1985

Effect Of Preparatory Guidance And Specialized Suction Technique On Post-Suction Anxiety And Transcutaneous Oxygen Tension (Endotracheal).

Sarah Vines Latham
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EFFECT OF PREPARATORY GUIDANCE AND SPECIALIZED SUCTION TECHNIQUE ON POST-SUCTION ANXIETY AND TRANSCUTANEOUS OXYGEN TENSION

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EFFECT OF PREPARATORY GUIDANCE AND SPECIALIZED SUCTION TECHNIQUE ON POST-SUCTION ANXIETY AND TRANSCUTANEOUS OXYGEN TENSION

by

SARAH VINES LATHAM

A DISSERTATION

Submitted in partial fulfillment of the requirements for the degree of Doctor of Science in Nursing in the School of Nursing in The Graduate School, University of Alabama at Birmingham

BIRMINGHAM, ALABAMA

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ABSTRACT OF DISSERTATION
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Title Effect of Preparatory Guidance and Specialized Suction Technique on Post-Suction Anxiety and Transcutaneous Oxygen Tension

Though a necessary component of airway care, endotracheal suctioning may result in anxiety and hypoxemia. The purpose of the study was to determine the effect of preparatory guidance and a specialized suction technique on post-suction anxiety and transcutaneous oxygen tension ($P_{tc}O_2$).

The independent variables were type of preparation for suctioning and type of suctioning technique. Forty consenting, responsive, adult patients who were ventilated with a volume cycled ventilator were randomly assigned to one of four groups of 10 each. The groups were differentiated by the unique combination of independent variables manipulated. The dependent variables were post-suction anxiety (as measured by the investigator-developed Non-Verbal Assessment of Anxiety Score (NAAS)) and $P_{tc}O_2$. The pre-suction $P_{tc}O_2$ was used as a covariate.

Statistical analysis with MANCOVA revealed that the combined dependent variables were significantly affected by type of preparation prior to suctioning ($p = .02$). Step-down analysis revealed that only NAAS was significantly affected by type of preparation. Preparatory guidance yielded a statistically significant lower NAAS. There was no significant difference in the dependent variables based on type of suctioning

technique, nor was there an interaction between the independent variables. Suctioning with Trach Care System adaptor was as effective in preventing post-suction hypoxemia as traditional suctioning.

Recommendations include: (a) continued refinement of the reliability and validity of NAAS, (b) continued research to enhance the psychological comfort of critically ill patients, (c) replication of this study with use of only one transcutaneous monitor, (d) research to determine if there is increased incidence of infection with the Trach Care System adaptor, (e) replication of the study with one group receiving congenial interaction with the nurse, and (f) research to determine if the anxiety reducing effects of preparatory guidance are maintained with repeated episodes.

Abstract Approved by: **Committee Chairman** Marguerite R. Kinney

Program Director [signature]

Date 11-27-85 **Dean of Graduate School** Lemmer R. Boozer

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CHAPTER I

Introduction

Removal of secretions by endotracheal suctioning is a necessary component of airway care for the intubated patient (Adlkofer & Powaser, 1978; Urban & Weitzner, 1969). Though necessary, suctioning may result in deleterious effects to the patient. Endotracheal suctioning may be physiologically and psychologically harmful.

The literature documents that suctioning patients' airways is consistently accompanied by a fall in arterial oxygen tension (PaO2) (Bodai, 1982; Jung & Newman, 1982; Langrehr, Washburn, & Guthrie, 1981; Skelley, Deeren, & Powaser, 1980; Woodburne & Powaser, 1980). Suction-induced hypoxemia has been cited as a causative factor in life-threatening arrhythmias and cardiac arrest (Bodai, 1982; Boutros, 1970; Jung & Newman, 1982; Urban & Weitzner, 1969). Urban and Weitzner (1969) documented that suctioning interrupts the sequence of ventilation and aspirates intrapulmonic gas. Both of these factors lead to hypoxemia. In addition, sterile saline may be inserted into the trachea to lavage and aid in removal of secretions (Jung & Newman, 1982). Different types of endotracheal suction procedures are currently used in caring for intubated patients. The most effective technique for minimizing suction induced hypoxemia has not been determined (Bodai, 1982; Naigow & Powaser, 1977).

These studies document that ongoing research is aimed at reducing the harmful physiological effects of suctioning. Acknowledgement of the psychological effects of suctioning is conspicuously sparse in the literature.

Grossbach-Landis and McLane (1979) utilized a 21-item instrument to assess the learning needs of nurses responsible for suctioning patients. The instrument outlined the correct procedure for suctioning. Only 1 of 21 items addressed psychological support of the patient.

McGuire (1983) described perceptions of an intubated patient. The following is one example from a patient:

> I try to scream, but I can't even talk because some kind of hard tube or a plastic handle or something is jammed in my mouth, and I can feel it in the back of my throat. I retch and gag and try to cry out for help. My lips move but there is tape or something wrapped around my chin and my neck so tightly that I can hardly open or close my mouth. Even my lips feel numb and are so dry that my tongue sounds like sandpaper when I rub it against the side of the tube. Why doesn't somebody say something to me? Why doesn't somebody see me? I feel the panic rising inside. The bed shakes. I know that I've got to control my mind and get hold of my panic. I know that soon someone will come around to touch my shoulder and talk to me, not over or around me (p. 53).

Demers and Saklad (1975) note the patient's response to suctioning is sometimes dramatic. They point out that during the suctioning experience there is resistance to breathing. Anxiety may be generated by suctioning the alert patient whose respiratory drive is intact.

Anxiety is a pervasive phenomenon, especially among hospitalized individuals. It is not necessarily benign. Anxiety has been noted to influence perceived pain, post-operative delirium, and recovery from surgery (Friedlander, Steinhart, Daly, & Snyder, 1982). Glazer (1980) cited anxiety as one variable suspected in maternal and fetal complications. Hartfield, Cason, and Cason (1982) noted studies in which anxiety played a role in the amount of medication required and the stability of post-procedure heart rates. Post-operative pain and vomiting have been shown to be positively correlated with anxiety (Hinshaw, Gerber, Atwood, & Allen, 1983). Researchers have shown that anxiety is a widespread entity that is implicated in some detrimental effects to patients. Bedsworth

and Molen (1982) and Fuller and Foster (1982) document that it is nursing's responsibility to assist the patient in dealing with anxiety.

The environment is also a significant factor in anxiety. The literature supports the notion that patients in critical care units are exposed to more stressful stimuli and experience higher levels of anxiety than patients on generalized nursing units (Bohannan-Reed, Dugan, & Huck, 1983; Byers, 1983; Esteban, Ballesteros, & Caballero, 1983; Sime & Kelly, 1983). Although anxiety in the intensive care unit is widely acknowledged, many reports of psychological stress have been based on subjective impressions (Gentry & Parkes, 1982). Therefore, empirical studies are clearly needed.

Endotracheal suctioning is conceptualized as a stressor that has profound psychological, as well as physiological, effects. The psychological effect of suctioning is viewed as suction-induced anxiety. The physiological effect of suctioning is hypoxemia. The most effective method of preventing hypoxemia has not been documented. The issue of suction-induced anxiety has not been clearly addressed in the published research literature. Both patient problems pose concerns that should be addressed in a holistic approach to client care. Nursing interventions should be formulated to deal with both suction-induced hypoxemia and anxiety.

Purpose

The purpose of this study was to determine the effect of preparatory guidance and a specialized suction technique on post-suction anxiety and transcutaneous oxygen tension.

Conceptual Framework

Endotracheal suctioning is viewed as a stressor with profound psychological and physiological dimensions. Averill (1973) and Johnson

(1978) offered a theoretical framework from which to view the psychological aspect of stress; Selye (1974) explored the theoretical basis for the physiological response to stress.

Personal control has been considered to be important in coping with stressful events. Averill (1973) distinguished between three different types of control: cognitive, behavioral, and decisional. Cognitive control is the way a potentially harmful event is interpreted. Cognitive control is the processing of threatening information in such as way as to reduce stress. One way that this control is achieved is when individuals are given information that allows then to form a cognitive image of the event (Averill, 1973). Descriptions of an experience convey a sense of control becuase such descriptions increase the patient's ability to predict the experience (Johnson, 1984). Both behavioral control and decisional control imply active participation. Active patient participation is often not a feasible option with endotracheal suctioning. There is little opportunity for the patient to exert either behavioral control or decisional control over the event; therefore, these aspects of personal control will not be discussed.

In research that spanned a decade Johnson (1973, 1984), Johnson and Leventhal (1974), and Johnson, Kirchhoff, and Endress (1975) conducted studies based on Averill's (1973) conceptualization of cognitive control. These researchers hypothesized that when accurate expectations of the sensations produced by threatening stimuli have been formed, the degree of incongruency between expectations and experience is reduced. The degree of emotional response is a function of the level of incongruence between actual and expected experiences.

In expanding the body of knowledge related to cognitive control, Johnson (1973, 1978) demonstrated that information about the sensory

aspects of an impending aversive event contributes to reduced stress. Sensory information is content about the environment that is obtained via the senses (sight, hearing, touch, taste, and smell). Johnson's work suggested that cognitive control may best be facilitated by sensory information. Johnson (1984) explained that mental images are formed from past experiences. These images or schemata help the interpretation of new data. Individuals have difficulty interpreting experiences that are different from anything in their past. When patients are given information about typical experiences to anticipate, that information will assist them in forming a schema regarding the event. This information provides a structure for interpretation and a guide for behavior. Sensory information should include both objective data (time, location, event, order of activities) and subjective data (how it will feel, what the individual will see or hear). This information, particularly of a sensory nature, is seen as a means to provide a patient with cognitive control over a threatening event. The control should result in a more positive outcome after the aversive experience (Johnson, 1984).

Anxiety represents an emotional response to a perceived threat or stressor (Chapman & Cox, 1977; Hartfield et al., 1982; Hinshaw et al., 1983; Lustman & Sowa, 1983; Scott, 1983; Svensson & Theorell, 1982). Endler and Edwards (1982) described anxiety as a subjectively experienced quality close to fear; it is closely related to terror, horror, alarm, fright, and dread. May (1977) said that the qualities of uncertainty and helplessness were most characteristic of anxiety. Lazarus (1966) used uneasiness, worry, and apprehension to describe anxiety.

The investigator talked with several individuals regarding their memory of having been suctioned. Terms which appeared in their

descriptions were fear, helplessness, lack of control, and anxiety. Therefore, the term anxiety is utilized to describe the emotional response to being suctioned.

There is literature support for anxiety reduction via cognitive and sensory input. Patients who are told what a procedure entails (cognitive orientation) and how the procedure will feel (sensory orientation) have less anxiety than patients who do not have that input (Hinshaw et al., 1983; Johnson, 1978).

The role of affective support, in this context, has not been addressed in the literature. Affective support is the communication of caring and reassurance through touch and verbal interaction. Touch is included as an essential component in this communication process because in situations of intense personal stress touch can be incomparable in soothing the patient (Knable, 1982). Good (1979) cited touch as an appropriate technique to indicate concern and to lower anxiety. Knable (1982), in studying critically ill patients, considered that they regressed in thought and behavior. Because touch is a more primitive form of communication, both Burnside (1983) and Knable (1982) supported the use of touch with regressed or critically ill patients. Affective support is indicated as an appropriate nursing intervention, especially during an aversive procedure.

Selye (1974) pioneered the research related to physiological stress. He defined the concept of stress as the "non-specific response of the body to any demand made on it" (p. 27). The response is nonspecific in the sense that any agent or stressor, either positive or negative, evokes a similar response. Selye coined the term General Adaptation Syndrome (G.A.S.) to describe the physiological response to stressors. The concept of G.A.S. consists of three stages:

1. The alarm reaction reflects nervous system changes characteristic of the first exposure to a stressor. Heart rate and force of contraction increase, blood volume and blood pressure increase, bronchial dilitation occurs, and blood is shunted from the periphery to the vital organs. When resistance and level of functioning are diminished, the stressor may result in death.

2. The stage of resistance ensues if continued exposure to the stressor is compatible with adaption. Signs of the alarm reaction have disappeared; resistance is above normal.

3. The stage of exhaustion occurs when long continued exposure to the same stressor eventually exhausts adaptation energy. Irreversible signs of alarm reappear and the person dies (Selye, 1974).

The magnitude of the alarm reaction is proportional to the magnitude of the stressor (Selye, 1974). This research will test the ability to reduce the magnitude of the stressor, endotracheal suctioning. If the magnitude of the stressor can be reduced, the alarm reaction should be diminished. Only the alarm reaction of the G.A.S. is pertinent because the stimulus is removed within 30 seconds. Selye's complete model, with the stages of resistance and exhaustion, is for continued exposure to a stressor. The stages of resistance and exhaustion are not relevant to this study.

Significance of Study

Researchers have addressed the recognized problem of suction-induced hypoxemia. A definitive protocol to prevent the fall in Pa_{02} has not been established. Emphasis has been on the profound physiological effects of suctioning, with little discussion of the noxious, threatening nature of the stimuli to the patient's psychological state. Theoretical foundations of nursing emphasize the holistic nature of humanity. Therefore,

both the psychological and the physiological problems associated with the stressor (endotracheal suctioning) will be addressed.

Definition of Terms

Definitions for salient terms are as follows:

Anxiety - The emotional response to a perceived threat or stressor which is manifested through non-verbal behavior. The Non-Verbal Assessment of Anxiety Score (NAAS) was utilized to measure anxiety.

Transcutaneous Oxygen - The partial pressure of oxygen in the cutaneous epidermis. The transcutaneous oxygen was measured with a Biochemp Transcutaneous Oxygen Monitor and a Litton Transcutaneous Oxygen Monitor. Both monitors provided digital displays of the transcutaneous oxygen tension ($P_{tc}O_2$).

Suction - The process of removing secretions from an oral, nasal, or tracheostomy tube by applying negative pressure via a suction catheter (Grossbach-Landis & McLane, 1979). Suctioning was performed with either a Ballard Trach Care System adaptor or a Bard-Gard suction catheter, size 14 French.

Preparatory Guidance - The nursing intervention implemented prior to suction consisting of:

1. Cognitive Orientation - telling the patient what a procedure entails (Johnson, 1978).

2. Sensory Orientation - telling the patient how the procedure will feel (Johnson, 1978).

3. Affective Support - a term meaning the communication of caring and reassurance through touch and verbal interaction.

Trach Care System Adaptor - An endotracheal adaptor that allows for suctioning without disconnection from the ventilator. The sterile suction catheter is contained within a sterile sleeve and is used for 24 hours.

Responsive - A level of consciousness characterized by the ability to open one's eyes when spoken to, squeezing the investigator's hand on request, and moving one's feet upon request.

Assumptions

Assumptions underlying the study are as follows:

1. Suctioning is within the domain of nursing.

2. A goal of nursing is to reduce the deleterious psychological and physiological effects of suctioning.

3. Pulmonary pathology will be normally distributed among the subjects if they are randomly assigned to groups.

4. Non-verbal behavior is an indicator of anxiety level.

5. Non-verbal behavior can be quantified according to intensity.

Limitations

Limitations to this study include:

1. The control treatment protocol for preparation for suctioning contained an element of preparatory guidance (cognitive information).

2. Results of this study are generalizable only to patients comparable to those in this research project.

Hypotheses

Three null hypotheses are offered:

1. There is no significant difference in the anxiety indicator and transcutaneous oxygen tension between patients receiving preparatory guidance and those receiving standard preparation for suctioning when the initial transcutaneous oxygen tension is used as a covariate.

2. There is no significant difference in the anxiety indicator and transcutaneous oxygen tension between patients receiving suctioning via Trach Care System adaptor and those being suctioned via the standard adaptor when the initial transcutaneous oxygen tension is used as a covariate.

3. There is no significant interaction between mode of suctioning and type of nursing intervention affecting the anxiety indicator and transcutaneous oxygen tension when the initial transcutaneous oxygen tension is used as a covariate.

CHAPTER II

Review of Literature

Research related to endotracheal suctioning has focused on one of two major features: pre-oxygenation techniques and adaptor techniques. Studies conducted at the University of Wisconsin represent an ongoing, concerted attempt to refine pre-oxygenation techniques (Adlkofer & Powaser, 1978; Naigow & Powaser, 1977; Skelley et al., 1980).

Pre-oxygenation

Early attempts to study suction-induced hypoxemia were conducted by Naigow and Powaser (1977) using mongrel dogs. Five suction procedures were compared:

1. suction alone,
2. 100% oxygen for 3 minutes prior to suctioning,
3. hyperinflation with room air,
4. hyperinflation with 100% oxygen prior to suctioning, and
5. hyperinflation with 100% oxygen before, during, and after suctioning.

All suctioning techniques consisted of one catheter pass not exceeding 15 seconds. Hyperinflation with 100% oxygen, whether before, during, and after suctioning or only prior to suctioning, raised arterial oxygen tension and prevented suction induced hypoxemia. The use of 100% oxygen before suctioning prevented hypoxemia immediately after suctioning, but oxygen tension fell at 5 minutes. The investigators had reservations,

however, about recommending hyperinflation in people because of the potentially rapid acid-base changes caused by hyperventilation.

Adlkofer and Powaser (1979) included 64 cardiac surgery patients in a study which compared two suction techniques. The majority of the patients (54) were suctioned without receiving pre-oxygenation; between suction passes, they were reconnected to the ventilator. Ten patients were pre-oxygenated prior to suctioning with the manual "sigh" control on the ventilator or with a resusciation bag. There was a significant fall in the partial pressure of oxygen for patients without pre-oxygenation. The rate and amount of fall could not be linked to clearly identifiable variables. The patients who received some form of pre-oxygenation did not have a statistically significant change in oxygen level. There was, however, considerable variation among the oxygen levels of these 10 patients. These investigators suggested that pre-oxygenation be performed on all patients prior to suctioning.

The findings of the previous study led to the investigation by Skelley et al. (1980) on the effectiveness of pre-oxygenation methods. Pre-oxygenation protocols were tested first in anesthetized dogs and were used later in post-cardiac surgery patients. Three suctioning protocols were utilized with 11 cardiac patients. In protocols requiring pre-oxygenation, the lung hyperinflations with 100% oxygen were delivered with a second primed ventilator at 150% of the tidal volume. The three protocols (spaced at 1-hour intervals) were:

1. suction without pre-oxygenation,
2. one hyperventilation breath with 100% oxygen prior to suctioning, and
3. three hyperventilation breaths with 100% oxygen prior to suctioning.

Suctioning without pre-oxygenation produced a mean fall in oxygen tension of 33 mmHg.; the magnitude of fall was unpredictable. One hyperinfaltion with 100% oxygen initially raised the mean post-suction oxygen level, but after 90 seconds it was 8 mmHg below control values. At no time did the oxygen tension fall below control values with three hyperinflations of 100% oxygen.

The study by Skelley et al. (1980) yielded valuable information regarding effective pre-oxygenation techniques. It is this investigator's opinion that a standby ventilator would rarely be available in the usual clinical setting.

Adaptors

Urban and Weitzner (1969) published some of the early attempts to suction patients who remained on a ventilator. In their work, seven patients on volume cycled ventilators (Engstrom) had arterial blood gases drawn as a control, at the end of conventional suctioning (15 seconds), and at the end of modified suctioning. To implement the modified suctioning, a Rovenstine Adaptor was interposed in the ventilator circuit. The amount of gas removed by suctioning was measured with a Wright Respirometer; the inspiratory minute volume was then increased by this amount. The percentage of oxygen delivered to the patient (Fi_{02}) remained the same. Suctioning occurred for 2 minutes while the patient remained connected to the ventilator. Oxygen tensions fell during both the conventional and the modified suctioning techniques. The modified technique, however, always decreased the arterial oxygen level less than the conventional suctioning technique. It is this investigator's opinion that increasing the ventilatory flow rate would be difficult to achieve routinely in the clinical setting.

Belling, Kelley, and Simon (1978) compared suctioning through a swivel adaptor and disconnecting the patient from the ventilator for suctioning purposes. Twenty open heart surgery patients were given 60% oxygen for at least 1/2 hour prior to and during suctioning. Each patient was suctioned with both the swivel adaptor and by disconnecting from the ventilator. Suctioning with either technique was spaced 2 hours apart. Three passes were made with the endotracheal cuff deflated; none of the patients were pre-oxygenated with a resuscitator bag. Arterial blood gases were drawn just before and after each suctioning procedure. With either suctioning method, there was a statistically significant drop in Pa_{O2} ($\underline{p} < 0.001$) from the pre-suction status. However, suctioning off the ventilator produced statistically greater decrease in Pa_{O2} than suctioning on the ventilator ($\underline{p} < 0.001$).

The effect of three different suctioning techniques on arterial oxygen tension of patients receiving positive and expiratory pressure was investigated by Baker, Baker, and Koen (1980). All methods utilized a 1-minute period of pre-hyperoxygenation with 100% oxygen, 15 seconds of suction, followed by 1 minute of hyperoxygenation with 100% oxygen. Suction method one consisted of leaving the patient on the ventilator, increasing the Fi_{O2}, and suctioning through a swivel adaptor without disconnecting the patient from the ventilator. Method two utilized manual pre-oxygenation with a resuscitation bag and suctioning through the swivel adaptor. In method three, the patient was manually hyperoxygenated, and the swivel adaptor was removed for suctioning. The Pa_{O2} was measured at the end of the hyperoxygenation and at the completion of suctioning. Hyperoxygenation with the ventilator (method one) significantly increased ($\underline{p} < .005$) the Pa_{O2} as compared to manually bagging (method two). Additionally, the Pa_{O2} was significantly higher

after suctioning with method one as compared to method two ($p < .005$). There was no significant difference between Pa_{02} in method two and method three. This study concluded that hyper-oxygenation with a ventilator maintains a higher Pa_{02} than manual bagging.

In a study done at the Albert Einstein Medical Center, 10 post-open heart surgery patients were suctioned with both a swivel adaptor and by disconnecting from the ventilator (Bell, Fein, & Kimbel, 1980). The standard suctioning method consisted of manually "sighing" the patient with three breaths before and after suctioning; suctioning occurred while the patient was disconnected from the ventilator. The experimental method consisted of suctioning the patient through the adaptor while connected to the ventilator; there were no "sighs" with this technique. Arterial blood gases were obtained prior to and at 10, 30, 60, and 120 seconds after suctioning, and the alveolar to arterial oxygen gradient (A-a) P_{02} was significantly elevated in the standard group ($p = .001$). This study suggested that use of the swivel adaptor is a superior method of suctioning to prevent post-suction hypoxemia.

Bodai (1982) studied seven patients in severe respiratory failure; all required positive and expiratory pressure. This group of patients had demonstrated either hypoxemia or cardiac disturbances during suctioning. Five of the patients developed bradycardia; one developed asystole. Two others developed ventricular arrhythmias. For this study, arterial blood gases were obtained 1 minute before, during, and at 1 and 5 minutes following suctioning. Each patient had three passes of the catheter. The control technique consisted of instillation of 1 cc of normal saline, manual bagging for three breaths at 15 liters of oxygen per minute, and suctioning. With the experimental technique, the patient was "sighed" three times with the ventilator at the same Fi_{02} and tidal volume prior

to suctioning through a specially designed valve. This valve allowed for suctioning the patient who remained connected to the ventilator. Statistical analysis of the Pa_{O2} values was done with a two-tailed dependent t-test on individual paired differences. The mean drop in partial pressure of arterial oxygen was 34.5 mm Hg. without the valve. With the valve system in place, partial pressures dropped an average of 7.0 mm Hg. There was significantly less drop in Pa_{O2} with the experimental technique ($p < 0.001$). The maximum drop in Pa_{O2} occurred during suctioning and 1 minute afterwards. Recovery to baseline was evident in 5 minutes with both techniques. After patients were suctioned with the valve, there were no further episodes of cardiac disturbances noted with suctioning. Bodai (1982) suggested that by preventing suction-induced hypoxemia the cardiac arrhythmias were avoided.

The Novametrix Medical Systems, Inc. developed an adaptor with two accessory ports which allowed for suctioning without disconnecting the patient from the ventilator. Studies with neonates (Cabal, Devaskar, Siassi, Plajstek, Waffarn, Blanco, & Hodgman, 1979) showed fewer arrhythmias and less oxygen desaturation with these adaptors. Therefore, Jung and Newman (1982) utilized this product to determine if these beneficial results were obtainable in adults. Eighteen patients receiving intermittent mandatory ventilation (IMV) via a Bennett MA-1 ventilator were studied. In a randomly selected fashion, the patient was suctioned through either the standard adaptor or the Novametrix adaptor. The standard suctioning consisted of disconnecting the patient from the ventilator, lavaging with 10 cc of saline and suctioning with a size 14 French catheter. The disconnection time varied between 10 and 15 seconds. When using the Novametrix adaptor, the identical method was employed except that the patient remained on the ventilator. Continuous oxygen

saturation was monitored with an ear oximeter; patients also had continuous electrocardiogram tracings. The greatest rise or fall in heart rate and the greatest fall in oxygen saturation was recorded and compared with pre-suction values. For both groups, there was no difference in baseline arterial oxygen saturations or in heart rate after suctioning. There was a statistically significant difference between the oxygen saturations of the two groups ($p < 0.01$) after suctioning. Suctioning with the Novametrix adaptor produced less oxygen desaturation than disconnecting the patient from the ventilator to suction. Baseline oxygen saturations and heart rates were achieved within 5 minutes after suctioning for both groups. Of the 18 patients, 13 developed oxygen saturations of less than 90%; therefore pre-oxygenation was recommended in addition to using the Novametrix adaptor.

A recent study by Brown, Stansbury, Merrill, Linden, Gregory, and Light (1983) determined the incidence, magnitude, and duration of desaturation caused by suctioning and the efficacy of the three maneuvers in minimizing this effect. All patients were ventilated with Bennett (MA-1 ventilators; the IMV mode was utilized. The IMV circuit provided for continuous free flow of gas into the circuit except when the ventilator was cycling. A size 14 French catheter was inserted into the airway until resistance was met and then pulled back 2 to 3 cm. Negative pressure was interrupted several times throughout the 15-second suctioning interval. Phase one of the study addressed four suctioning techniques:

1. suctioning off the ventilator without extra breaths,

2. suctioning off the ventilator after four pre-suctioning breaths at the same Fi_{O2},

3. suctioning off the ventilator with four post-suctioning breaths at the same Fi_{O2}, and

4. suctioning through an adaptor which allowed the patient to remain connected to the ventilator.

No extra breaths were given in technique four. The group suctioned off the ventilator without extra breaths had a statistically significant drop in oxygen saturation ($p < 0.001$) as compared to pre-suction values. The other three methods also showed a statistically significant drop in oxygen saturation ($p < 0.005$). However, the mean desaturation with the adaptor was significantly less ($p < 0.05$) than the mean desaturation of the other three methods.

Phase two of this study (Brown et al., 1983) examined four different suctioning techniques:

1. suctioning on the ventilator with the adaptor as in phase one,

2. suctioning off the ventilator with six pre-suctioning breaths at an Fi_{O2} of 100%,

3. suctioning off the ventilator with six post-suctioning breaths at 100% oxygen, and

4. suctioning off the ventilator with six pre- and post-suctioning breaths at an Fi_{O2} of 100%.

The hyperoxygenation pre- and post-suctioning was achieved by changing the Fi_{O2} on the ventilator for 1 minute. The oxygen desaturation that occurred with six pre-breaths and six pre- and post-breaths was not significantly different than the desaturation that occurred with the adaptor. The desaturation that occurred with six post-breaths was significantly greater than with the adaptor ($p < 0.05$). Suctioning with an adaptor without extra breaths was as effective in preventing desaturation as hyperoxygenating the patient before or before and after suctioning.

Phase three compared the adaptor with extra breaths for four successive passes of the catheter. The conclusion from this phase was that suctioning through the adaptor was as effective as ventilating patients between each pass with high concentrations of oxygen.

Infant Studies

The Novametrix C/D suction adaptor was investigated by Cabal et al. (1979) with infants having Respiratory Distress Syndrome. Eight preterm infants were suctioned alternatively with two procedures. Procedure A involved disconnection from the ventilator, pre-oxygenation for 15 seconds with an anesthesia bag, instillation of 0.5 cc of normal saline, and endotracheal suctioning which did not exceed 10 seconds. During pre-oxygenation, the Fi_{02} was increased. Procedure B consisted of instillation of 0.5 cc of normal saline and a 10-second suction pass while remaining attached to the ventilator. The Fi_{02} remained the same. Dependent variables were arterial oxygen saturation (measured via an umbilical catheter) and heart rate measured by electrocardiogram. Statistical analysis was performed with Student's *t*-test and paired *t*-test for heart rate and oxygen saturation changes. The heart rate decelerated during suctioning with both procedures. Procedure A, however, produced significantly lower drops and drops of greater magnitude than Procedure B ($p < 0.001$). Likewise, the oxygen saturation dropped with both techniques; Procedure A resulted in significantly greater declines in oxygen saturation ($p < 0.001$). This study demonstrated that use of the Novametrix C/D adaptor decreased the heart rate deceleration and oxygen desaturation seen with traditional suctioning methods.

Zmora and Merritt (1980) produced similar results with use of a side-hole adaptor. The construction of the adaptor and the suctioning protocol were slightly different, but the experimental technique was

similar in that the infant was not removed from the ventilator for suctioning. The transcutaneous oxygen drop was substantially greater in infants disconnected from the ventilator for suctioning. The investigators felt that the significant drop in oxygen level for infants suctioned traditionally was due to the loss of positive end expiratory pressure upon disconnection. In this sample, bradycardia was not always avoided with the special adaptor.

The infant studies reported that an abrupt decrease in arterial oxygen level has been shown to induce bradycardia in premature infants (Cabal et al., 1979). Hypoxemia usually results in tachycardia in adult patients unless they are extremely unstable patients who have lost the ability to compensate for hypoxemia.

Summary of Suctioning Research

There is no doubt that pre-oxygenation is superior to no pre-oxygenation in preventing post-suction hypoxemia (Adlkofer & Powaser, 1978; Skelley et al., 1980). Pre-oxygenation which the ventilator is superior to manual pre-oxygenation (Baker et al., 1980). To achieve pre-oxygenation with the ventilator, the Fi_{02} must be changed to 100% for at least 1 minute prior to suctioning (Baker et al., 1980). Both techniques have distinct advantages. A standby ventilator is not feasible. Changing the Fi_{02} carries the risk of forgetting to return the setting to the prescribed percentage of oxygen. Oxygen toxicity has inherent risks to the patient. It is this investigator's opinion that changing the ventilator settings several times in an hour could be burdensome to the nursing staff.

Several studies documented that suctioning the patient while remaining on the ventilator was superior to disconnecting the patient to suction (Bell et al., 1980; Belling et al., 1978; Bodai, 1982; Jung &

Newman, 1982). These studies used a form of pre-oxygenation, extra breaths, or "sighing" for all subjects. Brown et al. (1983) also confirmed that suctioning with an adaptor was superior to disconnecting the patient to suction. Their study was unique, however, in that they further determined that while using an adaptor the patient does not require pre-oxygenation. This study determined that suctioning with an adaptor was effective in preventing post-suction hypoxemia whether the patient was pre-oxygenated or not. Being able to suction without pre-oxygenation is a revolutionary idea in endotracheal suctioning. Omitting the pre-oxygenation would eliminate changing the Fi_{O2} on the ventilator or the cumbersome bagging that traditional techniques require.

Research suggests that suctioning the patient via an adaptor which allows the patient to remain connected to the ventilator offers the best technique for preventing post-suction hypoxemia. Possibly the use of an adaptor is so efficient that pre-oxygenation is not required. The suction technique for this study was designed to determine the most efficient suctioning technique for preventing post-suction hypoxemia.

Aversive Stimuli

The second focus of this study, post-suction anxiety, has not been addressed in published research. The body of work related to patient response to aversive stimuli is relevant. Studies in this field deal with effective ways of assisting individuals in coping with distressing events.

Staub and Kellett (1972) studied the pain tolerance of 43 male volunteers. A series of electric shocks was administered. Subjects were asked to indicate the levels of pain experienced including when they were unwilling to endure more. Subjects received information about the apparatus that delivered the shock or they did not; they either received

information about sensations or they did not. Individuals receiving both kinds of information accepted significantly more shocks with a higher milliamperes before they reported the shocks as painful ($p < .05$). The other three groups did not differ significantly from each other. The investigators concluded that both types of information were indicated in patient teaching.

Johnson (1973) tested the hypothesis that accurate expectations about the physical sensations to be experienced reduce the distress caused by painful stimuli. She was specifically interested in characteristics of information which facilitate cognitive control of emotional response to threatening stimuli. The 20 subjects had ischemic pain induced by an inflated blood pressure cuff. Each individual received either information regarding the sensations to expect or a message describing the procedure. Subjects receiving the description of the sensations reported lower distress during the painful stimulation. Distress was measured with a Mood Adjective Check List. The mean endurance time for both groups was the same.

Schmitt and Wooldridge (1973) found that patients receiving information about impending surgery and how they could aid in recuperation slept better, had less anxiety, required less anesthesia and less pain medication, had significantly lower heart rates and blood pressures, and were discharged sooner than patients not receiving this intervention. The 50 male subjects were matched for surgical procedure and level of threat. Group sessions were held the evening before surgery. Each session had a unique discussion; however, the general topics included: orientation information, specific knowledge, feelings about surgery, and health teaching.

Johnson, Morrissey, and Leventhal (1973) studied 99 patients undergoing endoscopic examination. One group of 33 heard a message which described the sensations to expect during the procedure. Another group received an objective description of the procedure. The control group did not receive a message. Indicators for distress and fear were dose of Valium required for sedation, heart rate changes, hand and arm movements indicating tension, gagging during insertion, and restlessness during the first 15 minutes of the procedure. Gripping or extension of the fingers and movements to push the tube or physician away were scored as indicating distress. Restlessness was scored on a 7-point scale, with 1 labeled none, 4 moderate (requiring mild physical restraint), and 7 extreme (requiring additional Valium). Both messages resulted in less Valium. Patients who heard the description of sensations displayed fewer indications of tension and were less restless. The p value was less than .05 for all comparisons.

Similar results were found in a study of 24 young women undergoing pelvic examination (Fuller, Endress, & Johnson, 1978). Information was given either regarding the sensations that would be experienced or health-education practices. Also, patients were either instructed in abdominal relaxation or were given no instructions. Results showed that sensory information yielded less distress as measured by heart rate changes and overt signs of distress. No significant effects were demonstrated for relaxation techniques.

Johnson's work with cognitive control via sensory information was expanded to include behavioral control via instructions to patients regarding how they could improve their recovery from surgery (Johnson, Rice, Fuller, & Endress, 1978; Johnson, Fuller, Endress, & Rice, 1978). The focus of Johnson's work in recent years has been long term outcomes

such as amount of ambulation, length of postoperative hospitalization, and time after discharge before patients ventured from their homes.

Mumford, Schiesinger, and Glass (1982) analyzed the literature related to the effects of psychological intervention on recovery from surgery and heart attacks. The investigators reviewed 34 controlled experimental studies. Outcome indicators (179 out of 210) were positive for psychological intervention groups. The outcome variables included pain, speed of recovery, physiological indices, and length of hospitalization. Interventions aimed at enhancing the psychological state of the patient had favorable effects even though the interventions were modest and not tailored to the needs of any individual patient. The consensus was that patients provided with information or emotional support to help them master medical crisis do better than patients who receive care without attention to these concerns.

Johnson (1984) reached similar conclusions in her review of 21 studies related to coping with elective surgery. There was a consistent association between various types of interventions and emotional response. Each type of intervention was associated with a reduction in negative emotional response. Additionally, there was a consistent relationship between interventions and self-reports of satisfaction, well-being, and emotional status. Johnson suggested that the wide variety of interventions may share the common element of personal interest conveyed by the researcher who provided the relevant information. Johnson further concluded that the theoretical framework of personal control appeared to be relevant to coping with surgery.

Summary of Aversive Stimuli Literature

Research related to how patients cope with aversive stimuli has consistent results. When procedural facts alone are compared to sensation

information, the sensation information yields more positive results than procedure information alone (Staub & Kellett, 1972; Johnson, 1973; Johnson et al., 1973; Fuller et al., 1978). Or particular importance is that these results have been demonstrated with a variety of patient experiences such as pain perception, pelvic examination, surgery, and endoscopic examination. Johnson (1984) and Mumford et al. (1982) published analyses of research related to psychological interventions to enhance coping and recovery from surgery or heart attacks. Both studies reached the same conclusions. Interventions that offer support or information yield positive outcomes even when the interventions are modest and not specifically tailored to the individual.

CHAPTER III

Methodology

Setting

The study was conducted in two intensive care units located in a university medical center and in a regional medical center in the southeast. The hospitals were selected because of the consistently high census of ventilated patients. The university medical center intensive care unit has nine beds and admits patients primarily in respiratory failure. The regional medical center has a 16-bed combined medical-surgical intensive care unit. The nurse patient ratio in both units is 1:1 or 1:2. Each bed can be partitioned with curtains or is in a cubicle by itself.

Sample

The sample consisted of 40 responsive, adult, intubated patients receiving mechanical ventilation with a positive pressure volume cycled ventilator. Subjects were deemed responsive if they opened their eyes and looked at the investigator when spoken to, squeezed the investigator's hand upon request, and moved their feet upon request. Patients were intubated with a nasotracheal, endotracheal, or tracheostomy tube. Ventilators were set on either the intermittent mandatory ventilation (IMV) mode or the assist control (AC) mode.

Use of a transcutaneous monitor necessitated limiting the sample to patients who were not excessively obese or edematous and to those patients who did not have a contagious skin disorder. Excessively obese

was defined as greater than 30% of the ideal weight and the presence of pitting edema constituted excessive edema. A preliminary study by the investigator demonstrated that obese or edematous individuals do not have a highly correlated $P_{tc}O_2$ and Pa_{O2} values as do individuals who are not obese and edematous. The transcutaneous monitor electrode was cleaned but not sterilized between patients. Therefore, patients with contagious skin conditions were excluded. Staff were questioned and charts reviewed to validate the absence of contagious skin disorders.

Patients with a pacemaker were excluded from the sample because heart rate was recorded. During a preliminary study, one patient with a pacemaker was observed to have dramatic $P_{tc}O_2$ changes during suctioning. His heart rate, however, remained at 72, the rate of his pacemaker.

Non-verbal behavior was observed in this study. Narcotics could lessen the reaction to suctioning and the associated non-verbal behavior. Therefore, patients who received a narcotic within 4 hours before data collection were excluded.

Instrumentation

Independent Variables

There were two independent variables, type of preparation for suctioning and suctioning technique. The control preparation for suctioning was cognitive information only. After observing staff nurses, it was determined that they consistently make a statement such as, "I'm going to suction your airway" prior to suctioning.

The experimental preparation for suctioning was based on Johnson's (1973, 1978, 1984) framework of cognitive control. Johnson recommended telling the patient procedural and sensory information regarding the adversive stimulus. A sense of safety should be conveyed with the message (Johnson, 1973). Johnson's (1984) review of research related to

coping with surgery suggested that personal interest may have a significant impact on positive outcome. Affective support was designed to offer the element of personal interest and support. The experimental preparatory guidance was designed to contain components of factual and sensory information, a message conveying the safety of the procedure, and a message of personal interest in the patient. Type of preparation for suctioning was as follows:

1. Cognitive Information Only. The nurse stated, "Mr./Ms. _____, I'm going to suction your airway to remove the secretions." This information was delivered in a pleasant tone of voice.

2. Preparatory Guidance. The nurse took the patient's hand and attempted to establish eye contact. The nurse stated:

> Mr./Ms. _____, I'm going to put a tube in your airway to suction the secretions. You will feel a pulling sensation. Suctioning may be uncomfortable for you, but it will only take a few seconds, and it will help you breathe better. I will be as gentle as possible.

A pleasant tone of voice was used to deliver this message.

The second independent variable was suctioning technique. The control suctioning technique consisted of the standard protocol for the intensive care units. The experimental protocol consisted of the use of a Trach Care System Adaptor which allows suctioning while the patient remains connected to the ventilator. Use of an adaptor is the most efficient method of preventing post-suction hypoxemia (Baker et al., 1980; Bell et al., 1980; Belling et al., 1978; Bodai, 1982; Urban & Weitzner, 1969). Recent research (Brown et al., 1983) suggested that preoxygenation is not necessary when using an adaptor of this type. Suctioning techniques were as follows:

1. Standard Suctioning

    A. Remove the patient from the ventilator.

B. Bag the patient for three breaths with 100% oxygen. A self-inflating resuscitation bag should be used.

C. Using sterile technique, insert the suction catheter (size 14 French 22 in.) into the 8 to 9 mm orotracheal, nasotracheal, or tracheostomy tube until resistance is met; pull back 2 to 3 cm.

D. Apply negative pressure by occluding the side bore orifice and rotate the catheter gently as it is withdrawn. Interrupt the negative pressure momentarily several times throughout the 15-second suctioning period to minimize airway trauma. The total summed duration of these interruptions should not exceed 1.0 to 1.5 seconds. The wall-mounted suction should be set at full.

E. Bag the patient for three breaths with 100% oxygen.

F. Reconnect the patient to the ventilator (Brown et al., 1983).

2. Trach Care System Adaptor. The Trach Care System Adaptor is designed so that the patient remains connected to the ventilator during suctioning. Pre-oxygenation is not used. The sterile suction catheter is built into the adaptor. Ballard Manufacturing Company's (personal communication, April, 1985) instructions were used:

A. Unlock the thumb control valve.

B. Grasp the T-piece with one hand and gently advance catheter with thumb and forefinger of the opposite hand. When resistance is met, withdraw the catheter 2 to 3 cms.

C. Apply suction by depressing control valve as catheter is withdrawn. Interrupt the negative pressure momentarily several times throughout the 15-second suctioning period to minimize airway trauma. The total summed duration of these interruptions should not exceed 1.0 to 1.5 seconds.

D. Be sure that the suction catheter is fully extended from the endotracheal tube.

E. Lavage the suction catheter with 5 ml of sterile normal saline via the irrigation port.

Dependent Variables

The dependent variables were transcutaneous oxygen tension ($P_{tc}O_2$) and an anxiety indicator. Transcuatenous oxygen tension was selected as a reflection of Pa_{02} because $P_{tc}O_2$ can be measured with a painless, non-invasive instrument at no cost to the patient. A preliminary study by the investigator demonstrated that there is a high correlation between $P_{tc}O_2$ and Pa_{02} in multiple readings from the same patient. The $P_{tc}O_2$ was obtained as follows:

1. Transcutaneous oxygen tension was measured with a Biochemp Transcutaneous Oxygen Monitor or a Litton Transcutaneous Oxygen Monitor. The technique involved placing an electrode on the patient's skin; it was noninvasive and painless.

2. The monitor was calibrated to room air for at least 20 minutes and zeroed prior to applying to the patient.

3. An area on the upper quadrant of the anterior thorax was selected and cleaned with alcohol. The electrode was not placed over bone or broken skin; subclavian catheters were avoided.

4. One drop of conducting solution was applied to the center of the electrode. If the solution ran off the electrode, it was wiped dry before another drop was applied.

5. After the electrode was applied to the skin, it was secured with silk tape and allowed to equilibrate to the patient for at least 20 minutes prior to reading from the digital display.

An investigator-developed Non-Verbal Assessment of Anxiety Checklist was utilized to measure anxiety during and up to 30 seconds after suctioning. Trained nurse observers scored the patient's reaction to suctioning. Prior to data collection, the investigator and the nurse observer simultaneously scored at least five suctioning episodes. There was interrater agreement with 90% of the scores. Thereafter the trained nurse observers independently rated anxiety with the Non-Verbal Assessment of Anxiety Checklist. This instrument is discussed under Preliminary Study 2 (pp. 45-51).

Heart rate and blood pressure were measured in order to determine if there was a correlation between anxiety score and heart rate and anxiety score and systolic blood pressure. Heart rate was determined by counting the number of R waves in a 1-minute rhythm strip. Recommendations by the American Heart Association (Kirkendall, Feinleib, & Mark, 1980) were followed in taking the blood pressure:

> The deflated cuff should be applied with the lower margin about 2½ cm above the antecubital space. Care should be taken to insure that the center of the bladder is applied directly over the medial surface of the arm. A preliminary palpatory determination of systolic pressure should be done to give the examiner an estimate of the maximal pressure to which the system needs to be elevated in subsequent determinations. The bell of the stethescope should be applied to the antecubital space over the previously palpated brachial artery. The stethoscope head should be applied firmly, but with as little pressure as possible, and with no space between the skin and the stethoscope. . . . with the stethoscope in place, the pressure is raised approximately 30 mm above the point at which the radial pulse disappears and then released at a rate of 2 to 3 cm per second. As the pressure falls, the Korotkoff sounds become audible over the artery below the cuff . . . . The systolic pressure is the point at which the initial tapping sound is heard. To make certain that the sound is not extraneous, one should hear at least two connective beats as the pressure falls (pp. 10-11).

To insure the reliability of the blood pressure readings, approximately one-third of the post suction blood pressures (15) were randomly

checked by another nurse. At no point were the reading of this investigator and the nurse more than 2 mmHg different.

Study Design

The paitents who consented to participate were randomly assigned to one of four groups of 10 each. The groups were differentiated by the unique combination of independent variables manipulated. Subjects received one of the following treatment protocols:

1. Suctioning with Trach Care Adaptor, Preparatory Guidance;
2. Suctioning with Trach Care Adaptor, Cognitive Information Only;
3. Standard Suctioning, Preparatory Guidance;
4. Standard Suctioning, Cognitive Information Only.

After informed consent (Appendix A) was obtained, the transcutaneous oxygen monitor was calibrated, zeroed, and applied to the patient. When the nurse assigned to the patient determined by auscultation that the patient needed to be suctioned, the curtains around the bed were drawn to decrease extraneous stimulation. The systolic blood pressure was palpated and the investigator waited 1 minute before a systolic blood pressure was auscultated. This technique conformed to the American Heart Association's (Kirkendall et al., 1980) standard for measuring blood pressure. Other pre-suction variable measures were heart rate (obtained after a 1-minute rhythm strip) and transcutaneous oxygen tension.

The predetermined type of information, either Cognitive Information only or Preparatory Guidance, was given and the patient suctioned according to the type of adaptor in place. During suctioning, a trained nurse observer completed the Non-Verbal Assessment of Anxiety Checklist. Thirty seconds after the completion of suctioning, a 1-minute rhythm strip was

run, blood pressure was taken, and transcutaneous oxygen tension recorded. Completion of suctioning was identified by the suction catheter being completely out of the endotracheal tube.

Demographic Variables

In order to describe the sample adequately, the following demographic data were collected:

1. Primary diagnosis,
2. Number of days ventilated at time of data collection,
3. Set rate,
4. Fi_{O2},
5. Age,
6. Sex.

Preliminary Study I

Preliminary Study I was conducted to develop a reliable and valid instrument with which to measure anxiety in critically ill patients. The procedure received university Institutional Review Board approval for protection of human subjects and approval from nursing administration of the participating institution. The sample consisted of nine hospitalized diabetics who were participating in formalized diabetic teaching. The subjects went to daily sessions related to topics such as diet, insulin injections, insulin reaction, foot care, and exercise. Consent was obtained from both the physician and the patient. Individuals were over 18 years of age; persons with a diagnosed psychiatric problem or a pacemaker were excluded.

Spielberger's State-Trait Anxiety Inventory Form X-1 (STAI) was chosen as one instrument because it has been labeled as one of the best standardized anxiety measures (Dreger, 1978). Alpha reliability coefficients for the normative samples range from .83 to .92 for A-State

scores. The A-State measures state or current anxiety level. The STAI content, concurrent, and construct validity compare favorably with other published tests of anxiety (Spielberger, 1970). The STAI has been extensively utilized in research as evidenced by 333 citations in The Eighth Mental Measurements Yearbook (Burros, 1978). The A-State consists of a 20-item self report rating scale for measuring current level of anxiety. Critically ill patients might not be capable of responding to a 20-item questionnaire. Therefore, the preliminary study was undertaken to develop an instrument that compared favorably with the A-State but which would be appropriate for the critically ill. Instruments utilized in Preliminary Study I were:

1. Spielberger's A-State,
2. Four-Item Anxiety Scale,
3. Electromography,
4. Galvanic Skin Response.

The Four-Item Anxiety Scale consisted of four questions extracted from the A-State questionnaire. Factor analysis of STAI by Barker, Barker, and Wadsworth (1977) was utilized in the selection of questions. These items were:

1. I feel calm,
2. I am tense,
3. I feel nervous,
4. I am relaxed.

The items were printed on 11-inch by 14-inch cardboard. The participant was instructed to respond to the statement which described feelings at that moment. The rating scale was:

1. Not at all,
2. Somewhat,
3. Moderately,
4. Very much so.

Electromyography (EMG) readings were taken with the Cyborg EMG J33 Biofeedback Instrument. The EMG is an instrument that reflects muscle activity by measuring the electrical impulses that cause the muscle fiber to contract. The action potential is measured in microvolts. The EMG was attached to the forearm of the participant. EMG readings were obtained from a dial on the face of the instrument.

Galvanic skin response (GSR) was measured with the Stoelting Ultra-Scribe Polygraph Instrument. GSR reflects changes in electrical conductivity of the skin as a result of autonomic nervous system arousal. When the electrical current increases, the GSR pen moves upward; a decrease in electrical current causes the pen to drop. Electrical conductivity increases with increased perspiration which occurs immediately with autonomic nervous system stimulation (Atlantic Security Agency, personal communication, June, 1984). The chart paper is divided by horizontal lines spaced 0.1 inches apart. Scores were assigned corresponding to the pen deflection evoked by the statement. For example, a statement which resulted in a pen deflection of 15 spaces received a score of 15. Scores were taken during nine specific statements regarding diabetic management such as diet or insulin injections.

Potential candidates were visited the day prior to testing, the study was discussed, the consent form signed, and the instruments were explained and shown to the subjects. Pre- and post-teaching anxiety scores were obtained within 1½ hours of the teaching session.

A dependent t-test analysis revealed statistically significant differences between pre- and post-scores for GSR. All post-GSR scores were significantly less after teaching ($p = .009$). Post-teaching scores for the Four-Item Anxiety Scale, STAI, and EMG were also less. The difference was not, however, statistically significant at the .05 level of significance. It is possible that the GSR is a more sensitive index of anxiety than the other instruments. In working with the GSR, however, it was discovered that any extraneous stimulation caused profound needle deflections. For example, a door slamming was observed to cause the needle to go off the page. In another situation the subject laughed. The needle went off the page and it was some time before it returned to baseline. Use of GSR in a controlled laboratory would be a useful means to measure anxiety. Use of the GSR in the clinical setting was judged to be impractical and open to too many extraneous variables.

Pearson correlation coefficients revealed significant correlations between GSR and STAI. The r^2 was .66 ($p = .02$). The correlation coefficient was .60 ($p = .04$) for Four-Item Anxiety Scale and STAI given before teaching. An r^2 of .63 ($p = .03$) was obtained for the correlation between Four-Item Anxiety Scale and STAI given after teaching. These data suggested that both GSR and Four-Item Anxiety Scales are acceptable measures of anxiety. A degree of concurrent validity was established for both the GSR and Four-Item Anxiety Scale.

The Alpha Reliability Coefficient for the Four-Item Anxiety Scale was .84. Factor analysis revealed that the alpha could be raised to .86 if the item stating "I am relaxed" was removed. These data reflected an acceptable degree of reliability for the Four-Item Anxiety Scale.

Preliminary Study II

The second preliminary study was designed with the following purposes:

1. To determine the feasibility of using the Four-Item Anxiety Scale with critically ill ventilated patients,

2. To establish a correlation coefficient between the transcutaneous oxygen tension ($P_{tc}O_2$) and arterial oxygen tension (Pa_{02}),

3. To establish a correlation coefficient between the Four-Item Anxiety Scale and heart rate,

4. To establish a correlation coefficient between the Four-Item Anxiety Scale and systolic blood pressure,

5. To refine the methodology of the project.

The Institutional Review Board approval was obtained; appropriate nursing and medical administrative approval was obtained. Patient consent was voluntary. Subjects were apprised of their anonymity and their right to withdraw from the study at any time during data collection.

Ten patients meeting study criteria had simultaneous Pa_{02} and $P_{tc}O_2$ values recorded. The correlation between $P_{tc}O_2$ and Pa_{02} was .665. This moderate correlation could be explained by a variety of factors such as thinkness of epidermis and perfusion variables. The values for transcutaneous and arterial oxygen tension are illustrated in Table 1.

Repeated simultaneous $P_{tc}O_2$ and Pa_{02} values on the same patient gave significant correlations. Four patients had simultaneous readings taken on three different occasions. The mean correlation coefficient was .943. One of the subjects (B) was extremely obese and edematous. The r for her oxygen tensions was only .827. When this subject's values were not included, the mean r was .982. Subject C was also obese; her correlation coefficient was the second lowest. These findings led to the exclusion

of obese or edematous individuals from future studies utilizing a transcutaneous oxygen monitor. The actual values are illustrated in Table 2, along with the individual correlation coefficients.

Table 1

Values for Simultaneous $P_{tc}O_2$ and Pa_{O2} Readings of Ten Subjects

Subject No.	$P_{tc}O_2$	Pa_{O2}
1	49	65
2	59	71
3	66	110
4	84	91
5	76	72
6	68	95
7	112	121
8	96	92
9	116	119
10	80	81

In order to expand the population from which to draw the sample, an intensive care unit in another city was identified as having comparable patients. The transcutaneous monitor from hospital B was taken to hospital A to determine if there was a significant correlation between simultaneous recordings of transcutaneous oxygen tension. The calculated Pearson correlation coefficient was .85. A dependent *t*-test was computed to determine if there was a statistical difference in the mean $P_{tc}O_2$ values from Monitor A and Monitor B. There was no statistical difference

Table 2

Repeated $P_{tc}O_2$ and Pa_{O2} Values on Four Subjects

Subject	$P_{tc}O_2$	Pa_{O2}	r	r^2
	68	95		
	255	487		
A	255	519	.997	.995
	66	110		
	66	101		
B	88	117	.827	.685
	84	92		
C	80	71		
	112	121	.950	.903
	86	91		
D	49	65		
	59	71	.999	.998

in the means of the two groups ($\underline{t}$ = 1.50; $\underline{p}$ = 0.176). Therefore, subjects from two intensive care units were recruited for the study. The simultaneous readings are listed in Table 3.

Multiple simultaneous transcutaneous and arterial oxygen tension readings were recorded with Monitor B to establish that monitor's reliability and validity. For subject A the Pearson correlation coefficient

for three readings was .996; subject B had an r^2 of .999. The actual simulatenous readings are listed in Table 4.

Table 3

Simulatenous $P_{tc}O_2$ Readings from Monitor A and Monitor B of Eight Subjects

	Monitor	Monitor
Subject	A	B
1	96	84
2	116	112
3	80	60
4	94	64
5	117	125
6	94	90
7	104	102
8	87	95

Sixteen ventilated subjects judged to be awake and alert were asked to respond to the Four-Item Anxiety Scale after they had been suctioned. None of the subjects could respond. Patients were instructed to squeeze the investigator's hand when the statement that best described the subject's feelings was read. Patients gave varying types of responses. Some subjects squeezed the investigator's hand for every option; others did not give any indication that the statements described their feelings. Some subjects gave other types of non-verbal cues such as looking up to the ceiling, or raising both arms and shrugging the shoulders as if to

say, "I don't know." One patient looked away from the investigator. Several gave quizzical looks as if to indicate that they did not understand what they were to do. It was apparent to the investigator that this type of instrument would not work with the designated population. Therefore, the Non-Verbal Assessment of Anxiety Checklist was developed.

Table 4

Repeated Simultaneous $P_{tc}O_2$ and Pa_{O2} Readings of Two Subjects with Monitor B

Subject	$P_{tc}O_2$	Pa_{O2}	r	r^2
	60	79		
A	63	85	.998	.996
	65	90		
	66	82		
B	48	58	.999	.999
	44	52		

Two studies involving patients undergoing endoscopy examinations utilized non-verbal behaviors as indicators of distress. Johnson et al. (1973) and Johnson and Leventhal (1974) used a scale which reflected movements indicative of distress. These investigators recorded the presence or absence of gripping or extension of the hands and movement to push away the physician performing the endoscopy. Subjects received a score from 0 to 2 depending on the absence or presence of these behaviors. Johnson et al. (1973) also recorded degree of restlessness on a

scale of 0 to 7. A score of 0 represented no restlessness; 4 represented moderate restlessness requiring mild physical restraint; 7 reflected extreme agitation requiring diazepam (Valium).

A study of children's distress behavior during orthopedic cast removal (Johnson et al., 1975) utilized recordings of the following minor indicators of distress:

1. Facial indicators (grimace, frown, tension in the mouth, tightly closed eyes),

2. Hand movement (hands clenching or extending),

3. Feet movement (feet extended or inwardly rotated or held in a tense position).

A score of 0 was given for none or one of the above behaviors. A score of 1 was given for the above behavior in two or more body parts. Major signs of distress were: kicking, hitting, pulling away, crying, screaming, or holding the doctor's hand. A score of 0 was given if none of these signs were observed. A score of 1 was given if any of the major signs of distress were seen.

An instrument for determining the psychological status of critically ill patients was developed at the E. J. Meyer Memorial Hospital in Buffalo, New York (Sgroi, Holland, & Solkoff, personal communication, July 1985). The Anxiety-Depression Scale for Medically Ill Patients was designed for patients who could talk and interact with the interviewer. Scores for mental status, anxiety, and depression can be derived. The entire instrument is not appropriate for ventilated patients but there are observations of the patient that are relevant. The following observations were extracted from that instrument:

1. The patient's general behavior appeared:
   - Calm and composed
   - Composed but mildly apprehensive and uneasy
   - Distressed with moderate apprehension and fear
   - Extremely frightened with loss of emotional control;
2. Patient's muscle tone:
   - Appeared relaxed
   - Was characterized by a moderate amount of tension in muscles though lying still
   - Was characterized by generalized tension in muscles with tightening of muscles, fists, and jaws
   - Showed extreme tension; extremities held absolutely taut with no intervals of relaxation. Head may be held off the pillow;
3. Patient's motor activity (e.g., rate and amount) was:
   - Within normal limits for his physical condition
   - Characterized by restless and fidgety movements
   - Hyperactive with frequent changing of position and gross movements of arms and legs
   - Characterized by ceaseless non-purposeful activity of all extremities;
4. Patient's facial appearance was:
   - Responsive with full range of appropriate expression
   - Strained and tense
   - Fearful and distressed
   - Panicky with dilated pupils, tremulousness of mouth and jaws.

The Anxiety-Depression Scale (Sgroi et al., personal communication, July 1985) involes a 15-minute interview with the patient which allows for extensive observation, questioning, and clarification. Because the suctioning experience is so short, this investigator felt that four levels of behavior might be hard to differentiate.

Therefore, a checklist indicating three levels of anxiety was devised that combines the non-verbal cues used in previous research.

Non-Verbal Assessment of Anxiety Checklist

A. The patient's general behavior appeared:
   _____1. Calm and composed
   _____2. Mildly-moderately apprehensive/distressed
   _____3. Extremely frightened;
B. Patient's muscle tone:
   _____1. Appeared relaxed
   _____2. Was characterized by tension in mouth, tightening of muscles in the jaw, generalized tightening of muscle tone, but lying still
   _____3. Was characterized by more wide spread tension with clenching fists, or extending fingers, extension of feet and legs;

C. Patient's amount and rate of motor activity was:
   _____1. No movement; lying still
   _____2. Characterized by restless and fidgety movements
   _____3. Hyperactive, pushing or pulling away, combative, twisting in the bed;

D. Patient's facial appearance was:
   _____1. Calm, eyes open looking at investigator
   _____2. Strained, brows knitted together
   _____3. Fearful, distressed, panicky, eyes tightly closed or wide open with pupils dilated.

The observer should mark the response that best describes the patient. The Non-Verbal Assessment of Anxiety Score (NAAS) can range from 4 to 12.

Two experts in psychiatric nursing reviewed the Non-Verbal Assessment of Anxiety Checklist and validated that the items were indicative of anxiety. No changes were recommended by these experts.

Studies related to patient response to aversive stimuli have traditionally used heart rate and blood pressure to assess the degree of distress or autonomic nervous system arousal (Schmitt & Wooldridge, 1973). The subjects in the project differed from those previously studied. Patients in this study were so profoundly ill that multiple factors impacted on heart rate and blood pressure. Therefore, heart rate and blood pressure were not dependent variables. Pearson correlation coefficients were calculated between the Non-Verbal Assessment of Anxiety Score (NAAS) and post-suction heart rate and systolic blood pressure to assist in establishing the validity of the NAAS.

Protection of Human Subjects

The Institutional Review Board of the university approved this project for the protection of human subjects prior to implementation (Appendix B). Both the nursing and the medical directors of the intensive care units provided written consent for the study to be conducted in their facility (Appendix C). Patient consent was voluntary. Written consent

from the next of kin was obtained (Appendix A). Subjects were apprised of their anonymity and their right to withdraw from the study at any time during data collection

Data Analysis

An IBM computer, utilizing the Statistical Package for the Social Sciences (Norusis, 1985) was used for data analysis. Two-way multivariate analysis of covariance (MANCOVA) was the statistical test used to examine the data. The independent variables were type of preparation for suctioning and suctioning technique; the dependent variables were post-suction $P_{tc}O_2$ and the post-suction anxiety indicator (NAAS). The covariate was the pre-suctioning $P_{tc}O_2$. The *F* statistic was utilized to test three hypotheses, two main effects and one interaction effect. Equal numbers of subjects per group assured robustness to violations of homogeneity of variance covariance. The assumption of homogeneity of variance covariance matrices was assessed with Box's M; the critical assumption of homogeneity of regression slope was evidenced by a nonsignificant *F*. The data were also examined for violations of the following assumptions: absence of skewness, absence of outliers, normal distribution of variables, and a linear relationship between the covariate and the dependent variables.

The reliability and validity values for the investigator-developed NAAS were determined. An alpha reliability coefficient was utilized to assess the internal consistency of NAAS. Concurrent validity was evidenced by significant Pearson correlation coefficients between NAAS and post-suction heart rate and NAAS and post-suction systolic blood pressure.

Secondary analyses were conducted to determine if NAAS were correlated with other physiological variables. Dependent *t*-tests were calculated to determine if suctioning, irregardless of treatment group, significantly affected heart rate, systolic blood pressure, and $P_{tc}O_2$.

CHAPTER IV

Findings

The purpose of this study was to determine the effect of preparatory guidance and specialized suction technique on post-suction anxiety and transcutaneous oxygen tension. Ventilated patients from two medical centers in the southeast were invited to participate.

Total Sample

The total sample consisted of 40 responsive adult patients who were mechanically ventilated with volume cycled ventilators. The subjects were divided into four treatment groups of 10 each. Two-way analyses of variance showed there were no differences among treatment groups for age, set respiratory rate, or Fi_{O2}. There was a significant difference in days ventilated at the time of data collection. Two subjects in the sample were ventilated an unusually long period of time (90 and 99 days) and were univariate outliers. By chance alone, they were assigned to the same treatment group. Even with the outliers included in the sample, other demographic variables were normally distributed among the groups; therefore, the subjects were retained in the sample. There was a univariate outlier for pre-suction systolic blood pressure. When analysis of covariance was calculated for post-suction systolic blood pressure with pre-suction systolic blood pressure as the covariate, no statistical difference existed in post-suction systolic blood pressure. Descriptive statistics for the 22 male and 18 female subjects are shown in Table 5.

Table 5

Descriptive Statistics for Demographic Variables

Variable	Mean	Std. Dev.	Range
Age	58	16.7	20-83
Days on ventilator	10.7	21.6	1-99
Set respiratory rate	11.9	2.8	4-18
F_{iO2}	39	17.5	21-90

n = 40

Medical and surgical patients with a variety of diagnoses were utilized in the study. Primary diagnoses are listed in Appendix D, along with age and sex of the patient.

Reliability and Validity of NAAS

The alpha reliability coefficient for NAAS was calculated as .87. A reliability coefficient of this magnitude was indicative of a high degree of internal consistency. Concurrent validity was established by significant Pearson correlation coefficients between NAAS and post-suction heart rate and between NAAS and post-suction systolic blood pressure. An inverse relationship was established between NAAS and both pre- and post-suction $P_{tc}O_2$ (PREO2 and POSTO2). The proportion of variance accounted for in the relationship between NAAS and the physiological variables ranged from 5% to 8%. The Pearson correlation coefficients are shown in Table 6.

Table 6

Pearson Correlation Coefficients and Levels of Significance for Physiological Variables

Variables	NAAS	p value
Pre-suction		
PREO2	-.23	.08
PREHR	-.28	.04
PREBP	.14	.19
Post-suction		
POSTO2	-.23	.08
POSTHR	-.26	.05
POSTBP	.28	.04

Testing of Hypotheses

Data obtained from the 40 subjects were used to test the hypotheses:

1. There is no statistically significant difference in the anxiety indicator and transcutaneous oxygen tension between patients receiving preparatory guidance and those receiving standard preparation for suctioning, when the initial transcutaneous oxygen tension is used as a covariate.

2. There is no statistically significant difference in the anxiety indicator and transcutaneous oxygen tension between patients receiving suctioning via Trach Care System adaptor and those being suctioned via the standard adaptor when the initial transcutaneous oxygen tension is used as a covariate.

3. There is no statistically significant interaction between mode of suctioning and type of nursing intervention affecting the anxiety indicator and transcutaneous oxygen tension when the initial transcutaneous oxygen tension is used as a covariate.

SPSSX MANOVA was utilized for data analysis. Pre-suction $P_{tc}O_2$ was a significant covariate with an F (2,34) of 281.56, $p < .001$. Further analysis showed that pre-suction $P_{tc}O_2$ was a significant covariate for post-suction $P_{tc}O_2$ ($t = 24.07$, $p < .001$), but not for NAAS ($t = -1.10$, $p = .28$).

The data were examined for violations of assumptions. There were no missing data for the 40 subjects; the 4 cells were comprised of 10 subjects each. The covariate (PREO2) was linearly related to the dependent variable post-suction $P_{tc}O_2$ (POSTO2) as evidenced by a Pearson correlation coefficient of .97, $p < .001$.

Absence of skewness was used as a criterion of univariate normality. Skewness was determined by the ratio of skewness to the standard error of skewness. A ratio of skewness within three standard deviations was acceptable. A ratio of skewness was calculated for univariate variables overall and within the subgroups formed by the combination of treatment groups. None of the variables were significantly skewed.

To determine univariate outliers, standard scores were calculated in the following manner: maximum score minus the mean divided by the standard deviation; minimum score minus the mean divided by the standard deviation. A z score within three standard deviations was deemed acceptable. There was an outlier in pre-suctioning systolic blood pressure. One value (208) was 3.42 standard deviations from the mean of 130.28. However, blood pressure was not a dependent variable utilized in the MANCOVA calculations. There were no other outliers.

The assumption of homogeneity of variance-covariance matrices was met, as the Box's M was not significant with an F of .991, p = .466. The within cell correlation determinant was .999; therefore, there was no multicollinearity or singularity. Scattergrams were run to assess the linearity of the interrelationships. There were no curvilinear relationships. The assumption of homogeneity of regression was met as evidenced by a non significant F (3,32) or .53, p = .666. The regression coefficients within each group were homogeneous across groups.

With the use of Wilks' criterion, the combined dependent variables were significantly affected by preparation for suctioning (PREP), F (2,34) = 4.41, p = .02. The dependent variables were not significantly affected by suctioning technique (SUCTION), F (2,34) = 1.32, p = .87, or the interaction, F (2,34) = .444, p = .645. The results reflected a moderate association between preparatory guidance and a low NAAS, Eta squared = .21. Cell means and standard deviations are shown in Table 7.

The mean POSTO2 for patients receiving suction via Trach Care, regardless of type of preparation, was 65.55; the mean NAAS score was 8.35. Patients receiving suction via the standard adaptor had a mean POSTO2 of 82.05 and the mean NAAS was 8.15, regardless of type of preparation for suctioning. The mean POSTO2 for patients receiving preparatory guidance was 77.40; the mean POSTO2 for those receiving cognitive information only was 70.20, regardless of type of suctioning. Patients receiving preparatory guidance had a mean NAAS of 7.30 and those receiving cognitive information only had a mean NAAS of 9.2, regardless of type of suctioning technique.

To investigate the effect of the significant main effects on the individual dependent variables, a step-down analysis was performed on

Table 7

Cell Means and Standard Deviations for Four Treatment Groups

		N	Mean	Std. Dev.
Variable: PREO2				
Suction	Trach Care			
	Prep. Guide	10	69.60	39.35
	Cognitive	10	64.60	27.46
Suction	Standard			
	Prep. Guide	10	88.10	20.10
	Cognitive	10	77.80	33.47
Total Sample		40	75.03	31.05
Variable: POSTO2				
Suction	Trach Care			
	Prep. Guide	10	67.00	40.62
	Cognitive	10	64.10	26.14
Suction	Standard			
	Prep. Guide	10	87.80	19.30
	Cognitive	10	76.30	32.30
Total Sample		40	73.80	30.87
Variable: NAAS				
Suction	Trach Care			
	Prep. Guide	10	7.60	1.84
	Cognitive	10	9.10	2.23
Suction	Standard			
	Prep. Guide	10	7.00	1.62
	Cognitive	10	9.30	1.83
Total Sample		40	8.25	2.07

the basis of an a priori ordering of the dependent variables. It was considered that the effect size due to preparation might be negligible due to the critical status of the subjects. Therefore, POSTO2 was entered first. Each dependent variable was analyzed with the higher priority dependent variable as a covariate. Only the dependent variable NAAS had a significant relationship with PREP even though it was entered secondly. The results of this step-down analysis are shown in Table 8.

Table 8

Step-down F-Tests of PREP on Dependent Variables

Variable	Hyp. MS	Step-down F	Hyp. df	Error df	p
POSTO2	.23	.0004	1	35	.95
NAAS	32.41	8.82	1	34	.005

The first hypothesis was rejected. There is a significant difference in the anxiety indicator and transcutaneous oxygen tension between patients receiving preparatory guidance and those receiving standard preparation for suctioning. There is a moderate association between receiving preparatory guidance and lower anxiety as measured by NAAS. The second and third hypotheses were not rejected. There is no significant difference in the anxiety indicator and transcutaneous oxygen tension between patients receiving suctioning via Trach Care System adaptor and those being suctioned by the standard technique when the initial $P_{tc}O_2$ is controlled. There is no significant interaction between mode of suctioning and type of preparation for suctioning when the initial $P_{tc}O_2$ is controlled.

Supplemental Analyses

Dependent *t*-tests were calculated for the physiological variables to determine if there were significant changes from pre- to post-suction situations. Heart rate and blood pressure increased significantly ($p < .1$). $P_{tc}O_2$ decreased but not significantly. These data are shown in Table 9.

Table 9

Means, Standard Deviation, t-Tests for Physiological Variables

Variable	Mean	Std. Dev.	*t* Value	df	*p*
PREO2	74.95	31.02	1.01	39	.317
POSTO2	73.8	30.87			
PREHR	106.4	17.46	-2.12	39	.04
POSTHR	108.5	18.76			
PREBP	130.28	22.76	-1.84	39	.074
POSTBP	134.53	25.4			

Summary

A total of 40 ventilated patients participated in a study to determine the effect of preparatory guidance and specialized suction technique on post-suction anxiety and transcutaneous oxygen tension. The subjects were randomly assigned to four treatment groups of 10 persons each. The groups did not differ with respect to age, Fi_{O2}, or set respiratory rate.

The reliability and validity of the anxiety indicator (NAAS) was substantiated with an alpha reliability coefficient of .87, and significant correlations between NAAS and heart rate and NAAS and systolic

blood pressure. The covariate (pre-suction $P_{tc}O_2$) did significantly correlate with one of the dependent variables (post-suction $P_{tc}O_2$).

The combined dependent variables were significantly affected by type of preparation prior to suctioning. Step-down analysis revealed that only NAAS was significantly affected by type of preparation. Preparatory guidance yielded a statistically significant lower Non-Verbal Assessment of Anxiety Score. The first hypothesis was rejected. There is a statistically significant difference in post-suction $P_{tc}O_2$ and the anxiety indicator between patients receiving preparatory guidance and those receiving cognitive information only when the pre-suction $P_{tc}O_2$ is used as a covariate. The second and third hypotheses were not rejected.

The dependent variable reflecting post-suction anxiety (NAAS) was significantly correlated with both pre- and post-suction heart rate, post-suction systolic blood pressure, pre- and post-suction $P_{tc}O_2$. Both heart rate and systolic blood pressure increased from the pre- to post-suction situation.

CHAPTER V

Conclusions, Discussion, Implications and Recommendations

Conclusions and Discussion

The purpose of this study was to determine the effect of preparatory guidance and a specialized suction technique on post-suction anxiety. Anxiety was measured with Non-Verbal Assessment of Anxiety Score (NAAS) and level of oxygenation was measured with transcutaneous oxygen tension ($P_{tc}O_2$).

Researchers have utilized instruments to measure anxiety evidenced by non-verbal behaior (Johnson et al., 1973; Fuller et al., 1978; Sgroi et al., personal communication, July 1985). Reliability and validity studies were not found on any instruments to measure non-verbal anxiety. The NAAS was an investigator-developed tool which utilized previous research in this area. To avoid bias, trained registered nurses scored the response to suctioning. These nurses were told simply that the response to suctioning was being recorded. The experimental and control preparations for suctioning were not included in the nurse's orientation to the study. The alpha reliability coefficient of .87 lends one measure of reliability to this instrument.

Traditionally, researchers have utilized heart rate and systolic blood pressure to indicate stress and the associated autonomic nervous system arousal (Schmitt & Wooldridge, 1973). Therefore, Pearson correlation coefficients were calculated between NAAS and heart rate and

NAAS and systolic blood pressure. For this sample, a positive linear relationship existed between NAAS and post-suction systolic blood pressure. Higher levels of anxiety (as measured by NAAS) were associated with higher post-suction systolic blood pressure. An inverse relationship existed between heart rate and systolic blood pressure ($\underline{p}$ = .003). The literature supports this relationship. Baroreceptors in the aortic arch and the carotid bodies detect an elevation of arterial blood pressure. The response is inhibition of sympathetic discharge with resultant bradycardia (Hinshaw, 1972). Higher levels of NAAS and systolic blood pressure were associated with lower heart rates. Concurrent validity is evidenced by these associations.

It was not anticipated that NAAS would correlate with pre- and post-suction $P_{tc}O_2$. There was an inverse linear relationship between NAAS and both pre- and post-suction $P_{tc}O_2$ at the 0.1 level of significance. In this sample, lower readings of $P_{tc}O_2$ were associated with increased NAAS. Nursing texts universally cite agitation, anxiety, and restlessness as early signs of hypoxemia (Luckmann & Sorenson, 1983; Brunner & Suddarth, 1984). The statistical relationship between NAAS and physiological variables is slight. The percentage of the variance in physiological variables associated with variation in the level of anxiety was small (.05 to .08). In critically ill patients, however, even slight variations in vital signs could be clinically significant.

The first hypothesis was rejected. There was a significant difference in the post-suction indicator of anxiety and transcutaneous oxygen tension between patients receiving preparatory guidance and those recieving cognitive formation only when the initial transcutaneous oxygen tension was used as a covariate. Further analysis revealed that 21% of the variation in post-suction anxiety was accounted for by type

of preparation for suctioning. Preparatory guidance, which contains elements of cognitive information, sensory information, and affective support is associated with lower levels of anxiety as measured by NAAS. This finding is congruent with work by Johnson (1973, 1978, 1984) and Johnson et al. (1973). Patients who are given accurate information regarding aversive procedures, particularly information of a sensory nature, demonstrate fewer overt signs of distress than patients who are not given that data. Schmitt and Wooldridge (1973) and Fuller et al. (1978) concurred with Johnson's findings. Findings from this study supported the conceptual framework proposed by Johnson (1984). Mumford et al. (1982) and Johnson (1984) reviewed the published research related to assisting patients to cope with aversive stimuli. Both concluded that nursing interventions offering information and support consistently yeild positive results.

A potential competitive explanation for these results is the novelty of the preparatory guidance experience. Perhaps any attentive interaction with the patient would have elicited the same response.

Another concern that arises is the effect of subsequent preparatory guidance experiences on reducing patient anxiety. It is unknown if the anxiety reducing effects of preparatory guidance will be maintained with repeated episodes.

For this sample, there was no difference in anxiety indicators and post-suction $P_{tc}O_2$ between patients suctioned via the Trach Care System adaptor and those suctioned with the standard suctioning technique. The effect size for suctioning was so minimal that an inordinately large sample size would be required to detect differences due to suctioning technique. There was clearly no difference in dependent variables due to suctioning technique.

Two transcutaneous monitors were utilized in this study. The correlation between the readings of the monitors was statistically significant but not perfect. Readings with monitor A seemed to be consistently higher than readings from monitor B. This observation is partially substantiated by the $P_{tc}O_2$ mean scores being higher for the standard suctioning technique. By chance alone, there were more patients suctioned with the standard technique at hospital A. The comparability of the two monitors could have been a factor in failing to reject the second hypothesis.

Although the second hypothesis was not rejected, the findings are of clinical significance and support the findings of Belling et al. (1978), Bodai (1982), and Brown et al. (1983). The Trach Care System adaptor is as efficient in preventing suction-induced hypoxemia as the standard method. The standard technique involves removing the patient from the ventilator (and thereby breaking the sterile closed system), bagging the patient with 100% oxygen, and reconnecting the patient to the ventilator. The Trach Care System adaptor maintains the sterile closed system, does not expose the patient or the nurse to infectious organisms, and is easier and faster to use than the standard method.

The supplemental analyses yeilded results consistent with the literature. A dependent *t*-test between pre- and post-suction $P_{tc}O_2$ revealed no significant difference. This finding is congruent with the work of Adlkofer and Powaser (1978), Skelley et al. (1980), and Brown et al. (1983). These studies showed that pre-oxygenation with at least three breaths of 100% oxygen prevented significant drops in the arterial oxygen and that use of an adaptor was as effective as pre-oxygenation in preventing suction-induced hypoxemia.

Dependent t-tests for heart rate and systolic blood pressure revealed statistically significant differences between pre- and post-suction values. Both heart rate and systolic blood pressure rose as a result of the stimulus of suctioning. This finding supports Selye's (1974) general adaptation syndrome. Selye (1974) purported that stress would result in an elevated heart rate and blood pressure. The positive Pearson correlation coefficient for NAAS and post-suction blood pressure further supports Selye's (1974) work.

Implications

Nursing research indicates the usefulness of nursing interventions in reducing patient distress during aversive procedures. Specifically, information that contains cognitive information, sensory information, and affective support decreases non-verbal indicators of anxiety. The statistical support of this phenomenon should enhance the incorporation of this type of nursing intervention in practice and education of nursing students.

The A.N.A. Social Policy Statement (1980) included in the nature and scope of nursing assisting the client in dealing with emotional problems related to illness and treatment, and specifically cites anxiety as a patient response amenable to nursing. Psychological, as well as physical, comfort promotion undergirds the practice of nursing. Patients being mechanically ventilated in intensive care are experiencing possibly the most stressful events (physically and emotionally) of their lives. Preparatory guidance is one nursing intervention for decreasing suction-induced anxiety. Patient anxiety reduction is desirable from a philosophical, as well as a clinical, viewpoint.

Recommendations

The initial work with NAAS provided promising results related to the reliability and validity of this instrument. NAAS is remarkably easy to utilize with critically ill patients and could prove useful in evaluation of their anxiety state. Further refinement of the reliability and validity of NAAS is indicated.

An unexpected finding was the correlation between increased NAAS and lower pre- and post-suction $P_{tc}O_2$. Changes in patient behavior (as evidenced by NAAS) indicative of hypoxemia are appropriate for further research.

A consideration at the onset of this project was that the subjects were so critically ill that nursing measures to increase their psychological comfort would not produce measurable changes in patient behavior. This study indicated nursing interventions to reduce anxiety are effective even when the patient is near death (approximately 50% of the sample expired within 2 months after the study). The quality of life can be enhanced regardless of the patient clinical condition. Continued research to enhance patient's comfort is indicated for critically ill patients.

It is possible that the second and third hypotheses were not rejected due to a comparability problem between the two transcutaneous monitors. It is recommended that the study be repeated with only one monitor utilized for the $P_{tc}O_2$ readings.

The Trach Care System adaptor is as efficient as the standard suctioning technique in preventing post-suction hypoxemia. The Trach Care System adaptor remains connected to the patient's circuit for 24 hours. It is possible that an increased infection rate could occur with this adaptor. Studies comparing infection rates with Trach Care System

adaptors with standard adaptors should be conducted before a recommendation to use a closed system adaptor could be made.

The novelty of preparatory guidance may have accounted for the anxiety-reduction in these patients. A replication of the study with the addition of another treatment group receiving pleasant nurse-patient interaction is indicated.

The anxiety reducing effects of preparatory guidance may not be maintained with repeated episodes. A study to answer this question is indicated.

Summary

The purpose of this study was to determine the effect of preparatory guidance and a specialized suction technique on post-suction anxiety indicators (NAAS) and $P_{tc}O_2$. In this study, patients who received preparatory guidance had lower NAAS. There was no significant difference in anxiety indicators and post-suction $P_{tc}O_2$ between patients suctioned via the Trach Care System adaptor and those suctioned with the standard technique when the initial $P_{tc}O_2$ was used as a covariate. There was no significant interaction between preparation for suctioning and suctioning technique.

The reliability and validity of NAAS were enhanced by an alpha reliability coefficient of .87 and by a positive linear relationship between NAAS and post-suction systolic blood pressure ($p = .04$). Increased blood pressure was associated with increased NAAS. NAAS was inversely correlated with $P_{tc}O_2$ at the 0.1 level of significance. Lower $P_{tc}O_2$ levels were associated with increased NAAS.

Findings of this study are congruent with the published research related to suction-induced hypoxemia, use of adaptors for suctioning,

and reduction of patient distress during aversive procedures. The conceptual frameworks of Johnson (1984) and Selye (1974) are supported by this study.

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Appendix A

Consent Form

PATIENT CONSENT FORM

As a doctoral student at U.A.B. School of Nursing, I am requesting your participation in a study concerning endotracheal suctioning. Your participation would involve having your blood pressure, heart rate, and blood oxygen level taken before and after you are suctioned. The blood oxygen can be measured painlessly with a warm electrode placed on your skin. There is the possibility that skin injury could occur if the electrode is left on for a long period of time. However, the electrode will only be on the patient for a short period of time, and I will be present at all times to check the temperature. I will also observe your facial expression and body movement during suctioning. Your part in this study will take about 5 minutes. The ultimate purpose of this study is to improve suctioning for patients like you who need to have the aid of a ventilator.

Points for you to consider are:
- The U.A.B. Institutional Review Board has approved this study.
- The Medical and Nursing Directors for this unit have approved your participation in this study.
- Your participation is strictly voluntary. If you choose not to participate, it will no NO WAY affect the care that you receive.
- You may withdraw from this study at any time during data collection.
- Your name will not be used in any report of this study.

Thank you for your consideration of this request. Please feel free to ask questions or share your concerns with me. Home: (205) 447-9491; Work: (205) 435-9820) College of Nursing.

Sincerely,

Sarah Latham, R.N., M.S.N.
Graduate Student, U.A.B. School of Nursing

I, _____, of _____
(relationship to patient) (patient)

have read the above information and discussed it with Sarah Latham, R.N. I voluntarily consent to the above named relative's participation in this study. I understand that my relative's name will not be used, and I may withdraw consent from the study at any time during data collection.

_____ _____
Relative Signature Date

_____
Relationship to Patient

_____ _____
Witness Date

Appendix B

Institutional Review Board Approval

The University of Alabama in Birmingham
Institutional Review Board for Human Use
205/934-3789

FORM 4: IDENTIFICATION AND CERTIFICATION OF RESEARCH PROJECTS INVOLVING HUMAN SUBJECTS

The Institutional Review Board (IRB) must complete this form for all applications for research and training grants, program project and center grants, demonstration grants, fellowships, traineeships, awards, and other proposals which might involve the use of human research subjects independent of source of funding.

This form does not apply to applications for grants limited to the support of construction, alterations and renovations, or research resources.

PRINCIPAL INVESTIGATOR SARAH LATHAM

PROJECT TITLE EFFECT OF PREPARATORY GUIDANCE AND SPECIALIZED SUCTION TECHNIQUE ON POST SUCTION ANXIETY AND TRANSCUTANEOUS OXYGEN

_____ 1. This is a training grant. Each research project involving proposed by trainees must be reviewed separately be the Institutional Review Board (IRB).

_X_ 2. This application includes research involving human subjects. The IRB has reviewed and approved this application on 7-5-85, in accordance with UAB's assurance approved by the United States Public Health Service. The project will be subject to annual continuing review as provided in that assurance.

_X_ This project received expedited review.

_____ This project received full board review.

_____ 3. This application may include research involving human subjects. Review is pending by the IRB as provided by UAB's assurance. Completion of review will be certified by issuance of another FORM 4 as soon as possible.

_____ 4. Exemption is approved based on number(s) _____.

7-5-85
Date

R [illegible]
Russell Cunningham, M.D.
Interim Chairman of the
Institutional Review Board

Appendix C

Nursing and Medical Directors' Approval

The University of Alabama in Birmingham
School of Medicine/Department of Medicine
Dick D. Briggs, Jr., M.D.
Professor and Vice-Chairman
205/934-5400

April 22, 1985

Sara Latham, RN
Merimac Drive
Piedmont, Alabama 36272

Dear Ms. Latham:

I have reviewed your project entitled "Effect of Preparatory Guidance and Trach Care System Adaptor on Post-suction Anxiety and Oxygen Desaturation". Since the study has been approved by the Institution of Review Board, I endorse your going forward with the project on the Hohenberg Critical Care Unit and on the Pulmonary Service on 3 East of Jefferson Tower. In both instances, the protocol should be accomplished without violating the scope of existing nursing unit protocols, and with the concurrence of the respected head nurses on those units.

Sincerely yours,

Dick D. Briggs, Jr.

Dick D. Briggs, Jr., M.D.
Professor and Vice-Chairman
Department of Medicine
Director, Division of Pulmonary
and Critical Care Medicine

DDBJr:csc
cc: BeBe Barksdale, Head Nurse HCCU
Stacy Hyatt, Head Nurse 3 East

The University of Alabama in Birmingham
University of Alabama Hospitals
Department of Nursing/Division of Medical Nursing
Lanette Sherrill, Director
205/934-5226

March 6, 1985

Sarah Latham, RN, MSN
Merimac Drive
Piedmont, Alabama 35223

Dear Ms. Latham,

I have reviewed your proposed pilot study for the MICU. This letter is to confirm our telephone discussion of March 5, 1985. I do support and give my permission for the study following receipt of Dr. Goetter's and IRB approval. If at all possible I would like feedback concerning the results.

It was good to talk with you again. Please stop by next time you are in the University Hospitals. Don't hesitate to call if I can be of further assistance.

Lanette Sherrill

LS/sh

The University of Alabama in Birmingham
School of Medicine/Department of Medicine
Division of Pulmonary and Critical Care Medicine
W. E. Goetter, M.D., Associate Professor
205/934-7020

11 March 1985

Sara Latham, R.N.
Jacksonville State University
Jacksonville, Alabama

Dear Sara,

I have reviewed your project titled "Effect of Preparatory Guidance and Trache Care System Adaptor on Post Suction Anxiety and Oxygen Desaturation". I give my approval for you to go ahead with your research on this project in the University Hospital Medical Intensive Care Unit.

Sincerely,

William E. Goetter, M.D.

WEG/lg

NORTHEAST ALABAMA
Regional Medical Center

Ms. Sarah Latham
Jacksonville State University
Jacksonville, Alabama 36265

Dear Sarah

In regards to your request you have permission to conduct the study "Effects of Preparatory Guidance and Specialized Suction Technique on Post Suction Anxiety and Transcutaneous Oxygen Tension" in the Intensive Care Unit at Northeast Alabama Regional Medical Center.

Sincerely,

Martha M. Bumpious

Martha M. Bumpious, R.N.
Director of Critical Care

MMB/bhm

Appendix D

Age, Sex, and Diagnoses of Subjects

Age, Sex, and Diagnoses of Subjects

Subject No.	Age	Sex	Primary Diagnoses
1	83	M	COPD*
2	72	M	Sideroblastic anemia
3	68	F	Pulmonary edema
4	41	M	Wilson's disease
5	24	F	Pneumonia, sepsis, ARDS**
6	49	M	Lung cancer
7	67	F	Renal fialure, sepsis
8	76	F	Respiratory arrest
9	59	M	Ideopathic fibrotic alveolitis
10	39	M	Drug overdose
11	73	F	Pancreatic abscess
12	70	M	Gangrenous gallbladder, cholecystectomy
13	75	M	Aortic aneurysm repair
14	58	M	COPD*
15	65	F	Sepsis
16	61	F	MI***, cardiac arrest
17	79	F	Reticulosarcoma
18	20	F	Postpartum sepsis, ARDS**
19	78	F	Lymphoma, sepsis
20	37	F	COPD*
21	35	M	Respiratory arrest
22	80	F	Carotid endarterectomy
23	41	M	Pulmonary thromboembolus
24	71	M	Chronic restrictive lung disease, CHF****
25	73	F	Thoracotomy, oat cell carcinoma
26	47	F	Metastatic breast cancer
27	57	F	Thoracentesis, profound hypotension
28	64	M	Leukemia, pneumonia
29	58	M	COPD*, cor pulmonale
30	65	M	Abdominal aortic aneurysm repair
31	70	M	Pulmonary thromboembolus
32	64	F	GI Bleed
33	26	F	Aspiration pneumonia, sepsis
34	41	F	Corneal transplant, pneumonia, sepsis
35	68	M	Suprapubic prostatectomy, respiratory failure
36	68	M	Pulmonary edema
37	46	M	Multiple trauma to abdomen
38	41	M	Sepsis, renal failure
39	54	M	Acute MI***, pulmonary edema
40	69	M	Pulmonary edema, COPD*

*Chronic obstructive pulmonary disease
**Adult respiratory distress syndrome
***Myocardial infarction
**** Congestive heart failure

Appendix E

Data Sheets

DATA SHEET

GROUP A

- Assist or IMV
- No contagious skin conditions
- Responsive
- No pacemaker
- No narcotic within 4 hours
- Not obese or edematous

- Consent form signed _____
- ICU nursing staff/respiratory notified of type adaptor
- Telemetry notified of approximate time of study

1. Subject number: _____ 2. Age: _____
3. Sex: _____ 4. Days ventilated _____
5. Rate: _____ 6. FiO2 _____
7. Diagnosis _____

Tc to air _____ Tc to pt _____
Need for suctioning established
Call telemetry to get ready
Pull curtains
Palpate systolic B/P, wait one minute

1 MINUTE PRIOR

Call telemetry to start strip

8. Heart Rate _____

9. $P_{tc}O_2$ _____

10. Blood Pressure _____

- Trach Care System Adaptor
- Preparatory Guidance: Take hand, establish eye contact, "Mr./Ms. _____, I'm going to put a tube in your airway to suction the secretions. You will feel a pulling sensation. Suctioning may be uncomfortable for you, but it will only take a few seconds and it will make you breathe better. I will be as gentle as possible."

Non-Verbal Assessment of Anxiety Checklist

A. The patient's general behavior appeared:

_____ 1. Calm and composed
_____ 2. Mildly-moderately apprehensive/distressed
_____ 3. Extremely frightened

B. Patient's muscle tone:

_____ 1. Appeared relaxed
_____ 2. Was characterized by tension in mouth, tightening of muscles in the jaw, generalized tightening of muscle tone, but lying still
_____ 3. Was characterized by more wide spread tension with clenching fists, or extending fingers, extension of feet and legs

C. Patient's amount and rate of motor activity was:

_____ 1. No movement; lying still
_____ 2. Characterized by restless and fidgety movements
_____ 3. Hyperactive, pushing or pulling away, combative, twisting in the bed

D. Patient's facial appearance was:

_____ 1. Calm, eyes open looking at investigator
_____ 2. Strained, brows knitted together
_____ 3. Fearful, distressed, panicky, eyes tightly closed or wide open with pupils dilated

30 SECONDS POST

Call telemetry to do 1 minute strip

11. Heart rate _____

12. $P_{tc}O_2$ _____

13. Blood Pressure _____

14. Non-verbal assessment of anxiety score _____

DATA SHEET

GROUP B

- Assist or IMV
- No contagious skin conditions
- Responsive
- No pacemaker
- No narcotic within 4 hours
- Not obese or edematous

- Consent form signed _____
- ICU nursing staff/respiratory notified of type adaptor
- Telemetry notified of approximate time of study

1. Subject number: _____ 2. Age: _____
3. Sex: _____ 4. Days ventilated _____
5. Rate: _____ 6. FiO2 _____
7. Diagnosis _____

Tc to air _____ Tc to pt _____
Need for suctioning established
Call telemetry to get ready
Pull curtains
Palpate systolic B/P, wait one minute

1 MINUTE PRIOR

Call telemetry to start strip

8. Heart Rate _____

9. $P_{tc}O_2$ _____

10. Blood Pressure _____

- Trach Care System Adaptor
- Cognitive Information Only: "Mr./Ms. _____, I'm going to suction your airway to remove the secretions."

Non-Verbal Assessment of Anxiety Checklist

A. The patient's general behavior appeared:

_____ 1. Calm and composed
_____ 2. Mildly-moderately apprehensive/distressed
_____ 3. Extremely frightened

B. Patient's muscle tone:

_____ 1. Appeared relaxed
_____ 2. Was characterized by tension in mouth, tightening of muscles in the jaw, generalized tightening of muscle tone, but lying still
_____ 3. Was characterized by more wide spread tension with clenching fists, or extending fingers, extension of feet and legs

C. Patient's amount and rate of motor activity was:

_____ 1. No movement; lying still
_____ 2. Characterized by restless and fidgety movements
_____ 3. Hyperactive, pushing or pulling away, combative, twisting in the bed

D. Patient's facial appearance was:

_____ 1. Calm, eyes open looking at investigator
_____ 2. Strained, brows knitted together
_____ 3. Fearful, distressed, panicky, eyes tightly closed or wide open with pupils dilated

30 SECONDS POST

Call telemetry to do 1 minute strip

11. Heart rate _____

12. $P_{tc}O_2$ _____

13. Blood Pressure _____

14. Non-verbal assessment of anxiety score _____

DATA SHEET

GROUP C

- Assist or IMV
- No contagious skin conditions
- Responsive
- No pacemaker
- No narcotic within 4 hours
- Not obese or edematous

- Consent form signed _____
- ICU nursing staff/respiratory notified of type adaptor
- Telemetry notified of approximate time of study

1. Subject number: _____ 2. Age: _____
3. Sex: _____ 4. Days ventilated _____
5. Rate: _____ 6. FiO2 _____
7. Diagnosis _____

Tc to air _____ Tc to pt _____
Need for suctioning established
Call telemetry to get ready
Pull curtains
Palpate systolic B/P, wait one minute

1 MINUTE PRIOR

Call telemetry to start strip

8. Heart Rate _____

9. $P_{tc}O_2$ _____

10. Blood Pressure _____

- Standard Suctioning: Ambu X 3 with 100% oxygen
- Preparatory Guidance: Take hand, establish eye contact, "Mr./Ms. _____, I'm going to put a tube in your airway to suction the secretions. You will feel a pulling sensation. Suctioning may be uncomfortable for you, but it will only take a few seconds and it will make you breathe better. I will be as gentle as possible."

Non-Verbal Assessment of Anxiety Checklist

A. The patient's general behavior appeared:

_____ 1. Calm and composed
_____ 2. Mildly-moderately apprehensive/distressed
_____ 3. Extremely frightened

B. Patient's muscle tone:

_____ 1. Appeared relaxed
_____ 2. Was characterized by tension in mouth, tightening of muscles in the jaw, generalized tightening of muscle tone, but lying still
_____ 3. Was characterized by more wide spread tension with clenching fists, or extending fingers, extension of feet and legs

C. Patient's amount and rate of motor activity was:

_____ 1. No movement; lying still
_____ 2. Characterized by restless and fidgety movements
_____ 3. Hyperactive, pushing or pulling away, combative, twisting in the bed

D. Patient's facial appearance was:

_____ 1. Calm, eyes open looking at investigator
_____ 2. Strained, brows knitted together
_____ 3. Fearful, distressed, panicky, eyes tightly closed or wide open with pupils dilated

30 SECONDS POST

Call telemetry to do 1 minute strip

11. Heart rate _____

12. $P_{tc}O_2$ _____

13. Blood Pressure _____

14. Non-verbal assessment of anxiety score _____

DATA SHEET

GROUP D

- Assist or IMV
- No contagious skin conditions
- Responsive
- No pacemaker
- No narcotic within 4 hours
- Not obese or edematous

- Consent form signed _____
- ICU nursing staff/respiratory notified of type adaptor
- Telemetry notified of approximate time of study

1. Subject number: _____ 2. Age: _____
3. Sex: _____ 4. Days ventilated _____
5. Rate: _____ 6. FiO2 _____
7. Diagnosis _____

Tc to air _____ Tc to pt _____
Need for suctioning established
Call telemetry to get ready
Pull curtains
Palpate systolic B/P, wait one minute

1 MINUTE PRIOR

Call telemetry to start strip

8. Heart Rate _____

9. $P_{tc}O_2$ _____

10. Blood Pressure _____

- Standard Suctioning: Ambu X 3 with 100% oxygen
- Cognitive Information Only: "Mr./Ms. _____, I'm going to suction your airway to remove the secretions."

Non-Verbal Assessment of Anxiety Checklist

A. The patient's general behavior appeared:

_____ 1. Calm and composed
_____ 2. Mildly-moderately apprehensive/distressed
_____ 3. Extremely frightened

B. Patient's muscle tone:

_____ 1. Appeared relaxed
_____ 2. Was characterized by tension in mouth, tightening of muscles in the jaw, generalized tightening of muscle tone, but lying still
_____ 3. Was characterized by more wide spread tension with clenching fists, or extending fingers, extension of feet and legs

C. Patient's amount and rate of motor activity was:

_____ 1. No movement; lying still
_____ 2. Characterized by restless and fidgety movements
_____ 3. Hyperactive, pushing or pulling away, combative, twisting in the bed

D. Patient's facial appearance was:

_____ 1. Calm, eyes open looking at investigator
_____ 2. Strained, brows knitted together
_____ 3. Fearful, distressed, panicky, eyes tightly closed or wide open with pupils dilated

30 SECONDS POST

Call telemetry to do 1 minute strip

11. Heart rate _____

12. $P_{tc}O_2$ _____

13. Blood Pressure _____

14. Non-verbal assessment of anxiety score _____