987).

Anemia, sedation, malignancy, paralysis, and renal failure have also been associated with pressure ulcer development. Patients with a history of smoking, diabetes, peripheral vascular disease, and cardiovascular disease are at risk for pressure ulcer development (Insinger & Bailes, 1993).

Surgical Patients at Risk for Pressure Ulcer Development

A surgical patient may or may not be at risk with the existing conditions described yet these patients are at a unique risk for pressure ulcer development due to having the surgical intervention alone. All surgical patients by the nature of immobility and sustained unrelieved pressure may be at risk for pressure ulcer development (Recommended Practices for Positioning the Patient in a Perioperative Practice Setting, 1996; Wagner, 1994).

Hypothermia, hypotension, and prolonged procedures with or without a position change can lead to decreased tissue perfusion (Gillette, 1992). The risk of tissue and nerve damage increases when a procedure is longer than three hours (Gillette). Hicks (1971) found the incidence of pressure sores in patients having surgery that lasted more than four hours was twice that of patients whose surgery lasted less than four hours.

Predictors for pressure ulcers in surgical patients have been proposed and suggested to include time on the operating table, hypotensive episodes, age, the presence of diabetes, a low preoperative Braden Scale assessment, and a low preoperative serum albumin, hemoglobin, and hematocrit (Kemp et al.,1990; Lewicki, Mion, Splane, Stamsteg & Secic, 1997). Sacral pressure ulcers developed during vascular,

cardiovascular, and orthopedic procedures in patients identified as not as being at risk for pressure ulcer development (Vermillion, 1990). The initial presentation of the pressure ulcer was a bruised like appearance evident at the second post operative day. Ulcer development progressed despite treatment and healing did not occur until twelve to fourteen post operative days (Vermillion).

Bostman et al. (1990) reported a mean blood loss of 376 ml with a range of 150-1100 ml for first time and reoperation laminectomy patients positioned prone. They reported a positive correlation between the amount of blood loss and the length of surgery. In this study, anesthesiologists estimated for spinal fusion surgery, which is a considerably longer surgery than a laminectomy, that intraoperative blood loss averages 1000-2000 ml with a range of 1000 to 6000 ml depending on the length of surgery (Wineinger, K. & McGaffic, W., personal communication November 21, 1996).

Other factors placing a surgical patient at risk for pressure ulcer development have been proposed. The use of the electrosurgical equipment for hemostasis has been blamed for unexplained burn like injuries after lengthy surgical positions. Gendron (1980) identified these injuries as pressure ulcers. Time, vascular surgery, and sustained pressure were common factors identified for these incidents. Also, pooled surgical prep solutions under the patient exposes the skin to moisture which leads to maceration and the development of pressure ulcers (Bergstrom et al., 1987; Bridel, 1992; Scott et al., 1992).

Patient Positioning for Surgery and the Prone Position

The goals of proper patient positioning in surgery are to provide the best possible exposure to the operative area without compromise to physiological functions or mechanical stresses on body parts, to provide the best possible body alignment within patient limitations, and to provide an access for administration of medications, intravenous fluids, and anesthetic agents (Biddle & Cannady, 1990; Gruendemann &

Fernsebner, 1995). Surgeons, anesthesiologists, and perioperative nurses work as a team to properly position patients and to assure freedom from injury (Gruendemann & Fernsebner).

Patient Assessment

Patient positioning for surgery begins with an assessment of the patient preoperatively to include physical limitations, skin condition, nutritional status, vital signs, and the anticipated position related to the surgical procedure. Massive obesity and late stages of pregnancy are contraindications for the prone position (Martin, 1987).

It is important to note there is not a skin assessment tool available for use specific to the surgical population. The Braden Scale for Predicting Pressure Sores and the Norton Scale are two skin assessment tools used primarily for nursing home patients and hospitalized patients other than surgical patients (Braden & Bergstrom, 1994; Taylor, 1988). The Norton Scale assesses physical condition, level of consciousness, activity, mobility, and incontinence (Norton, McLaren, & Exton-Smith, 1962). The Braden Scale for Predicting Pressure Sores assesses sensory perception, moisture, activity, mobility, nutrition, friction, and shear (Bergstrom et al., 1987). The Braden Scale alone is not a predictor of pressure ulcers for surgical patients due to the lack of measures for contributing surgical factors such as prolonged unrelieved sustained pressure and immobility (Kemp et al., 1990).

A more recent method for skin assessment specific to the surgical patient population was researched by Lewicki et al. (1997). Their study focused on intraoperative variables and the development of pressure ulcers in 350 open heart surgery patients. Data collected included length of time on the operating room table, duration of hypotensive episodes, length of time of extracorporeal circulation, demographic data, laboratory values, and the incidence of pressure ulcer development. Significant factors associated

with pressure ulcer development in their study included a presence of diabetes, a low preoperative Braden Scale assessment, and lower preoperative hemoglobin, hematocrit, and serum albumin levels.

Positioning the Patient

Components of safe positioning include knowledge, planning, sufficient personnel, and adequate equipment to ensure no harm to the patient. Bony prominences should be well padded to distribute pressure to decrease the possibility of ischemic tissue damage. Newer padding materials such as gel pads, foam, and laminated vinyl fabrics are designed to decrease pressure yet little was found in the literature addressing research findings and patient outcomes with different materials used to pad.

The ventral (front) aspects of the human body were never intended to be weight bearing structures (Martin, 1987). The needs of the surgeon for exposure to the surgical site may conflict with the limitations of the patient's physique and physiology (Martin). Anesthetic agents inflict a totally unfamiliar physiologic environment to all body systems. Except for physical injury, the major hazard to repositioning patients after the induction of anesthesia relates to hypotension (Martin). Anesthesia alters vascular status, blood pressure, tissue perfusion, responses to pressure and pain, the exchange of oxygen and carbon dioxide, which place the patient at a greater risk for tissue damage (Campbell, 1989; Walsh, 1993). A patient who is under anesthesia, possibly hypotensive and immobile, risks pressure ulcer development.

Possible Injuries Occurring in the Prone Position

Many safety issues and potentials for patient injury are apparent when positioning a patient prone for surgery. Corneal abrasions, air embolism, stretch injuries to the brachial plexuses, and loss of skin integrity are possible injuries in the prone position (Lincoln & Sawyer, 1961; Martin, 1987; Walsh, 1993). Vulnerable body sites for

pressure ulcers include the eyes, ears, cheeks, acromion processes, clavicles, breasts in women, genitalia in men, sternum, bony prominences, patellas, and toes (Anderton, Keen, & Neave, 1988; Gruendemann, 1987; Souther, Carr, & Vistnes, 1973; Wolfe, Lospinuso, & Burke, 1992).

If the head is positioned below the level of the heart during the prone position, there may be a significant increase in blood and cerebrospinal fluid that accumulates around the brain causing edema and congestion in the conjunctivae, nasal passages, and larynx (Martin, 1987). Ocular edema, compression of the facial nerve, and retinal ischemia from pressure on the eye globe may lead to unilateral blindness (Martin: Wolfe et al., 1992). The patient's face must be allowed to rest on the forehead to avoid pressure on the eyes. Therefore, it is extremely important to properly and safely position patients in the prone position to prevent complications, life changing injuries, and skin and deep tissue damage.

Knee-Chest or Seated Prone Position

In the knee-chest prone position weight is distributed and borne primarily on the thighs, knees, and lower legs (Martin, 1987). The abdomen is left unsupported in the knee-chest position and there is no pressure on the abdominal wall. A disadvantage to the knee-chest position is the dependence of the lower extremities and compression stockings must be used (Martin).

The "seated prone" or "sitting prone" position is a variation of the knee chest position (Figure 4). Supported by a frame in which the weight is distributed to knees and buttocks, intraoperative blood loss was reported less than when the patients were positioned prone with longitudinal bolsters under the patients sides (Bostman, Hyrkas, Hirvensalo & Kallis, 1990). The Hastings frame (Hastings, 1969) and the Andrews Spinal Surgery Table SST-3000 ^{TM} position the patient in this position (Figure 4).

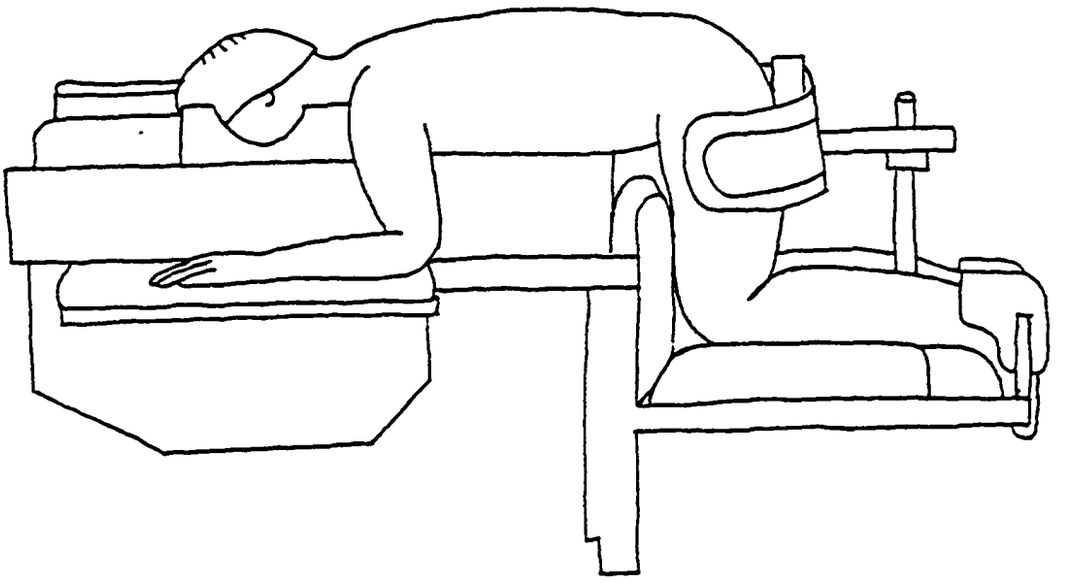

Figure 4. An illustration of a patient positioned in the seated prone position for spinal surgery.

Summary

There are a limited number of research studies addressing the development of intraoperatively acquired pressure ulcers and limited number of research studies of the effects of the prone position and the development of pressure ulcers. Spinal surgery patients are at a unique risk positioned prone for lengthy surgical procedures. Further investigation into characteristics, whether in the patient, the surgery related events, or the medical/nursing interventions, to prevent the development of pressure ulcers in these patients was necessary . This study focused on possible associations between the development of intraoperatively acquired pressure ulcers as the dependent variable, and the length of surgery, the age of the patient, and the amount of blood loss as the independent variables. This work is likely to expand knowledge about these risk factors for spinal surgery patients so that primary prevention interventions can be targeted to patients at risk (Figure 1).

CHAPTER 3

METHODOLOGY

Research Design and Subjects

A retrospective descriptive research design was used employing medical records of spinal surgery patients at a 390 bed acute care hospital in a large southwestern city in the United States. The hospital served a large Caucasian and Hispanic population. A purposive sample (Burns & Grove, 1993) consisting of 142 subjects was selected reviewing records from 1994 to present. Sample selection criteria included:

1. Male and female patients over the age of 18 years.
2. Patients who had a spinal fusion surgery or laminectomy surgery.
3. The patients were positioned in the seated prone position during surgery.
4. Patients with no pressure ulcers prior to surgery.

These medical records of spinal surgery patients were previously identified by the institution for a quality assurance project.

Protection of Human Subjects

A conditions of admission consent was signed when the patient entered the hospital. This consent permitted research related activities. A Project Approval Form was submitted to the College of Nursing and the study was declared exempt from full Human Subjects review (APPENDIX A). Permission was granted from the participating hospital to review the medical records. The researcher assigned case control numbers to the medical records to assure confidentiality of the data and anonymity of the subjects.

Data Collection Procedure

Medical records were reviewed and information was recorded on a data collection sheet (APPENDIX B). The data collection sheet was developed by reviewing the literature and identifying factors for pressure ulcer development. It was adapted from a

tool used by Lewicki et al. (1997) in their research study of 350 open heart surgical patients and intraoperative variables impacting the development of pressure ulcers.

On the data collection sheet, information about patient characteristics including age, gender, race, height, weight, previous medical problems, preoperative laboratory values, and skin condition was collected. Alteration in skin integrity as evidenced by redness of skin 24 hours or more after surgery was also collected. Description, staging, location, and size of any pressure ulcer that developed after surgery was recorded.

Data on the surgical event including the length of surgery, the amount of intraoperative blood loss as documented by the anesthesiologist on the anesthesia record under estimated blood loss, the surgical procedure, patient position, and the length of hospital stay were compiled. Finally, data regarding medical/nursing interventions including the anesthesiologist's physical assessment score (ASA score), the types of positioning aides, and length of time in the post anesthesia recovery areas were collected.

Data Analysis

First, the data from the collection tool were entered into a spreadsheet and were analyzed on SigmaStat ™ Jandel Scientific software using a Hewlett Packard 7050 PC. Columns were created to organize the data on the spreadsheet. Examples of column labels included age, age category younger than 65 years or 65 years or older, length of surgery in hours, length of surgery category less than four hours or four hours or more, amount of blood loss in milliliters, blood loss category less than 1500 ml or 1500 ml or greater, presence or absence of pressure ulcer, sex, race, height, weight, type of surgery, medical problems listed, laboratory values, and preoperative vital signs. The descriptive statistics for the total sample were calculated including the mean, range, and standard deviation. Also, descriptive statistics were calculated for the data grouped into those patients developing pressure ulcers after surgery and patients who did not develop

pressure ulcers after surgery. Then, Chi square two by two contingency tables were used to examine if there were associations between pressure ulcer development (the dependent variable) and the length of surgery over four hours, or equal to or under four hours, the age greater than 65 years or less than or equal to 65 years, and the amount of intraoperative blood loss greater than 1500 ml. or less than or equal to 1500 ml (the independent variables). Chi square two by two contingency tables were also used to examine if associations exist between the development of intraoperatively acquired pressure ulcers and other variables including previous medical conditions (history of diabetes mellitus, cancer, peripheral vascular disease, and hypertension), social behaviors of smoking and alcohol abuse, and preoperative blood values. Finally, the Student's t-test (two-tailed) for independent variables was used to compare mean values of the length of surgery in hours, the patient age in years, the amount of intraoperative blood loss in milliliters, preoperative blood values (blood glucose, albumin, hemoglobin, protein, and white blood cell count), and patient weight in kilograms between the two groups (those patients who developed pressure ulcers and those patients free of pressure ulcers). The statistical significance level was set at $p \leq 0.05$.

CHAPTER 4

RESULTS

Characteristics of the Sample

Medical records of 142 patients over the age of 18 years, who had spinal surgery in the seated prone position, were examined. As shown in Table 1, the records were from 74 males and 68 females (52% and 48% of the sample, respectively) who ranged in age from 21 to 84 years. The majority of the patients were either Caucasian or Hispanic. None of the patients had pressure ulcers prior to surgery. However, over 30% of the patients had documented previous medical problems of which arthritis and hypertension were the most common, 32.8% and 34.7% respectively, as shown in Table 2. Heart disease was documented for 22% of the patients and 14% of the sample had diabetes mellitus. Preoperative laboratory values were for the most part within normal limits (Table 3).

As seen in Table 4, the most common type of spinal surgery performed on the patients sampled (64%) was spinal fusion with instrumentation, in which rods, plates, or screws were implanted to stabilize or repair a spinal problem. However, some patients had spinal fusions without instrumentation and some had lumbar laminectomies. The mean length of surgery was 3.5 ± 1.6 hours during which time an average of 1202.5 ± 1185 ml of blood was lost. All of the medical records contained documentation of padding or positioning aides for the patients in the seated prone position on the Andrews Spinal Surgery table or Andrews frame. Despite the preventive measures of padding and positioning aides, 35 of the 142 medical records (24.6%) had documentation of pressure ulcer development after the spinal surgery. The pressure ulcers identified were either Stage I, which is characterized by skin redness present 24 or more hours after surgery, or Stage II, in which blistering or an abrasion is present.

Table 1

Characteristics of the Sample

Sex	
Male	52%
	(74/142)[a]
Female	48%
	(68/142)[b]
Age (years)	52.8 ± 16.2[c]
	(21 - 84)[d]
Race	
Caucasian	69%
Hispanic	26%
Other	5%

Note. [a] 74 males of a total sample of 142

[b] 68 females of a total sample of 142

[c] Mean ± Standard Deviation

[d] Range

Table 2

Previous Medical History of the Sample

Condition	Per cent	n/Total Sample[a]
Hypertension	34.7	49/141
Arthritis	32.8	45/137
Heart Disease	22.8	32/140
Steroid Use	15.7	21/133
Diabetes	14.0	20/142
Cancer	12.9	18/139
Peripheral Vascular Disease	5.8	8/137
Glaucoma	2.1	3/141
Renal Failure	00.0	0/142
History of Smoking	37.1	52/140
History of Alcohol Abuse	12.6	11/139

Note. [a] The variations in sample size are due to missing data.

Table 3

Preoperative Laboratory Values of the Sample

Laboratory Value	M ± SD
Hemoglobin (gm/dl)	13.9 ± 1.7
Hematocrit (ml/dl)%	41.0 ± 4.7
Protein (gm/dl)	6.8 ± 0.7
Albumin (gm/dl)	4.0 ± 0.5
White Blood Cells (mm^3)	7.7 ± 2.2
Glucose (mg/dl)	116.3 ± 54.2
BUN (mg/dl)	14.5 ± 5.2
Creatinine (mg/dl)	1.2 ± 1.9

Table 4

Surgical Characteristics of the Sample

Surgical Procedures	
Lumbar Laminectomy	30%
Lumbar Spinal Fusion	
With Instrumentation	64%
Without Instrumentation	6%
Surgery Length (hours)	3.5 ± 1.6[a]
	(1.1 - 8.7)[b]
Blood Loss (ml)	1202.5 ± 1185.5[a]
	(50 - 6000)[b]
Pressure Ulcers	24.6%

Note. [a] Mean ± Standard Deviation

[b] Range

Findings Related to the Research Questions

Question 1: Is the development of an intraoperatively acquired pressure ulcers in spinal surgery patients related to length of surgery greater than four hours?

To initially examine this question, a Chi square 2 x 2 contingency table was used to determine if pressure ulcer development was associated with length of surgery greater or less than or equal to four hours, as shown in Table 5. This failed to show statistical significance, however the power was below the desired level (Table 5). The lower power, which was probably due to a small sample size relative to the incidence of pressure ulcer development in the population, made rejection of a valid hypothesis highly probable. Next, a Student's t test was used to compare mean length of surgery in hours in the pressure ulcer and no pressure ulcer groups (Table 6). This showed differences ($p=0.002$) between the the two groups with those patients with pressure ulcers having surgery that lasted 4.2 ± 1.60 hours ($n = 35$) compared to 3.3 ± 1.5 hours for those patients with no pressure ulcer development ($n = 107$). Thus, the length of surgery does appear to be associated with pressure ulcer development.

Question 2: Is the development of intraoperatively acquired pressure ulcers in spinal surgery patients related to patients over the age of 65 years?

Again, a Chi square 2 x 2 contingency table was used, only this time to determine if pressure ulcer development was associated with patient age greater or less than or equal to 65 years (Table 7). This also failed to show statistical significance, however the power was below the desired level (Table 7). This again made the rejection of a valid hypothesis highly probable. The Student's t test was used to compare the mean age in years ($p=0.002$) between the two groups with patients with pressure ulcer development age was 60.1 ± 13.8 years ($n = 35$) compared to 50.5 ± 16.3 years ($n = 107$) in those patients

Table 5

Contingency Table to Test Associations between Pressure Ulcer Development and Length of Surgery

	Pressure Ulcers		
	Present	Absent	Totals
Length of Surgery			
Less than 4 Hours	14	65	79
4 Hours or More	21	42	63
Totals	35	107	142

Note. Chi square = 3.8 ($p = 0.0513$ for $N = 142$ and 1 df; power = 0.4832 for $a = 0.05$).

Table 6

Student's t tests Comparisons between Pressure Ulcer Present and Pressure Ulcer Absent Groups (140 degrees of freedom)

Variable	n	M ± S.D.	t test	p
Length of Surgery				
Present	35	4.2 ± 1.60	3.03	p = 0.002
Absent	107	3.3 ± 1.5		
Patient Age				
Present	35	60.1 ± 13.8	3.15	p = 0.002
Absent	107	50.5 ± 16.3		
Intraoperative Blood Loss				
Present	35	1551.4 ± 1351.1	2.06	p = 0.049
Absent	107	1081.6 ± 1104.2		

Table 7

Contingency Table to Test Associations between Pressure Ulcer Development and Age

	Pressure Ulcers		
	Present	Absent	Totals
Age of Patient			
Less than 65 years	19	74	93
65 Years or More	16	31	47
Totals	35	105	140

Note. Chi square = 2.4 ($p = 0.1212$ for $N = 140$ and 1 df; power = 0.3232 for $\alpha = 0.05$).

with no pressure ulcer development (Table 6). Patient age does appear to be associated with pressure ulcer development.

Question 3: Is the development of intraoperatively acquired pressure ulcers in spinal surgery patients related to the amount of intraoperative blood loss greater than 1500 ml?

Once again, a Chi square 2 x 2 contingency table was used this time to determine if pressure ulcer development was associated with the amount of intraoperative blood loss greater or less than or equal to 1500 ml (Table 8). This showed statistical significance (p=0.0076) (Table 8). Additionally, the Student's t test to compare the mean intraoperative blood loss in the pressure ulcer and no pressure ulcer groups showed differences (p= 0.040) between the two groups of those patients obtaining pressure ulcers had a mean intraoperative blood loss of 1551.4 $\pm$ 1351 ml (n = 35) as compared to 1081.6 $\pm$ 1104.2 ml (n = 107) for those patients not developing pressure ulcers as shown in Table 6. The amount of intraoperative blood loss appears to be associated with pressure ulcer development.

Question 4: Do other variables for spinal surgery patients influence the development of intraoperatively acquired pressure ulcers?

As previous, Chi square 2 x 2 contingency tables were used and this time to determine if associations exist between pressure ulcer development and other variables including previous medical problems (diabetes mellitus, cancer, peripheral vascular disease, and hypertension), gender, a history of smoking, patient weight, the length of hospital stay, and preoperative laboratory values (blood glucose, hemoglobin, albumin). From these analyses, pressure ulcer development appears to be related to a history of diabetes and an elevated preoperative blood glucose values when a Chi square 2 x 2

Table 8

Contingency Table to Test Associations between Pressure Ulcer Development and Amount of Intraoperative Blood Loss

	Pressure Ulcers		
	Present	Absent	Totals
Blood Loss			
Less than 1500 ml	18	78	96
1500 ml or More	17	23	40
Totals	35	101	136

Note. Chi square = 7.14 ($p = 0.0076$ for $N = 136$ and 1 df; power = 0.7728 for $a = 0.05$).

contingency table was used to determine if pressure ulcer development was associated with a history of diabetes, statistical significance was achieved (p=0.0482) as shown in Table 9.

A Student's t test was used to compare the mean preoperative blood glucose level in the pressure ulcer and no pressure ulcer group. This showed differences (p=0.022) between the two groups with those patients with pressure ulcers having a higher mean blood glucose value of 134.5 $\pm$ 73.7 mg/dl (n = 35) compared to 110.4 $\pm$ 45.2 mg/dl (n = 107) in those patients with no pressure ulcer development. Thus, diabetes and an elevated blood glucose level appear to be factors in the development of pressure ulcers.

A Chi square 2 x 2 contingency table was used to determine associations between the development of pressure ulcers and previous medical problems including cancer, peripheral vascular disease, hypertension, a history of smoking, and gender. No statistical significance was found for these variables. Pressure ulcer development and cancer, peripheral vascular disease, hypertension, a history of smoking, and gender do not appear to be related.

Using the Student's t test for the each of the other variables, preoperative albumin, hemoglobin, protein,white blood cell count, and the weight of the patient and the number of days in the hospital, to compare the mean values between the pressure ulcer group and the no pressure ulcer group, no statistical differences were found.

Pressure Ulcer Characteristics

Medical records of 35 patients had documentation of pressure ulcer development after surgery. Areas of the body, where the pressure ulcers were found, included the head, trunk, upper extremities, and lower extremities (Table 10). Descriptors of the pressure ulcers included redness, bruises, blisters, skin breakdown, skin tear, and abrasion (Figure 5). Multiple areas of redness were documented on many of the medical

Table 9

Contingency Table to Test Associations between Pressure Ulcer Development and a History of Diabetes

	Pressure Ulcers		
	Present	Absent	Totals
Diabetes			
Yes	9	11	20
No	26	95	121
Totals	35	106	141

Note. Chi square = 3.9 ($p = 0.0482$ for $N = 141$ and 1 df; power = 0.4946 for $a = 0.05$).

Table 10

Pressure Ulcer Description by Stage and Number of Occurrences on Area on Body

	Number of Occurrences	
Stage of Pressure Ulcer	Stage I (n = 18)	Stage II (n = 17)
Area on Body[a]		
Head		
Forehead	4	4
Eye Area	4	3
Face[b]	3	0
Chin	1	3
Nose	0	2
Cheek	2	0
Lips	2	0
Trunk		
Chest	4	2
Hips	3	0
Abdomen	1	1
Sternum	3	1
Breast	2	2
Buttocks	0	1

Table 10 (continued)

Pressure Ulcer Description by Stage and Number of Occurrences on Area on Body

	Number of Occurrences	
Stage of Pressure Ulcer	Stage I (n = 18)	Stage II (n = 17)
Area on Body[a]		
Upper Extremity		
Hand	0	1
Arm	1	0
Lower Extremity		
Knee	2	0
Shin	1	1
Heel	0	1

Note. [a] Patients had multiple areas of pressure ulcers on body.

[b] Documentation was not specific to area on face.

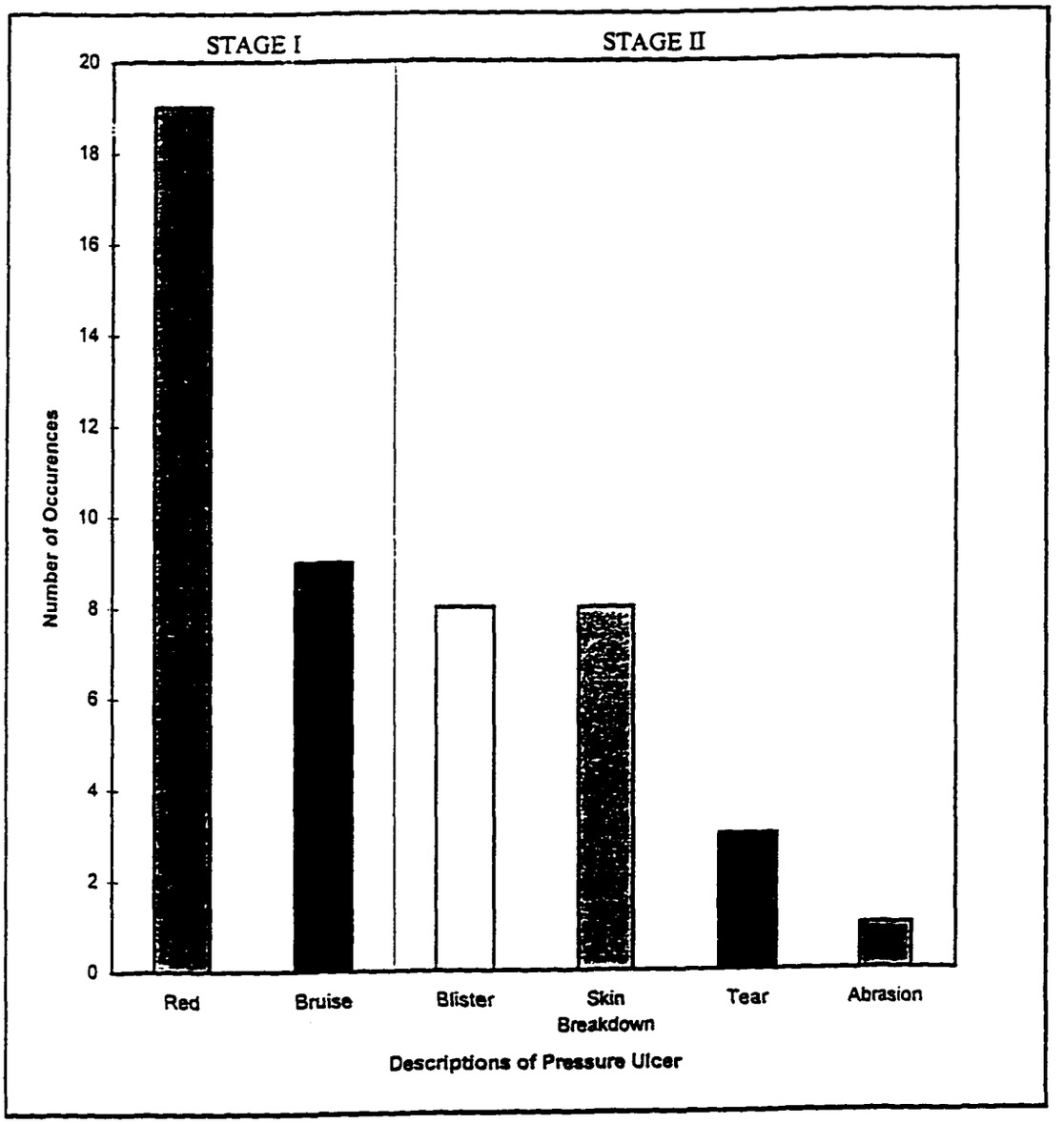

Figure 5. Number of occurrences of pressure ulcer by description.

records (Table10).

Stage I pressure ulcers were identified in 18 patients and 16 patients had Stage II pressure ulcers. One medical record had documentation of Stage I and Stage II pressure ulcers. Stage I pressure ulcers (redness 24 hours postoperative) were described in the records as edematous reddened lips, purplish, reddened areas on the upper and middle chest, "very dark red on sternum", and "almost like a burn". One record had documentation of "tape burns? on the sternum".

Stage II pressure ulcers (superficial, partial thickness skin loss) were interestingly described in one medical record as a five to six inch blister along the forehead near the hairline ear to ear. Another reviewed record described skin breakdown three inches long above the eyebrow on the forehead. A "blister-like red eye on the sclera" was documented. One medical record described an oozing, bloody, reddened, skin breakdown on the patient's chin.

Stage II pressure ulcers were additionally described as blisters and bruises near the chest, sternum, and breast area. A 10 to 11 inch blister across the chest with blisters on the abdomen and the sternum was described in a record. A draining skin breakdown under the patient's breast with redness on the patient's thigh and abdomen was documented in another. One of the medical records described a Stage II heel blister.

No Stage III or Stage IV pressure ulcers were identified. Although the medical records described the pressure ulcers characteristics including area of body and type of ulcer, only 8 of the 35 (22.8%) medical records had a description of the size of the pressure area.

CHAPTER 5

DISCUSSION

Discussion

For this preliminary study of spinal surgery patients, factors were identified which may have influenced the development of pressure ulcers. It is important to note 24.6% of the relatively healthy sample of patients developed Stage I or Stage II pressure ulcers described in the medical records as persistent redness of the skin (24 or more hours postoperatively), blistering, bruising, and skin tears. The original parameters selected for the variables, length of surgery less than or equal to or greater than 4 hours, age of the patients less than or equal to or greater than 65 years, and the amount of intraoperative blood loss less than or equal to or greater than 1500 ml, may have been too high to detect relationships. The older aged patient, a higher intraoperative blood loss, and longer surgery times appear to be related to the development of pressure ulcers as evidenced by the mean values between those patients who developed pressure ulcers and those patients who did not develop pressure ulcers were significantly different. A patient with a history of diabetes and the development of a pressure ulcer was significantly related which supports previous research findings (Allman et al., 1986; Bergstrom et al., 1994; Goodman et al., 1990; Insinger & Bailes, 1993).

This study appears to support the conceptual framework's basis (Figure 1) that patient characteristics, medical/nursing interventions, and surgery events collectively or individually, may influence the development or prevention of intraoperatively acquired pressure ulcers. Older age, longer surgery times, a history of diabetes, and an increased amount of intraoperative blood loss can be perceived as stressors to the lines of defense as described by Neuman (Figure 2). The patient's skin, as conceptualized as a first line of defense for protection from pressure ulcer development, was compromised by

the stressors, resulting in pressure ulcers observed postoperatively (Figure 3). The promotion of well-being through the use of a preoperative nursing assessment, the use of padding and positioning aides to properly position the patient, preoperative hydration and promotion of an increased level of nutritional status may strengthen the lines of defense to help decrease the development of pressure ulcers in the intraoperative phase. An increased understanding and identification of risk factors for pressure ulcer development in surgery may lead to preoperative opportunities to implement prevention measures.

Limitations

With this initial retrospective study of spinal surgery patients, the data were confined to the information documented in the medical records at one hospital for spinal surgery patients positioned in one position (seated prone) on one type of operating room table. Documentation was lacking in the descriptions of the pressure ulcers observed. Only 8 of the 35 pressure ulcers documented in the medical record had the size of the pressure ulcer. The findings for this study may not be generalizable to other patients positioned another way for the same surgery or to other patients having different surgeries in the lateral or the supine position.

The time frame was limited to after the first 24 hours after surgery and during the time of the hospitalization. Some pressure ulcers initially present as redness and the skin may continue to break down for several days, even up to 12 days postoperatively (Gruendemann & Fernsebner, 1995; Vermillion, 1990; Wagner, 1994), so that pressure ulcers assessed in this study as a Stage I pressure ulcer may have developed into Stage II or Stage III. A dark red area on the sternum 24 hours after surgery may have developed one week later into a Stage II or Stage III pressure ulcer. No data were collected after the patients were discharged from the hospital.

No established assessment tool specific to surgical patients was available for use

to identify these patients at risk for skin integrity alterations and possible pressure ulcer development. The data collection tool was an adaptation of a tool used by Lewicki et al. (1997) and validity and reliability studies for the tool have not been researched.

Recommendations

Further studies are necessary to quantify and evaluate the scope of the problem of intraoperatively acquired pressure ulcers. Longer observation times to describe the full development and progression of the intraoperatively acquired pressure ulcers may be beneficial. Examination of interventions currently in place for pressure ulcer prevention could be explored. Foam padding and pillows are routinely used to protect bony prominences and skin from tissue damage for a patient positioned prone for surgery (Gruendemann & Fernsebner, 1995). Yet, in this study, patients experienced Stage I and Stage II pressure ulcers using the foam padding and pillows. Implementation of newer techniques to pad and protect the skin from breakdown could be investigated. Air filled padding, gel filled padding. and/or alternating pressure pads could be examined for effectiveness to protect patients positioned in the seated prone position.

Development of operating room equipment including pressure reducing tables and materials such as foam padding or gel-based padding is another avenue for research. It has been suggested to redesign operating room tables to use materials to conform to the patient size and shape, make the table available in multiple sizes, and to customize the table to relieve pressure and redistribute weight for each patient (Gruendemann & Fernsebner, 1995).

Other patient populations and other surgical positions could be studied. Lewicki et al. (1997) researched open heart patients and Versluysen (1986) observed patients after hip surgery. Surgeries placing the patient in the lateral position and the prone position could be researched for the pressure ulcer problems. Is a patient who has

neurosurgery for four hours or more at the same risk for pressure ulcer development as the open heart surgery patient or the spinal surgery patient? Are diabetic patients having shorter surgeries at high risk for pressure ulcer development? Does a trauma patient, such as a patient in a motor vehicle accident who experiences a large amount of blood loss, have an increased risk for pressure ulcer development during surgery?

Diet and nutrition in the surgical patient could be further researched. Can a nutritional profile preoperatively identify dietary deficiencies which would encourage or discourage the development of pressure ulcers? Would changes in the diet help prevent pressure ulcers in surgical patients? What roles do preoperative vitamins and protein supplements play in relatively healthy patients undergoing surgery? These are only possibilities for continued research to further explore this problem.

Education for the nursing staff assessing patients preoperatively is necessary to heighten the awareness of patients at risk for pressure ulcers during surgery and situations that may make a patient at a higher risk for pressure ulcer development. Also, education can be targeted to the postoperative assessment of the patient's skin to recognize alterations in skin integrity. A nurse assessing a patient after surgery may not recognize that persistent redness or discoloration of the skin may be the initial presentation of a pressure ulcer which may have begun to develop during surgery.

Research instruments to identify surgical patients at risk may quantify the scope of the problem. Although the Braden Scale for Predicting Pressure Sores and the Norton Scale are widely used skin assessment scales for nursing home patients and hospitalized patients, these tools do not account for additional risks not incorporated in the scale for surgical patients immobile for long periods of time under anesthesia (Stotts, 1988; Kemp et al., 1990). Development of assessment tools focusing on the surgical patient population may begin to identify those patients at risk for pressure ulcer development.

Implications for Nursing

There is a need to provide the tools to enable nurses to complete a thorough preoperative assessment to begin to identify patients who are at high risk and situations which may place patients at high risk for intraoperatively acquired pressure ulcers. Early preoperative nutritional assessments may reveal dietary insufficiencies that may hinder the maintenance of skin integrity. Preoperative nutritional changes may be necessary. Surgery can be a time when patients not usually at risk for pressure ulcer development are placed at high risk (Scott et al., 1992). A patient who is older, is scheduled for a lengthy surgery, and considerable blood loss is anticipated, appears to be at high risk for pressure ulcer development during surgery. A diabetic patient must be identified as high risk for pressure ulcer development during spinal surgery and treated accordingly. A combination of these risk factors may place a patient at even higher risk. It is important for the nurses caring for these patients to be cognizant of these patients at risk to be able to implement prevention measures prior to surgery.

Conventional approaches to prevent pressure ulcers, i.e. turning a patient every one or two hours, active or passive range of motion, and promoting activity (Braden & Bryant, 1990; Cummings, Thompkins, Jones & Margolis, 1986; Panel for Prediction and Prevention of Pressure Ulcers in Adults, 1992), are unrealistic for a patient who is anesthetized and immobilized for a spinal surgery. Considering these limitations, a suggested approach may be the anesthesiologist could raise the patient's head every 30 minutes. This may be a practical intervention to temporarily relieve the pressure from the patient's facial area. Also, the preoperative placement of additional high density foam padding and/or gel-filled padding under vulnerable body areas may be useful for maintenance of the patient's skin integrity.

Changes or revisions of nursing practices may be necessary once patients are

identified as high risk for pressure ulcer development. Attention to avoiding moisture collection under a patient, such as from pooled surgical preparation solutions, is a routine nursing intervention during surgery (AORN Standards and Recommended Practices, 1997), yet this must be scrupulously adhered to for these high risk patients. For the most part, nursing interventions to decrease the length of surgery time are limited. Nurses can implement time management strategies to prevent unnecessary delays in the surgical procedure by obtaining the appropriate equipment and sterile supplies prior to the induction of the anesthesia. Written positioning protocols for the patient in the prone position, if not already developed, would be useful as guidelines to promote appropriate prevention practices. Improved documentation in the medical record to describe and stage the identified pressure ulcer is necessary to allow the nurse to continually assess the progression of the pressure ulcer. Postoperative visits to a patient identified as high risk for pressure ulcer development or to a patient with an observed intraoperatively acquired pressure ulcer may further reveal additional information,which in turn, will drive changes in nursing practices.

Collaboration with other health care professionals through interdisciplinary approaches may provide opportunities to promote positive outcomes for patients who develop pressure ulcers during surgery. Physicians, skin care consultants, dietitians, pharmacists, and nurses may work as a continuous quality improvement team to explore treatment and prevention strategies for these patients.

Summary

This study was a beginning research step in identifying possible factors which may influence the development of pressure ulcers in spinal surgery patients. Further research is necessary to continue this endeavor to identify variables that place surgical patients at high risk for pressure ulcer development.

Research instruments to measure risk factors associated with pressure ulcer development specific to the surgical patient are necessary. Education directed to the nursing staff to heighten awareness of the incidence of intraoperative pressure ulcer development and to begin to identify those patients at high risk, is a beginning step to address the focus of this study. Continued interest in this area can only promote positive outcomes for spinal surgery patients.

Nursing practices can be evaluated and new practices implemented that will be beneficial to the patients. Interdisciplinary teamwork of all health care professionals interested in this concern may provide avenues for additional research. Further clinical nursing research to evaluate patient outcomes or to test new nursing interventions will broaden the knowledge base for intraoperatively acquired pressure ulcer development. Questions that are raised as a result of this study can be viewed as opportunities to implement changes or to explore new ideas, which in turn, will ultimately benefit the patient.

APPENDIX A

Project Approval Letter from Human Subjects Committee

Human Subjects Committee

THE UNIVERSITY OF
ARIZONA.
HEALTH SCIENCES CENTER

1622 E. Mabel St
Tucson, Arizona 85724
(520) 626-6721

13 February 1997

Ellice Mellinger, BSN, RN
c/o Carrie Merkle, Ph.D.
College of Nursing
PO BOX 210203

RE: INTRAOPERATIVELY ACQUIRED PRESSURE ULCERS IN SPINAL SURGERY PATIENTS: A RETROSPECTIVE STUDY

Dear Ms. Mellinger:

We have received documents concerning your above referenced project. It is our understanding that you will be reviewing existing medical records and that data will be recorded without identifiers. Therefore, regulations published by the U.S. Department of Health and Human Services [45 CFR Part 46.101 (b)(4)] exempt this type of research from review by our Committee.

Please be advised that **clearance from official authorities for site(s) where proposed research is to be conducted must be obtained prior to performance of this study.**

Thank you for informing us of your work. If you have any questions concerning the above, please contact this office.

Sincerely,

WFDenny

William F Denny, M.D.
Chairman
Human Subjects Committee

WFD:js
cc: Department/College Review Committee

APPENDIX B

Data Collection Sheet for Spinal Surgery Patients

Data Collection Sheet for Spinal Surgery Patients Case Number

Preoperative

Age Gender Male Female Race

Height Weight

Previous Medical Problems

Arthritis	yes	no	I (not documented, indeterminent)
Heart Disease	yes	no	I
Peripheral Vascular Disease	yes	no	I
Hypertension	yes	no	I
Cancer	yes	no	I
Chemotherapy	yes	no	I
Radiation	yes	no	I
Diabetes	yes	no	I
Renal Failure	yes	no	I
Glaucoma	yes	no	I
Steroid Use	yes	no	I
Behaviors Smoker	yes	no	I
Alcohol Abuse	yes	no	I

Hospitalization

AM Admit for surgery? yes no ASA I II III IV V

Days in Hospital before surgery

Pressure Ulcers present pre-op? yes no Stage I II III IV

size location

description

Preop Labs: Hemoglobin Hematocrit Total Protein

Serum Albumin WBC Blood Glucose BUN Creatinine

Pre-op BP Pre-op Temp

Case Number

Intraoperative

Date of Surgery Preoperative Diagnosis

Surgical Procedure (circle) Laminectomy Spinal Fusion Spinal Fusion with instrumentation

Wound Classification I II III IV

Position of Patient Position of Head Face Down Turned to Side

Type of OR Bed Andrews Table Other

Time on OR Bed Time Off OR Bed Total minutes on OR Table

Type of positioning aides Pillows Foam padding Other:

SCD's on Patient? yes no

Number of hypotensive episodes during surgery (below 90mmHg systolic, count on anesthesia record)

Estimated Blood Loss for surgery

Cell Saver Used during surgery? yes no Own blood given back? yes no cc

Blood Products given during surgery ? YES NO If yes, describe product and number of units:

Post Operative

Time in minutes in PACU

Blood Products given in PACU? yes no If yes: describe product and amount of units:

Total days in hospital

Pressure Ulcers Post Operative Stage I II III IV

Size

location description

Comments:

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